

March 21, 2019

VIA EMAIL & HAND DELIVERY

Mr. Mark Bergeron, Director
Bureau of Land Resources
Department of Environmental Protection
17 State House Station
Augusta, ME 04333

Ellsworth Hydroelectric Project (FERC No. 2727)
New Application for Water Quality Certification (Section 401)

Dear Mr. Bergeron:

On behalf of Black Bear Hydro Partners, LLC (BBHP or Licensee), enclosed please find a hardcopy of a new application for water quality certification (WQC) for the Ellsworth Hydroelectric Project (FERC No. 2727). The application is for the continued operation, with modification, of the Ellsworth Hydroelectric Project (Project). This application includes material revisions to the operating proposals contained in BBHP's application for WQC dated April 9, 2018. The April 9, 2018 application is hereby withdrawn. The materially revised operating proposals include a reduction in the annual operating range of Graham Lake from 10.8 feet to 5.7 feet, and an increase in seasonal minimum flows from 105 cfs to 125 cfs.

As required, a check in the amount of \$5,348.90 made payable to the State of Maine for the processing of the WQC application is enclosed. In accordance with MDEP regulations for WQC application processing, BBHP provides herein one hard copy and one CD of the WQC application. Two hard copies of the FERC license application and subsequent filings were previously provided to the Department and are incorporated herein by reference. Also provided herein is one CD of the final FERC license application, including the appendices to the final FERC license application and subsequent FERC filings. BBHP is also sending by certified mail a duplicate of the WQC application to the town clerks for Ellsworth, Mariaville, and Waltham, Maine and to the Land Use Planning Commission, as representative for the unorganized township of Fletchers Landing.

If you have any questions regarding the WQC application, please contact me by phone at (207) 755-5603 or by email at Frank.Dunlap@BrookfieldRenewable.com.

Sincerely,



Frank H. Dunlap
Licensing Specialist

CC: Kathy Howatt, Maine DEP
Project Manager, FERC

Attachments:

- Hardcopy of the WQC Application with Attachments (1 copy)
- A CD of the WQC Application with Attachments (including FERC License Application and Appendices and Licensee's subsequent filings)

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Land Resource Regulation
17 State House Station
Augusta, Maine 04333
Telephone: 207-287-7688

FOR DEP USE
ATS # _____
#L- _____
Fees Paid _____
Date Fees Received _____

**APPLICATION FOR
WATER QUALITY CERTIFICATION
(U.S. P.L. 92-500, SECTION 401)**

HYDROPOWER PROJECT LICENSING/RELICENSING ONLY

This form shall be used to request Water Quality Certification for the proposed FERC licensing or relicensing of an existing hydropower generating or storage project where no construction, reconstruction or structural alteration of project facilities which would affect water levels or flows is proposed.

All required fees must be paid before application processing will begin. Please contact the Department for current fee schedule information. Fees are payable to Treasurer, State of Maine.

APPLICANT INFORMATION

Name of Applicant: _____

Mailing Address: _____

Name of Contact or Agent: _____

Telephone: _____

PROJECT INFORMATION

Name of Project: _____ FERC No. _____

Address (use "911" address, if available): _____

Name of Waterbody Affected: _____

Municipality or Township: _____ County: _____

GPS Coordinates, if known: _____

REQUIRED INFORMATION

1. Provide all the information requested by this application form.
2. If applicant is a registered corporation, provide either a *Certificate of Good Standing* (available from the Secretary of State) or a statement signed by a corporate officer affirming that the corporation is in good standing.
3. A signed Certification of Publication and a completed Notice of Intent to File an application for Water Quality Certification.

NOTE: All supporting documents summarized above must be attached to this form and sent to the DEP Office listed below:

Department of Environmental Protection Bureau of Land Resource Regulation 17 State House Station Augusta, ME 04333 Tel: (207) 287-7688
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"I certify under penalty of law that I have personally examined the information submitted in this document and all attachments thereto and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the information is true, accurate, and complete. I authorize the Department to enter the property that is the subject of this application, at reasonable hours, including buildings, structures or conveyances on the property, to determine the accuracy of any information provided herein. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

DATE: March 21, 2019

(IF SIGNATURE IS OTHER THAN APPLICANT,
ATTACH LETTER OF AGENT AUTHORIZATION
SIGNED BY APPLICANT)

SIGNATURE OF APPLICANT

Thomas Uncher

PRINTED NAME & TITLE

Vice President

WATER QUALITY CERTIFICATION APPLICATION

GENERAL INFORMATION

1. By submitting this application, an applicant requests Water Quality Certification pursuant to Section 401 of the Federal Clean Water Act for the continued operation of an existing hydropower generating or storage project under the terms of an initial or a new license from the Federal Energy Regulatory Commission. Certification must be obtained for any activity requiring a federal license or permit which may result in a discharge into the navigable waters of the United States.
2. The purpose of this application form is to obtain from the applicant a thorough description of project facilities and operation and the impacts of the continued operation of the project on water quality.

The Department's Regulations provide that the applicant bears the burden of proof in the application process. This is the burden of presenting sufficient evidence for the Department to make the affirmative findings required by law regarding matters about which no questions are raised and the burden of presenting a preponderance of the evidence regarding matters about which questions are raised.

3. In order to grant certification, the Department must conclude that there is a reasonable assurance that the continued operation of a hydropower generating or storage project will not violate applicable Water Quality Standards. These standards have been established in the State's Water Classification Program (Title 38 MRSA Sections 464-469). These standards designate the uses and related characteristics of those uses for each class of water and establish water quality criteria necessary to protect those uses and related characteristics.
4. Any applicant for a FERC license must complete a three stage consultation process with appropriate state and federal agencies. The purpose of this process is to identify and analyze the potential environmental and socioeconomic impacts of a project.

The consultation process requires an applicant to have either requested or obtained water quality certification at the time of filing with FERC. The process also requires that an applicant serve a copy of its FERC application, including any revisions, supplements or amendments thereto, on each of the agencies consulted.

WATER QUALITY CERTIFICATION APPLICATION

FILING INSTRUCTIONS AND PROCEDURES

1. When filing, send an original paper copy plus one (1) electronic copy of a completed Application for Water Quality Certification to the Department, along with two (2) copies of the Application for Initial License or New License that has been or will be filed with FERC. The State filing can be made prior to or concurrent with the FERC filing.
2. The Department is required by law to assess fees for processing applications and for monitoring permit compliance. Application processing will not begin until all required fees have been paid. When filing, submit full fee payment as shown on the [DEP fee schedule](#). Please make checks payable to: Treasurer, State of Maine.
3. A number of consulting agencies will be involved in the State review process of hydropower projects. Distribution of copies of the FERC application to these agencies may be coordinated by DEP or may be handled directly by the applicant. When filing, please notify the DEP staff to discuss distribution procedures.
4. Most information requested by this application form can be provided by making reference to the appropriate exhibit of the FERC license application. Space is provided on the form for such references.
5. Within 15 working days of receiving an application and all required fees, the DEP shall determine whether the application as filed is acceptable for processing.
6. Additional information may be required during the review process on any aspect of the project relating to compliance with applicable statutory criteria.

WATER QUALITY CERTIFICATION APPLICATION

1. **NATURE OF ACTIVITY.** Check appropriate item:

_____ Application for Initial License.

_____ Application for New License (Relicense).

A COPY OF A COMPLETED FERC APPLICATION FOR LICENSE (THIRD STAGE CONSULTATION) MUST ACCOMPANY THIS FORM.

NOTE: A copy of any document revising, supplementing, amending, or correcting deficiencies in the application as originally filed with FERC must also be filed with D.E.P.

2. **EXISTING ENVIRONMENT.** Provide a description of the physical environment of the project site and its immediate vicinity. The project site includes all land and water areas affected by the project.

REFERENCE: FERC EXHIBIT(S) _____

3. **PROJECT DESCRIPTION.** Provide a detailed description of the existing project. A hydropower project includes all powerhouses, dams, water conduits, transmission lines, water impoundments, roads, and other appurtenant works and structures that are part of the development. This description must include:

- A. The physical composition, dimensions, and general configuration of all project structures;
- B. The normal maximum surface area and elevation, gross storage capacity, and usable storage capacity of any impoundments;
- C. The number, type, and rated capacity of any turbines or generators; and
- D. The number, length, and voltage of any primary transmission lines.

REFERENCE: FERC EXHIBIT(S) _____

4. **PROJECT OPERATION.** Provide a description of project operation, to include:

- A. The mode of project operation during low, mean, and high water years, including extent and duration of flow release and impoundment fluctuations;
- B. An estimate of the dependable capacity and average annual energy production, in kilowatt hours, of the project;
- C. An estimate of minimum, mean, and maximum flows, in cubic feet per second, at the project site, including a flow duration curve;
- D. An estimate of the maximum and minimum hydraulic capacities, in cubic feet per second, of any powerplant; and
- E. A statement of the manner in which the power generated at the project is utilized.

REFERENCE: FERC EXHIBIT(S) _____

5. **PROJECT PLANS.** Provide general design drawings showing all major project structures in sufficient detail to provide a full understanding of the project, including:
- A. Plans (overhead view);
 - B. Elevations (front view); and
 - C. Sections (side view).

Because Exhibit F drawings contain Critical Energy Infrastructure Information,

REFERENCE: FERC EXHIBIT(S) _____

6. **PROJECT MAPS.** Provide maps of the project showing:
- A. The location of the project, including principal project structures and features, with reference to local geographic features; and
 - B. A project boundary enclosing all principal project structures and features proposed to be licensed.

REFERENCE: FERC EXHIBIT(S) _____

7. **TITLE, RIGHT OR INTEREST.** The Department's Regulations require that any applicant must possess sufficient title, right or interest in all project lands and waters in order to have standing to seek a permit, license, or certification. Please complete the appropriate item(s) below establishing title, right or interest and attach a copy of the indicated document(s):

- _____ Deed.
- _____ Option to buy.
- _____ Lease.
- _____ Valid FERC License (including all amendments/modifications).
- _____ Exercise of flowage rights through operation of the Mill Act (12 MRSA Section 651).
- _____ Exercise of eminent domain under FERC License.

8. **WATER QUALITY.** Provide a description of the impact of the project on water quality, including:
- A. A description of the applicable water quality standards and stream segment classification for the project impoundment and downstream waters, including a description of designated uses;
 - B. A description of existing water quality in the project impoundment and downstream waters affected by the project, including a description of existing in-stream water uses;
 - C. A statement of the existing measures to be continued and new measures proposed for the purpose of protecting and improving water quality, including measures for the mitigation of project impacts on the designated uses of project waters; and
 - D. A description of any anticipated continuing impact on water quality from the continued operation of the project, including impacts on the designated uses of project waters.

REFERENCE: FERC EXHIBIT(S) Exhibit E, Section 4.4-2, Attachment 1; FERC DEA Sections 2.2.2, 3.3.2

9. **PUBLIC NOTICE.** The Department requires that an applicant provide public notice describing the location and nature of the activity proposed for approval. The public notice requirements that apply to this application are described in the Certification of Publication below, which must be signed and dated by the applicant or authorized agent.

The following information must be submitted with this form:

- A copy of a completed Notice of Intent to File.
- A list of abutters to whom notice was provided. [For the purposes of public notice of this application, an "abutter" is any person who owns property that is both (1) adjoining and (2) within 1 mile of the delineated project boundary, including owners of property directly across a public or private right of way.]

CERTIFICATION OF PUBLICATION

By signing below, the applicant (or authorized agent) certifies that he or she has:

1. Published a Notice of Intent to File once in a newspaper circulated in the area where the project site is located, within 30 days prior to filing the application;
2. Sent a completed copy of the Notice of Intent to File by certified mail or Certificate of Mailing to abutters, as determined by local tax records or other means, within 30 days prior to filing the application; and
3. Sent a copy of the Notice of Intent to File by certified mail or Certificate of Mailing and filed a duplicate of this application with the town clerk of the municipality(ies) where the project is located, within 30 days prior to filing the application.



Signature of Applicant

March 21, 2019

Date

Thomas Uncher, Vice President

Name and title of applicant

If signature is other than that of the applicant, attach letter of agent authorization signed by the applicant.

**ATTACHMENT 1
WATER QUALITY CERTIFICATION
APPLICATION ADDENDUM**

**WATER QUALITY CERTIFICATION APPLICATION
ELLSWORTH HYDROELECTRIC PROJECT (FERC No. 2727)
ATTACHMENT 1**

Name of Applicant: Black Bear Hydro Partners, LLC

Name of Project: Ellsworth Hydroelectric Project

Name of Waterbody Affected: Union River, Lake Leonard, Graham Lake

Background

On December 30, 2015, the Licensee for the Ellsworth Hydroelectric Project (Black Bear Hydro Partners, LLC) filed an Application for New License (Final License Application or FLA) with the Federal Energy Regulatory Commission (FERC). On April 9, 2018, the Licensee filed an initial Application for Water Quality Certification (WQC) with the Maine Department of Environmental Protection (MDEP). On September 28, 2018 the Licensee filed its Draft Biological Assessment and Species Protection Plan (SPP) with FERC. On November 21, 2018, FERC issued a Draft Environmental Assessment (DEA) for the Ellsworth Project relicensing. The DEA contains information regarding 1) comments and information that were filed with FERC in response to the FLA; 2) FERC staff's environmental review of the Project as proposed by the Licensee; 3) a review of alternative proposals submitted by resource agencies and other stakeholders; and 4) FERC staff's recommendations for the continued operation of the Project.

The Licensee carefully reviewed the DEA, and the supporting information referenced therein, and filed comments on the DEA with FERC on January 21, 2019. In response to the information provided in the DEA, along with comments filed by resource agencies and others in response to the DEA, the Licensee is filing a new application for WQC to reflect new proposals being made by the Licensee for the operation of the Ellsworth Hydroelectric Project. This attachment includes additional information regarding the Licensee's new proposals and the effects of the proposals on Project-related resources, arranged by MDEP Water Quality Certification application section, as appropriate.

Section 1 – Nature of Activity – See references on application form.

Section 2 – Existing Environment - A detailed description of the existing environment can be found in the FLA Exhibit E Sections 1.0, 4.1 and 4.4 and DEA Sections 3.1, 3.3.1 through 3.3.3, 3.3.4 and 3.3.5.

Section 3 – Project Description – See references on application form.

Section 4 – Project Operation

The Licensee is proposing changes to Ellsworth Project operations that are materially different than the proposals included in the December 2015 FLA or the April 2018 WQC Application.

- 1) The Licensee is proposing to modify its operation of Graham Lake, to reduce the operating range of the storage reservoir from a current range of elevation 104.2' to 93.4' (10.8 ft annual drawdown limit) to an operating range of elevation 104.2' to 98.5' (5.7 ft annual drawdown limit). The winter drawdown limit of el. 98.5' (5.7 ft) would be in effect unless Snowpack Conditions exist, as defined.¹ If such Snowpack Conditions exist, the reservoir may be drawn down to elevation 95.0' for flood control purposes, as determined through consultation with the Maine Emergency Management Agency (MEMA).
- 2) The Licensee is proposing to increase its proposed seasonal minimum flow from Graham Lake and Ellsworth Dam as follows:
 - From January 1 to March 31, release 105 cfs;
 - From April 1 to April 30, release 125 cfs;
 - From May 1 to June 30, release 250 cfs; and
 - From July 1 to December 31, or ice in, release 125 cfs.

A minimum flow requirement of 125 cfs from April 1 to April 30 and from July 1 to December 31 represents an increase of 20 cfs from the existing seasonal minimum flow of 105 cfs.

These two changes are proposed in response to FERC's analysis in the DEA of Graham Lake operations and minimum flows, and as outlined by resource agencies in comment letters on the DEA.² As discussed in Section 8 below, the new minimum flow schedule is expected to enhance downstream fish passage, and, in combination with the proposed narrowing of the Graham Lake operating range will enhance downstream aquatic habitat and allow the Project to meet state water quality standards. The Licensee expects an annual loss of potential generation of approximately 800 MWh's due to the restrictions to the management of Graham Lake storage.

Other than these specific revised proposals, the proposed operation of the Ellsworth Project remains the same as outlined in the FLA Exhibit B, Section 1.0 and Exhibit E Section 3.0.

Section 5 – Project Plans – See references on application form. The Exhibit F drawings contain Critical Energy Infrastructure Information (CEII), instead see Exhibit G Sheets 1-3 for information regarding the location of Project structures.

Section 6 – Project Maps – See references on application form.

¹ "Snowpack Conditions" means that the water content observed in the snowpack is significantly greater than normal during early-mid March.

² FERC's DEA also included a recommendation for lowering the normal full pond elevation by 1.2 ft but that recommendation is not adopted herein.

Section 7 – Title, Right or Interest – See references on application form.

Section 8 – Water Quality

- A) A description of applicable water quality standards and stream segment classification for the project impoundment and downstream waters, including a description of designated uses.** - See references on application form.
- B) A description of existing water quality in the project impoundment and downstream waters affected by the project, including a description of existing instream water uses.** - See references on application form and discussion in 8(C), below.
- C) A statement of the existing measures to be continued and new measures proposed for the purpose of protecting and improving water quality, including measures for the mitigation of project impacts on the designated uses of project waters.**

Existing Measures to be Continued

Other than these specific revised proposals, the proposed operation of the Project remains as outlined in the FLA, Exhibit B Section 1.0 and Exhibit E Section 3. In addition, a description of the existing measures to be continued can be found in the FLA Exhibits identified in the corresponding section of the WQC application form.

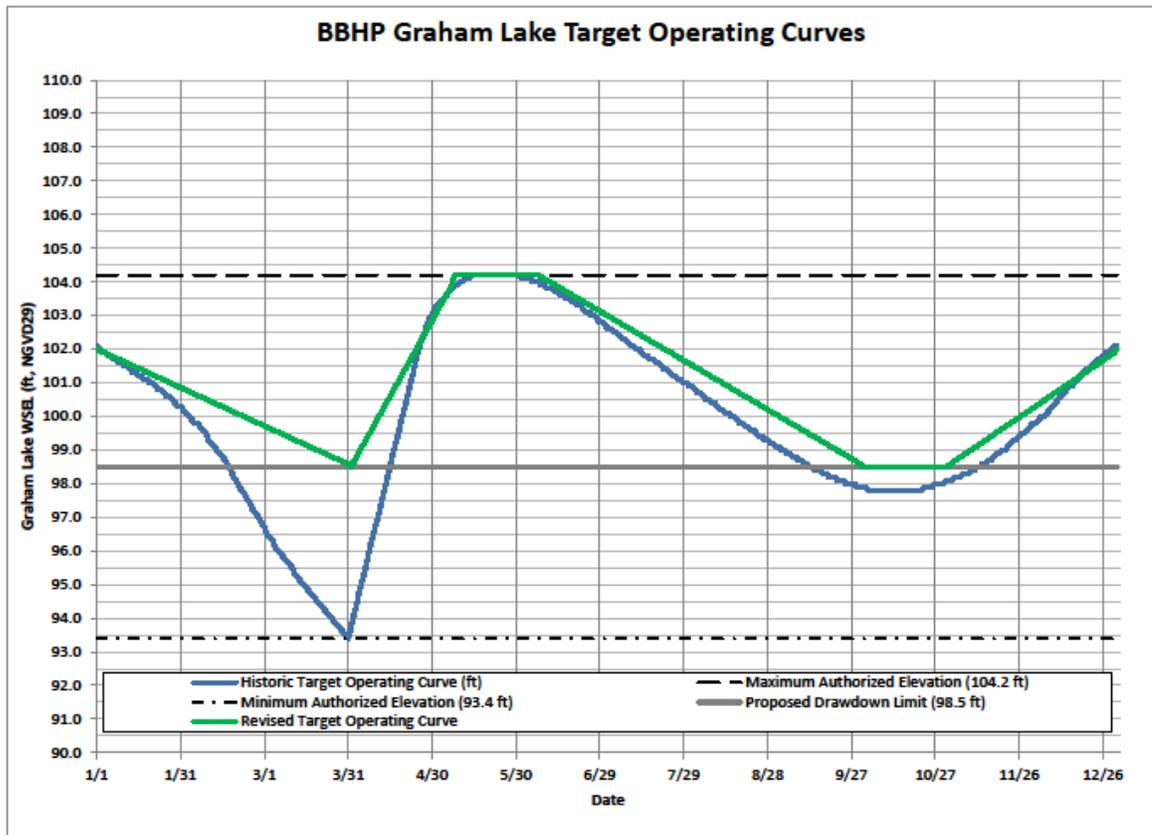
Proposed Changes to Project Operations

As detailed in Section 4 of this application, the Licensee is proposing to modify its operation of Graham Lake, to target an operating range of elevation 104.2' to 98.5' (5.7 ft annual drawdown limit), see Figure 1. The Licensee is also proposing to increase its seasonal minimum flow from Graham Lake and Ellsworth Dam as follows:

- From January 1 to March 31, release 105 cfs;
- From April 1 to April 30, release 125 cfs;
- From May 1 to June 30, release 250 cfs; and
- From July 1 to December 31, or ice in, release 125 cfs.

The Licensee is making these proposals in part to address issues raised and discussed in the FERC DEA regarding the effects of the current Graham Lake operating regime on resources, and the comments of resource agencies on the DEA. As discussed in Section 8(D) below, these proposals are expected to result in water quality improvements and further protection of aquatic habitat and will allow the Project to meet state water quality standards.

Figure 1. Historic and Proposed Graham Lake Operating Ranges



Other than these specific revised proposals, the proposed operation of the Ellsworth Project remains the same as outlined in the FLA Exhibit B Section 1.0 And Exhibit E Section 3.0.

Other New Measures Proposed

Additionally, the Licensee has previously proposed several measures to protect or enhance Project area resources and protect the State’s designated uses such as recreation, and fish and aquatic life (including proposed improvements to fish passage) and are unchanged as described in the FLA and subsequently filed Species Protection Plan (See Attachment 5).

D) A description of any anticipated continuing impact on water quality from the continued operation of the project, including impacts on the designated uses of project waters.***Proposed Modification to Graham Lake Operations***

The Licensee is proposing to modify its operation of Graham Lake to reduce the annual operating range of the storage reservoir from a current range of 10.8 ft to a far more limited operating range of 5.7 ft. The effects of the proposed modification on applicable designated uses is discussed below.

Habitat for Fish and Other Aquatic Life

As shown in Table 1, raising the lower reservoir elevation from elevation 93.4' to 98.5' will ensure 84% of the reservoir surface area is maintained and would keep 1,187 acres of littoral zone habitat permanently inundated. This represents an increase in the minimum reservoir surface area of 11% over current operations and an additional 1,046 acres of littoral habitat that, under current operations, becomes exposed at low pond.

Table 1. Graham Lake Surface Area at Different Elevations (as reported in DEA)

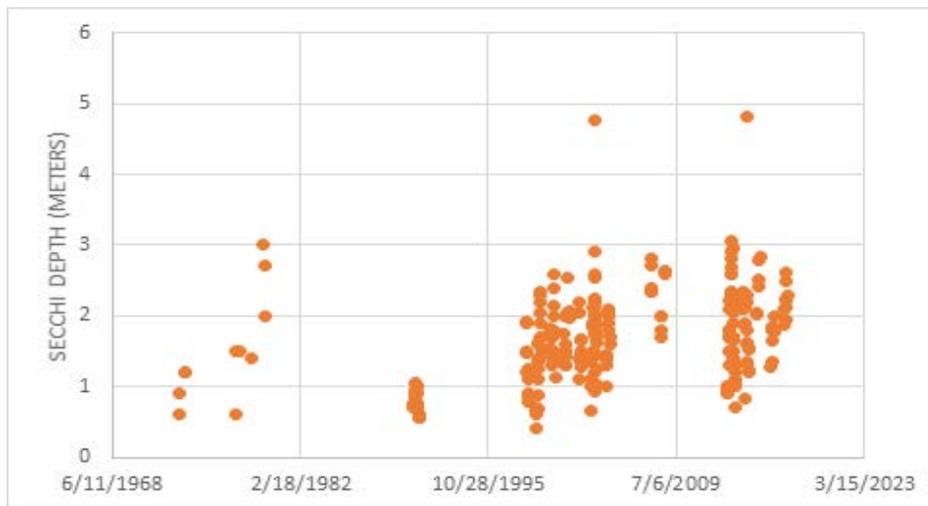
Reservoir Elevation (feet)	Description	Surface Area (acres)	% of Reservoir Inundated	Acres of Littoral Zone Maintained
104.2'	Normal full pool	10,042	100%	2,810
98.5'	Proposed minimum pool	8,419	84%	1,187
93.4'	Current minimum pool	7,374	73%	141
92.6' *	Bottom of littoral zone	7,232	72%	0

*As estimated in the FLA.

In addition to maintaining more reservoir surface area and littoral zone, the Licensee's proposal may also have a beneficial effect on water clarity. A comparison of Secchi depth data from 1990 to data collected in recent years demonstrates that water clarity was lower thirty years ago than it is today (Figure 2, below). This suggests that over time, water clarity is improving in the reservoir, and provides support for a 1990³ report that concluded that water clarity is improving as the reservoir reaches a new equilibrium with its shoreline. Because the Licensee is proposing no change in the maximum reservoir elevation and will maintain the maximum elevation at the current 104.2', there will be no disruption to the continued stabilization of the reservoir shoreline, and, as a result, improvements in water clarity are expected to continue occur over time.

³ Northrup, Devine and Tarbell, 1990. Graham Lake Study of the Effectiveness of Water Elevation Management Plan.

Figure 2. Secchi Depths in Graham Lake Over Time (1973-2016)



Some improvement in water clarity may also result from reducing the operating range of the reservoir from the current 10.8 ft to 5.7 ft. In the DEA, FERC staff argues that shallow Secchi depth readings in Graham Lake are due to suspended sediment rather than phytoplankton, and that changing water levels lead to decreased water clarity due to the resuspension of sediments as water moves over mudflats when the reservoir is refilled or drawn down. While the DEA does not demonstrate a statistically significant relationship between reservoir elevation and Secchi depth, to the extent that less reservoir substrate will be exposed under the Licensee's proposed drawdown limit of 5.7 feet, some additional improvements in water clarity may result. However, the Licensee would note that water color also can reduce Secchi depth readings. In fact, water color is likely a significant contributing factor to the more limited Secchi depth readings at Graham Lake, since the area inundated by the reservoir is largely comprised of peat bogs and wetlands. Water color data collected at Graham Lake during the relicensing studies demonstrates that the reservoir's waters are very strongly colored (naturally). These color values are unrelated to turbidity and sediments and are not a result of Graham Lake operations or water levels. Rather they are a natural feature of the waters in this area, due to tannins from bogs and wetlands.

Wetland and Waterfowl Habitat

The Licensee's proposal to maintain the current full pond level with a 5.7 ft limited drawdown will maintain and provide benefits to wetlands and waterfowl. There are nine (9) Inland Waterfowl and Wading Bird Habitat (IWWH) areas that have been identified on Graham Lake, five (5) of which provide high value habitat.⁴ The proposal to maintain

⁴ DEA Section 3.3.3.1, pg 180.

the reservoir at or above elevation 98.5’ will ensure that an additional 1,046 acres of reservoir bottom will remain wetted year round, as compared to current operations, and may allow additional wetland vegetation to develop in some locations.

Table 2. Graham Lake Surface Area and Exposed Lake Bottom at Different Elevations

Reservoir Elevation (ft)	Description	Surface Area (acres)	Exposed Area (acres) from Full
104.2’	Normal full pool	10,042	0
98.5’	Proposed minimum pool	8,419	1,623
93.4’	Current minimum pool	7,374	2,669

Recreation in and on the Water and Fishing

As the Maine Department of Inland Fisheries and Wildlife noted in their comments on the DEA in a letter dated January 22, 2019, raising the minimum reservoir level is also expected to enhance winter ice fishing and reduce impacts to angler access and navigation during the open water season. FERC too discussed a number of potential benefits suggested by property owners of raising the minimum pond level in the DEA, including improved aesthetics, better ice fishing access, improved boat access resulting from less of the reservoir bottom being exposed, and improved boat access in areas having stumps and boulders that may be exposed at lower lake levels. In the DEA FERC further noted:

The effects of the seasonal reservoir drawdowns on recreation access and the aesthetic value of the project vicinity are more pronounced at lower elevations. ...Reducing the seasonal reservoir drawdown by increasing the minimum water level elevation, as suggested by landowners and other stakeholders, would improve recreation access to Graham Lake by increasing accessibility to private and public boat ramps and docks relative to the existing minimum elevation level of 93.4 feet msl. Reducing the extent of seasonal drawdowns would also reduce the size of the mudflats that are exposed on a seasonal basis, which could allow for easier access to the lake from the shoreline and improve the aesthetic quality of the lake.

Thus, raising the minimum pond level by more than 5 feet will result in benefits for aesthetics, ice fishing access, boat access, and recreation in general.

Proposed Minimum Flow from Graham Lake and Ellsworth Dam

Article 401 of the existing license specifies a continuous minimum flow release of 105 cfs from the Graham Lake Dam and the Ellsworth Dam from July 1 through April 30 and a continuous minimum flow release of 250 cfs from May 1 through June 30 for the protection of fishery resources (FERC 1987)⁵ (Table 3). Based on FERC’s Staff Alternative and analysis related to minimum flows proposed in the DEA, and corresponding support of FERC’s proposal by resource agencies presented in comment letters on the DEA, the Licensee is proposing to modify its proposed minimum flow releases from Graham Lake and the Ellsworth Dam from 105 cfs to 125 cfs from April 1 to April 30 and July 1 to December 31 or ice in (Table 3).

Table 3. Minimum flows proposed for the Ellsworth Project

Period	Flow (cfs)		
	FLA	FERC - DEA	Licensee current proposal
January 1 to March 31	105	105	105
April 1 to April 30		123	125
May 1 to June 30	250	250	250
July 1 to December 31, or ice in	105	123	125

These flows are expected to enhance downstream fish passage and, in combination with the proposed narrowing of the Graham Lake operating range, are expected to enhance downstream aquatic habitat and allow the Project to meet state water quality standards.

Habitat for Fish and Other Aquatic Life

In their Section 18 prescriptions, USFWS and NMFS recommended that the attraction flow for downstream passage facilities should be 5 percent of station capacity. NMFS described the downstream fish passage as occurring from April 1 through December 31, or ice in. The Licensee estimates the Project’s maximum hydraulic capacity is 2,460 cfs, of which 5 percent would be 123 cfs, which the Licensee has rounded to 125 cfs. The proposed minimum flow would therefore meet the fishery agencies’ objectives for improving fish passage at the Project which, in turn, enhances Project habitat as a migratory corridor for fish.

⁵ Except as temporarily modified by (1) approved maintenance activities, (2) extreme hydrologic conditions, as defined below, (3) emergency electrical system conditions, as defined below, or (4) agreement between the Licensee, the Maine DEP, and appropriate state and/or federal fisheries management agencies.

Section 9 – Public Notice

In accordance with MDEP regulations the following Notice was provided to the public:

- 1) A Notice of Intent to File was published in the Ellsworth American on March 21, 2019. A copy is attached as Attachment 3.
- 2) A completed copy of the Notice of Intent to File was sent by certified mail to landowners abutting the Project, a copy of the transmittal letter attached as Attachment 3.
- 3) A copy of the Notice of Intent to File and a duplicate of this application was sent by certified mail to the City of Ellsworth and Towns of Mariaville, Waltham, and Fletchers Landing (via the Land Use Planning Commission) on March 22, 2019.

**ATTACHMENT 2
CERTIFICATE OF GOOD STANDING**

State of Maine



Department of the Secretary of State

I, the Secretary of State of Maine, certify that according to the provisions of the Constitution and Laws of the State of Maine, the Department of the Secretary of State is the legal custodian of the Great Seal of the State of Maine which is hereunto affixed and of the reports of qualification of foreign limited liability companies in this State and annual reports filed by the same.

I further certify that BLACK BEAR HYDRO PARTNERS, LLC, a DELAWARE limited liability company, is a duly qualified foreign limited liability company under the laws of the State of Maine and that the application for authority to transact business in this State was filed on July 17, 2009.

I further certify that said foreign limited liability company has filed annual reports due to this Department, and that no action is now pending by or on behalf of the State of Maine to forfeit the authority to transact business in this State and that according to the records in the Department of the Secretary of State, said foreign limited liability company is a legally existing limited liability company in good standing under the laws of the State of Maine at the present time.

In testimony whereof, I have caused the Great Seal of the State of Maine to be hereunto affixed. Given under my hand at Augusta, Maine, this nineteenth day of March 2019.



A handwritten signature in black ink, appearing to read 'Matthew Dunlap', written over a horizontal line.

Matthew Dunlap
Secretary of State

ATTACHMENT 3
NOTICE OF INTENT / LIST OF ABUTTERS / MAILING RECEIPTS

PUBLIC NOTICES

Every day throughout the United States, newspapers publish thousands of public notices about events, conditions or actions that affect countless individuals, families, neighborhoods and businesses. Public notices cover many topics including business matters, liquor licensing, public auctions and estate sales, zoning, public meetings, bids to sell goods and services to the government, local government finances and state and local elections. Public notice is a fundamental component of our system of representative democracy, which depends upon the participation of educated, responsible citizens. Notices appear in this newspaper and online at ellsworthamerican.com and mdislander.com. For all public notices printed in Maine newspapers and to receive emails about new notices check out mainenotices.com a searchable website hosted by the Maine Press Association.

IN THE EIGHTH JUDICIAL DISTRICT COURT OF THE STATE OF NEVADA IN AND FOR CLARK COUNTY

In the Matter of the CASE NO. D-19-583342-R Parental Rights as to DEPT. NO. P K. E. H. A MINOR CHILD.

NOTICE OF HEARING TO: JOEY LAMEROUX and TO: JOHN DOE, the putative father of the above-named minor child: **YOU ARE HEREBY NOTIFIED** that there has been filed in the above-entitled Court a Petition seeking the termination of your parental rights over the above-named minor child, and that said Petition has been set for hearing before this Court in Department P thereof in CLARK COUNTY, State of Nevada on the 14th day of MAY, 2019, at the hour of 9:30 a.m., at which time and place you are required to be present if you desire to oppose said Petition. DATED this 29th day of January, 2019.

CLERK OF THE COURT
By Deputy EIGHTH JUDICIAL DISTRICT COURT CLARK COUNTY, STATE OF NEVADA AFFIRMATION PURSUANT TO NRS 239B.030
The undersigned does hereby affirm that the preceding document, NOTICE OF HEARING: X Document does not contain the social security number of any person Date: 01/29/19
Diane Denato

OTIS SCHOOL DEPARTMENT INVITATION TO BID BEECH HILL SCHOOL BUS TRANSPORTATION

The Otis School Committee is seeking bids to provide transportation for students for a five (5) year term beginning SY 19-20.
Interested applicants should contact Nichole Pothier, Principal, at 537-3302 or npothier@beech-hillsschool.org. Deadline for receiving bids will be April 12, 2019.

CITY OF ELLSWORTH PUBLIC HEARING NOTICE

The City of Ellsworth will hold a Public Hearing on Friday, March 29, 2019, at 8:00 AM, at the Ellsworth City Hall to discuss amendments to the Ellsworth Housing Rehabilitation Program guidelines. Public comments will be solicited at this hearing and will be submitted to the Maine Department of Economic and Community Development. All persons wishing to make comments or ask questions are invited to attend this Public Hearing. Comments may be submitted in writing to: Dwight Tilton at One City Hall Plaza, Ellsworth, Maine 04605 or at dtilton@ellsworthmaine.gov any time prior to the Public Hearing. TDD/TTY users may call 711. If you are physically unable to access any of the City's programs or services, please call Penny Weinstein at (207) 669-6616, so that accommodations can be made.

TOWN OF MARIAVILLE NOTICE OF ANNUAL TOWN MEETING

The annual Town Meeting of the Town of Mariaville will be held on Monday, March 25, 2019 at 7pm at the Beech Hill School in Otis.

AGENDA

1. Call to Order.
2. Public Hearing and consideration on amending the Ellsworth Housing Rehabilitation Program guidelines.
3. Adjournment.

SPECIAL MEETING NOTICE

A special meeting of the Ellsworth City Council will be held on Friday, March 29, 2019 at 8:00 AM in the Ellsworth City Hall Council Chambers.

OTIS SCHOOL DEPARTMENT INVITATION TO BID BEECH HILL SCHOOL ROOFING PROJECT

Asphalt shingle removal and installation (approximately 70 square) Plans and Specifications are available at the Otis Town Office, 132 Otis Road, Otis, ME. Interested applicants should contact Bob Cote, Otis School Committee Chair, at 537-3302. Deadline for receiving bids will be April 12, 2019.

NOTICE OF INTENT TO FILE MAINE WATER QUALITY CERTIFICATION APPLICATION ELLSWORTH HYDRO-ELECTRIC PROJECT

Please take notice that Black Bear Hydro Partners, LLC of 150 Main Street, Lewiston, Maine 04240, is intending to file an application with the Maine Department of Environmental Protection (MDEP) for a Water Quality Certification (WQC) pursuant to the provisions of the Federal Clean Water Act, Section 401. The application is for the Federal Energy Regulatory Commission (FERC) relicensing of the continued operation of the existing Ellsworth Hydroelectric Project, FERC No. 2727, located on the Union River in Hancock County, in the towns of Ellsworth, Mariaville, and Waltham, Maine, and in the unorganized township of Fletchers Landing, Maine under the terms of a new license from the FERC.

STATE OF MAINE PROBATE COURT 50 STATE STREET HANCOCK COUNTY

2019-039 JESSICA DOW WIKEN, petition for Change of Name (Adult) filed by Jessica Dow Wiken, requesting her name to be changed to JESSICA ROSE DOW, 68 Fernald Point Rd, Southwest Harbor, ME 04679.
2019-041 CARLIE JO LUDDEN, Petition for Change of Name (Adult) filed by Carlie Jo Ludden, requesting her name be changed to CARLIE JO JAMES, P. O. Box 85, Winter Harbor, ME 04693.
2019-051 JORDAN LEE BULLARD, Petition for Change of Name (Adult) filed by Jordan Lee Bullard, requesting his name be changed to JASON LEE JAROSZ, 272 Old Rt. 1, Hancock, ME 04640.
2019-061 AARON JOSEPH MORRIS, Petition for Change of Name (Adult) filed by Aaron Joseph Morris, requesting his name to be changed to Abigail Jo Morris, 105 Eden St, Hancock, ME 04609.
Date: February 25, 2019 /s/Gale S. Coughlin Register of Probate

STATE OF MAINE PROBATE COURT 50 STATE STREET HANCOCK COUNTY

2019-076 DALIS SAUNDERS, late of Orland, ME, deceased, Robin Wardwell PO Box 198 Orland, ME 04472, appointed Personal Representative.
2019-077 MARY ELIZABETH HUTCHINSON, late of Stonington, deceased, Stephen E. Hutchinson, 417 S. Deer Isle Rd., Deer Isle, ME 04627, appointed Personal Representative.
2019-078 JEREMY KANE, late of Hancock, ME, deceased, Robert E. Kane 282 Eastside Rd Hancock, ME 04640, appointed Personal Representative.
2019-080 ANN MATHEWS, late of Bar Harbor, deceased, J. Clifford Mathews 63 Parker Ridge Lane, Apt 216 Blue Hill, ME 04614, appointed Personal Representative.
2019-081 GRACE M. SCHIMPF, late of Hancock, deceased, George A. Schimpf 65 Martin Ave Hancock, ME 04640, appointed Personal Representative.
2019-082 VAUGHN A. LOWELL, late of Bucksport, deceased, David B. Lowell, 423 Fountain St. Port Charlotte, FL 33653, appointed Personal Representative.
2019-083 DOUGLAS PHILLIP STOVER, late of Blue Hill, deceased, Ellen S. Best, ESQ PO. Box 386 Blue Hill, ME 04614, appointed Personal Representative.
2019-087 M. MCCORMICK HASSEL, late of Southwest Harbor, ME, deceased, Kathleen Cawley 3620 East Randolph st #2606 Chicago, IL 60601, appointed Personal Representative.
2019-091 FREDERICK LAWLESS, SR., late of Bucksport, ME, deceased, Janice E. Deans 49 Kent Dr Orrington, ME 04474, appointed Personal Representative.
Date: March 18, 2019 /s/Gale S. Coughlin Register of Probate

LEGAL NOTICE PETITION FOR A PARDON STATE OF MAINE

AGUSTA, JANUARY 24, 2019
Notice is hereby given that a Petition for a Pardon for CURTIS CARVER who was convicted of the crimes CR 90-46 - ROBBERY; AGGRAVATED ASSAULT, is now pending before the Governor and a hearing will be conducted in the MAINE DEPARTMENT OF CORRECTIONS BOARD ROOM, 25 TYSON DRIVE, 3rd FLOOR in Augusta, on THURSDAY the 2nd day of MAY 2019 at 9:00 o'clock A.M.

BLASTING NOTICE

Harold MacQuinn, Inc. will be blasting in our Hancock Quarry on the Henderson Road for the month of March 2019. Monday through Friday between the hours of 9 a.m. and 4 p.m. Access: the "Henderson Road" is gated at Route 1 and before and after the "MacQuinn Quarry."
Warning:
Three whistles - blasting in five minutes
Two whistles - blasting in one minute
One whistle - blasting is complete - all clear
No homes (s) within one-half mile.
Any questions can be directed to the office of Harold MacQuinn, Inc. at 667-4653.

MEMORANDUM OF AGREEMENT

The Maine Department of Environmental Protection (MEDEP), Petroleum Management Division is hereby providing public notice of the intent of MEDEP to enter into a Memorandum of Agreement (MOA) with The Jackson Laboratory to establish an alternative procedure to the immediate reporting of certain oil discharges of ten (10) gallons or less at their Ellsworth facility. Under the Memorandum of Agreement, The Jackson Laboratory will clean-up any spills and maintain a log of these spills at the facility that is available to MEDEP personnel upon request. The Jackson Laboratory will also be required to send a copy of this log to MEDEP for review on an annual basis. This agreement would expire three (3) years from the signature date. The purpose of this public notice is to initiate a thirty (30) calendar day comment period beginning on the date of publication. During this period, the public is invited to comment in writing on the proposed MOA. The public may view a copy of the proposed Memorandum of Agreement at MEDEP's Augusta office or at the clerk's office in Ellsworth, Maine. A copy of the proposed Memorandum of Agreement will be mailed by the Department by 5:00 PM on April 5. A final decision regarding the proposed Memorandum of Agreement will not be made until the comment period has ended. For more information call the MEDEP at 207-287-7688.
The MEDEP files pertinent to the facility are available for public review by contacting MEDEP at: Maine Department of Environmental Protection File Room 17 State House Station Augusta, Maine 04330-0017 Ph: 207-287-7688

Town of Sullivan

PUBLIC HEARING

There will be a public hearing on Monday, April 8th at 5:00 p.m. at the Sullivan Town Office to review the renewal application for a Malt, Vinous and Spirituous liquor license for
Traceys Seafood
Levon & Florice Tracey, Proprietors
2719 U S Highway 1, Sullivan
All persons having knowledge as to why this application should be accepted or rejected should be present.
Selectmen, Town of Sullivan

Town of Winter Harbor

Nomination Papers

Nomination papers are available at the Town Office for the Annual Town Meeting Election to be held June 5, 2019.
Board of Selectmen – 3-year term - One Vacancy
Planning Board Members – 5-year term - Two Vacancies
Water District Trustee – One vacancy
Utilities District Trustee – One vacancy
Completed nomination papers must be filed with the Town Clerk no later than 4:00 pm, April 12, 2019.

Jobs, careers, work wanted, services offered...
Find it all in the Classifieds.

TOWN OF SORRENTO HEAVY LOAD LIMIT

All Sorrento town roads are closed to heavy loads except when solidly frozen. Load limit: 23,000 LBS. Gross Vehicle Weight Closing Date March 13, 2019
Joey Clark, Sorrento Road Commissioner

Town of Sullivan

NOTICE HEAVY LOAD LIMITS

All of the public ways in Sullivan except Rt 200 (Bert Gray Rd) and Rt 183 (Tunk Lake Rd from US Rt 1 to the railroad tracks) are closed to heavy loads until further notice. Load Limit: 23,000 lbs Gross Vehicle Weight Effective Date March 22, 2019.
Per Order of the Selectmen
Town of Sullivan

Town of Trenton

INVITATION TO BID WINTER ROAD SAND

The Town of Trenton is seeking bids for 2,000 yards of 5/8" screened sand, NO DEAD SAND. Bidder agrees to mix with Town-supplied salt, on premises at the Town salt-sand shed. Sand to be put up by October 1, 2019. Bidder must provide the Town with a certificate of insurance with the bid. All bids must be sealed, clearly marked "SAND BID", and received no later than Wednesday, May 1, 2019. Mail or drop off to the Town Office before 4:00 p.m. - 59 Oak Point Road, Trenton, ME 04605

Town of Trenton

INVITATION TO BID WINTER ROAD SAND

The Town of Trenton is seeking bids for 2,000 yards of 5/8" screened sand, NO DEAD SAND. Bidder agrees to mix with Town-supplied salt, on premises at the Town salt-sand shed. Sand to be put up by October 1, 2019. Bidder must provide the Town with a certificate of insurance with the bid. All bids must be sealed, clearly marked "SAND BID", and received no later than Wednesday, May 1, 2019. Mail or drop off to the Town Office before 4:00 p.m. - 59 Oak Point Road, Trenton, ME 04605

Town of Winter Harbor

NOTICE TO TAXPAYERS (Pursuant to Title 36, M.R.S.A., Section 706)

You must furnish to the Assessors of the Town of Winter Harbor a true and perfect list of all of your estates, not exempt from taxation, which you possess on April 1st each year. Failure to furnish this list may bar you from making an application for or appealing tax abatement. This list includes property holdings such as land, buildings, and taxable personal property. The form is available at the Winter Harbor Town Office. Please return the completed form to the Town Office on or before April 1, 2019. The Assessors of the Town of Winter Harbor hereby give notice to all persons liable to taxation in Winter Harbor that they will be in session on Monday, April 1, 2019 from 10:00 am to 12:00 noon for the purpose of receiving your list of taxable estates.
HOMESTEAD EXEMPTION
Anyone wishing to apply for a homestead exemption may do so at this time. If you applied last year, you need not apply again.
NOTICE TO VETERANS
Veterans who served in the Armed Forces of the United States and have reached the age of 62 years or are receiving any form of pension or compensation for disability, service-connected or non-service-connected, MAY be eligible for a property tax exemption. Applicant must be a resident of Winter Harbor and must make written application and provide proof of entitlement by April 1st of the year in which exemption is first being claimed. Surviving spouses of eligible veterans must reapply in their own names in order to be eligible. Applications and further information may be obtained at the Town Office.

Hancock County Unorganized Territories

NOTICE OF INVITATION TO BID EQUIPMENT

Notice is hereby given that the County of Hancock will receive sealed bids for Equipment for the Unorganized Territories of Hancock County. Instructions to bidders and Tractor Specifications are available at the County Commissioners Office. All bids must be in writing, signed by the bidder, marked "Sealed Bid - Equipment" and submitted to the Commissioner's Office by 9:30 a.m. on Wednesday, May 1, 2019 at which time and place all proposals will be publicly opened and read aloud. A pre-bid conference with the Unorganized Territory Supervisor is mandatory and is scheduled for Wednesday April 3, 2019 at 9:30 am in the Unorganized Territories Office at 50 State Street Suite #7, Ellsworth, Maine 04605. The County Commissioners reserve the right to reject any and/or all bids. For additional information contact: Millard Billings, Unorganized Territory Supervisor, 50 State Street Suite #7, Ellsworth, Maine 04605. Telephone 667-6885.

Hancock County Unorganized Territories

NOTICE OF INVITATION TO BID TRACTOR

Notice is hereby given that the County of Hancock will receive sealed bids for Tractor with cab and loader for the Unorganized Territories of Hancock County. Instructions to bidders and Tractor Specifications are available at the County Commissioners Office. All bids must be in writing, signed by the bidder, marked "Sealed Bid - Tractor" and submitted to the Commissioner's Office by 9:30 a.m. on Wednesday, May 1, 2019 at which time and place all proposals will be publicly opened and read aloud. A pre-bid conference with the Unorganized Territory Supervisor is mandatory and is scheduled for Wednesday April 3, 2019 at 9:30 am in the Unorganized Territories Office at 50 State Street Suite #7, Ellsworth, Maine 04605. The County Commissioners reserve the right to reject any and/or all bids. For additional information contact: Millard Billings, Unorganized Territory Supervisor, 50 State Street Suite #7, Ellsworth, Maine 04605. Telephone 667-6885.

NEED A RENTAL CAR?

Rent from Stanley Subaru today.

Our entire fleet are the latest model years. We have Foresters, Outbacks and Crosstreks. Competitive daily, weekly and monthly rates, too!

Call Today

207-667-4641 or 1-800-439-8989 or email rental@stanleysubaru.com



22 Bar Harbor Road, Ellsworth



Captains, Mates, Deckhands and Galley Help, Shore-side Ticket Staff and Dock Help Wanted

We are passionate about taking people out and sharing the waters we love and enjoy. Our company offers Whale Watching, Bird Watching & Puffin trips, Nature Tours, National Park tours from the water, hiking tours of islands, light house tours, Lobster and Seal watching trips. We also help visiting cruise ships moving passengers from ship to shore. We help Allied Whale and College of the Atlantic conduct observational research on marine mammals from our boats.
We have shore side jobs in ticket sales and both licensed mariner and crew jobs on the boats. Working around the water is good fun but it can be a lot of work caring for the passengers and maintaining the boats for safety. Good customer service skills are needed. Patience and a humble sense of humor is helpful.
The weather on the water changes constantly, be ready for all conditions, beautiful sunny calm days can change to stormy 4-6' seas and thick fog.
Our preferred candidate can work from early Spring through the end of October. Previous experience is helpful but not required.
EMPLOYEE PERKS!
Free Lunch! Discounts on retail, associated hotels and restaurants.
OUR JOBS
Many of our crew work late April through the first week of November. Exceptions can be made for those who are returning to school in the fall. We require a diverse group of people, from bird watchers to boat fanatics, business tycoons, biologists to motor heads.
All jobs on the boats require pre employment and random drug testing since they are safety related transportation jobs.
New crew training is provided, safety/security drills and training is conducted regularly.
To apply go to: www.barharborwhales.com/employment/ or call (207) 288-2386 and ask for Captain Brian or Larry. E-mail: silverman9368@hotmail.com or larry@barharborwhales.com

SEARCHING FOR YOUR DREAM HOME?

Check out the Real Estate section for new listings.

Every week in
The Ellsworth American and Mount Desert Islander



March 20, 2019

Via USPS – Delivery Confirmation™

Ellsworth Hydroelectric Project FERC No. 2727
Application to Maine Department of Environmental Protection for Water Quality Certification

Dear Recipient:

Black Bear Hydro Partners LLC (BBHP or Licensee), licensee for the Ellsworth Hydroelectric Project (Project) previously applied to the Federal Energy Regulatory Commission (FERC) for a New License pursuant to the Federal Power Act to continue operation of the Ellsworth Hydroelectric Project, a hydroelectric generating project located on the Union River in the City of Ellsworth, towns of Mariaville and Waltham, and the township of Fletcher's Landing in Hancock County. The license application was filed with FERC on December 30, 2015.

As part of the FERC licensing process, BBHP must also apply for a Water Quality Certification (WQC) from the Maine Department of Environmental Protection (MDEP) under the provisions of Section 401 of the Federal Clean Water Act. BBHP initially filed an application for WQC on April 9, 2018. BBHP is filing a new application for WQC from the MDEP. The new WQC application contains new operating proposals and will be available for public inspection at the Licensee's offices in Lewiston, Maine during normal working hours, at the MDEP, at the town offices of Ellsworth, Mariaville, and Waltham, and at the offices of the Land Use Planning Commission in Augusta, Maine on or after March 21, 2019. The WQC application process requires the advanced publication of the attached notice to those landowners whose property abuts the Ellsworth Hydroelectric Project lands, which is why you are receiving this letter.

Sincerely,



Frank H. Dunlap
Licensing Specialist

Attachment: Notice

**NOTICE OF INTENT TO FILE
MAINE WATER QUALITY CERTIFICATION APPLICATION
ELLSWORTH HYDROELECTRIC PROJECT**

Please take notice that Black Bear Hydro Partners, LLC of 150 Main Street, Lewiston, Maine 04240, is intending to file an application with the Maine Department of Environmental Protection (MDEP) for a Water Quality Certification (WQC) pursuant to the provisions of the Federal Clean Water Act, Section 401. The application is for the Federal Energy Regulatory Commission (FERC) relicensing of the continued operation of the existing Ellsworth Hydroelectric Project, FERC No. 2727, located on the Union River in Hancock County, in the towns of Ellsworth, Mariaville, and Waltham, Maine, and in the unorganized township of Fletchers Landing, Maine under the terms of a new license from the FERC.

The FERC license application was filed with FERC on December 30, 2015. The WQC application will be filed with the MDEP on or about March 21, 2019 and will be available for public inspection at MDEP's offices in Augusta, Maine during normal working hours. A copy of the application will also be available for inspection at the town offices in Ellsworth, Mariaville, and Waltham, Maine, and at the offices of the Land Use Planning Commission in Augusta, Maine.

A request for a public hearing or a request that the Board of Environmental Protection assume jurisdiction over this application must be received by the Department, in writing, no later than 20 days after the application is found by the Department to be complete and is accepted for processing. Public comment on the application will be accepted throughout the process of the application. For Federally licensed, permitted, or funded activities in the Coastal Zone, review of this application shall also constitute the State's consistency review in accordance with the Maine Coastal Program pursuant to Section 307 of the federal Coastal Zone Management Act.

Written public comments may be sent to the Department of Environmental Protection, Bureau of Land Resources, 17 State House Station, Augusta, Maine 04333.

**Ellsworth Hydroelectric Project (FERC No. 2727)
Abutter List for Water Quality Certification Application**

ABESS, LEONARD JR (TRUSTEE)
100 SE 32ND RD
MIAMI, FL 33129

ADAMS, BETH WILLIAMS
65 HEMLOCK LANE
MARIAVILLE, ME 04605

ADAMS, BRUCE A & MARGARET A
57 STONEYBROOK WAY
HERMON, ME 04401

ALDEN MICHAEL D
107 CLOVER LANE
BREWER, ME 04412

ALLEN ELIZABETH A & FREY VALERIE C
443 FLETCHERS LANDING ROAD
ELLSWORTH, ME 04605

ALLENS BLUEBERRY FREEZER
PO BOX 536
ELLSWORTH, ME 04605

AMES, P FOERD
308 MORRISON FARM RD
MARIAVILLE, ME 04605

AMIRAULT THOMAS
24R BOSTON ROAD
ANDOVER, MA 01810

ANDERSEN, HENRIETTA M
211 MAPLE AVE
DELANCO, NJ 08075

ANDERSON AUSTIN M
2922 WOODCREST DRIVE
SARASOTA, FL 34239

ARCHER CHIPPER W
63 PIGEON ROAD
FLETCHERS LANDING TOWNSHIP, ME 04605

ASTLE, MICHAEL
781 CROOKED RD
BAR HARBOR, ME 04609

AWALT, JIMMIE W &
1624 MARIAVILLE RD
MARIAVILLE, ME 04605

AYERS, DAMIAN & MARILYN
625 PETER PLACE
BRICK, NJ 08723

BABINE, JOHN G SR & BRIGITE M
3785 SW QUAIL MEADOW TRAIL UNIT A
PALM CITY, FL 34990

BABSTOCK LUCINDA E
77 WILBUR ST
WALTHAM, MA 02453

BABSTOCK LUCINDA E & JOHN J JR
20 WAVERLY ST
WALTHAM, MA 02453

BACHELDER, WALTER ROGER
PO BOX 142
MANCHESTER, ME 04351

BACKLUND, JENNY L
129 TROUT BROOK RD
MARIAVILLE, ME 04605

BAGLEY, LINDA T
PO BOX 88
ROCHESTER, MA 02770

BALL, JERRILYN M
338 MORRISON FARM RD
MARIAVILLE, ME 04605

BALLARD TIMOTHY J
PO BOX 217
WORCHESTER, NY 12197

BARNA, WILLIAM J & ANNA L
1 SHOSHONEAN TRAIL
SOUTHURRY, CT 06488

BARNES ANTHONY W
131 BANGOR ROAD
ELLSWORTH, ME 04605

BARRY JOHN D
440 MARIAVILLE ROAD
ELLSWORTH, ME 04605

BARRY, BRIAN R
PO BOX 160
EDDINGTON, ME 04428

BARTELT, FREDERICK H III & RUTH ANN
154 OLD HAY RD
MARIAVILLE, ME 04605

BATCHELDER ELEANOR R
54 EAGLE ROAD
ELLSWORTH, ME 04605

BATES LUTHER J
15 CROSBY LANE
CHATHAM, MA 02633-1591

BAUERSFELD C DIANN
253 SHORE ROAD
ELLSWORTH, ME 04605

**Ellsworth Hydroelectric Project (FERC No. 2727)
Abutter List for Water Quality Certification Application**

BAXTER BENJAMIN A
3 STRAWBERRY HILL
BAR HARBOR, ME 04609

BEAUCHESNE, DALE &
30 TASSEL TRAIL
CASCO, ME 04015

BEAUDOIN, CHARLES & LISA
48 RUTH LANE
LYMAN, ME 04002

BEESON, SHARON & OTLEY
170 TANNERY BROOK ROAD
MARIAVILLE, ME 04605-7028

BEHLER LEON
11 BRIMMER POINT WAY
ELLSWORTH, ME 04605

BELLOCCHI PAUL L
79 EAST RIDGE ROAD
SOUTHWEST HARBOR, ME 04679

BENNETT, SCOTT G
28 RICHARD BENNETT LANE
THOMPSON, CT 06277

BENOIT, DENNIS & SANDY
PO BOX 108
PAXTON, MA 01612

BERNARD, JAMES M &
9979 SW STONEGATE DR
PORT SAINT LUCIE, FL 34987

BERNIER, GEORGE & RITA ANN
230 MAST HILL RD
BUCKSPORT, ME 04416

BILLINGS, DANA E & BOBBI A
300 SUNSHINE RD
DEER ISLE, ME 04627

BLACK BEAR HYDRO PARTNERS LLC
75 STATE STREET SUITE 2701
BOSTON, MA 02109

BLAIR JOANN
722 OAK GLEN RD
HOWELL, NJ 07731

BLANCHETTE BRADLEY DAVID
514 MARIAVILLE ROAD
ELLSWORTH, ME 04605

BLANCHETTE, WILLIAM H & SUSAN L
127 ROCKY HILL RD
SUMMERSWORTH, NH 03878

BLANDINE, JAMES & DOROTHY V
242 NEWARK RD SOUTH
BARNEGAT, NJ 08005

BORDEN, ROY HEATH
38719 EDGEWOOD CIRCLE
DENHAM SPRINGS, LA 70706

BORER, JOSEPH M & KATHLEEN M
221 FROST MILL RD
MARIAVILLE, ME 04605

BORLAN, VIOLA
7912 TIMBERLAKE RD
LYNCHBURG, VA 24502

BOTT RONALD
52 FLOWER WAY
ELLSWORTH, ME 04605

BOUDREAU, SUSAN M
187 WEST BRANCH RD
MARIAVILLE, ME 04605

BOUDREAU, THOMAS C
8063 CRYSTAL PLACE
VENTURA, CA 93004

BRAGG ROBERT J JR
PO BOX 471
ELLSWORTH, ME 04605

BRAGG, RONALD & BEVERLY
500 MORRISON FARM RD
MARIAVILLE, ME 04605

BRANCA MARY L ESTATE OF
2616 RIDGE AVENUE
EGG HARBOR TWP, NJ 08234

BRIDGES SARAH B
20 SARI LANE
FLETCHERS LANDING, ME 04605

BRIDGETWINN LLC
136 SURRY ROAD
ELLSWORTH, ME 04605

BRODY, SCOTT M
115 GARRISON RD
ELMER, NJ 08318

BROWN DWIGHT A JR
PO BOX 701
ELLSWORTH, ME 04605

BRYANT TWYLA
PO BOX 1564
ELLSWORTH, ME 04605

Ellsworth Hydroelectric Project (FERC No. 2727)
Abutter List for Water Quality Certification Application

BUCK KYLE
24 COUNTY ROAD
BAR HARBOR, ME 04609

BUDD, BERNADETTE A &
BOX 619
WADING RIVER, NY 11792

BUDWINE, KATHRYN G &
754 SURRY RD
SURRY, ME 04684

BURRELL WENDY WATSON
PO BOX 1523
ELLSWORTH, ME 04605

BUTLER DAVID G
1125 MARIAVILLE ROAD
ELLSWORTH, ME 04605

BUYOFSKY, CONRAD & ALICIA
10 LYONS ST
SOUTH RIVER, NJ 08882

BUZZELL PROPERTIES LLC
88 STATE STREET
ELLSWORTH, ME 04605

BYRNE, CHARLES J & HALINA
66 WEST 4TH ST
NORTH BERWICK, ME 03906

CALABRO, BRIAN T (TRUSTEE)
41 ADORN ST
WEYMOUTH, MA 02188

CALLIS, BONNIE
95 BONNIE LANE
EAST FALMOUTH, MA 02536

CAMPBELL, JOSEPH & ROSEANN
574 MORRISON FARM RD
MARIAVILLE, ME 04605

CARD JAMES B II
4 JIMS WAY
ELLSWORTH, ME 04605

CARD JAMES B II
25 FOSTER STREET
ELLSWORTH, ME 04605

CARMICHAEL, MARTIN H & PAMELA J
PO BOX 163
GREENBUSH, ME 04418

CAROL JEAN JORDAN
200 DOWNEAST HIGHWAY
ELLSWORTH, ME 04605

CARTER MICHAEL H
262 NORTH ST
ELLSWORTH, ME 04605

CARTER, ROLAND C
520 TILTON HILL RD
PITTSFIELD, NH 03263

CASTLEBERRY TRAVIS
991 MARIAVILLE ROAD
ELLSWORTH, ME 04605

CESLOWSKI, STANLEY (DEV)
26 FIRST ST
SOUTH RIVER, NJ 08882

CHADBOURNE, DANVILLE &
126 SCHOOL HOUSE RD
MARIAVILLE, ME 04605

CHADBURN, BEVERLY &
186 WEST ST
BIDDEFORD, ME 04005

CHALMERS, FRANCIS T III & SANDRA H (TRUST)
334 SEAWALL RD
SOUTHWEST HARBOR, ME 04679

CHANDLER, NEIL A SR & KAREN A
63 LORDS COVE WAY
SURRY, ME 04684

CHASSE, BEVERLY J
70 TANNERY BROOK RD
MARIAVILLE, ME 04605

CHATTLEY CHARLES
121 FLETCHERS LANDING ROAD
FLETCHERS LANDING TOWNSHIP, ME 04605

CHURCH OF CHRIST IN ISRAEL
US HIGHWAY 1
ELLSWORTH, ME 04605-0802

CHURCHILL JOHN F
371 CHRISTIAN RIDGE RD
ELLSWORTH, ME 04605

CHURCHILL SHERRY A & CHRISTOPHER C HUH
PO BOX 991
ELLSWORTH, ME 04605

CLAYTON WENDY S
89 MORGAN ROAD
JULIETTE, GA 31046

CLIFFORD & LAUREN RADCLIFFE
371 BIRDSALL DRIVE
YORKTOWN HEIGHTS, NY 10598

**Ellsworth Hydroelectric Project (FERC No. 2727)
Abutter List for Water Quality Certification Application**

CLINCH, ROBERT &
21 SPRING RD
MIDDLETON, MA 01949

COLSON, ORA ALBERT & YOSHIMI
73 HEMLOCK LANE
MARIAVILLE, ME 04605

CONDON RICHARD
1023 NEW HARWINTON ROAD
TURRINGTON, CT 04790

CONNERY JANE C
PSC 37 BOX 2887
APO, AE 09459

CONNOR, PAUL S & DEBORAH
215 TANNERY BROOK RD
MARIAVILLE, ME 04605

CONRY, JOSEPH M & JANET
PO BOX 134
HAMPTON, NJ 08827

COOK LINDA J & FRANCIA J PLUNKETT
283 NEY ST
SAN FRANCISCO, CA 94112

COOPER, ERIC MIKEMAN
253 FROST MILL RD
MARIAVILLE, ME 04605

CORMIER BRUCE D
36 CENTRAL STREET
ELLSWORTH, ME 04605

COSGROVE, DENNIS M & DEBORAH E
10558 SE 178TH ST
SUMMERFIELD, FL 34491

COTRONEO MAINE LLC
571 MARIAVILLE ROAD
ELLSWORTH, ME 04605

COUSINS LEROY
PO BOX 214
HULLS COVE, ME 04644

CRAIG COULOMBE
105 CHERRYWOOD LANE
FARMINGTON, ME 04938

CROWLEY KERRY
250 SHORE ROAD
ELLSWORTH, ME 04605

CURTIS JEANINE
PO BOX 233
ELLSWORTH, ME 04605

DALE HENDERSON
45 ROBERTSON BOULEVARD, SUITE 5
BREWER, ME 04412

DALTON EMILY
382 NE 191ST STREET #39393
MIAMI, FL 33179-3899

DAMM EDWARD A
24 LEDGELAWN AVENUE
BAR HARBOR, ME 04609

DANIEL SARGENT/SCOTT TOOTHAKER
PO BOX 368
ELLSWORTH, ME 04605

DAVID & RHEA ROBBINS
641 SOUTH MAIN STREET
BREWER, ME 04412

DAVID LINDBERG
625 PARKER HILL ROAD
CAVENDISH, VT 05142

DAVIS JAMES W
52 NORTH STREET
ELLSWORTH, ME 04605

DAWSON MICHELLE R & JAMES F
BIRMINGHAM
1225 PATAPSCO STREET
BALTIMORE, MD 21230

DEAN YOUNG
364 EASTBROOK ROAD
FRANKLIN, ME 04634

DEBLOIS, BERNICE B
89 OLD COUNTY RD
BROOKLIN, ME 04616

DEMERS, KELLY R
24 AIRLINE RD
CLIFTON, ME 04428

DENBOW, CHAS & THEODORE
392 ELM ST UNIT E3
WEST HAVEN, CT 06516

DENNIS & TIMOTHY NEYLON
111 EDMUND STREET
CHICOPEE, MA 01020

DENNIS, EDWARD J & ANN M
39 THOMPSON RD
VEAZIE, ME 04401

DICKSON, PAUL S
515 WALNUT ST
SAUGUS, MA 01906

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DIVELLO, MATTHEW J & LAUREN A
723 GRAVELLY HOLLOW RD
MEDFORD, NJ 08055

DODSON GREGORY B
629 MARIAVILLE ROAD
ELLSWORTH, ME 04605

DORITY ARTHUR B
593 MARIAVILLE ROAD
ELLSWORTH, ME 04605

DORITY, SHELDON A
177 DORITY FARM RD
MARIAVILLE, ME 04605

DORNHEIM MARC
47 BAYBERRY ROAD
NORTHPORT, NY 11768

DORR, DAVID W
BOX 1005
SOUTHWEST HARBOR, ME 04679

DOUG GOTT & SONS INC
110 BASS HARBOR ROAD
S W HARBOR, ME 04679

DOW NEAL K
31 STERLING STREET
ELLSWORTH, ME 04605

DUBON, BYRON D & LINDA
216 TANNERY BROOK RD
MARIAVILLE, ME 04605

DUCLOS, AIME E & JENNIFER R
65 PORTLAND ST
SOUTH BERWICK, ME 03908

DUDIK JOHN, ET AL COTTAGE LLC
PO BOX 1428
TAMPA, FL 33601-1428

DUDLEY, JAMES & BARBARA
2330 BELGRADE RD
SIDNEY, ME 04330

DUNN THOMAS P
35 BRIMMER POINT WAY
ELLSWORTH, ME 04605

DUNN, THOMAS G & PENNY L
PO BOX 64
HULLS COVE, ME 04644

DUPUY, CLAUDE
PO BOX 400
BLUE HILL, ME 04614

DURKO JOSEPHINE B ET AL
84 WOODLAND AVE
S AMBOY, NJ 08879

EARLEY, WILLIAM J & LUELLA REED
17 HUBBARD POND RD
NEW IPSWICH, NH 03071

EBERHARDT, ERNEST K
62 LAUREL ST
HOLBROOK, NY 11741

EDGEComb, MARGARET
PO BOX 1852
ELLSWORTH, ME 04605

EDGEComb, SPENSER E
92 TROUT BROOK RD
MARIAVILLE, ME 04605

EGGLESTON ALBERT E
PO BOX 248
ELLSWORTH, ME 04605

ELIZABETH & ARTHUR WILDER
499 WILDER HILL ROAD
NORRIDGEWOCK, ME 04957

ELLSWORTH CITY OF
L-LAKE WATER CO LOT
ELLSWORTH, ME 04605

ELLSWORTH CITY OF
1 CITY HALL PLAZA
ELLSWORTH, ME 04605

ELLSWORTH FALLS LUMBER CO
261 STATE STREET
ELLSWORTH, ME 04605

EMERA MAINE
970 ILLINOIS AVENUE
BANGOR, ME 04402

EMERA MAINE
28 PENOBSCOT MEADOW DRIVE
HAMPDEN, ME 04444

EMERSON KRYSTAL
257 CHRISTIAN RIDGE ROAD
ELLSWORTH, ME 04605

ENOCH & GAIL WENSTROM
88 BECKETT STREET, APT 1
PORTLAND, ME 04101

EVANS DIANNE C & LYNN M HALPIN
5075 BETTS ROAD
GREENBRIER, TN 37073

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Abutter List for Water Quality Certification Application**

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1026 SOUTH RD
MARIAVILLE, ME 04605

FALLS BRUCE R
98 STARKS HILL ROAD
TORRINGTON, CT 06790

FARKAS, KENNETH & SUSAN
8 CANDLEWOOD HEIGHTS
NEW MILFORD, CT 06776

FARRIN BRUCE A
471 NORTH STREET
ELLSWORTH, ME 04605

FELLIS FAMILY GRAVEL PIT LLC
1571 MARIAVILLE RD
MARIAVILLE, ME 04605

FELLIS LIVING TRUST
1490 MARIAVILLE RD
MARIAVILLE, ME 04605

FELLIS MEGHAN
1571 MARIAVILLE ROAD
ELLSWORTH, ME 04605

FIELD, MARSHALL SR
324 E RANDALL AVE
NORFOLK, VA 23503

FISCHER, HENRY W III & DONNA M
428 MANOR AVE
MILLERSVILLE, PA 17551

FLOWER EUGENE R
2933 TENBROECK AVENUE
BRONX, NY 10469

FORGIT FRANCIS
65 INDIAN RIDGE ROAD
EAST HAMPSTEAD, NH 03826

FORGIT GERALD A
36790 STATE HWY 102 SW
FERTILE, MN 56540

FORGIT PAUL
14 GARDNER STREET
OXFORD, MA 01540

FORGIT RAYMOND W
86 DIPPER COVE RD
ORRS ISLAND, ME 04066

FORNAL, JOHN J
86 ROUTE 80
KILLINGSWORTH, CT 06419

FOSSA, JOSEPH
78 BEECHER ST
ESSEX, MA 07729

FOSTER RUTH S
93 MAIN STREET
ELLSWORTH, ME 04605

FRANK & JOAN BERTKIEWICZ
9 FOX DEN ROAD
DERRY, NH 03038

FRENCHMAN BAY CONSERVANCY
PO BOX 150
HANCOCK, ME 04640

FRIEND COOPER F TRUSTEE
PO BOX 688
ELLSWORTH, ME 04605

FROST, GARY E & ADAM E
120 GRAHAM WAY
ELLSWORTH, ME 04605

FROST, MAURICE
294 MARIAVILLE RD
ELLSWORTH, ME 04605

FULLER JACKIE
241 FLETCHERS LANDING RD
FLETCHERS LANDING TWP, ME 04605

GADDIS JAMES P
PO BOX 1883
ELLSWORTH, ME 04605

GAGNE, DAVID & RONDA
225 FROST MILL RD
MARIAVILLE, ME 04605

GARDINER JUANITA
155B FLETCHERS LANDING ROAD
FLETCHERS LANDING, ME 04605

GARDNER MARK
36 CEDAR BREEZE NORTH
GLENBURN, ME 04401

GARLAND JESSE C
3230 CYPRESS COVE WAY
SEVIERVILLE, TN 37876

GARLAND KENNETH A
29 HUMMINGBIRD LANE
ELLSWORTH, ME 04605

GARLAND NORA B & ROBERT D
6 HUMMINGBIRD LANE
FLETCHER'S LANDING, ME 04605

**Ellsworth Hydroelectric Project (FERC No. 2727)
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GATES NANCY E & JONATHAN
15 BUTTERMILK FALLS
NYACK, NY 10960

GCM LLC
195 OTIS ROAD
OTIS, ME 04605

GENDROLIS, JOHN & ELIZABETH
20 TUTTLE ST
DORCHESTER, MA 02125

GEORGE STRINGER & CAROLEE TULLY
PO BOX 1537
ELLSWORTH, ME 04605

GERBER ADRIAAN J
937 MARIAVILLE ROAD
ELLSWORTH, ME 04605

GILLINGHAM, DEBRA
169 MORRISON FARM RD
MARIAVILLE, ME 04605

GILLIS, DERRICK N
9 MILLER DR
PLYMOUTH, MA 02360

GOEBEL FRANZ TRUSTEE
20 MUSKET LANE
SUDBURY, MA 01776

GOODMAN JAMES J & REBECCA J
6977 NORTHWEST HARTNEY WAY
PORT ST LUCIE, FL 34983

GORMLEY STEPHEN V
285 CHRISTIAN RIDGE ROAD
ELLSWORTH, ME 04605-3205

GOTT, DOUG & SONS INC
110 BASS HARBOR RD
SOUTHWEST HARBOR, ME 04679

GRAHN, CARL J &
274 REED ST
HANSON, MA 02341

GREENE, ELIZABETH LEE (TTEE)
23 MEADOW LANE
RYE, NH 03870

GREENSTONE PAUL J
PO BOX 792
BRUNSWICK, ME 04011-0792

GREGORY JORDAN
1499 WALTHAM ROAD
WALTHAM, ME 04605

GREGORY, JOHN H & CAROL A
37 MAIN ST
OLD TOWN, ME 04468

GRINDALL, OLNEY M JR & MARJORIE L
485 REACH RD
SARGENTVILLE, ME 04673

GRINDLE EVERETT JR
485 NORTH STREET
ELLSWORTH, ME 04605

GRINDLE SCOTT E
23 HALLBROOK WAY
ELLSWORTH, ME 04605

GUILLORY, THOMAS J & ELAINE C
516 MORRISON FARM RD
MARIAVILLE, ME 04605

GULOWSEN, EDWARD M III & NICHOLE E
2821 MARIAVILLE RD
MARIAVILLE, ME 04605

GUY WILLIAM T & BETTY J
42 TWITCHELL RD
BRYANT POND, ME 04219

HABERMAN KATHERINE D
2319 CONCORD AVE
BETHLEHEM, PA 08017

HABITAT FOR WILDLIFE
PO BOX 1145
YARMOUTH, ME 04046

HADLEY, ARTHUR L JR
82 BEACHRIDGE DR
EAST AMHERST, NY 14051

HAGEN, SUSAN
9808 DANFORD ST
FREDERICKSBURG, VA 22407

HALLIE EHLEN
142 MCKINLEY AVENUE
NORTHVILLE, NY 12134

HAMEL, ELIZABETH L
126 SUNFLOWER ST
GEORGETOWN, TX 78633

HANCOCK COUNTY OF
50 STATE STREET
ELLSWORTH, ME 04605

HANCOCK FRANKLIN SURETY LLC
39 EGYPT LANE
FRANKLIN, ME 04634

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HANSCOM BENJAMIN S
17 RUSSIAN ROAD
ELLSWORTH, ME 04605

HARGOOD, DEBRA A
24 PERKINS LANE
KENNEBUNK, ME 04043

HARRIS, JOHN
12 INDUSTRIAL RD
ELLSWORTH, ME 04605

HATCH, EDWARD D & CRYSTAL R
40 GRAY MEADOW RD
ORLAND, ME 04472

HAVEY, BRUCE & CYNTHIA E
200 PENINSULA DR
MARIAVILLE, ME 04605

HAZELL JOHN G
13616 COLBY WAY APT 202
MIDLOTHIAN, VA 23112-8326

HECKMAN RANDALL SAMUEL
40 THIRD STREET
ELLSWORTH, ME 04605

HERMIS, BLAKE R & MICHELLE Y
9 WEST STEARNS AVE
HOOKSETT, NH 03106

HERRINGTON DONALD L
54 THIRD STREET
ELLSWORTH, ME 04605

HIGGINS ALICE A
45 WILDER WAY
ELLSWORTH, ME 04605

HIGGINS KAREN A
14 HIGGINS WAY
ELLSWORTH, ME 04605

HIGGINS KATHI
16 HIGGINS WAY
ELLSWORTH, ME 04605

HOBBS, RICHARD
107 SILSBY RD
MARIAVILLE, ME 04605

HOBSON, ELIZABETH S
3449 62ND PLACE
GAINESVILLE, FL 32653

HOLT, DONALD E & JENNIFER E
242 PENINSULA DR
MARIAVILLE, ME 04605

HOROWITZ MARC LANCE
PO BOX 605
ELLSWORTH, ME 04605

HOUSMAN, CHARLES E & GAIL M
191 CLIFF DR
NORTH ATTLEBORO, MA 02760

HULBERT PHILIP JR & SHIRLEY
138 NEW YORK AVENUE
CONGERS, NY 10920

HUNNEFELD, JOHN A
582 MORRISON FARM RD
MARIAVILLE, ME 04605

HURLEY BROOKE
745 LOWER RED ROCK ROAD
BASTROP, TX 78602

INFRAN BORA & PATRICIA RUGGLES
52 BRIARWOOD ROAD
FLORHAM PARK, NJ 04932

JACQUELY PIERCE
160 FITCHBURG ROAD
WALTHAM, ME 04605

JAMES CURTIS
355 MARIAVILLE ROAD
ELLSWORTH, ME 04605

JAMES DUNN & JOAN MONTGOMERY
60 TATE ROAD
OTIS, ME 04605

JANSSON, KURT L & JACQUELINE R
9 RUSSIAN RD
ELLSWORTH, ME 04605

JEFFREY HUME
203 WENDELL DEPOT ROAD
ORANGE, MA 01364

JENKINS PAUL R
220 SHORE ROAD
ELLSWORTH, ME 04605

JESTER BURRIS T
PO BOX 534
ELLSWORTH, ME 04605-0534

JESTER, BURRIS J & KIERSTEN A
PO BOX 911
ELLSWORTH, ME 04605

JEWETT, DARYL & CHARMARIE
140 MORRISON FARM RD
MARIAVILLE, ME 04605

**Ellsworth Hydroelectric Project (FERC No. 2727)
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299 MAIN STREET
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12935 TAR FLOWER DR
TAMPA, FL 33626

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PO BOX 659
ORLEANS, MA 02653

JOHN BAPST MEMORIAL HIGH SCHOOL
100 BROADWAY
BANGOR, ME 04401

JOHNSON, RICHARD F & BAILEY S
144 SCHOOL HOUSE RD
MARIAVILLE, ME 04605

JOHNSTON, STEPHEN REED (HEIRS)
50 TREASURES PLACE
QUEENSBURY, NY 12804

JONATHAN PIERCE & DEBORAH DIK
133 FITCHBURG ROAD
WALTHAM, ME 04605

JONES DONALD H
3 NORMAN AVENUE
NEWBURYPORT, MA 01950

JONES HARRY S III TRUSTEE
232 MAIN STREET
ELLSWORTH, ME 04605

JORDAN EVELYN M
738 NORTH STREET
ELLSWORTH, ME 04605

JORDAN, TOMMY & DAWN L
17 PARK ST
ELLSWORTH, ME 04605

JOSLIN PHILIP T
409 MARIAVILLE ROAD
ELLSWORTH, ME 04605

JOSLIN PHILIP T
407 MARIAVILLE ROAD
ELLSWORTH, ME 04605

JOY DAVID G
80 CRESTVIEW RD
TERRYVILLE, CT 06786

JOY LOUISE M
129 NORTH STREET
ELLSWORTH, ME 04605

KANE KEVIN S
126 US HWY 1
HANCOCK, ME 04640

KANE SEAN R
230 FLETCHERS LANDING ROAD
FLETCHERS LANDING TWP, ME 04605

KARWASINSKI PAMELA A
54 FLOWER WAY
ELLSWORTH, ME 04605

KATSIAFICAS LILLIAN S
278 HIGH STREET
ELLSWORTH, ME 04605

KEITH HUME
581 SOUTH MAIN STREET
ORANGE, MA 01364

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ELLSWORTH, ME 04605

KELLEY LARRY D
601 OAK HILL ROAD
SWANVILLE, ME 04915

KELLEY, JOHN B
93 RIVER RD
BIDDEFORD, ME 04005

KIDSPACE OF NEW ENGLAND
16 KIDS PEACE WAY
ELLSWORTH, ME 04605

KIEF ROBERT J
PO BOX 1601
ELLSWORTH, ME 04605

KING, DAVID A
11 LIBERTY LANE
GORHAM, ME 04038

KING, EDWIN
1736 MARIAVILLE RD
MARIAVILLE, ME 04605

KISH JOSEPH
525 MARIAVILLE RD
ELLSWORTH, ME 04605

KLOONGIAN, PAMELA &
38 MYSTIC RIVER RD
MEDFORD, MA 02155

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24910 FALCON HOLLOW LANE
KATY, TX 77450

Ellsworth Hydroelectric Project (FERC No. 2727)
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252 MORRISON FARM RD
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KOTHMAYER, PHILIP W & KATHERINE H
4747 SOUTHWEST 3RD AVE
OCALA, FL 34471

KOVACS, MARIA
265 BAYSIDE RD
ELLSWORTH, ME 04605

LABELLE, WILLIAM A JR
58 MEGAN LANE
MARIAVILLE, ME 04605

LACEY, JOHN A SR & SHARON A
6 LAKESHORE DR
MARIAVILLE, ME 04605

LAFFIN, ROBERT W JR
310 PENNISULA DR
MARIAVILLE, ME 04605

LAFLAMME CORDA W
113 HIGHLAND AVENUE
OLD TOWN, ME 04468

LAHAYE MICHELLE & MATTHEW
PO BOX 476
SOUTHWEST HARBOR, ME 04679

LANIGAN, EDWARD P & LORRAINE
131 MILDRED AVE
MARIAVILLE, ME 04605

LAPLANT PETER
302 NORTH ST
ELLSWORTH, ME 04605

LAPLANTE, EDWARD A & GAYLE F
363 TEN ROD RD
NORTH KINGSTON, RI 02852

LASHER VICTOR J
867 PHILLIPS ROAD
WARMINSTER, PA 18974

LAWRENCE & ALICE WORDEN
24 CHASE ROAD
WINDHAM, VT 05359

LAWRENCE JOAN
370 HEMENWAY ST, APT 304
MARBOROUGH, MA 01752

LAWRENCE JOY E
545 WINTER ST
FRAMINGHAM, MA 01702

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OLDSMAR, FL 34677

LEBEL, CAROL ANNE
114 ATTUCKS LANE
HYANNIS, MA 02601

LEE, ROBERT ET AL
5901 STRESEMANN ST
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LEMAY, PAUL E
23 SMITH ST
LEWISTON, ME 04240

LEVESQUE RAYMOND N
27 HALLBROOK WAY
ELLSWORTH, ME 04605

LEWIS, KENT H & KAREN M
468 PUTNAM RD
DANIELSON, CT 06239

LIGHT MICHAEL A
460 NORTH STREET
ELLSWORTH, ME 04605

LINDA MICHISK
549 MOSES HASLAM ROAD
WALTHAM, ME 04605

LINDSEY EVELYN L
11 FARRELL WAY
ELLSWORTH, ME 04605

LINDSEY TERRY A
371 MARIAVILLE ROAD
ELLSWORTH, ME 04605

LINNEHAN HEATHER M TRUSTEE
PO BOX 678
ELLSWORTH, ME 04605

LINNELL, DAVID & SANDRA
90 SILSBY RD
MARIAVILLE, ME 04605

LIPKVICH, STEVEN
40 BLUEBERRY LANE
MARIAVILLE, ME 04605

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AURORA, ME 04408

LONCTO DONALD E
207 FLETCHERS LANDING RD
FLETCHERS LANDING TWP, ME 04605

Ellsworth Hydroelectric Project (FERC No. 2727)
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BATH, ME 04530

LOUNDER DONALENE E
6345 CASPER RIDGE
EL PASO, TX 79912

LOUNDER SCOTT V & HOLLY M
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LYNCH KEVIN M & CAROLYN R
22 MYRNAS WAY
FLETCHERS LANDING TWP, ME 04605

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STATESVILLE, SC 28677

MACDOWELL, ROGER P
46 OLD FIELD RD
TRENTON, ME 04605

MACFARLANE MICHAEL L
581 NORTH STREET
ELLSWORTH, ME 04605

MADDOCKS CHESTER H & PATIENCE A
18 DRIFTWOOD WAY
FLETCHERS LANDING TOWNSHIP, ME 04605

MADDOCKS HOLLIS
27 PIGEON ROAD
FLETCHERS LANDING, ME 04605-4810

MALLET DAVID C
23 PALMER ST #1
WALTHAM, MA 02451-3618

MANCINI, JAMES G
824 ROOSEVELT TRAIL #160 BOX 4000
WINDHAM, ME 04062

MANETTE BRAD A
35 ELM STREET
ELLSWORTH, ME 04605

MANNING CHRISTOPHER
452 NORTH STREET
ELLSWORTH, ME 04605

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244 N GREENBRIER STREET
ARLINGTON, VA 22203

MARDEN, KERI G & LORI
27 MILL POND RD
EXETER, RI 02822

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3381 KNIGHT ST
JACKSONVILLE, FL 32205

MARIAVILLE LLC
PO BOX 170
WEST HYANNISPORT, MA 02672

MARINO PAUL
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HARPERS FERRY, WV 25425

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51 OAK STREET
HARWICH, MA 02645

MARRAMA, PHILIP & CHERYL A
3 ALGONQUIN DR
HADLEY, MA 01035

MARY TALLEY
129 FITCHBURG ROAD
WALTHAM, ME 04605

MATHER, DIAN H & DARI A
22 ROTHRY LANE
TRENTON, ME 04605

MCCRUM, NEAL S & BEVERLY
246 HOWARD ST
BANGOR, ME 04401

MCDARBY, JAMES & BARBARA
3113 SE 19TH AVE
CAPE CORAL, FL 33904

MCDEVITT MARION J
1187 SHORE ROAD
LAMOINE, ME 04605

MCDONALD, ROBERT V
32 WILEY ST
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MCDONALD, THOMAS & KAREN
103 SPINDLE RD
ELLSWORTH, ME 04605

Ellsworth Hydroelectric Project (FERC No. 2727)
Abutter List for Water Quality Certification Application

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3045 BASTONE CT
WEST SACRAMENTO, CA 95691

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SULLIVAN, ME 04664

MCHALE LISA J
6 SUNCREST AVE
WILMINGTON, MA 01887

MCKAY, ANTOINETTE
77 WHITMORE RD
MARIAVILLE, ME 04605

MCKAY, TIMOTHY J & TRACY R
542 MORRISON FARM RD
MARIAVILLE, ME 04605

MCKENNEY JUDITH C
11 COOKS LANE
ELLSWORTH, ME 04605

MEHDI MOSTAGHIMI
PO BOX 569
MADISON, CT 06443

MERCALDO ALAN
220 HIGHLANDS LAKE DRIVE
CARY, NC 27518

MERRICK, EDWARD L & DONNA L
292 HIGH ST
NORTH BERWICK, ME 03906

MERRILL BLUEBERRY FARMS
PO BOX 149
ELLSWORTH, ME 04605

MICHAEL & HYON CHRISTOPHER
4 DAHL ROAD
MERRIMACK, NH 03054

MICHALIK STELLA
8190 STRAWBERRY LANE APT 503
FALLS CHURCH, VA 22042-1041

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483 NORTH STREET
ELLSWORTH, ME 04605

MILLER ROBERT P
PO BOX 1553
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MILLIKEN, ROBERT & MARY
138 HAMPDEN RD
SOMERS, CT 06071

MILLIKEN, STEPHEN D & LISA R
157 COUNTY RD
SOMERS, CT 06071

MINNIS, BOYD & DOROTHY A
PO BOX 672
ELLSWORTH, ME 04605

MITCHELL, CHARLES E
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MOLEON, R DAVID
227 STATE ST
BANGOR, ME 04401

MONSULICH, JOSEPH M
20 W SECOND MOUNTAIN RD
POTTSVILLE, PA 17901

MOREAU RAYMOND
478 MARIAVILLE ROAD
ELLSWORTH, ME 04605

MORIN, ROGER
346 MORRISON FARM RD
MARIAVILLE, ME 04605

MORRILL, BARRY A
100 LOCKSLEY RD
AUBURN, ME 04210

MORYC, RICHARD
189 FROST MILL RD
MARIAVILLE, ME 04605

MUISE LEROY A
1904 BAYSIDE RD
ELLSWORTH, ME 04605

MULLEN, TERENCE P &
119 DOANE AVE
EAST BROOKFIELD, MA 01515

MUMMERT, CARROLL E & JUDITH E
70 OLD ORCHARD LANE
CHADDS FORD, PA 19317

MUNRO PAUL T & DONNA H
BOX 125
OWLS HEAD, ME 04854

MURZYN, PAUL R & MARYELLEN
PO BOX 1
EASTHAM, MA 02642

MUSCHLITZ, BRUCE H
85 SILSBY RD
MARIAVILLE, ME 04605

**Ellsworth Hydroelectric Project (FERC No. 2727)
Abutter List for Water Quality Certification Application**

NASE, CARRIE B
2506 HILLTOWN PIKE
PERKASIE, PA 18944

NELSON HARRY E JR ET AL
127 HILL RD
W BATH, ME 04530

O HALLORAN SHARON
545 BANGOR ROAD
ELLSWORTH, ME 04605

OGLE DEBORAH L
9 MECHANIC ST
BRIDGTON, ME 04009

OKANE GALEN R
8 OKANE WAY
ELLSWORTH, ME 04605

OLSEN, RICHARD
258 AUGUSTA RD
BELMONT, ME 04952

PALMACCI JOSHUA
941 MARIAVILLE ROAD
ELLSWORTH, ME 04605

PARENT, RONALD W & WENDY J
65 HANCOCK ST
ELLSWORTH, ME 04605

PARK, WILLIAM W & TERRI L
4225 BRIDGE LANE
CUTCHOGUE, NY 11935

PARKER, STEPHEN S
292 PYLE RD
MARIAVILLE, ME 04605

PARTRIDGE JOHN SR
PO BOX 724
ELLSWORTH, ME 04605

PATTEN STEPHAN M & LINDA B
PO BOX 1983
BUCKSPORT, ME 04416

PEASE, DAVID M
164 HEALD ST
PEPPERELL, MA 01463

PEASLEY WILLIAM W
122 OTIS RD
OTIS, ME 04605

PEMBERTON CHRISTOPHER A AND
PO BOX 16099
TWO RIVERS, AK 99716

PENDERGIST JAMES L
PO BOX 417
ELLSWORTH, ME 04605

PERRY, RICHARD & CANDY M
27 MAKERS COVE RD
OWLS HEAD, ME 04854

PHILIP VIVEK M
19 STERLING STREET
TRENTON, ME 04605

PIDHURNEY, MICHAEL J & SUSAN J
PO BOX 843
ELLSWORTH, ME 04605

PIERSON GEORGE A
316 GRANT STREET
ELLSWORTH, ME 04605

PIERZYNSKI, JOHN P JR (DEV)
554 HIGH ST
HAMPTON, NH 03842

PINKHAM RYAN A
443 MARIAVILLE ROAD
ELLSWORTH, ME 04605

PONTBRIANT, WILLIAM J JR & SUSAN M
PO BOX 222
BIDDEFORD, ME 04005

POORS BRYANT L ET AL
28 WINDMERE WAY
FLETCHERS LANDING TWP, ME 04605

POTTS DANIEL C
21 WINDMERE WAY
FLETCHERS LANDING, ME 04605-4811

POTTS DANIEL C TRUSTEE
2485 HILLCREST ROAD
QUAKERTOWN, PA 18951-2272

PRICE, CHERYL D
5 LITTLE BROOK RD
MARIAVILLE, ME 04605

QUINN MARJORIE A
35 FLETCHERS LANDING ROAD
FLETCHERS LANDING TOWNSHIP, ME 04605-4802

RAMBONE, JOHN A
81 PECK HILL RD
JOHNSTON, RI 02919

RAMSAY DAVID J
23 LILLY LANE
HERMON, ME 04401

Ellsworth Hydroelectric Project (FERC No. 2727)
Abutter List for Water Quality Certification Application

RANKIN BASIL G JR & MARYANN
26 RANKINS ROAD
FLETCHERS LANDING, ME 04605

REED, JOHN F
518 LAUREL WAY
HERMON, ME 04401

RENBARGER, MICHAEL P
1091 102ND ST
PLEASANT PRAIRIE, WI 53158

REYNOLDS WILLIAM W
PO BOX 1374
ELLSWORTH, ME 04605

RICH, DAVID & DONNA
79 HATCHET MOUNTAIN RD
HOPE, ME 04847

RICHARD & LORRAINE KALA
12 THRUSTON STREET
RIVERSIDE, RI 02915

RICHARD C HARDISON SR
1648 WALTHAM ROAD
WALTHAM, ME 04605

RIPLEY, CHARLES W & TINA L
229 FROST MILL RD
MARIAVILLE, ME 04605

ROBBINS, TIMOTHY D
203 PENINSULA DR
MARIAVILLE, ME 04605

ROBERGE CHRISTINA B
935 MARIAVILLE ROAD
ELLSWORTH, ME 04605

ROBERT & SHARON CYR
9 FERN STREET
NORWALK, CT 06854

ROLFE, DEBORAH D ET AL
169 CLEWLEYVILLE RD
EDDINGTON, ME 04428

ROSEHILL, KEAHONU I
409 A KEOLU DR
KAILUA, HI 96734

ROY, NORMAND & SHONNA
15 NORTH UNION RIVER RD
MARIAVILLE, ME 04605

RUDDY, ROBERT B & JOELLE A
1719 MARIAVILLE RD
MARIAVILLE, ME 04605

RUMERY BENJAMIN S
228 NORTH STREET
ELLSWORTH, ME 04605

RUTKEIWICZ, JAMES D & JANET A
187 WEST BRANCH RD
MARIAVILLE, ME 04605

RYAN KENNETH & NEVELLS SUZANNE
13 MYRNAS WAY
ELLSWORTH, ME 04605-4809

SABOL THOMAS S ET AL
80 ELDRIDGE ROAD
MARIAVILLE, ME 04605-7163

SALISBURY LAURA C
55 PINE HILL ROAD
OTIS, ME 04605

SALSBUURY CLARA I
65 GLADDING PLACE
KENSINGTON, CT 06037

SAMBOON & PANSY MOUTHAPONG
8341 SHUYLER
SHUYLER, VA 22969

SARGENT ROBERT P
PO BOX 1475
ELLSWORTH, ME 04605

SARGENT TIFFANY L
12 SECLUDED WAY
FLETCHERS LANDING, ME 04605-4858

SARVEY, PAULA
177 SILSBY RD
MARIAVILLE, ME 04605

SCHLAEFER JOSHUA W
817 RED BRIDGE ROAD
ELLSWORTH, ME 04605

SCHMIDT, DOUGLAS F & DEBORAH J
405 LEVENSELLER RD
HOLDEN, ME 04429

SESSIONS, BRIAN W & MARINA E
12 MARSTON ST
NORWAY, ME 04268

SHAPAZIAN VERNON E ET AL
PO BOX 681
ELLSWORTH, ME 04605

SHEA, GERALD W & MICHELE L
PO BOX 273
BROOKFIELD, MA 01506

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SHELTON STEVEN DAVID
31 HALLBROOK WAY
ELLSWORTH, ME 04605

SHERMAN CHARLES E & JANICE P
5 CHESLEY LANE
LINCOLN, ME 04457

SHERMAN, IRVING E JR & APRIL L
236 MORRISON FARM RD
MARIAVILLE, ME 04605

SILK JOHN H
42 FLETCHERS LANDING ROAD
FLETCHERS LANDING TWP, ME 04605

SILSBY RAYMOND S
PO BOX 1585
ELLSWORTH, ME 04605

SMITH BRADLEY P
31 GILES ROAD
FRANKLIN, ME 04634

SMITH JEFFREY S
179 NEWELL ROAD
YARMOUTH, ME 04096

SMITH ROBERT M
359 MACARTHUR AVENUE
LONG BRANCH, NJ 07740

SMITH, LARRY E JR & KAREN L
304 SOUTH GOULDSBORO RD
GOULDSBORO, ME 04607

SMITH, WENDI C
6 WAMPANOAG DR
FAIRHAVEN, MA 02719

SOPER ELIZABETH L TRUSTEE
90 BANGOR ROAD
ELLSWORTH, ME 04605

SOPER SCOTT H
NEWTON SAINT CYRES
EXETER, UK EX5 5AL

SORIANO, ROMEO MERIDITH
50 PORTIA AVE
ROCKPORT, TX 78382

SOULLIER, NORMAN &
10 BANAS LANE
HARRISVILLE, RI 02830

SPRAGUE BRENDA L
350 NORTH BEND ROAD
SURRY, ME 04684

ST PETER, SUSAN M
1859 LAKE FOREST LANE
ORANGE PARK, FL 32003

ST PIERRE, JEAN
364 MORRISON FARM RD
MARIAVILLE, ME 04605

STAGGS FRANK H
1311 CAMPBELL AVENUE
DES PLAINES, IL 60016

STANLEY WENDY RAE
58 FLOWER WAY
ELLSWORTH, ME 04605

STANWOOD WILDLIFE SANCTUARY
PO BOX 485
ELLSWORTH, ME 04605

STEARNS, LEWIS
61 AMES RD
KENDUSKEAG, ME 04450

STEDMAN, DONALD W
200 TANNERY BROOK RD
MARIAVILLE, ME 04605

STEVENSON FAMILY INVESTMENTS LLC
2686 ROUTE 206
MOUNT HOLLY, NJ 08060

STONE, ARTHUR & JUDITH
144 TANNERY BROOK RD
MARIAVILLE, ME 04421

SULLIVAN, JOHN G & JAYNE H
39 SULLIVAN WAY
TROY, ME 04987

SUNDSTROM, TIMOTHY F
84 SULLIVAN RD
HUDSON, NH 03051

SWEENEY, COLIN N & LINDA G
491 DUTTON ST #510
LOWELL, MA 01854

SZILVA, ANDREW J III
74 ANN RD
LONG VALLEY, NJ 07853

TALARICK PETER D
1051 MARIAVILLE ROAD
ELLSWORTH, ME 04605

TALLMAN ANTHONY & ROSALIND
11709 159 COURT NORTH
JUPITER, FL 33478

Ellsworth Hydroelectric Project (FERC No. 2727)
Abutter List for Water Quality Certification Application

THOMAS & NANCY HAMEL
120 PEACEFUL POINT ROAD
WALTHAM, ME 04605

TINTLE, JAMES E
23 MILDRED AVE
MARIAVILLE, ME 04605

TOWN OF MARIAVILLE (BOATS)
1686 MARIAVILLE RD
MARIAVILLE, ME 04605

TOZIER, DENNIS G & MARYANN
375 CHRISTIAN RIDGE RD
ELLSWORTH, ME 04605

TREE TOP MANUFACTURING, INC
381 CAVE HILL ROAD
WALTHAM, ME 04605

TRIPP BONNIE M
88 GRAHAM WAY
ELLSWORTH, ME 04605

TROGER FRED
14 TROGER WAY
ELLSWORTH, ME 04605

TUELL JULIE L
PO BOX 492
ELLSWORTH, ME 04605

URSA MAJOR LLC
40 CHAMPION LANE
MILFORD, ME 04461

US FISH & WILDLIFE SERVICE
1 HATCHERY WAY
ELLSWORTH, ME 04605

VACHON, J MARTIN & JANET R
590 MORRISON FARM RD
MARIAVILLE, ME 04605

VAN DER DOES HANS E TRUSTEE
PO BOX 610
NORTH BERWICK, ME 03906

VES REVOCABLE TRUST
PO BOX 681
ELLSWORTH, ME 04605

WALKER BONNIE E
8201 DISION DRIVE
MONTGOMERY, AL 36117

WALKER, DAVID A & KIM L
145 MUD CREEK RD
HANCOCK, ME 04640

WATERS, PAUL A (REVOCABLE TRUST)
95 SILSBY RD
MARIAVILLE, ME 04605

WEAVER, JEFFREY W & KAREN L
490 MORRISON FARM RD
MARIAVILLE, ME 04605

WEBB, LINDA &
22 KENNEBEC RD
HAMPDEN, ME 04444

WEDGE TIMOTHY
11 STONEY BROOK WAY
ELLSWORTH, ME 04605

WEGLINSKI, ROSE
PO BOX 854
ELLSWORTH, ME 04605

WEISS LINDA S
805 SECRETARIAT AVE
ALBUQUERQUE, NM 87123

WELKER, BETTY LOU L/E
68 MORRISON FARM RD
MARIAVILLE, ME 04605

WELLS FARGO BANK
707 SABLE OAK DRIVE, SUITE 250
BREWER, ME 04412

WESCOTT, SEAN P & SEAN M
215 PENINSULA DR
MARIAVILLE, ME 04605

WHEATON KEITH & KATHLEEN
175 FLETCHERS LANDING ROAD
FLETCHERS LANDING TOWNSHIP, ME 04605

WHEATON, KENNETH & LINDA K
1042 NORWAY RD
GLENBURN, ME 04401

WHITEHOUSE, BRADLEY T
9 MARYS WAY
SOUTH YARMOUTH, MA 02664

WHITEHOUSE, DARYL L
76 SEAPIT RD
EAST FALMOUTH, MA 02536

WHITMORE JOHN J
PO BOX 885 PLANTATION 8
ELLSWORTH, ME 04605

WHITMORE JOYCE
115 DANA'S LEDGE
FLETCHERS LANDING TWP, ME 04605

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WHYNE, ROBERT & KIMBERLY S
682 RAKER RD
SUNBURY, PA 17801

WIBBY, WAYNE W
20 BELLEVUE AVE
BANGOR, ME 04401

WILBUR JULIETTE A M
20 HIGGINS WAY
ELLSWORTH, ME 04605

WILBUR, LEE S & ARLETTA
PO BOX 1422
SOUTHWEST HARBOR, ME 04679

WILLIAM & DYMUNA VERNON
PO BOX 97
SOUTH JAMESPORT, NY 11970

WILLIAMS, PAUL D & MARILYN A
422 MORRISON FARM RD
MARIAVILLE, ME 04605

WILSON LOUIS & LINDA
135 FLETCHERS LANDING RD
FLETCHERS LANDING TWP, ME 04605

WONG, JOHN &
PO BOX 1563
ELLSWORTH, ME 04605

WOODARD TODD J
228 CHRISTIAN RIDGE ROAD
ELLSWORTH, ME 04605

YARDLEY, MARY A
PO BOX 5
CALAIS, ME 04619

ZACZYK, JAN & MELANIE E
186 MARKET ST
NEW BRITAIN, CT 06051

TOWN OF WALTHAM
1520 WALTHAM ROAD
WALTHAM, ME 04605

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=====
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AUGUSTA
ME
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2202550330
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	ABESS, LEONARD JR (TRUSTEE) 100 SE 32ND RD MIAMI, FL 33129											
	ALDEN MICHAEL D 107 CLOVER LANE BREWER, ME 04412											
	AMES, P FOERD 308 MORRISON FARM RD MARIAVILLE, ME 04605											
	ANDERSON AUSTIN M 2922 WOODCREST DRIVE SARASOTA, FL 34239											
	AWALT, JIMMIE W & 1624 MARIAVILLE RD MARIAVILLE, ME 04605											
	BABSTOCK LUCINDA E 77 WILBUR ST WALTHAM, MA 02453											
	BACKLUND, JENNY L 129 TROUT BROOK RD MARIAVILLE, ME 04605											
	BALLARD TIMOTHY J PO BOX 217 WORCHESTER, NY 12197											

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 ME 04330

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1.	BARRY JOHN D 440 MARIAVILLE ROAD ELLSWORTH, ME 04605											
2.	BATCHELDER ELEANOR R 54 EAGLE ROAD ELLSWORTH, ME 04605											
3.	ADAMS, BETH WILLIAMS 65 HEMLOCK LANE MARIAVILLE, ME 04605											
4.	ALLEN ELIZABETH A & FREY VALERIE C 443 FLETCHERS LANDING ROAD ELLSWORTH, ME 04605											
5.	AMIRAULT THOMAS 24R BOSTON ROAD ANDOVER, MA 01810											
6.	ARCHER CHIPPER W 63 PIGEON ROAD FLETCHERS LANDING TOWNSHIP, ME 04605											
7.	AYERS, DAMIAN & MARILYN 625 PETER PLACE BRICK, NJ 08723											
8.	BABSTOCK LUCINDA E & JOHN J JR 20 WAVERLY ST WALTHAM, MA 02453											



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1.	BAGLEY, LINDA T PO BOX 88 ROCHESTER, MA 02770											
2.	BARNA, WILLIAM J & ANNA L 1 SHOSHONEAN TRAIL SOUTHBURY, CT 06488											
3.	BARRY, BRIAN R PO BOX 160 EDDINGTON, ME 04428											
4.	BATES LUTHER J 15 CROSBY LANE CHATHAM, MA 02633-1591											
5.	ADAMS, BRUCE A & MARGARET A 57 STONEYBROOK WAY HERMON, ME 04401											
6.	ALLENS BLUEBERRY FREEZER PO BOX 536 ELLSWORTH, ME 04605											
7.	ANDERSEN, HENRIETTA M 211 MAPLE AVE DELANCO, NJ 08075											
8.	ASTLE, MICHAEL 781 CROOKED RD BAR HARBOR, ME 04609											



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1.	BABINE, JOHN G SR & BRIGITE M 3785 SW QUAIL MEADOW TRAIL UNIT A PALM CITY, FL 34990											
2.	BACHELDER, WALTER ROGER PO BOX 142 MANCHESTER, ME 04351											
3.	BALL, JERRILYN M 338 MORRISON FARM RD MARIAVILLE, ME 04605											
4.	BARNES ANTHONY W 131 BANGOR ROAD ELLSWORTH, ME 04605											
5.	BARTELT, FREDERICK H III & RUTH ANN 154 OLD HAY RD MARIAVILLE, ME 04605											
6.	BAUERSFELD C DIANN 253 SHORE ROAD ELLSWORTH, ME 04605											
7.	BAXTER BENJAMIN A 3 STRAWBERRY HILL BAR HARBOR, ME 04609											
8.	BEESON, SHARON & OTLEY 170 TANNERY BROOK ROAD MARIAVILLE, ME 04605-7028											



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1.	BENNETT, SCOTT G 28 RICHARD BENNETT LANE THOMPSON, CT 06277											
2.	BERNIER, GEORGE & RITA ANN 230 MAST HILL RD BUCKSPORT, ME 04416											
3.	BLAIR JOANN 722 OAK GLEN RD HOWELL, NJ 07731											
4.	BLANDINE, JAMES & DOROTHY V 242 NEWARK RD SOUTH BARNEGAT, NJ 08005											
5.	BORLAN, VIOLA 7912 TIMBERLAKE RD LYNCHBURG, VA 24502											
6.	BOUDREAU, THOMAS C 8063 CRYSTAL PLACE VENTURA, CA 93004											
7.	BRANCA MARY L ESTATE OF 2616 RIDGE AVENUE EGG HARBOR TWP, NJ 08234											
8.	BRODY, SCOTT M 115 GARRISON RD ELMER, NJ 08318											



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1.	BEAUCHESNE, DALE & 30 TASSEL TRAIL CASCO, ME 04015											
2.	BEHLER LEON 11 BRIMMER POINT WAY ELLSWORTH, ME 04605											
3.	BENOIT, DENNIS & SANDY PO BOX 108 PAXTON, MA 01612											
4.	BILLINGS, DANA E & BOBBI A 300 SUNSHINE RD DEER ISLE, ME 04627											
5.	BLANCHETTE BRADLEY DAVID 514 MARIAVILLE ROAD ELLSWORTH, ME 04605											
6.	BORDEN, ROY HEATH 38719 EDGEWOOD CIRCLE DENHAM SPRINGS, LA 70706											
7.	BOTT RONALD 52 FLOWER WAY ELLSWORTH, ME 04605											
8.	BRAGG ROBERT J JR PO BOX 471 ELLSWORTH, ME 04605											



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1. BRIDGES SARAH B
 20 SARI LANE
 FLETCHERS LANDING, ME 04605

2. BROWN DWIGHT A JR
 PO BOX 701
 ELLSWORTH, ME 04605

3. BEAUDOIN, CHARLES & LISA
 48 RUTH LANE
 LYMAN, ME 04002

4. BELLOCCHI PAUL L
 79 EAST RIDGE ROAD
 SOUTHWEST HARBOR, ME 04679

5. BERNARD, JAMES M &
 9979 SW STONEGATE DR
 PORT SAINT LUCIE, FL 34987

6. BLACK BEAR HYDRO PARTNERS LLC
 75 STATE STREET SUITE 2701
 BOSTON, MA 02109

7. BLANCHETTE, WILLIAM H & SUSAN L
 127 ROCKY HILL RD
 SUMMERSWORTH, NH 03878

8. BORER, JOSEPH M & KATHLEEN M
 221 FROST MILL RD
 MARIAVILLE, ME 04605



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 Augusta, ME 04330

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- Insured
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- Registered
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- Signature Confirmation

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1.	BYRNE, CHARLES J & HALINA 66 WEST 4TH ST NORTH BERWICK, ME 03906											
2.	CAMPBELL, JOSEPH & ROSEANN 574 MORRISON FARM RD MARIAVILLE, ME 04605											
3.	CARMICHAEL, MARTIN H & PAMELA J PO BOX 163 GREENBUSH, ME 04418											
4.	CARTER, ROLAND C 520 TILTON HILL RD PITTSFIELD, NH 03263											
5.	CHADBOURNE, DANVILLE & 126 SCHOOL HOUSE RD MARIAVILLE, ME 04605											
6.	CHANDLER, NEIL A SR & KAREN A 63 LORDS COVE WAY SURRY, ME 04684											
7.	CHURCH OF CHRIST IN ISRAEL US HIGHWAY 1 ELLSWORTH, ME 04605-0802											
8.	CLAYTON WENDY S 89 MORGAN ROAD JULIETTE, GA 31046											



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1.	CHURCHILL JOHN F 371 CHRISTIAN RIDGE RD ELLSWORTH, ME 04605											
2.	CLIFFORD & LAUREN RADCLIFFE 371 BIRDSALL DRIVE YORKTOWN HEIGHTS, NY 10598											
3.	CLINCH, ROBERT & 21 SPRING RD MIDDLETON, MA 01949											
4.	CONNERY JANE C PSC 37 BOX 2887 APO, AE 09459											
5.	COOK LINDA J & FRANCIA J PLUNKETT 283 NEY ST SAN FRANCISCO, CA 94112											
6.	COSGROVE, DENNIS M & DEBORAH E 10558 SE 178TH ST SUMMERFIELD, FL 34491											
7.	CRAIG COULOMBE 105 CHERRYWOOD LANE FARMINGTON, ME 04938											
8.	DALE HENDERSON 45 ROBERTSON BOULEVARD, SUITE 5 BREWER, ME 04412											



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1.	DANIEL SARGENT/SCOTT TOOTHAKER PO BOX 368 ELLSWORTH, ME 04605											
2.	DAVIS JAMES W 52 NORTH STREET ELLSWORTH, ME 04605											
3.	DEBLOIS, BERNICE B 89 OLD COUNTY RD BROOKLIN, ME 04616											
4.	DENNIS & TIMOTHY NEYLON 111 EDMUND STREET CHICOPEE, MA 01020											
5.	COLSON, ORA ALBERT & YOSHIMI 73 HEMLOCK LANE MARIAVILLE, ME 04605											
6.	CONNOR, PAUL S & DEBORAH 215 TANNERY BROOK RD MARIAVILLE, ME 04605											
7.	COOPER, ERIC MIKEMAN 253 FROST MILL RD MARIAVILLE, ME 04605											
8.	COTRONEO MAINE LLC 571 MARIAVILLE ROAD ELLSWORTH, ME 04605											



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	CROWLEY KERRY 250 SHORE ROAD ELLSWORTH, ME 04605											
	DALTON EMILY 382 NE 191ST STREET #39393 MIAMI, FL 33179-3899											
	DAVID & RHEA ROBBINS 641 SOUTH MAIN STREET BREWER, ME 04412											
	DAWSON MICHELLE R & JAMES F BIRMINGHAM 1225 PATAPSCO STREET BALTIMORE, MD 21230											
	DEMERS, KELLY R 24 AIRLINE RD CLIFTON, ME 04428											
	DENNIS, EDWARD J & ANN M 39 THOMPSON RD VEAZIE, ME 04401											
	CONDON RICHARD 1023 NEW HARWINTON ROAD TURRINGTON, CT 04790											
	CONRY, JOSEPH M & JANET PO BOX 134 HAMPTON, NJ 08827											



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1.	CORMIER BRUCE D 36 CENTRAL STREET ELLSWORTH, ME 04605											
2.	COUSINS LEROY PO BOX 214 HULLS COVE, ME 04644											
3.	CURTIS JEANINE PO BOX 233 ELLSWORTH, ME 04605											
4.	DAMM EDWARD A 24 LEDGELAWN AVENUE BAR HARBOR, ME 04609											
5.	DAVID LINDBERG 625 PARKER HILL ROAD CAVENDISH, VT 05142											
6.	DEAN YOUNG 364 EASTBROOK ROAD FRANKLIN, ME 04634											
7.	DENBOW, CHAS & THEODORE 392 ELM ST UNIT E3 WEST HAVEN, CT 06516											
8.	DICKSON, PAUL S 515 WALNUT ST SAUGUS, MA 01906											



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	DIVELLO, MATTHEW J & LAUREN A 723 GRAVELLY HOLLOW RD MEDFORD, NJ 08055											
	DORITY, SHELDON A 177 DORITY FARM RD MARIAVILLE, ME 04605											
	DOUG GOTT & SONS INC 110 BASS HARBOR ROAD S W HARBOR, ME 04679											
	DUCLOS, AIME E & JENNIFER R 65 PORTLAND ST SOUTH BERWICK, ME 03908											
	DUNN THOMAS P 35 BRIMMER POINT WAY ELLSWORTH, ME 04605											
	DURKO JOSEPHINE B ET AL 84 WOODLAND AVE S AMBOY, NJ 08879											
	EDGECOMB, MARGARET PO BOX 1852 ELLSWORTH, ME 04605											
	ELIZABETH & ARTHUR WILDER 499 WILDER HILL ROAD NORRIDGEWOCK, ME 04957											



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1.	EDGECOMB, SPENSER E 92 TROUT BROOK RD MARIAVILLE, ME 04605											
2.	ELLSWORTH CITY OF L-LAKE WATER CO LOT ELLSWORTH, ME 04605											
3.	EMERA MAINE 970 ILLINOIS AVENUE BANGOR, ME 04402											
4.	ENOCH & GAIL WENSTROM 88 BECKETT STREET, APT 1 PORTLAND, ME 04101											
5.	DORITY ARTHUR B 593 MARIAVILLE ROAD ELLSWORTH, ME 04605											
6.	DORR, DAVID W BOX 1005 SOUTHWEST HARBOR, ME 04679											
7.	DUBON, BYRON D & LINDA 216 TANNERY BROOK RD MARIAVILLE, ME 04605											
8.	DUDLEY, JAMES & BARBARA 2330 BELGRADE RD SIDNEY, ME 04330											



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1.	DUPUY, CLAUDE PO BOX 400 BLUE HILL, ME 04614
2.	EBERHARDT, ERNEST K 62 LAUREL ST HOLBROOK, NY 11741
3.	EGGLESTON ALBERT E PO BOX 248 ELLSWORTH, ME 04605
4.	ELLSWORTH CITY OF 1 CITY HALL PLAZA ELLSWORTH, ME 04605
5.	EMERA MAINE 28 PENOBSCOT MEADOW DRIVE HAMPDEN, ME 04444
6.	EVANS DIANNE C & LYNN M HALPIN 5075 BETTS ROAD GREENBRIER, TN 37073
7.	FAGE, DOUGLAS M & KATHRYN 1026 SOUTH RD MARIAVILLE, ME 04605
8.	FARRIN BRUCE A 471 NORTH STREET ELLSWORTH, ME 04605

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1.	FELLIS MEGHAN 1571 MARIAVILLE ROAD ELLSWORTH, ME 04605											
2.	FLOWER EUGENE R 2933 TENBROECK AVENUE BRONX, NY 10469											
3.	FORGIT PAUL 14 GARDNER STREET OXFORD, MA 01540											
4.	FOSSA, JOSEPH 78 BEECHER ST ESSEX, MA 07729											
5.	FRENCHMAN BAY CONSERVANCY PO BOX 150 HANCOCK, ME 04640											
6.	FROST, MAURICE 294 MARIAVILLE RD ELLSWORTH, ME 04605											
7.	GAGNE, DAVID & RONDA 225 FROST MILL RD MARIAVILLE, ME 04605											
8.	GARLAND JESSE C 3230 CYPRESS COVE WAY SEVIERVILLE, TN 37876											



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1.	FALLS BRUCE R 98 STARKS HILL ROAD TORRINGTON, CT 06790											
2.	FELLIS FAMILY GRAVEL PIT LLC 1571 MARIAVILLE RD MARIAVILLE, ME 04605											
3.	FIELD, MARSHALL SR 324 E RANDALL AVE NORFOLK, VA 23503											
4.	FORGIT FRANCIS 65 INDIAN RIDGE ROAD EAST HAMPSTEAD, NH 03826											
5.	FORGIT RAYMOND W 86 DIPPER COVE RD ORRS ISLAND, ME 04066											
6.	FOSTER RUTH S 93 MAIN STREET ELLSWORTH, ME 04605											
7.	FRIEND COOPER F TRUSTEE PO BOX 688 ELLSWORTH, ME 04605											
8.	FULLER JACKIE 241 FLETCHERS LANDING RD FLETCHERS LANDING TWP, ME 04605											



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								GARDINER JUANITA 155B FLETCHERS LANDING ROAD FLETCHERS LANDING, ME 04605												
								GARLAND KENNETH A 29 HUMMINGBIRD LANE ELLSWORTH, ME 04605												
								FARKAS, KENNETH & SUSAN 8 CANDLEWOOD HEIGHTS NEW MILFORD, CT 06776												
								FELLIS LIVING TRUST 1490 MARIAVILLE RD MARIAVILLE, ME 04605												
								FISCHER, HENRY W III & DONNA M 428 MANOR AVE MILLERSVILLE, PA 17551												
								FORGIT GERALD A 36790 STATE HWY 102 SW FERTILE, MN 56540												
								FORNAL, JOHN J 86 ROUTE 80 KILLINGSWORTH, CT 06419												
								FRANK & JOAN BERTKIEWICZ 9 FOX DEN ROAD DERRY, NH 03038												

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1. FROST, GARY E & ADAM E 120 GRAHAM WAY ELLSWORTH, ME 04605											
2. GADDIS JAMES P PO BOX 1883 ELLSWORTH, ME 04605											
3. GARDNER MARK 36 CEDAR BREEZE NORTH GLENBURN, ME 04401											
4. GARLAND NORA B & ROBERT D 6 HUMMINGBIRD LANE FLETCHER'S LANDING, ME 04605											
5. GATES NANCY E & JONATHAN 15 BUTTERMILK FALLS NYACK, NY 10960											
6. GEORGE STRINGER & CAROLEE TULLY PO BOX 1537 ELLSWORTH, ME 04605											
7. GILLIS, DERRICK N 9 MILLER DR PLYMOUTH, MA 02360											
8. GORMLEY STEPHEN V 285 CHRISTIAN RIDGE ROAD ELLSWORTH, ME 04605-3205											



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1.	GOEBEL FRANZ TRUSTEE 20 MUSKET LANE SUDBURY, MA 01776											
2.	GOTT, DOUG & SONS INC 110 BASS HARBOR RD SOUTHWEST HARBOR, ME 04679											
3.	GREENSTONE PAUL J PO BOX 792 BRUNSWICK, ME 04011-0792											
4.	GRINDALL, OLNEY M JR & MARJORIE L 485 REACH RD SARGENTVILLE, ME 04673											
5.	GUILLORY, THOMAS J & ELAINE C 516 MORRISON FARM RD MARIAVILLE, ME 04605											
6.	HABERMAN KATHERINE D 2319 CONCORD AVE BETHLEHEM, PA 08017											
7.	HAGEN, SUSAN 9808 DANFORD ST FREDERICKSBURG, VA 22407											
8.	HANCOCK COUNTY OF 50 STATE STREET ELLSWORTH, ME 04605											



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1.	GENDROLIS, JOHN & ELIZABETH 20 TUTTLE ST DORCHESTER, MA 02125											
2.	GILLINGHAM, DEBRA 169 MORRISON FARM RD MARIAVILLE, ME 04605											
3.	GOODMAN JAMES J & REBECCA J 6977 NORTHWEST HARTNEY WAY PORT ST LUCIE, FL 34983											
4.	GRAHN, CARL J & 274 REED ST HANSON, MA 02341											
5.	GREGORY JORDAN 1499 WALTHAM ROAD WALTHAM, ME 04605											
6.	GRINDLE EVERETT JR 485 NORTH STREET ELLSWORTH, ME 04605											
7.	GULOWSEN, EDWARD M III & NICHOLE E 2821 MARIAVILLE RD MARIAVILLE, ME 04605											
8.	HABITAT FOR WILDLIFE PO BOX 1145 YARMOUTH, ME 04046											



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2.	HANCOCK FRANKLIN SURETY LLC 39 EGYPT LANE FRANKLIN, ME 04634																
3.	HANSCOM BENJAMIN S 17 RUSSIAN ROAD ELLSWORTH, ME 04605																
4.	HATCH, EDWARD D & CRYSTAL R 40 GRAY MEADOW RD ORLAND, ME 04472																
5.	HECKMAN RANDALL SAMUEL 40 THIRD STREET ELLSWORTH, ME 04605																
6.	HIGGINS ALICE A 45 WILDER WAY ELLSWORTH, ME 04605																
7.	HOBBS, RICHARD 107 SILSBY RD MARIAVILE, ME 04605																
8.	HOROWITZ MARC LANCE PO BOX 605 ELLSWORTH, ME 04605																



Total Number of Pieces Listed by Sender: 8
 Total Number of Pieces Received at Post Office: MB

See Privacy Act Statement on Reverse

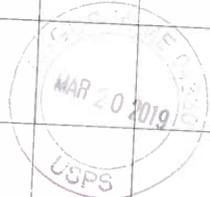
TRC TRC
 Attn: Michelle Blair
 14 Gabriel Drive
 Augusta, ME 04330

Check type of mail or service:

- Certified
- COD
- Delivery Confirmation
- Express Mail
- Insured
- Recorded Delivery (International)
- Registered
- Return Receipt for Merchandise
- Signature Confirmation

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 Date of Receipt

Article Number	Addressee (Name, Street, City, State, & ZIP Code)	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
1.	HUNNEFELD, JOHN A 582 MORRISON FARM RD MARIAVILLE, ME 04605											
2.	JACQUELY PIERCE 160 FITCHBURG ROAD WALTHAM, ME 04605											
3.	JANSSON, KURT L & JACQUELINE R 9 RUSSIAN RD ELLSWORTH, ME 04605											
4.	JESTER BURRIS T PO BOX 534 ELLSWORTH, ME 04605-0534											
5.	HARGOOD, DEBRA A 24 PERKINS LANE KENNEBUNK, ME 04043											
6.	HAVEY, BRUCE & CYNTHIA E 200 PENINSULA DR MARIAVILLE, ME 04605											
7.	HERMIS, BLAKE R & MICHELLE Y 9 WEST STEARNS AVE HOOKSETT, NH 03106											
8.	HIGGINS KAREN A 14 HIGGINS WAY ELLSWORTH, ME 04605											



Delivery Confirmation
 Signature Confirmation
 Special Handling
 Restricted Delivery
 Return Receipt

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1.	HOBSON, ELIZABETH S 3449 62ND PLACE GAINESVILLE, FL 32653																	
2.	HOUSMAN, CHARLES E & GAIL M 191 CLIFF DR NORTH ATTLEBORO, MA 02760																	
3.	HURLEY BROOKE 745 LOWER RED ROCK ROAD BASTROP, TX 78602																	
4.	JAMES CURTIS 355 MARIAVILLE ROAD ELLSWORTH, ME 04605																	
5.	JEFFREY HUME 203 WENDELL DEPOT ROAD ORANGE, MA 01364																	
6.	JESTER, BURRIS J & KIERSTEN A PO BOX 911 ELLSWORTH, ME 04605																	
7.	HARRIS, JOHN 12 INDUSTRIAL RD ELLSWORTH, ME 04605																	
8.	HAZELL JOHN G 13616 COLBY WAY APT 202 MIDLOTHIAN, VA 23112-8326																	



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			HERRINGTON DONALD L 54 THIRD STREET ELLSWORTH, ME 04605															
			HIGGINS KATHI 16 HIGGINS WAY ELLSWORTH, ME 04605															
			HOLT, DONALD E & JENNIFER E 242 PENINSULA DR MARIVILLE, ME 04605															
			HULBERT PHILIP JR & SHIRLEY 138 NEW YORK AVENUE CONGERS, NY 10920															
			INFRAN BORA & PATRICIA RUGGLES 52 BRIARWOOD ROAD FLORHAM PARK, NJ 04932															
			JAMES DUNN & JOAN MONTGOMERY 60 TATE ROAD OTIS, ME 04605															
			JENKINS PAUL R 220 SHORE ROAD ELLSWORTH, ME 04605															
			JEWETT, DARYL & CHARMARIE 140 MORRISON FARM RD MARIVILLE, ME 04605															



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1. JOANNE HASLAM
 299 MAIN STREET
 ELLSWORTH, ME 04605

2. JOHN BAPST MEMORIAL HIGH SCHOOL
 100 BROADWAY
 BANGOR, ME 04401

3. JONATHAN PIERCE & DEBORAH DIK
 133 FITCHBURG ROAD
 WALTHAM, ME 04605

4. JORDAN EVELYN M
 738 NORTH STREET
 ELLSWORTH, ME 04605

5. JOSLIN PHILIP T
 407 MARIAVILLE ROAD
 ELLSWORTH, ME 04605

6. KANE KEVIN S
 126 US HWY 1
 HANCOCK, ME 04640

7. KATSIAFICAS LILLIAN S
 278 HIGH STREET
 ELLSWORTH, ME 04605

8. KELLEY LARRY D
 601 OAK HILL ROAD
 SWANVILLE, ME 04915



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\$20.09
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Delivery Confirmation
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 Restricted Delivery
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49

Total Number of Pieces Listed by Sender

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1.	KEITH HUME 581 SOUTH MAIN STREET ORANGE, MA 01364											
2.	KELLEY, JOHN B 93 RIVER RD BIDDEFORD, ME 04005											
3.	KING, DAVID A 11 LIBERTY LANE GORHAM, ME 04038											
4.	KLOONGIAN, PAMELA & 38 MYSTIC RIVER RD MEDFORD, MA 02155											
5.	JOHN & OLIVE MURPHY PO BOX 659 ORLEANS, MA 02653											
6.	JOHNSTON, STEPHEN REED (HEIRS) 50 TREASURES PLACE QUEENSBURY, NY 12804											
7.	JONES HARRY S III TRUSTEE 232 MAIN STREET ELLSWORTH, ME 04605											
8.	JOSLIN PHILIP T 409 MARIAVILLE ROAD ELLSWORTH, ME 04605											



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	JOY LOUISE M 129 NORTH STREET ELLSWORTH, ME 04605											
	KARWASINSKI PAMELA A 54 FLOWER WAY ELLSWORTH, ME 04605											
	KELL DUGALD PO BOX 481 ELLSWORTH, ME 04605											
	KIDSPACE OF NEW ENGLAND 16 KIDS PEACE WAY ELLSWORTH, ME 04605											
	KING, EDWIN 1736 MARIVILLE RD MARIVILLE, ME 04605											
	KNIGHT, DORIS E 24910 FALCON HOLLOW LANE KATY, TX 77450											
	KOCHAKIAN, EDWYN & THERESA 252 MORRISON FARM RD MARIVILLE, ME 04605											
	LABELLE, WILLIAM A JR 58 MEGAN LANE MARIVILLE, ME 04605											



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1.	LAFHAMME CORDA W 113 HIGHLAND AVENUE OLD TOWN, ME 04468											
2.	LAPLANT PETER 302 NORTH ST ELLSWORTH, ME 04605											
3.	LAWRENCE & ALICE WORDEN 24 CHASE ROAD WINDHAM, VT 05359											
4.	LEBARNES, DANA P PO BOX 1708 OLDSMAR, FL 34677											
5.	LEMAY, PAUL E 23 SMITH ST LEWISTON, ME 04240											
6.	LIGHT MICHAEL A 460 NORTH STREET ELLSWORTH, ME 04605											
7.	LINDSEY TERRY A 371 MARIVILLE ROAD ELLSWORTH, ME 04605											
8.	LIPKVICH, STEVEN 40 BLUEBERRY LANE MARIVILLE, ME 04605											



Total Number of Pieces Listed by Sender: 8
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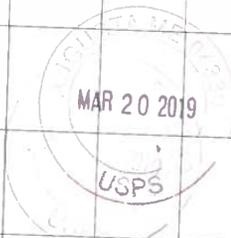
CTRC TRC
 Attn: Michelle Blair
 14 Gabriel Drive
 Augusta, ME 04330

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	KOTHMAYER, PHILIP W & KATHERINE H 4747 SOUTHWEST 3RD AVE OCALA, FL 34471											
	LACEY, JOHN A SR & SHARON A 6 LAKESHORE DR MARIAVILLE, ME 04605											
	LAHAYE MICHELLE & MATTHEW PO BOX 476 SOUTHWEST HARBOR, ME 04679											
	LAPLANTE, EDWARD A & GAYLE F 363 TEN ROD RD NORTH KINGSTON, RI 02852											
	LAWRENCE JOAN 370 HEMENWAY ST, APT 304 MARBOROUGH, MA 01752											
	LEBEL, CAROL ANNE 114 ATTUCKS LANE HYANNIS, MA 02601											
	LEVESQUE RAYMOND N 27 HALLBROOK WAY ELLSWORTH, ME 04605											
	LINDA MICHISK 549 MOSES HASLAM ROAD WALTHAM, ME 04605											



Total Number of Pieces Listed by Sender

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8

TRC
 Attn: Michelle Blair
 14 Gabriel Drive
 Augusta, ME 04330

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- 4.
- 5.
- 6.
- 7.
- 8.

Addressee (Name, Street, City, State, & ZIP Code)

LINNEHAN HEATHER M TRUSTEE
 PO BOX 678
 ELLSWORTH, ME 04605

LITTLE POND SALES INC
 PO BOX 96
 AURORA, ME 04408

KOVACS, MARIA
 265 BAYSIDE RD
 ELLSWORTH, ME 04605

LAFFIN, ROBERT W JR
 310 PENNISULA DR
 MARIAVILLE, ME 04605

LANIGAN, EDWARD P & LORRAINE
 131 MILDRED AVE
 MARIAVILLE, ME 04605

LASHER VICTOR J
 867 PHILLIPS ROAD
 WARMINSTER, PA 18974

LAWRENCE JOY E
 545 WINTER ST
 FRAMINGHAM, MA 01702

LEE, ROBERT ET AL
 5901 STRESEMANN ST
 SAN DIEGO, CA 92122

Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
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U.S. POSTAGE PAID
 AUGUSTA, ME
 04330
 MAR 20, 19
 AMOUNT
\$20.09
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Delivery Confirmation
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 Special Handling
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 Return Receipt

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1.	LEWIS, KENT H & KAREN M 468 PUTNAM RD DANIELSON, CT 06239											
2.	LINDSEY EVELYN L 11 FARRELL WAY ELLSWORTH, ME 04605											
3.	LINNELL, DAVID & SANDRA 90 SILSBY RD MARIAVILLE, ME 04605											
4.	LONCTO DONALD E 207 FLETCHERS LANDING RD FLETCHERS LANDING TWP, ME 04605											
5.	LONG, WILLIAM F & LYNN DATZ 701 MAIN ST RIVERTON, NJ 08077											
6.	LOUNDER SCOTT V & HOLLY M PO BOX 1012 ELLSWORTH, ME 04605											
7.	MACDOWELL, ROGER P 46 OLD FIELD RD TRENTON, ME 04605											
8.	MADDOCKS HOLLIS 27 PIGEON ROAD FLETCHERS LANDING, ME 04605-4810											



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MPB

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Postage

Fee

Handling
Charge

Actual Value
if Registered

Insured
Value

Due Sender
if COD

DC
Fee

SC
Fee

SH
Fee

RD
Fee

RR
Fee

1. MANETTE BRAD A
 35 ELM STREET
 ELLSWORTH, ME 04605

2. MARDEN, KERI G & LORI
 27 MILL POND RD
 EXETER, RI 02822

3. MARINO PAUL
 PO BOX 1518
 HARPERS FERRY, WV 25425

4. MARNA BATE
 51 OAK STREET
 HARWICH, MA 02645

5. MATHER, DIAN H & DARI A
 22 ROTHRY LANE
 TRENTON, ME 04605

6. MCDEVITT MARION J
 1187 SHORE ROAD
 LAMOINE, ME 04605

7. LOPRESTI, DANIEL R
 1289 WASHINGTON ST
 BATH, ME 04530

8. LYNCH KEVIN M & CAROLYN R
 22 MYRNAS WAY
 FLETCHERS LANDING TWP, ME 04605



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1. MACFARLANE MICHAEL L
 581 NORTH STREET
 ELLSWORTH, ME 04605

2. MALLET DAVID C
 23 PALMER ST #1
 WALTHAM, MA 02451-3618

3. MANNING CHRISTOPHER
 452 NORTH STREET
 ELLSWORTH, ME 04605

4. MARETT, ROBERT S & DEBRA S
 3381 KNIGHT ST
 JACKSONVILLE, FL 32205

5. MARION MICHAEL A
 195 FRENCHMAN'S HILL ROAD
 BAR HARBOR, ME 04609

6. MARRAMA, PHILIP & CHERYL A
 3 ALGONQUIN DR
 HADLEY, MA 01035

7. MCCRUM, NEAL S & BEVERLY
 246 HOWARD ST
 BANGOR, ME 04401

8. MCDONALD, ROBERT V
 32 WILEY ST
 BANGOR, ME 04401



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1.	MCDARBY, JAMES & BARBARA 3113 SE 19TH AVE CAPE CORAL, FL 33904											
2.	MCDONALD, THOMAS & KAREN 103 SPINDLE RD ELLSWORTH, ME 04605											
3.	MCGLOTHLIN, MICHAEL & WENDY 3045 BASTONE CT WEST SACRAMENTO, CA 95691											
4.	MCKAY, ANTOINETTE 77 WHITMORE RD MARIAVILLE, ME 04605											
5.	MEHDI MOSTAGHIMI PO BOX 569 MADISON, CT 06443											
6.	MERRILL BLUEBERRY FARMS PO BOX 149 ELLSWORTH, ME 04605											
7.	MICHAUD MELISSA J 483 NORTH STREET ELLSWORTH, ME 04605											
8.	MILLIKEN, STEPHEN D & LISA R 157 COUNTY RD SOMERS, CT 06071											



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1. MILLER ROBERT P
 PO BOX 1553
 ELLSWORTH, ME 04605

2. MINNIS, BOYD & DOROTHY A
 PO BOX 672
 ELLSWORTH, ME 04605

3. MONSULICH, JOSEPH M
 20 W SECOND MOUNTAIN RD
 POTTSVILLE, PA 17901

4. MORRILL, BARRY A
 100 LOCKSLEY RD
 AUBURN, ME 04210

5. MULLEN, TERENCE P &
 119 DOANE AVE
 EAST BROOKFIELD, MA 01515

6. MURZYN, PAUL R & MARYELLEN
 PO BOX 1
 EASTHAM, MA 02642

7. MCHALE LISA J
 6 SUNCREST AVE
 WILMINGTON, MA 01887

8. MCKENNEY JUDITH C
 11 COOKS LANE
 ELLSWORTH, ME 04605



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<input type="checkbox"/> Delivery Confirmation	<input type="checkbox"/> Return Receipt for Merchandise
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 Date of Receipt

1.	Addressee (Name, Street, City, State, & ZIP Code)	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
	MERRICK, EDWARD L & DONNA L 292 HIGH ST NORTH BERWICK, ME 03906											
	MICHALIK STELLA 8190 STRAWBERRY LANE APT 503 FALLS CHURCH, VA 22042-1041											
	MILLIKEN, ROBERT & MARY 138 HAMPDEN RD SOMERS, CT 06071											
	MITCHELL, CHARLES E PO BOX 114 HULLS COVE, ME 04644											
	MOREAU RAYMOND 478 MARIAVILLE ROAD ELLSWORTH, ME 04605											
	MORYC, RICHARD 189 FROST MILL RD MARIAVILLE, ME 04605											
	MUMMERT, CARROLL E & JUDITH E 70 OLD ORCHARD LANE CHADDS FORD, PA 19317											
	MUSCHLITZ, BRUCE H 85 SILSBY RD MARIAVILLE, ME 04605											



Total Number of Pieces Listed by Sender: 8
 Total Number of Pieces Received at Post Office: 8

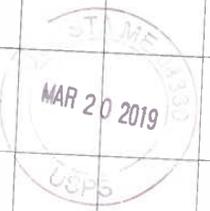
TRC
 Attn: Michelle Blair
 14 Gabriel Drive
 Augusta, ME 04330

Check type of mail or service:

- Certified
- COD
- Delivery Confirmation
- Express Mail
- Insured
- Recorded Delivery (International)
- Registered
- Return Receipt for Merchandise
- Signature Confirmation

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 certificate of mailing,
 or for additional
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 Date of Receipt

	Addressee (Name, Street, City, State, & ZIP Code)	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
1.	NASE, CARRIE B 2506 HILLTOWN PIKE PERKASIE, PA 18944											
2.	OGLE DEBORAH L 9 MECHANIC ST BRIDGTON, ME 04009											
3.	PALMACCI JOSHUA 941 MARIAVILLE ROAD ELLSWORTH, ME 04605											
4.	PARKER, STEPHEN S 292 PYLE RD MARIAVILLE, ME 04605											
5.	PEASE, DAVID M 164 HEALD ST PEPPERELL, MA 01463											
6.	PENDERGIST JAMES L PO BOX 417 ELLSWORTH, ME 04605											
7.	PIDHURNEY, MICHAEL J & SUSAN J PO BOX 843 ELLSWORTH, ME 04605											
8.	PINKHAM RYAN A 443 MARIAVILLE ROAD ELLSWORTH, ME 04605											



Delivery Confirmation
 Signature Confirmation
 Special Handling
 Restricted Delivery
 Return Receipt

Total Number of Pieces Listed by Sender: 8
 Total Number of Pieces Received at Post Office: 8

TRC
 Attn: Michelle Blair
 14 Gabriel Drive
 Augusta, ME 04330

Check type of mail or service:

<input type="checkbox"/> Certified	<input type="checkbox"/> Recorded Delivery (International)
<input type="checkbox"/> COD	<input type="checkbox"/> Registered
<input type="checkbox"/> Delivery Confirmation	<input type="checkbox"/> Return Receipt for Merchandise
<input type="checkbox"/> Express Mail	<input type="checkbox"/> Signature Confirmation
<input type="checkbox"/> Insured	

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	Addressee (Name, Street, City, State, & ZIP Code)	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
1.	POTTS DANIEL C 21 WINDMERE WAY FLETCHERS LANDING, ME 04605-4811											
2.	QUINN MARJORIE A 35 FLETCHERS LANDING ROAD FLETCHERS LANDING TOWNSHIP, ME 04605-4802											
3.	NELSON HARRY E JR ET AL 127 HILL RD W BATH, ME 04530											
4.	OKANE GALEN R 8 OKANE WAY ELLSWORTH, ME 04605											
5.	PARENT, RONALD W & WENDY J 65 HANCOCK ST ELLSWORTH, ME 04605											
6.	PARTRIDGE JOHN SR PO BOX 724 ELLSWORTH, ME 04605											
7.	PEASLEY WILLIAM W 122 OTIS RD OTIS, ME 04605											
8.	PERRY, RICHARD & CANDY M 27 MAKERS COVE RD OWLS HEAD, ME 04854											



Delivery Confirmation
 Signature Confirmation
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	Addressee (Name, Street, City, State, & ZIP Code)	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
1.	PIERSON GEORGE A 316 GRANT STREET ELLSWORTH, ME 04605											
2.	PONTBRIANT, WILLIAM J JR & SUSAN M PO BOX 222 BIDDEFORD, ME 04005											
3.	POTTS DANIEL C TRUSTEE 2485 HILLCREST ROAD QUAKERTOWN, PA 18951-2272											
4.	RAMBONE, JOHN A 81 PECK HILL RD JOHNSTON, RI 02919											
5.	O HALLORAN SHARON 545 BANGOR ROAD ELLSWORTH, ME 04605											
6.	OLSEN, RICHARD 258 AUGUSTA RD BELMONT, ME 04952											
7.	PARK, WILLIAM W & TERRI L 4225 BRIDGE LANE CUTCHOQUE, NY 11935											
8.	PATTEN STEPHAN M & LINDA B PO BOX 1983 BUCKSPORT, ME 04416											



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Total Number of Pieces Listed by Sender: 8
 Total Number of Pieces Received at Post Office: 10

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 Attn: Michelle Blair
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1.	Addressee (Name, Street, City, State, & ZIP Code)	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
	PEMBERTON CHRISTOPHER A AND PO BOX 16099 TWO RIVERS, AK 99716											
	PHILIP VIVEK M 19 STERLING STREET TRENTON, ME 04605											
	PIERZYNSKI, JOHN P JR (DEV) 554 HIGH ST HAMPTON, NH 03842											
	POORS BRYANT L ET AL 28 WINDMERE WAY FLETCHERS LANDING TWP, ME 04605											
	PRICE, CHERYL D 5 LITTLE BROOK RD MARIAVILLE, ME 04605											
	RAMSAY DAVID J 23 LILLY LANE HERMON, ME 04401											
	RANKIN BASIL G JR & MARYANN 26 RANKINS ROAD FLETCHERS LANDING, ME 04605											
	REYNOLDS WILLIAM W PO BOX 1374 ELLSWORTH, ME 04605											



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Total Number of Pieces Listed by Sender: 8
 Total Number of Pieces Received at Post Office: 10

119

TRC TRC
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1.	RICHARD C HARDISON SR 1648 WALTHAM ROAD WALTHAM, ME 04605											
2.	ROBERGE CHRISTINA B 935 MARIVILLE ROAD ELLSWORTH, ME 04605											
3.	ROSEHILL, KEAHONUI 409 A KEOLU DR KAILUA, HI 96734											
4.	RUMERY BENJAMIN S 228 NORTH STREET ELLSWORTH, ME 04605											
5.	SABOL THOMAS S ET AL 80 ELDRIDGE ROAD MARIVILLE, ME 04605-7163											
6.	SAMBOON & PANSY MOUTHAPONG 8341 SHUYLER SHUYLER, VA 22969											
7.	SARVEY, PAULA 177 SILSBY RD MARIVILLE, ME 04605											
8.	SESSIONS, BRIAN W & MARINA E 12 MARSTON ST NORWAY, ME 04268											



Delivery Confirmation
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Total Number of Pieces Listed by Sender: 8
 Total Number of Pieces Received at Post Office: MB

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 14 Gabriel Drive
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1.	REED, JOHN F 518 LAUREL WAY HERMON, ME 04401											
2.	RICH, DAVID & DONNA 79 HATCHET MOUNTAIN RD HOPE, ME 04847											
3.	RIPLEY, CHARLES W & TINA L 229 FROST MILL RD MARIAVILLE, ME 04605											
4.	ROBERT & SHARON CYR 9 FERN STREET NORWALK, CT 06854											
5.	ROY, NORMAND & SHONNA 15 NORTH UNION RIVER RD MARIAVILLE, ME 04605											
6.	RUTKEIWICZ, JAMES D & JANET A 187 WEST BRANCH RD MARIAVILLE, ME 04605											
7.	SALISBURY LAURA C 55 PINE HILL ROAD OTIS, ME 04605											
8.	SARGENT ROBERT P PO BOX 1475 ELLSWORTH, ME 04605											



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Addressee (Name, Street, City, State, & ZIP Code)

	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
1. SCHLAEFER JOSHUA W 817 RED BRIDGE ROAD ELLSWORTH, ME 04605											
2. SHAPAZIAN VERNON E ET AL PO BOX 681 ELLSWORTH, ME 04605											
3. RENBARGER, MICHAEL P 1091 102ND ST PLEASANT PRAIRIE, WI 53158											
4. RICHARD & LORRAINE KALA 12 THRUSTON STREET RIVERSIDE, RI 02915											
5. ROBBINS, TIMOTHY D 203 PENINSULA DR MARIAVILLE, ME 04605											
6. ROLFE, DEBORAH D ET AL 169 CLEWLEYVILLE RD EDDINGTON, ME 04428											
7. RUDDY, ROBERT B & JOELLE A 1719 MARIAVILLE RD MARIAVILLE, ME 04605											
8. RYAN KENNETH & NEVELLS SUZANNE 13 MYRNAS WAY ELLSWORTH, ME 04605-4809											



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Postage

Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
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1. SMITH ROBERT M
 359 MACARTHUR AVENUE
 LONG BRANCH, NJ 07740

2. SOPER ELIZABETH L TRUSTEE
 90 BANGOR ROAD
 ELLSWORTH, ME 04605

3. SOULLIER, NORMAN &
 10 BANAS LANE
 HARRISVILLE, RI 02830

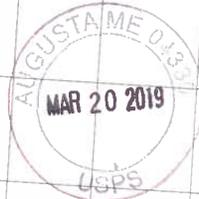
4. ST PIERRE, JEAN
 364 MORRISON FARM RD
 MARIVILLE, ME 04605

5. STANWOOD WILDLIFE SANCTUARY
 PO BOX 485
 ELLSWORTH, ME 04605

6. STEVENSON FAMILY INVESTMENTS LLC
 2686 ROUTE 206
 MOUNT HOLLY, NJ 08060

7. SUNDSTROM, TIMOTHY F
 84 SULLIVAN RD
 HUDSON, NH 03051

8. TALARICK PETER D
 1051 MARIVILLE ROAD
 ELLSWORTH, ME 04605



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	Addressee (Name, Street, City, State, & ZIP Code)	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
1.	SHERMAN, IRVING E JR & APRIL L 236 MORRISON FARM RD MARIAVILLE, ME 04605											
2.	SMITH BRADLEY P 31 GILES ROAD FRANKLIN, ME 04634											
3.	SMITH, LARRY E JR & KAREN L 304 SOUTH GOULDSBORO RD GOULDSBORO, ME 04607											
4.	SOPER SCOTT H NEWTON SAINT CYRES EXETER, UK EX5 5AL											
5.	SPRAGUE BRENDA L 350 NORTH BEND ROAD SURRY, ME 04684											
6.	STAGGS FRANK H 1311 CAMPBELL AVENUE DES PLAINES, IL 60016											
7.	STEARNS, LEWIS 61 AMES RD KENDUSKEAG, ME 04450											
8.	STONE, ARTHUR & JUDITH 144 TANNERY BROOK RD MARIAVILLE, ME 04421											



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 Return Receipt

Total Number of Pieces Total Number of Pieces

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 Attn: Michelle Blair
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 Augusta, ME 04330

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1.	SWEENEY, COLIN N & LINDA G 491 DUTTON ST #510 LOWELL, MA 01854											
2.	TALLMAN ANTHONY & ROSALIND 11709 159 COURT NORTH JUPITER, FL 33478											
3.	THOMAS & NANCY HAMEL 120 PEACEFUL POINT ROAD WALTHAM, ME 04605											
4.	TOZIER, DENNIS G & MARYANN 375 CHRISTIAN RIDGE RD ELLSWORTH, ME 04605											
5.	TROGER FRED 14 TROGER WAY ELLSWORTH, ME 04605											
6.	US FISH & WILDLIFE SERVICE 1 HATCHERY WAY ELLSWORTH, ME 04605											
7.	VES REVOCABLE TRUST PO BOX 681 ELLSWORTH, ME 04605											
8.	WATERS, PAUL A (REVOCABLE TRUST) 95 SILSBY RD MARIAVILLE, ME 04605											



Delivery Confirmation
 Signature Confirmation
 Special Handling
 Restricted Delivery
 Return Receipt

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	Addressee (Name, Street, City, State, & ZIP Code)	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
1.	WEDGE TIMOTHY 11 STONEY BROOK WAY ELLSWORTH, ME 04605											
2.	WELKER, BETTY LOU L/E 68 MORRISON FARM RD MARIAVILLE, ME 04605											
3.	WHEATON KEITH & KATHLEEN 175 FLETCHERS LANDING ROAD FLETCHERS LANDING TOWNSHIP, ME 04605											
4.	WHITEHOUSE, DARYL L 76 SEAPIT RD EAST FALMOUTH, MA 02536											
5.	TINTLE, JAMES E 23 MILDRED AVE MARIAVILLE, ME 04605											
6.	TREE TOP MANUFACTURING, INC 381 CAVE HILL ROAD WALTHAM, ME 04605											
7.	TUELL JULIE L PO BOX 492 ELLSWORTH, ME 04605											
8.	VACHON, J MARTIN & JANET R 590 MORRISON FARM RD MARIAVILLE, ME 04605											



Delivery Confirmation
 Signature Confirmation
 Special Handling
 Restricted Delivery
 Return Receipt



Firm Mailing Book For Accountable Mail

to: Michelle Blair
 Gabriel Drive
 Augusta, ME 04330

- Check type of mail or service
- Adult Signature Required
 - Adult Signature Restricted Delivery
 - Certified Mail
 - Certified Mail Restricted Delivery
 - Collect on Delivery (COD)
 - Insured Mail
 - Priority Mail
 - Priority Mail Express
 - Registered Mail
 - Return Receipt for Merchandise
 - Signature Confirmation
 - Signature Confirmation Restricted Delivery

Affix Stamp Here
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USPS Tracking/Article Number	Addressee (Name, Street, City, State, & ZIP Code™)	Postage	(Extra Service) Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	ASR Fee	ASRD Fee	RD Fee	RR Fee	SC Fee	SCRD Fee	SH Fee
	WALKER BONNIE E 8201 DISION DRIVE MONTGOMERY, AL 36117													
	WEAVER, JEFFREY W & KAREN L 490 MORRISON FARM RD MARIAVILLE, ME 04605													
	WEGLINSKI, ROSE PO BOX 854 ELLSWORTH, ME 04605													
	WELLS FARGO BANK 707 SABLE OAK DRIVE, SUITE 250 BREWER, ME 04412													
	WHEATON, KENNETH & LINDA K 1042 NORWAY RD GLENBURN, ME 04401													
	WHITMORE JOHN J PO BOX 885 PLANTATION 8 ELLSWORTH, ME 04605													
	TOWN OF MARIAVILLE (BOATS) 1686 MARIAVILLE RD MARIAVILLE, ME 04605													
	TRIPP BONNIE M 88 GRAHAM WAY ELLSWORTH, ME 04605													

Handling Charge - if Registered and over \$50,000 in value



Adult Signature Required

Adult Signature Restricted Delivery

Restricted Delivery

Return Receipt

Signature Confirmation

Signature Confirmation Restricted Delivery

Special Handling

Number of Pieces by Sender	Total Number of Pieces Received at Post Office
8	mb



Firm Mailing Book For Accountable Mail

RC Attention: Michelle Blair 14 Gabriel Drive Augusta, ME 04330		Mark type of mail or service <input type="checkbox"/> Signature Required <input type="checkbox"/> Priority Mail Express <input type="checkbox"/> Signature Restricted Delivery <input type="checkbox"/> Registered Mail <input type="checkbox"/> Certified Mail <input type="checkbox"/> Return Receipt for Merchandise <input type="checkbox"/> Certified Mail Restricted Delivery <input type="checkbox"/> Signature Confirmation <input type="checkbox"/> Collect on Delivery (COD) <input type="checkbox"/> Signature Confirmation Restricted Delivery <input type="checkbox"/> Insured Mail <input type="checkbox"/> Signature Confirmation Restricted Delivery <input type="checkbox"/> Priority Mail		Affix Stamp Here (if issued as an international certificate of mailing or for additional copies of this receipt). Postmark with Date of Receipt.													
USPS Tracking/Article Number	Addressee (Name, Street, City, State, & ZIP Code™)	Postage	(Extra Service) Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	ASR Fee	ASRD Fee	RD Fee	RR Fee	SC Fee	SCRD Fee	SH Fee			
	URSA MAJOR LLC 40 CHAMPION LANE MILFORD, ME 04461																
	VAN DER DOES HANS E TRUSTEE PO BOX 610 NORTH BERWICK, ME 03906																
	WALKER, DAVID A & KIM L 145 MUD CREEK RD HANCOCK, ME 04640																
	WEBB, LINDA & 22 KENNEBEC RD HAMPDEN, ME 04444																
	WEISS LINDA S 805 SECRETARIAT AVE ALBUQUERQUE, NM 87123																
	WESCOTT, SEAN P & SEAN M 215 PENINSULA DR MARIAVILLE, ME 04605																
	WHITEHOUSE, BRADLEY T 9 MARYS WAY SOUTH YARMOUTH, MA 02664																
	WHITMORE JOYCE 115 DANA'S LEDGE FLETCHERS LANDING TWP, ME 04605																
Number of Pieces by Sender	Total Number of Pieces Received at Post Office																
8	MPB																



Handling Charge - if Registered and over \$50,000 in value

Adult Signature Required

Adult Signature Restricted Delivery

Restricted Delivery

Return Receipt

Signature Confirmation

Signature Confirmation Restricted Delivery

Special Handling



Firm Mailing Book For Accountable Mail

Address of Sender
 n: Michelle Blair
 Gabriel Drive
 Justa, ME 04330

Check type of mail or service

Adult Signature Required
 Adult Signature Restricted Delivery
 Certified Mail
 Certified Mail Restricted Delivery
 Collect on Delivery (COD)
 Insured Mail
 Priority Mail

Priority Mail Express
 Registered Mail
 Return Receipt for Merchandise
 Signature Confirmation
 Signature Confirmation Restricted Delivery

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USPS Tracking/Article Number

Addressee (Name, Street, City, State, & ZIP Code™)

Postage	(Extra Service) Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	ASR Fee	ASRD Fee	RD Fee	RR Fee	SC Fee	SCRD Fee	SH Fee	
		Handling Charge - if Registered and over \$50,000 in value											
							Adult Signature Required	Adult Signature Restricted Delivery					
									Restricted Delivery	Return Receipt	Signature Confirmation	Signature Confirmation Restricted Delivery	Special Handling

Number of Pieces by Sender: 8
 Total Number of Pieces Received by Post Office: 8

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**ATTACHMENT 4
FERC LICENSE AND
AMENDMENTS**

41 FERC 162, 804

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

RECEIVED DEC 28 1987

Bangor Hydro-Electric Company

Project No. 2727-003

ORDER ISSUING NEW LICENSE
(Major Project - Existing Dam)
(Issued December 28, 1987)

Bangor Hydro-Electric Company has filed a license application under Part I of the Federal Power Act (Act) to continue to operate and maintain the Ellsworth Project, located in Hancock County, Maine, on the Union River, a navigable waterway of the United States. ^{1/}

Notice of the application has been published. The motions to intervene that have been granted and the comments and protests filed by agencies and individuals have been fully considered in determining whether to issue this license, as discussed below.

Recommendations of Federal and State Fish and Wildlife Agencies

Section 10(j) of the Act, as amended by the Electric Consumers Protection Act of 1986 (ECPA), Public Law No. 99-495, requires the Commission to include license conditions, based on recommendations of federal and state fish and wildlife agencies, for the protection, mitigation, and enhancement of fish and wildlife. The environmental assessment (EA) for the Ellsworth Hydroelectric Project addresses the concerns of the federal and state fish and wildlife agencies, and makes recommendations consistent with those of the agencies.

Comprehensive Plans

Section 10(a)(2) of the Act, as amended by ECPA, requires the Commission to consider the extent to which a project is consistent with comprehensive plans (where they exist) for improving, developing, or conserving a waterway or waterways affected by the project. The plans must be prepared by an agency established pursuant to federal law that has the authority to prepare such a plan or by the state in which the facility is or will be located. The Commission considers plans to be within the scope of section 10(a)(2), only if such plans reflect the preparers' own balancing of competing uses of a waterway, based on their data and applicable policy considerations (i.e., consider and balance all relevant public use considerations). With regard to plans prepared at the state level, such plans are within the scope of section 10(a)(2),

^{1/} 58 FPC 212 (1977).

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only if they are prepared and adopted pursuant to a specific act of the state legislature and developed, implemented, and managed by an appropriate state agency. 2/

The Commission has concluded that comprehensive planning under section 10(a)(2)(A), like comprehensive planning under section 10(a)(1), should take into account all existing and potential uses of a waterway relevant to the public interest, including navigation, power development, energy conservation, fish and wildlife protection and enhancement, recreational opportunities, irrigation, flood control, water supply, and other aspects of environmental quality. In order that the Commission may fully understand or independently confirm the content and conclusions of a comprehensive plan, it provided general guidelines for developing such plans that should contain the following: (1) a description of the waterway(s) that are subject to the plan, including pertinent maps; (2) a description of the significant resources of the waterway(s); (3) a description of the various existing and planned uses for these resources; and (4) a discussion of goals, objectives, and recommendations for improving, developing, or conserving the waterway(s) in relation to these resources. The more closely a plan conforms to these guidelines, the more weight it will have on the Commission's decisions. The Commission, however, will consider plans that do not meet the criteria for comprehensive plans, as it considers all relevant studies and recommendations in its public interest analysis pursuant to section 10(a)(1) to the extent that the documentation supports the plan.3/

The staff identified one comprehensive plan of the type referred to in section 10(a)(2) of the Act relevant to this project.4/ No conflicts were found. No resource plans that address various aspects of waterway management under section 10(a)(1) of the Act were brought our attention.

Based upon our review of the agency and public comments filed in this proceeding, and an independent analysis as discussed herein, it is concluded that the Ellsworth Project is best adapted to a comprehensive plan for the Union River, taking into consideration the beneficial public uses described in section 10(a)(1) of the Act.

2/ See Fieldcrest Mills, Inc. 37 FERC ¶61,264 (1986).

3/ See Commission Order No. 481, issued October 20, 1987.

4/ Maine State Planning Office's State of Maine Comprehensive Rivers Management Plan 1987.

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Federal Power Act - Section 15(a)

Section 4 of the ECPA amended Section 15 of the Act to specify a number of factors the Commission is required to consider in acting on applications for new license following the expiration of existing licenses.

1. The plans and abilities of the applicant to comply with the articles, terms, and conditions of any license issued to it and other applicable provisions of Part I of the Act (Section 15(a)(2)(A))

The Bangor Hydro-Electric Company (Bangor) states that, since obtaining the existing license, it has been committed to meeting the requirements of all the articles, terms, and conditions of the existing license. Bangor maintains that its past performance, in conjunction with its future operations and maintenance plans, and its record of compliance with the requirements of the jurisdictional agencies, demonstrate that it is committed to meeting the future requirements for the continued operation of the project.

Our review of the compliance record of the Bangor substantiates that the Bangor has generally complied with all articles, terms, and conditions of its existing license. Bangor has, on occasion, filed some compliance material late; however, staff will monitor closely Bangor's compliance in future requirements. Based on the above, and in consideration of the requirements of the new license, it is concluded that the Bangor will be able to comply with the terms and conditions of the new license and other provisions of Part I of the Act.

2. The plans of the applicant to manage, operate and maintain the project safely (Section 15(a)(2)(B))

The Bangor states that it is operating the generating facilities with a foremost concern for the safety of its employees and the public. Records indicate that there has never been an employee fatality. Also, there has been no injury or death to any member of the public within the project boundary. The Bangor has adopted a Safety Inspection Manual based on its operating experience, and this manual is continually updated. The project is, and will continue to be, operated as a peaking plant, which causes no extreme fluctuations, thus posing no project-caused hazard for fishermen and boaters. The Bangor has prepared an emergency action plan with a notification procedure to the public in case of a potential threat to life or property downstream.

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Based upon our review of the specific information provided by the Bangor on various aspects of the project that affect public safety, inspection reports by the Commission's Regional Director, and independent consultant reports filed under Part 12 of our regulations, 18 C.F.R. Part 12 (1987), it is concluded that with article number 301, the Bangor's plans to manage, operate, and maintain the project safely, would be adequate.

3. The plans and abilities of the applicant to operate and maintain the project in a manner most likely to provide efficient and reliable electric service (Section 15(a)(2)(C))

The Bangor states that during the past years they have: (1) removed the two 1,000 kW horizontal units (Units No. 2 and 3) and installed two new 2,000 kW units, one in 1937, the other in 1938, (2) replaced the damaged racks in 1950, (3) rebuilt Units No. 1 and 4 in 1982, (4) repaired concrete forebay walls and walkway and replaced roof over Unit No. 1 in 1983, (5) replaced hydraulic braking systems on Units No. 1, 2 and 3 in 1985, (6) replaced hydraulic braking system on Units No. 1, 2, and 3 in 1985, (7) placed rip-rap along the downstream river bank adjacent to the parking lot and regulators to prevent erosion, and (8) provided several smaller repair work between 1937 and 1986.

There are no water resource projects located upstream of Ellsworth Dam, except the Graham Dam, which would require the Bangor to coordinate the operation of the Ellsworth project.

The plant is operated in an automatic mode in a manner that maximizes generating efficiency. Maintenance upkeep has included upgrading electrical systems and repairs to the project works.

Operation of the Ellsworth Project enables the Bangor to reduce the loading of its transmission lines and the substation. The hydroelectric plant provides low-cost generation in the Bangor's system, and these benefits are expected to increase in the future because of the escalation of fuel costs.

Based on the above considerations, review of the operation inspection reports by the Regional Director, the Bangor's past performance, and future plans to operate the project, we believe that the project is, and under the new license will continue to be operated and maintained in an efficient and reliable manner.

4. The need of the applicant over the short and long term for the electricity generated by the project to serve its customers (Section 15(a)(2)(D))

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The applicant, Bangor, has applied to FERC for a new license to continue operation of the 8.9-MW Ellsworth Project. The project is located in the fastest growing portion of applicant's service area and substantial load growth is expected to continue.

Applicant's need for continuing operation of the project, over both the short and long terms is both economic and operational. From both economic and financial points of view, no source of replacement power is available which is cost-competitive with a hydroelectric facility whose original cost has been amortized, which has no fuel costs and which has modest operating and maintenance costs. From an operational point of view, the project provides the high reliability associated with hydroelectric facilities, has "black start" capacity which is used to bring other sources on-line in the event of a system outage, provides approximately 9 megawatts of spinning reserve and, when its output is not on dispatch, is available as a support source while repairs are being made. Additionally, it is the opinion of Staff that 79 years of operation and usefulness by, and to, the applicant give strong support to the applicant's need for the project and a new license.

In the event of denial of a new license, the applicant estimates the cost of replacement capacity and energy would be approximately \$43,000,000 (1987 dollars) for the first thirty years of the new license period. This estimate includes capital costs of existing and new combustion turbines and existing oil-fired steam plants. Also included in the estimate are fuel costs (principally imported oil) and operating and maintenance costs.

Other alternative sources of replacement power deserving consideration are the purchase of Canadian Hydropower and power from available cogeneration or small power producer facilities at avoided-cost rates.

The applicant has expressed concerns about the future costs and reliability of availability of replacement power purchases from a foreign sources (Canadian Hydro) or from sources which depend upon imported oil.

Except for Canadian hydro, alternative replacement power sources would consume non-renewable energy resources, principally oil, and would produce additional atmospheric pollution.

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Accepting applicant's estimate of the 30-year cost of 43 million 1987 dollars for replacement power, staff estimates that, in 1987 dollars, the unit cost of replacement power for the year 1986 would have been \$0.0415 per kilowatt-hour. In 1986 the project produced 34,493,700 net kilowatt-hours of electrical energy at a unit cost of \$0.0101 per kilowatt-hour.

5. The applicant's existing and planned transmission services (Section 15(a)(2)(E))

If the applicant is granted a new license to continue operation of the project, no changes will be required on the transmission line emanating from the project switch-yard and carrying only project power. Changes required on other lines of applicant's system will be such changes as are required as a result of load growth.

If the license is not renewed and applicant loses the project power, the project transmission line will not be needed and the 34.5-kV Ellsworth Substation located adjacent to the Ellsworth project powerhouse as well as lines L-1 and L-10 will require relocation. Applicant estimates that the cost of relocating the transmission system components located within the Ellsworth project boundary would approach \$150,000.

Applicant states that loss of the Ellsworth Project would result in higher system line losses; adverse impact on system reliability; and substantial expenditures to replace system components including substations, distribution lines and transmission lines.

6. Whether the plans of the applicant will be achieved, to the greatest extent possible, in a cost effective manner (Section 15(a)(2)(F))

With regard to the Ellsworth Project, the Bangor upgraded and modernized the equipment, and reduced the overall operation expenses. Units No. 2 and 3 were replaced by upgraded units to achieve higher efficiency.

No increase of capacity is planned. With the hydraulic capacity of 2,300 cfs and minimum flow release of 90 cfs, the Bangor adequately utilizes the flows of the Union River.

There are no projects, proposed or constructed on the Union River that this project would impact, and neither State or Federal agencies commented on flood control, navigation, water supply or irrigation requirements in the basin.

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The Director orders:

(A) This license is issued to Bangor Hydro Electric Company (licensee), for a period of 30 years, effective January 1, 1988, to continue to operate and maintain the Ellsworth Project. This license is subject to the terms and conditions of the Act, which is incorporated by reference as part of this license, and subject to the regulations the Commission issues under the provisions of the Act.

(B) The project consists of:

(1) All lands, to the extent of the licensee's interests in those lands, enclosed by the project boundary shown by Exhibit G:

<u>Exhibit G-</u>	<u>FERC No. 2727-</u>	<u>Showing</u>
G-1	18	General Location Map
G-2	19	General Project Area Map
G-3	20	Project Boundary Map
G-4	21	Project Boundary Map
G-5	22	Project Boundary Map

(2) Project works consisting of: (a) Graham Dam, an earthfill dam with concrete core walls, about 750 feet long and 30 feet high and having a gated concrete spillway; (b) Graham Lake, a reservoir extending approximately 15 miles above Graham Dam having a surface area of 12,200 acres at normal water surface elevation 104.2 feet U.S.G.S. datum; (c) Ellsworth Dam, a concrete buttress dam located about 4 miles downstream of Graham Dam, approximately 377 feet long and 60 feet high with 26-inch-high flashboards on the spillway; (d) Lake Leonard, a forebay reservoir extending approximately 1 mile above Ellsworth Dam and having a surface area of 125 acres at normal water surface elevation 66.67 feet U.S.G.S. datum; (e) a reinforced concrete and concrete block masonry powerhouse containing one 2,500-kW generating unit, two 2,000-kW generating units, and one 2,400-kW generating unit; (f) the generator leads; (g) three 2.3/34.5-kV step-up transformers; (h) the 34.5-kV transmission line connecting the step-up transformers to the 34.5-kV bus of the Ellsworth substation; and (i) appurtenant facilities.

The project works generally described above are more specifically shown and described by those portions of Exhibits A and F recommended for approval in the attached Safety and Design Assessment.

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As to the total project, the recreation resources are in accord with the Commission's policy on recreation.

Term of License

Section 5 of ECPA amended Section 15 of the Act specifying that any license issued under Section 15 shall be for a term which the Commission determines to be in the public interest, but not less than 30 years, nor more than 50 years. This new provision is consistent with pre-ECPA Commission policy, which was to establish 30-year terms for those projects which proposed no new construction or capacity, 40-year terms for those projects that proposed a moderate amount of new development, and 50-year terms for those projects that proposed a substantial amount of new development.^{5/}

Bangor Hydro-Electric Company proposes no modifications to the existing project facilities or changes in operation of the project. Accordingly, the new license for the project will be for a term of 30 years.

Summary of Findings

An EA was issued for this project. Background information, analysis of impacts, support for related license articles, and the basis for a finding of no significant impact on the environment are contained in the EA attached to this order. Issuance of this license is not a major federal action significantly affecting the quality of the human environment.

The design of this project is consistent with the engineering standards governing dam safety. The project will be safe if operated and maintained in accordance with the requirements of this license. Analysis of related issues is provided in the Safety and Design Assessment attached to this order.

The Director, Office of Hydropower Licensing, concludes that the project would not conflict with any planned or authorized development, and would be best adapted to comprehensive development of the waterway for beneficial public uses.

^{5/} See Montana Power Company, 56 F.P.C. 2008 (1976).

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(3) All of the structures, fixtures, equipment or facilities used to operate or maintain the project and located within the project boundary, all portable property that may be employed in connection with the project and located within or outside the project boundary, and all riparian or other rights that are necessary or appropriate in the operation or maintenance of the project.

(C) The Exhibit G described above and those sections of Exhibits A and F recommended for approval in the attached Safety and Design Assessment are approved and made part of the license.

(D) This license is subject to the articles set forth in Form L-3, (October 1975), entitled "Terms and Conditions of License for Constructed Major Project Affecting Navigable Waters of the United States." The license is also subject to the following additional articles:

Article 201. The licensee shall pay the United States the following annual charge, effective January 1, 1988:

For the purpose of reimbursing the United States for the cost of administration of Part I of the Act, a reasonable amount as determined in accordance with the provisions of the Commission's regulations in effect from time to time. The authorized installed capacity for that purpose is 11,900 horsepower.

Article 202. Pursuant to Section 10(d) of the Act, a specified reasonable rate of return upon the net investment in the project shall be used for determining surplus earnings of the project for the establishment and maintenance of amortization reserves. One-half of the project surplus earnings, if any, accumulated under the license, in excess of the specified rate of return per annum on the net investment, shall be set aside in a project amortization reserve account at the end of each fiscal year. To the extent that there is a deficiency of project earnings below the specified rate of return per annum for any fiscal year under the license, the amount of that deficiency shall be deducted from the amount of any surplus earnings subsequently accumulated, until absorbed. One-half of the remaining surplus earnings, if any, cumulatively computed, shall be set aside in the project amortization reserve account. The amounts established in the project amortization reserve account shall be maintained until further order of the Commission.

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The annual specified reasonable rate of return shall be the sum of the annual weighted costs of long-term debt, preferred stock, and common equity, as defined below. The annual weighted cost for each component of the reasonable rate of return is the product of its capital ratio and cost rate. The annual capital ratio for each component of the rate of return shall be calculated based on an average of 13 monthly balances of amounts properly includable in the licensee's long-term debt and proprietary capital accounts as listed in the Commission's Uniform System of Accounts. The cost rates for long-term debt and preferred stock shall be their respective weighted average costs for the year, and the cost of common equity shall be the interest rate on 10-year government bonds (reported as the Treasury Department's 10-year constant maturity series) computed on the monthly average for the year in question plus four percentage points (400 basis points).

Article 401. The licensee shall release a continuous minimum flow of 105 cubic feet per second (cfs) from the Ellsworth dam and the Graham dam from July 1 through April 30, and a continuous minimum flow of 250 cfs from May 1 through June 30, for the protection of fishery resources. These flows may be temporarily modified if required by operating emergencies beyond the control of the licensee, and for short periods upon agreement among the licensee, the U.S. Fish and Wildlife Service, and the Maine Department of Environmental Protection.

Article 402. The licensee shall operate the project so that water levels in Lake Leonard are maintained between the elevations of 65.7 feet mean sea level (msl) and 66.7 feet (flashboard crest), and water levels in Graham Lake are maintained between 104.2 feet msl and 93.4 feet msl. These requirements may be temporarily modified if required by operating emergencies beyond the control of the licensee, and for short periods upon agreement among the licensee, the U.S. Fish and Wildlife Service, and the Maine Department of Environmental Protection.

Article 403. The licensee, after consulting with the U.S. Fish and Wildlife Service, the Maine Department of Inland Fisheries and Wildlife, and the Maine Department of Environmental Protection, shall develop a study plan to determine the effectiveness of the water elevation management plan in controlling shoreline erosion and protecting water quality and providing for enhancement of fish and wildlife resources in Graham Lake. Within 6 months from the date of issuance of this license, the licensee shall file for Commission approval a copy of the study plan, the comments of the agencies on the plan, and a schedule for filing the results of the study. The Commission reserves the right to require modifications to the plan and the schedule.

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According to the schedule approved by the Commission, the licensee shall file with the consulted agencies and with the Commission a report on the results of the study. The licensee shall also file for Commission approval any recommended measures for changes in project operation necessary for further minimizing the effects of project operation on fish and wildlife resources in Graham Lake, and shall include agency comments on the study results and on the licensee's recommendations. The Commission reserves the right to require changes to the measures.

Article 404. The licensee, after consulting with the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the Maine Department of Marine Resources, and the Maine Department of Environmental Protection, shall develop a study plan to determine the effectiveness of minimum flow releases required by article 401 to protect fishery resources at the Ellsworth Hydroelectric Project. Within 1 year from the date of issuance of this license, the licensee shall file for Commission approval a copy of the study plan, the comments of the agencies on the plan, and a schedule for filing the results of the study. The Commission reserves the right to require modifications to the plan and the schedule.

According to the schedule approved by the Commission, the licensee shall file with the consulted agencies and with the Commission a report on the results of the study. The licensee also shall file for Commission approval any recommendations for changes in project operation needed to ensure the protection of anadromous fish resources, a schedule for implementing the recommendations, and the comments of the agencies on the recommendations. The Commission reserves the right to require changes to the measures.

Article 405. The licensee, in cooperation with the U.S. Fish and Wildlife Service, the Maine Department of Inland Fisheries and Wildlife, and the Maine Department of Environmental Protection, shall develop a plan to install streamflow gages in the Union River to monitor the minimum flow releases required by article 401. The plan shall include the location and design of gages, method of flow data collection, and provisions for providing the flow data to the agencies within 30 days of the agencies' request for the data. The plan shall be filed within 6 months from the date of issuance of this license, and shall include the comments of the agencies on the plan. The Commission reserves the right to require modifications to the plan.

Article 406. The licensee, after consulting with the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the Maine Department of Marine Resources, and the Maine Department of Environmental Protection, shall develop a plan, consistent with any prescription made by the Secretary of the Interior, for upstream and downstream fish passage that shall include, but shall not be limited to, the following: (1) functional design drawings of upstream fish passage facilities; (2) functional design drawings of downstream fish passage facilities, including intake screens and bypass facilities;

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(3) a quantification of the flows required for operation of the upstream and downstream fish passage facilities; (4) a schedule for constructing, operating, and maintaining the facilities; (5) a description of a program for monitoring the effectiveness of the upstream and downstream passage facilities, including a schedule for implementing the monitoring program and for filing with the consulted agencies and with the Commission, the program results and any recommendations for modifying project facilities or operation; and (6) provisions for maintaining the collection of Atlantic salmon broodstock that shall include, but shall not be limited to, the modification and operation of existing fish collection facilities. The licensee shall file the plan for Commission approval within 1 year after the date of issuance of this license, and shall include documentation of consultation and the comments of the agencies on the plan. The Commission reserves the right to require changes to the plan. Within 6 months after completion of construction, the licensee shall file as-built drawings of the fish passage facilities.

Article 407. The licensee, before starting any land-clearing or land-disturbing activities within the project boundaries, other than those specifically authorized in this license, shall consult with the Maine State Historic Preservation Officer (SHPO), and shall file with the Commission a cultural resources management plan, prepared by a qualified cultural resource specialist. If the licensee discovers previously unidentified archeological or historic properties during the course of constructing or developing project works or other facilities at the project, the licensee shall stop all land-clearing and land-disturbing activities in the vicinity of the properties, shall consult with the SHPO, and the licensee shall file with the Commission a cultural resource management plan, prepared by a qualified cultural resource specialist.

A cultural resources management plan shall include the following: (1) a description of each discovered property, indicating whether it is listed on or eligible to be listed on the National Register of Historic Places; (2) a description of the potential effect on each discovered property; (3) proposed measures for avoiding or mitigating effects; (4) documentation of the nature and extent of consultation; and (5) a schedule for mitigating effects and conducting additional studies. The Commission may require changes to the plan.

The licensee shall not begin land-clearing or land-disturbing activities, other than those specifically authorized in this license, or resume such activities in the vicinity of a property discovered during construction, until informed that the requirements of this article have been fulfilled.

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Article 408. The licensee, after consulting with the National Park Service, the Maine Bureau of Parks and Recreation, and the City of Ellsworth, shall prepare and file with the Commission for approval within 1 year from the date of issuance of this license, a revised Report on Recreational Resources that conforms to the requirements of the Commission's Regulations, 18 CFR at 4.51(f)(5). The Report shall include, but shall not be limited to, the following: (1) a description of existing and proposed recreational facilities; (2) identification of the entities responsible for constructing, operating, and maintaining any existing or proposed facilities; (3) maps or drawings showing the type and location of existing and proposed facilities at the project; (4) a map of land reserved for future recreational development; (5) a construction schedule, and (6) documentation of consultation with the agencies.

Article 409. (a) In accordance with the provisions of this article, the licensee shall have the authority 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 other types of use and occupancy, without prior Commission approval. The licensee may exercise the authority only if the proposed use and occupancy is consistent with the purposes of protecting and enhancing the scenic, recreational, and other environmental values of the project. For those purposes, the licensee shall also have continuing responsibility to supervise and control the uses and occupancies for which it grants permission, and to monitor the use of, and ensure compliance with the covenants of the instrument of conveyance for, any interests that it has conveyed, under this article. If a permitted use and occupancy violates any condition of this article or any other condition imposed by the licensee for protection and enhancement of the project's scenic, recreational, or other environmental values, or if a covenant of a conveyance made under the authority of this article is violated, the licensee shall take any lawful action necessary to correct the violation. For a permitted use or occupancy, that action includes, if necessary, cancelling the permission to use and occupy the project lands and waters and requiring the removal of any non-complying structures and facilities.

(b) The types of use and occupancy of project lands and waters for which the licensee may grant permission without prior Commission approval are: (1) landscape plantings; (2) non-commercial piers, landings, boat docks, or similar structures and facilities that can accommodate no more than 10 watercraft at a time and where said facility is intended to serve single-family type dwellings; and (3) embankments, bulkheads, retaining walls, or similar structures for erosion control to protect the existing shoreline. To the extent feasible and desirable to protect and enhance the project's scenic, recreational, and other environmental values, the licensee shall require multiple use and occupancy of facilities for access to project lands or waters. The licensee shall also ensure, to the satisfaction of the Commission's

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authorized representative, that the uses and occupancies for which it grants permission are maintained in good repair and comply with applicable state and local health and safety requirements. Before granting permission for construction of bulkheads or retaining walls, the licensee shall: (1) inspect the site of the proposed construction, (2) consider whether the planting of vegetation or the use of riprap would be adequate to control erosion at the site, and (3) determine that the proposed construction is needed and would not change the basic contour of the reservoir shoreline. To implement this paragraph (b), the licensee may, among other things, establish a program for issuing permits for the specified types of use and occupancy of project lands and waters, which may be subject to the payment of a reasonable fee to cover the licensee's costs of administering the permit program. The Commission reserves the right to require the licensee to file a description of its standards, guidelines, and procedures for implementing this paragraph (b) and to require modification of those standards, guidelines, or procedures.

(c) The licensee may convey easements or rights-of-way across, or leases of, project lands for: (1) replacement, expansion, realignment, or maintenance of bridges and roads for which all necessary state and federal approvals have been obtained; (2) storm drains and water mains; (3) sewers that do not discharge into project waters; (4) minor access roads; (5) telephone, gas, and electric utility distribution lines; (6) non-project overhead electric transmission lines that do not require erection of support structures within the project boundary; (7) submarine, overhead, or underground major telephone distribution cables or major electric distribution lines (69-kV or less); and (8) water intake or pumping facilities that do not extract more than one million gallons per day from a project reservoir. No later than January 31 of each year, the licensee shall file three copies of a report briefly describing for each conveyance made under this paragraph (c) during the prior calendar year, the type of interest conveyed, the location of the lands subject to the conveyance, and the nature of the use for which the interest was conveyed.

(d) The licensee may convey fee title to, easements or rights-of-way across, or leases of project lands for: (1) construction of new bridges or roads for which all necessary state and federal approvals have been obtained; (2) sewer or effluent lines that discharge into project waters, for which all necessary federal and state water quality certificates or permits have been obtained; (3) other pipelines that cross project lands or waters but do not discharge into project waters; (4) non-project overhead electric transmission lines that require erection of support structures within the project boundary, for which all necessary federal and state approvals have been obtained; (5) private or public marinas that can accommodate no more than 10 watercraft at a time and are

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located at least one-half mile from any other private or public marina; (6) recreational development consistent with an approved Exhibit R or approved report on recreational resources of an Exhibit E; and (7) other uses, if: (i) the amount of land conveyed for a particular use is five acres or less; (ii) all of the land conveyed is located at least 75 feet, measured horizontally, from the edge of the project reservoir at normal maximum surface elevation; and (iii) no more than 50 total acres of project lands for each project development are conveyed under this clause (d)(7) in any calendar year. At least 45 days before conveying any interest in project lands under this paragraph (d), the licensee must submit a letter to the Director, Office of Hydropower Licensing, stating its intent to convey the interest and briefly describing the type of interest and location of the lands to be conveyed (a marked Exhibit G or K map may be used), the nature of the proposed use, the identity of any federal or state agency official consulted, and any federal or state approvals required for the proposed use. Unless the Director, within 45 days from the filing date, requires the licensee to file an application for prior approval, the licensee may convey the intended interest at the end of that period.

(e) The following additional conditions apply to any intended conveyance under paragraph (c) or (d) of this article:

(1) Before conveying the interest, the licensee shall consult with federal and state fish and wildlife or recreation agencies, as appropriate, and the State Historic Preservation Officer.

(2) Before conveying the interest, the licensee shall determine that the proposed use of the lands to be conveyed is not inconsistent with any approved Exhibit R or approved report on recreational resources of an Exhibit E; or, if the project does not have an approved Exhibit R or approved report on recreational resources, that the lands to be conveyed do not have recreational value.

(3) The instrument of conveyance must include covenants running with the land adequate to ensure that: (i) the use of the lands conveyed shall not endanger health, create a nuisance, or otherwise be incompatible with overall project recreational use; and (ii) the grantee shall take all reasonable precautions to ensure that the construction, operation, and maintenance of structures or facilities on the conveyed lands will occur in a manner that will protect the scenic, recreational, and environmental values of the project.

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(4) The Commission reserves the right to require the licensee to take reasonable remedial action to correct any violation of the terms and conditions of this article, for the protection and enhancement of the project's scenic, recreational, and other environmental values.

(f) The conveyance of an interest in project lands under this article does not in itself change the project boundaries. The project boundaries may be changed to exclude land conveyed under this article only upon approval of revised Exhibit G or K drawings (project boundary maps) reflecting exclusion of that land. Lands conveyed under this article will be excluded from the project only upon a determination that the lands are not necessary for project purposes, such as operation and maintenance, flowage, recreation, public access, protection of environmental resources, and shoreline control, including shoreline aesthetic values. Absent extraordinary circumstances, proposals to exclude lands conveyed under this article from the project shall be consolidated for consideration when revised Exhibit G or K drawings would be filed for approval for other purposes.

(g) The authority granted to the licensee under this article shall not apply to any part of the public lands and reservations of the United States included within the project boundary.

(E) The licensee shall serve copies of any Commission filing required by this order on any entity specified in this order to be consulted on matters related to that filing. Proof of service on these entities must accompany the filing with the Commission.

(F) This order is issued under authority delegated to the Director and is final unless appealed under Rule 1902 to the Commission by any party within 30 days from the issuance date of this order. Filing an appeal does not stay the effective date of this order or any date specified in this order. The licensee's failure to appeal this order shall constitute acceptance of the license.



Fred E. Springer
Acting Director, Office of
Hydropower Licensing

ENVIRONMENTAL ASSESSMENT
DIVISION OF ENVIRONMENTAL ANALYSIS, OFFICE OF HYDROPOWER LICENSING
FEDERAL ENERGY REGULATORY COMMISSION

Ellsworth Project
FERC No. 2727-003, Maine
November 9, 1987

I. APPLICATION

Bangor Hydro-Electric Company (applicant) applied on December 19, 1984, for a new license for the Ellsworth Hydroelectric Project. The applicant supplemented the application on July 1, 1985, and March 5, 1986.

The Ellsworth Project is located on the Union River in the city of Ellsworth and the towns of Mariaville, Waltham, and Otis, in Hancock County, Maine (figure 1). The Union River flows into the Union River Bay, approximately 2 miles downstream from the project. There are no lands of the United States located within the project boundary.

II. RESOURCE DEVELOPMENT

A. Purpose

The existing project provides an estimated average annual generation of 31,055,000 kilowatthours (kWh) of electrical energy. All the power produced by the project is supplied to the applicant's transmission and distribution system and is sold directly to the applicant's customers.

B. Need for Power

The applicant requests a new license to continue operating the 8.9-megawatt (MW) project. The project is located in the fastest growing portion of the applicant's service area, and substantial load growth is expected to continue.

The applicant's need for continuing operation of the project, over both the short and long terms, is both economic and operational. From an economic point of view, no source of replacement power is available that is cost-competitive with the existing project, a hydroelectric facility for which original cost has been amortized, which has no fuel costs, and which has modest operating and maintenance costs. From an operational point of view, the project provides the high reliability associated with hydroelectric facilities, has "black start" capacity that is used to bring other sources on-line in the event of a system outage, provides approximately 9 MW of spinning reserve, and when its output is not on dispatch, is available as a support source while repairs are being made. Additionally, it is the opinion of the staff that 79 years of operation by and usefulness to the applicant give strong support to the applicant's need for the project and a new license.

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III. PROPOSED PROJECT AND ALTERNATIVES

A. Proposed Project

1. Project Description

The existing project consists of a lower dam with a small reservoir and an upper dam with a large storage reservoir (figure 2). The lower dam, known as the Ellsworth dam, forms the upper limit of tidal influence of the Union River. The Ellsworth dam is a concrete structure, 65 feet high and 377 feet long, a 275-foot-long section of which comprises a spillway. Flashboards, 27 inches in height, are installed on the spillway crest; the top of the flashboards is at elevation 66.7 feet mean sea level (msl). The reservoir impounded by the Ellsworth dam, called Lake Leonard, has a surface area of 90 acres at its normal maximum elevation of 66.7 feet msl. The Ellsworth powerhouse, which is integral with the dam, contains four generating units with a total capacity of 8.9 MW. No transmission lines are included within the project.

The Graham dam is about 4 miles upstream from the Ellsworth dam. The dam is about 25 feet high, and consists of an earth dike, about 550 feet long, and a concrete spillway, about 80 feet long. Three Taintor gates and a log sluice gate are located on the spillway. The upper reservoir, Graham Lake, has a normal maximum surface area of 9,025 acres and a maximum length of about 10 miles. There is no powerhouse associated with the dam and the lake.

The project is operated in peaking mode; no change in project operation is proposed, other than to maintain a seasonal minimum flow downstream from the project dams. The applicant currently has no plans for further development of the Ellsworth Project for power generation.

2. Proposed Mitigative Measures

The applicant proposes to install downstream fish passage facilities at the Ellsworth dam and to assist the city of Ellsworth in developing a riverside park.

B. Alternatives to the Proposed Project

The alternative to the proposed action is denial of a new license and cessation of project operation.

In the event of denial of a new license, the applicant estimates that the cost of replacement capacity and energy would be approximately \$43,000,000 (in 1987 dollars) for the first 30 years of the new license period. This estimate includes the capital costs of existing and new combustion turbines and existing oil-fired steam plants. Also included in the estimate are fuel costs (principally for imported oil) and operating and maintenance costs.

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Other alternative sources of replacement power are purchasing Canadian hydropower and obtaining power from available cogeneration or from other small-power producers at avoided-cost rates.

The applicant has expressed concern about the future costs and reliability of the available replacement power purchases from Canadian hydro or from sources that depend upon imported oil.

Except for Canadian hydro, alternative replacement power sources would consume nonrenewable energy resources, principally oil, and would produce additional atmospheric pollution.

Accepting the applicant's estimate of the 30-year cost of \$43 million 1987 dollars for replacement power, the staff estimates that in 1987 dollars, the unit cost of replacement power for the year 1986 would have been \$0.0415 per kWh. In 1986, the project produced 34,493,700 net kWh of electrical energy at a unit cost of \$0.0101 per kWh.

IV. CONSULTATION AND COMPLIANCE

A. Agency Consultation

The Commission's regulations require prospective applicants to consult with appropriate resource agencies before filing an application for license. This constitutes an initial stage in compliance with the Fish and Wildlife Coordination Act, the Endangered Species Act, the National Historic Preservation Act, and other federal statutes. Prefiling consultation must be complete and must be documented in accordance with the Commission's regulations.

After the Commission accepts an application, concerned entities may submit formal comments during a public notice period. In addition, organizations and individuals may petition to intervene and to become a party to any subsequent proceedings. The Commission makes the comments provided by concerned entities part of the record and the staff considers the comments during the review of the proposed project. After the Commission issued a public notice of the application on December 16, 1985, the following entities commented on the application.

<u>Commenting entity</u>	<u>Date of letter</u>
Maine Office of Energy Resources	January 9, 1986
National Marine Fisheries Service	February 3, 1986
Department of the Army, New England Division Corps of Engineers	February 10, 1986
Maine Department of Marine Resources	February 13, 1986
Environmental Protection Agency	March 12, 1986
Department of the Interior	March 13, 1986

Permission to intervene was granted to the Maine Department of Environmental Protection (DEP). The applicant responded to the letters of comment on August 28, 1986.

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B. Water Quality Certification

The applicant requested water quality certification for the Ellsworth Hydroelectric Project on November 13, 1984. Pursuant to Commission Order No. 464, DEP was notified that the certification requirements of section 401 (a)(1) of the Clean Water Act ^{1/} were waived for the project and on April 2, 1987, DEP was invited to submit comments and recommendations on water quality. DEP issued a water quality certification for the Ellsworth Project on April 22, 1987. This environmental assessment for the Ellsworth Project directly addresses the concerns of DEP and makes recommendations to protect water quality consistent with DEP's concerns.

DEP recommended inclusion of license provisions regarding recreation and fisheries resources. These recommendations are outside the scope of Commission Order No. 464 because they do not provide for the protection of water quality. The environmental assessment prepared for this project adequately addresses the resource issues raised by DEP.

V. ENVIRONMENTAL ANALYSIS

A. Proposed Project

The staff's analysis shows that adverse effects of the proposed project on visual and socioeconomic resources would be insignificant.

1. General Description of the Locale

The Union River Basin is characterized by numerous flat or gently rolling plains, a few high bedrock ridges and monadnocks, and a variety of lakes, ponds, and streams. Elevations in the basin range from sea level to a maximum of approximately 1,300 feet msl (Bangor Hydro-Electric Company, 1984, application, exhibit E).

Temperatures in the Union River Basin range from a mean minimum temperature in January of 14 degrees Fahrenheit (°F) to a mean maximum temperature in July of 70 °F. Prevailing westerly winds and cyclonic storms from the west and southwest bring most of the basin's precipitation. The average annual precipitation is about 43 inches. Precipitation is fairly uniform throughout the year, although coastal storms may bring periods of intense precipitation. In the coastal area, where the Ellsworth Project is located, the average annual snowfall is about 70 inches (Bangor Hydro-Electric Company, 1984, application, exhibit E).

^{1/} 33 United States Code §1341(a)(1)(1982).

2. Geology and Soils

Affected Environment: The bedrock of the southern section of the Union River Basin consists of a wide zone of schist and gneiss intruded by great masses of granite. The overburden throughout the basin consists of glacial till aqueo-glacial outwash, and marine sediments. While the glacial till covers most of the bedrock in the region, extensive areas of till have in turn been buried by subsequent glacial outwash and marine materials. These materials, consisting of sand and gravel, form numerous and extensive outwash plains, deltas, kaines, and eskers. Many of the flat, swampy areas in the basin are largely the result of graded material washed out by the retreating glacier (Bangor Hydro-Electric Company, 1984, application, exhibit E).

Soils in the Union River Basin consist mainly of marine clays in the low-lying areas, with glacial tills above. The tills are of a coarse sandy or stony nature, are well to excessively drained, and contain hardpan about 2 to 3 feet below the surface. In the southern portion of the basin, these coarse acid tills originated from granite (Baum, 1982).

Environmental Impacts and Recommendations: Soils in the project area are highly erodible, and shoreline erosion was a problem around Graham Lake in the past, especially when the reservoir surface elevation was higher than 104 feet msl. In response to the concerns of owners of seasonal residences around Graham Lake, the applicant developed an operating rule curve (figure 3) that limited the normal maximum surface elevation to 104.2 feet msl. The applicant started operating Graham Lake according to this rule curve in 1980. DEP states that available evidence from the past 7 years indicates that the current mode of project operation is not resulting in unreasonable shoreline erosion.

To verify that project operation is not accelerating shoreline erosion, the licensee should conduct a study to determine the effectiveness of the water elevation management plan in controlling shoreline erosion.

Unavoidable Adverse Impacts: There would be minor, long-term erosion from wave and ice action on the shores of Graham Lake and its islands.

3. Water Resources

Affected Environment: The Union River, about 65 miles long, is located on the central Maine coast. The drainage area is about 546 square miles, and is bordered by coastal rivers and by the Gulf of Maine to the south, the Penobscot River basin to the west and north, and the Narraguagus River basin to the east.

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The Ellsworth Project creates two impoundments on the Union River, Lake Leonard and Graham Lake. The Ellsworth dam, located on the mainstem near its tidal outlet, forms Lake Leonard, which has a surface area of about 90 acres at normal pool elevation (66.7 feet msl), a width of approximately 0.3 mile, and a maximum length of about 1.25 miles.

Graham dam impounds the Union River about 4 miles upstream of Ellsworth dam and creates Graham Lake, which has 9,025 surface acres at normal maximum surface elevation (104.2 feet msl), a maximum width of 2.75 miles, and a maximum length of approximately 10 miles. The Union River at Ellsworth dam has an average annual flow of 550 cubic feet per second (cfs).

Before 1986, minimum flows from Ellsworth dam and Graham dam consisted of leakage, estimated at 33 cfs and 22 cfs, respectively. In 1986, the applicant began releasing a continuous minimum flow of 105 cfs from each dam. The applicant currently operates the project as a peaking facility, depending on available inflows, and uses all available river flows 99 percent of the time. During the summer, the project operates for 2 to 4 hours a day; during the winter, about 6 to 8 hours a day; and during high-flow conditions (primarily in the spring and fall), up to 24 hours a day. Timed releases from Graham Lake are used at Ellsworth dam for power production. These releases result in minor (approximately 1 foot) surface elevation changes in Lake Leonard and greater changes (approximately 10 feet) in Graham Lake, as a result of operation within an operating rule curve established for Graham Lake.

Upstream from the Ellsworth Project, there are five retired, unlicensed hydroelectric projects and one operating, licensed project. The licensed project is the Green Lake Project, FERC No. 7189, which is located at the Green Lake National Fish Hatchery, on Reeds Brook between Green Lake and Graham Lake. (See figure 1.) Branch Lake, which is an impoundment of Branch Lake Stream, a tributary of Lake Leonard, provides water to the Ellsworth Water Company for domestic use (Bangor Hydro-Electric Company, 1984, application, exhibit E). Branch Lake has a usable storage capacity of 14,100 acre-feet (Federal Power Commission, 1965).

The water quality in the Union River in the project vicinity is good to poor. The water of Graham Lake and the water just below Graham dam, at Ellsworth Falls (a series of rapids, approximately midway between Ellsworth dam and Graham dam), meet the state's required class B-2 water quality standards. Class B-2 water is acceptable for recreational purposes, including water-contact recreation, for industrial and potable water supplies after adequate treatment, and for fish and wildlife habitat. The dissolved oxygen (DO) content must exceed 5 parts per million or 60 percent saturation, whichever is higher. From the area of the Union River below Ellsworth Falls to tidewater, water quality meets the

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state's required class C standards. Class C water is acceptable for recreational boating and fishing, for fish and wildlife habitat, and for other uses, except potable water supplies and water-contact recreation. The DO content of class C water must not be less than 5 parts per million. Water in the Union River below tidewater meets the state's required class SB-1 standards, for which water must be suitable for all clean water uses, including water-contact recreation, harvesting and propagation of shellfish, and fish and wildlife habitat.

Environmental Impacts and Recommendations:

Shoreline Erosion and Reservoir Turbidity

Water level changes in the impoundments could cause shoreline erosion and property loss, and because of related suspended sediment increases, could result in adverse changes to water quality. DEP states that wave action and high water levels have resulted in significant shoreline erosion problems along Graham Lake. The applicant modified the Graham Lake operating rule curve by 1 foot (from a normal maximum surface elevation of 105.2 feet msl to 104.2 feet msl) in an effort to minimize the problem. DEP states that this limit on the surface elevation appears adequate for managing shoreline erosion, and recommends that the applicant maintain the Graham Lake surface elevation within 104.2 feet msl and 92.4 feet msl, according to the applicant's proposed operation curve. To minimize shoreline erosion and turbidity in Lake Leonard, DEP recommends that the applicant maintain the level of Lake Leonard within 1 foot of the crest of the Ellsworth dam flashboards; that is, between 65.7 feet msl and 66.7 feet msl.

If impoundment elevation is not managed properly, the increase in suspended sediment levels would adversely impact water quality in nearshore areas. The proposed water surface elevation limits and the proposed rule curve would minimize shoreline erosion and changes in water quality. To protect water quality in Graham Lake and in the Union River, the licensee should operate Graham Lake according to the licensee's proposed operating rule curve, between elevations 104.2 feet msl and 93.4 feet msl, to the maximum extent possible. For the protection of water quality in Lake Leonard, the licensee should also maintain the level of the lake within 1 foot of the flashboard crest elevation, between 66.7 and 65.7 feet, to the maximum extent possible. To ensure that the proposed operating rule curve would adequately protect the water quality of Graham Lake, the licensee should establish a monitoring program to verify that the proposed impoundment elevation limits provide adequate protection for shorelines and water quality.

Unavoidable Adverse Impacts: There would be some increase in suspended sediment from wave and ice action on shoreline areas.

4. Fishery Resources

Affected Environment: The Union River supports resident populations of warmwater and coldwater fish. Graham Lake has smallmouth bass (Micropterus dolomieu), chain pickerel (Esox niger), and white perch (Morone americana) populations, and occasional coldwater fish, including brown trout (Salmo trutta) and brook trout (Salvelinus fontinalis). The Union River between the Ellsworth and Graham dams has a variety of habitats, including riffles, runs, and pools, which primarily support smallmouth bass. Lake Leonard also has smallmouth bass, chain pickerel, and white perch. The river below the Ellsworth dam is tidal, and freshwater fish found there come from occasional movement from upstream populations of white perch, brown trout, and brook trout.

Before dams were constructed, the Union River supported runs of anadromous Atlantic salmon (Salmo salar), alewife (Alosa pseudoharengus), and American shad (A. sapidissima). The Union River is included in plans for restoration of Atlantic salmon to Maine (Beland, 1984). At present, the Atlantic Sea-Run Salmon Commission (ASRSC) manages the Union River to produce up to 250 adult salmon broodstock a year and to support a limited sport fishery below Ellsworth dam. ASRSC owns a fish-trapping facility at the base of Ellsworth dam. Adult salmon trapped at the facility are used as broodstock at the Green Lake and Craig Brook National Fish Hatcheries, which are operated by the U.S. Fish and Wildlife Service (FWS). The long-term goal of the ASRSC is to restore a self-sustaining run of salmon to the Union River, which has an estimated run potential of 1,000 adult salmon.

The Union River also currently supports a small alewife run. The run is a result of residual stocks from below Ellsworth dam, strays from tributary runs, and since 1933, fish trapped at Ellsworth and stocked in Graham and Leonard Lakes. The alewife population is currently harvested and managed by the city of Ellsworth, with the approval of the Maine Department of Marine Resources (DMR). The goal of DMR is full use of upstream habitat, which has the potential to produce an estimated 1 million pounds of fish a year.

Environmental Impacts and Recommendations:

Reservoir Fishery Resources

Operation of hydroelectric projects may cause changes in their associated impoundments that could adversely affect fish and wildlife resources in nearshore and shoreline areas. Depending on the time of year and the extent of the habitat affected, water-level fluctuations could have a significant adverse impact on fish resources through dessication, freezing, and increased turbidity in areas used by fish for cover, spawning, and rearing. DEP states that the surface area of Graham Lake varies by approximately 2,000 acres, when operated between the proposed elevations of 93.4 feet and 104.2 feet msl. The applicant states that there are no indications that present water level management is causing any problems

or limiting the smallmouth bass population. For the past 50 years, populations of sport fish in Graham and Leonard Lakes have been subject to water level management similar to that now proposed. During that time, resource agencies and the public have not raised concerns about the effects of water level fluctuations, and the available evidence suggests that the lakes support good sport fish populations. However, an opportunity exists for enhancement by minor alterations to the operating curve to further minimize impacts to fish resources, particularly during the spawning season. The licensee should monitor the effects of water level changes due to project operation on fish resources in Graham Lake, and if appropriate, adjust it for enhancement of the sport fishery.

Minimum Flow Releases

Minimum flow releases from the project dams are needed to maintain fish habitat, to facilitate anadromous fish migration, and to protect downstream water quality. The Department of the Interior (Interior) recommends that the applicant provide an instantaneous release from both dams of 105 cfs or the inflow to the project, whichever is less, based on the historical median August flow in the Union River at Ellsworth. DEP states that a minimum continuous flow release of 105 cfs at all times would minimize the chlorine residual toxicity from the city of Ellsworth's sewage effluent in the Union River below the Ellsworth dam. DEP and the National Marine Fisheries Service (NMFS) recommend that the applicant release from both dams an instantaneous flow of 105 cfs from July 1 through April 30 and 250 cfs from May 1 through June 30. DEP and NMFS also recommend that the applicant evaluate the adequacy of the minimum flow release of 250 cfs in maintaining anadromous fish resources and in the collection of salmon broodstock and after 5 years of implementation, if appropriate, revise the minimum flow releases. The applicant has proposed to release the minimum flows recommended by DEP and NMFS.

Historically, minimum flows from Ellsworth dam and Graham dam have consisted of uncontrolled leakage, estimated at 33 cfs and 22 cfs, respectively. Since July 30, 1986, the applicant has released a continuous minimum flow of 105 cfs from both dams. A minimum continuous flow of 105 cfs, the aquatic base flow (ABF), at all times below the Ellsworth and Graham dams would provide protection for fishery resources and maintain water quality.

During May and June, anadromous fish attempting to migrate up the Union River congregate below the Ellsworth dam. Both Atlantic salmon and alewives are present. Since salmon cannot be efficiently trapped until the alewife run is over, early-run salmon must remain below the dam. While salmon are holding below the dam, they would be vulnerable to fishing, especially at low flows, and may leave the river to seek alternative spawning habitat. At low flows, low oxygen concentrations would adversely affect holding fish during periods of low tide, high temperatures, particularly when a large run of alewives is present. A minimum continuous flow of 250 cfs exceeds twice the ABF and would provide

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adequate cover and oxygen to protect anadromous fish. To protect fish resources in the Union River, the licensee should provide an instantaneous continuous release of 105 cfs from Ellsworth dam and from Graham dam from July 1 through April 30. To protect anadromous fish resources, the licensee should provide an instantaneous release of 250 cfs from both dams from May 1 through June 30. To ensure that such flows are appropriate, the licensee should monitor the effectiveness of these flows for the protection of fish resources, and if necessary, should provide recommendations to protect or to enhance those resources.

Fish Passage

The project dams currently block anadromous fish passage. An effort to restore anadromous fish is underway, supported by the trapping facility owned by ASRSC at the Ellsworth dam. The city of Ellsworth also employs the trap for commercial alewife harvest and its upstream stocking program.

NMFS states that the fish trapping facility at the Ellsworth dam is inadequate for anadromous fish passage, and that the facility should be modified to improve efficiency. Because large alewife runs collected at the trap may interfere with salmon collection, however, NMFS recommends that new upstream passage facilities be constructed at the Ellsworth Project to accommodate returning Atlantic salmon. Interior recommends that the applicant design, construct, operate, and maintain adequate upstream and downstream facilities for migratory fish. In a letter dated October 14, 1987, Interior, under section 18 of the Federal Power Act (Act), filed a "Reservation of Authority to Prescribe Fishways" at the Ellsworth Hydroelectric Project. 1/

DMR recommends that the existing fish trap facility be modified to improve trapping efficiency to obtain adult salmon and alewives for upriver stocking. DMR also recommends that in the event the city of Ellsworth does not continue to accept responsibility for stocking of alewives, the applicant should provide for upstream passage of alewives.

DEP recommends that the applicant modify the existing fish trap to accommodate projected annual runs of alewives and salmon and to provide for upstream stocking of alewives, should the city of Ellsworth discontinue its current stocking effort. DEP further recommends that the applicant provide upstream passage from the trapping facility for any adult salmon in excess of the 250 fish needed for hatchery broodstock.

1/ Section 18 of the Act provides: "The Commission shall require the construction, maintenance, and operation by a licensee at its own expense of . . . such fishways as may be prescribed by the Secretary of Interior or the Secretary of Commerce as appropriate."

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DEP recommends that the applicant provide downstream passage for salmon 30 months after at least 25 female and 12 male Atlantic salmon are stocked above Graham Lake. The applicant states that if the city of Ellsworth discontinues its stocking program, the applicant will modify the trapping facility to improve trap efficiency for upstream passage, provide for downstream alewife passage at the Ellsworth dam, and stock adult alewives in the project reservoirs.

The use of the existing fish trap below Ellsworth dam for alewife harvest and restoration stocking, while important for achieving ASRSC short-term management objectives, is inadequate for upstream anadromous fish passage. Modifying the trap could improve its efficiency in collecting adult salmon broodstock and alewives for upstream passage, but it would be at the expense of increased incompatibility with salmon collection as alewife run size increases. Also, as the long-term restoration goal of approximately 1,000 salmon is pursued, the usefulness of the trap in achieving this goal would decrease further. To protect and enhance anadromous fish resources in the Union River, the licensee, as prescribed by Interior and the Secretary of Commerce, should construct, operate, and maintain upstream and downstream fish passage facilities at the Ellsworth and Graham dams. For the protection of Atlantic salmon resources, the licensee should provide for the continued collection of salmon broodstock, and should monitor the effectiveness and efficiency of the facilities to ensure successful fish passage at the dams.

Unavoidable Adverse Impacts: During project operation, some injury and mortality to resident and anadromous fish could result from passage through the turbines.

5. Terrestrial Resources

Affected Environment: The plant associations of the project area are generally shown in figure 4. Lake Leonard is bordered on the east by a marsh. Typical wetland plant species are common cattail (Typha latifolia), arrowheads (Sagittaria spp.), sedges (Carex spp.), and softstem bulrush (Scirpus validus). The marsh is bordered by a forest composed of willows (Salix spp.), birches (Betula spp.), alders (Alnus spp.), and maples (Acer spp.). At higher elevations, the species composition of the forest is that of a mature white pine (Pinus strobus)-mixed hardwood forest. Typical hardwood species are red oak (Quercus rubra), white ash (Fraxinus americana), black ash (F. nigra), American beech (Fagus grandifolia), sugar maple (Acer saccharum), and paper birch (Betula papyrifera).

The banks on the west side of Lake Leonard are steeper and support a mixed pine-hardwood forest.

Marshes also occur along the eastern shore of Graham Lake. Typical wetland plant species are cattail, softstem bulrush, arrowhead, pickerelweed (Pontederia spp.), sedges, and meadowsweet spiraea

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(Spiraea spp.). Timber was harvested recently on the east side of Graham Lake, and the area is now occupied by a transitional forest, composed of pioneer tree species, such as quaking aspen (Populus tremuloides), balsam poplar (Populus balsamifera), gray birch (Betula populifolia), and cherry (Prunus spp.).

Northwest of Graham Lake, barrens occur, surrounded by a mixed pine-hardwood forest. The barrens are areas where a thin layer of topsoil covers ledge and the vegetation consists of low-growing plants, such as grasses, blueberry (Vaccinium spp.), and common yarrow (Achillea millefolium). The barrens are fringed with aspens and poplars.

Boreal forest areas occur on the north end and on the east side of Graham Lake. Typical boreal forest tree species are tamarack larch (Larix laricina), northern white cedar (Thuja occidentalis), and black spruce (Picea mariana). Highbush blueberry (V. corymbosum) and sphagnum moss (Sphagnum spp.) are characteristic understory species.

The islands in Graham Lake comprise bog habitat. Black spruce and white pine are typical tree species found in this habitat. The understory contains shrubs, such as bog kalmia (Kalmia polifolia), and sedges. The islands are surrounded by emergent wetlands, composed of cattails, arrowhead, and pickerelweed.

Big game species occurring in the project area are black bear (Ursus americanus), moose (Alces alces), and white-tailed deer (Odocoileus virginianus). Other game species include American woodcock (Scolopax minor), ruffed grouse (Bonasa umbellus), Canada goose (Branta canadensis), green-winged teal (Anas crecca), blue-winged teal (A. discors), mallard (A. platyrhynchos), and American black duck (A. rubripes).

Environmental Impacts and Recommendations: Federal, state, and local agencies have not identified any adverse effect of project operation on botanical or wildlife resources, and the staff does not anticipate that relicensing of the project would have any adverse effect. The measures that the staff recommends to protect anadromous and resident fish in the project area (section on fishery resources) would indirectly benefit wildlife species whose diets include fish. The release of the minimum flows recommended by the staff might benefit marsh habitat and associated wildlife downstream from Graham dam.

Unavoidable Adverse Impacts: None.

6. Threatened and Endangered Species

Affected Environment: Bald eagles (Haliaeetus leucocephalus), which are federally listed as endangered, have three nesting territories near the project, two of which are on Graham Lake. Eagles from these territories and transient eagles would be expected in

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the project area. No other threatened or endangered species is known to occur in the project area.

Environmental Impacts and Recommendations: FWS states that it does not anticipate that continued project operation would affect bald eagles adversely (letter from Bruce Blanchard, Director, Office of Environmental Project Review, Department of the Interior, Washington, D.C., March 13, 1986). The staff agrees, because eagles nest on Graham Lake under existing conditions and issuance of a new license would not affect those conditions. The applicant proposes recreational development at Lake Leonard, but not at Graham Lake. (See the section on recreation and other land and water uses.) Therefore, there would be no loss of eagle habitat caused by land clearing for recreational facilities, and no disturbance of eagles because of noise and human activity. Further, the measures that the staff recommends to protect anadromous and resident fish in the project area (section on fishery resources) would indirectly benefit bald eagles, for whom fish are a major food source.

Unavoidable Adverse Impacts: None.

7. Cultural Resources

Affected Environment: The applicant has conducted a cultural resources survey of the project area and found no properties in the project area that are listed on or eligible for listing on the National Register of Historic Places (Bourque and Kopec, 1984). The Maine State Historic Preservation Officer (SHPO) has reviewed the results of the survey and agrees that continued project operation would not affect National Register listed or eligible properties (letter from Earle G. Shettleworth, Jr., State Historic Preservation Officer, Maine Historic Preservation Commission, Augusta, Maine, October 31, 1984). The results of the survey and of the SHPO's concurrence with the no-effect determination are based on the proposed method of operation described in the application for a new license and in the applicant's subsequent filings.

Environmental Impacts and Recommendations: The SHPO's comments on the proposed relicensing of the project contemplate that the project would be operated as described in the application without significant changes. Changes to the project are occasionally found to be necessary after a license has been issued, and may require an application to amend the license. Under these circumstances, whether or not an application for amendment of license is required, the survey results and the SHPO's comments would no longer reliably depict the cultural resources impacts that would result from continued project operation. Therefore, before beginning land-clearing or land-disturbing activities within the project boundaries, other than those specifically authorized in the license and previously commented on by the SHPO, the licensee should consult with the SHPO about the need to conduct archeological or historical survey and to implement further avoidance or mitigative measures.

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Also, land-clearing and land-disturbing activities could adversely affect archeological and historic properties not identified in the cultural resources survey. Therefore, if the licensee encounters such sites or properties during the development of project facilities, the licensee should stop land-clearing and land-disturbing activities in the vicinity of the sites or properties, should consult with the SHPO on the eligibility of the properties, and should carry out any necessary measures to avoid or to mitigate effects on the properties.

Sixty days before starting land-clearing or land-disturbing activities associated with any changes to the project, both proposed and necessitated, and 60 days before resuming land-clearing and land-disturbing activities in the vicinity of the sites or properties discovered, the licensee should file a plan and a schedule for conducting the appropriate studies, along with a copy of the SHPO's written comments on the plan and the schedule. The licensee should not start or resume land-clearing or land-disturbing activities, other than those specifically authorized in the license and commented on by the SHPO, or resume such activities in the vicinity of an archeological or historic property discovered during construction, until informed by the Commission that the requirements discussed above have been fulfilled.

Unavoidable Adverse Impacts: None.

8. Recreation and Other Land and Water Uses

Affected Environment: Land use around Lake Leonard is primarily undeveloped woodland interspersed with residences. Most of the residential development is on the east side of the Union River and Lake Leonard. Residential development is more pronounced downstream and upstream of the Ellsworth dam.

Land use around the much larger Graham Lake is primarily residential, with a large percentage being seasonal dwellings.

Outdoor recreational uses at Graham Lake include boating, fishing, swimming, and camping. The total annual recreational use is estimated at 5,000 visitors, with a peak day use of 100 visitors. Most of the recreational use at Graham Lake is from residents of private vacation camps located adjacent to the project. There is an existing public boat-launching ramp, developed by the applicant, on project land adjacent to Graham dam.

Environmental Impacts and Recommendations: Relicensing of the Ellsworth Project would not have any environmental impact on recreation and land and water uses.

Although no specific recreational needs have been identified, the applicant entered into a memorandum of understanding (MOU) with the city of Ellsworth in 1984 to assist in the development of a park adjacent to Lake Leonard and the Union River downstream from Ellsworth dam. Plans for the park include nature trails, picnic

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areas, boat and canoe launch facilities, a boat dock, a swimming area, and parking areas. The MOU states that the applicant would grant easements to the city of Ellsworth for access across project lands to trails and boat-launching facilities the city plans to install on the east side of the river, and to a canoe-launching facility the city would install on the west side of the river, downstream from the powerhouse. The MOU also states that the applicant would provide the following recreational improvements: (1) a safety boom, upstream from Ellsworth dam; (2) a security gate at the boat-launching facility the city plans to build on Lake Leonard; (3) a security fence, 300 feet long, in the area of the east abutment of Ellsworth dam; and (4) a plaque explaining project operation.

Interior states that the park that the applicant and the city of Ellsworth would develop should be adequate for meeting present recreation needs. Interior recommends that the applicant complete the proposed facilities within 2 years from the date of issuance of a new license, should include within the project boundary all lands developed or proposed for recreational development, and should develop an operation and maintenance schedule or implement an agreement for operation and maintenance services. DEP recommends that the applicant develop a specific plan to provide recreational facilities in accordance with the MOU.

The Report on Recreational Resources does not include a schedule showing when the applicant proposes to complete construction of the safety boom, security gate and fence, and informational plaque. The MOU specifies that the applicant would construct the safety boom and security gate after the city of Ellsworth completes the planned trail and boat landing, and would construct the security fence after the city completes the trails. The staff concedes that it is sensible to tie the timetable to when other recreational development by the city necessitates the safety and security measures. The staff agrees with Interior, however, that the licensee should provide a schedule for installing the proposed facilities. If the licensee believes that the city may not develop the park in a timely fashion, and that consequently, a definite schedule cannot be formulated, the applicant should consider other recreational development that can be implemented independently of action by the city. Therefore, the licensee should file a revised Report on Recreational Resources, including a specific recreation plan, prepared in coordination with the city of Ellsworth, the National Park Service, and the Maine Bureau of Parks and Recreation. The plan should identify the entities responsible for constructing, operating, and maintaining any existing or proposed facilities and should include any agreements for operation and maintenance services.

Sheet 6 of exhibit G shows the existing Graham Lake boat-launching facility and some of the recreational facilities that the applicant and the city of Ellsworth would install along Lake Leonard. The drawing does not, however, distinguish between facilities the applicant proposes to install and the facilities the city plans to install. Also, the drawing does not show the safety boom, the

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security gate, and the informational plaque, or the location of lands reserved for future recreational development, such as for the swimming area and boat dock. Therefore, the licensee should include in the revised Report on Recreational Resources maps or drawings clearly showing the design and location of all existing and proposed recreational facilities, and all lands reserved for future recreational development.

Unavoidable Adverse Impacts: None.

B. Alternative of No Action

Under the no-action alternative, electrical power that would be generated by the Ellsworth Project would have to be generated from other available sources or offset by conservation measures. The applicant also could not carry out its proposal to install fish passage facilities and a riverside park.

C. Recommended Alternative

The proposed project is preferred over the no-action alternative, because the purpose of the project can be achieved without significant environmental impacts.

VI. FINDING OF NO SIGNIFICANT IMPACT

Continued operation of the project would result in some injury and mortality of resident and anadromous fish, caused by passage through the turbines. There would be minor, long-term erosion and turbidity from wave and ice action on the shores of Graham Lake.

This environmental assessment was prepared in accordance with the National Environmental Policy Act of 1969. On the basis of the staff's independent environmental analysis, issuance of a license for the Ellsworth Hydroelectric Project would not constitute a major federal action significantly affecting the quality of the human environment.

VII. LITERATURE CITED

Bangor Hydro-Electric Company. 1984. Application for license for the Ellsworth Project, FERC No. 2727, Maine. Bangor, Maine.

Baum, E.T. 1982. The Union River: an Atlantic salmon river management report. Maine Atlantic Sea-Run Salmon Commission. Bangor, Maine. 60 pp.

Beland, K.F. 1984. Management of Atlantic salmon in the state of Maine: a strategic plan. Maine Atlantic Sea-Run Salmon Commission. 71 pp.

Bourque, B.J., and D.R. Kopec. 1984. An evaluation of the dam pool impact on sites 58.1 and 58.10, Ellsworth, Maine. Maine State Museum. June 8, 1984. 40 pp.

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Federal Power Commission. 1965. Planning status report: New England coastal areas. Washington, D.C. 12 pp.

VIII. LIST OF PREPARERS

Dianne Rodman--EA Coordinator; Geology and Soils, Terrestrial Resources, and Threatened and Endangered Species (Ecologist; M.S., Biology).

Robert Kirby--Recreation (Environmental Protection Specialist; M.S., Geography, City and Regional Planning).

Frank Miller--Purpose, Need for Power, and Alternatives to the Proposed Project (Electrical Engineer; D.E., Electrical Engineering).

John Mitchell--EA Editor (Writer-editor; B.S., Social Sciences).

William Perry--Water and Fishery Resources (Fishery Biologist; Ph.D., Biology).

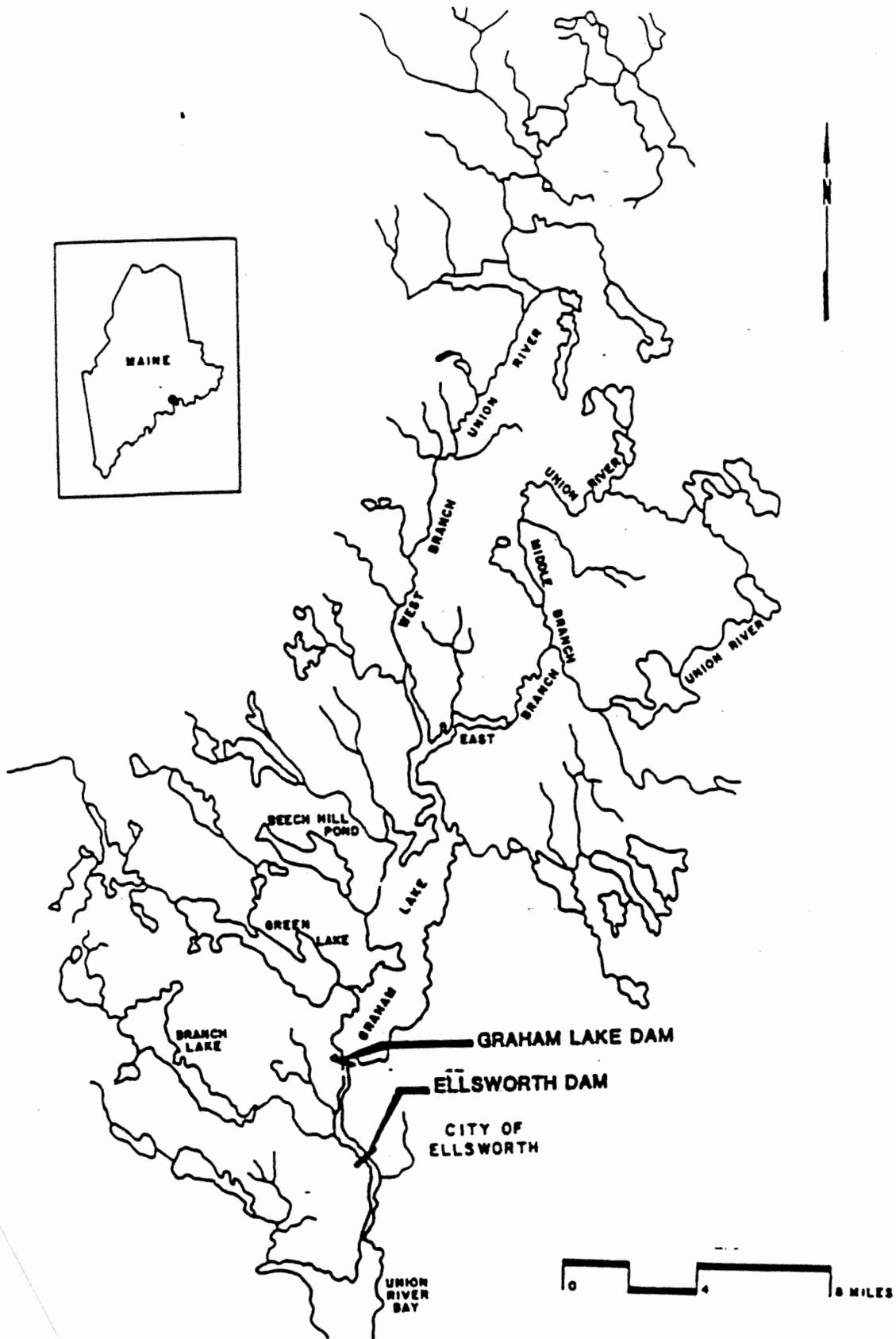


Figure 1. Location of the Ellsworth Project, FERC No. 2727, Maine (Source: the staff, modified from Bangor Hydro-Electric Company, 1984).

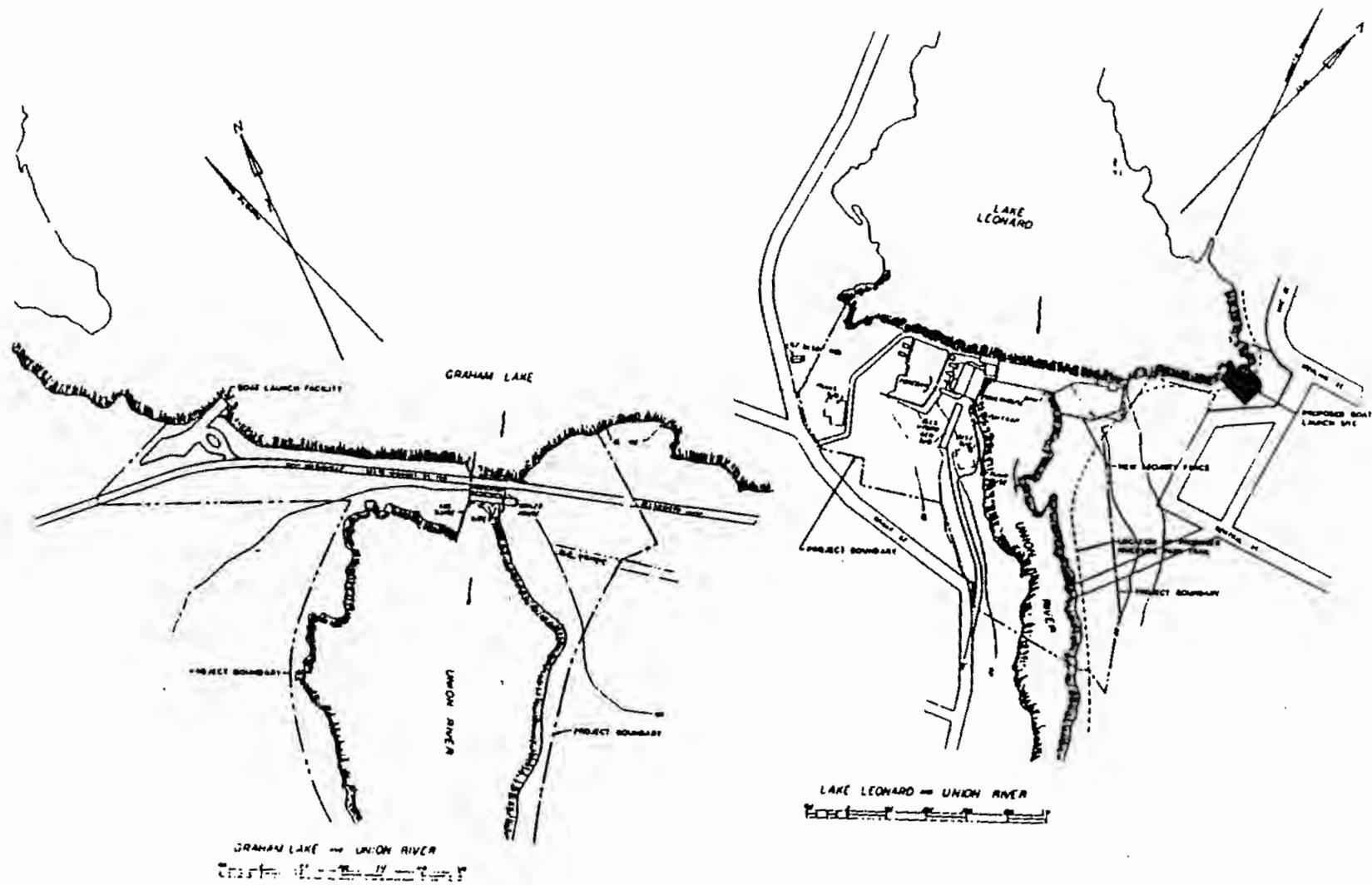


Figure 2. Features of the Ellsworth Project, FERC No. 2727, Maine (Source: the staff, modified from Bangor Hydro-Electric Company, 1984).

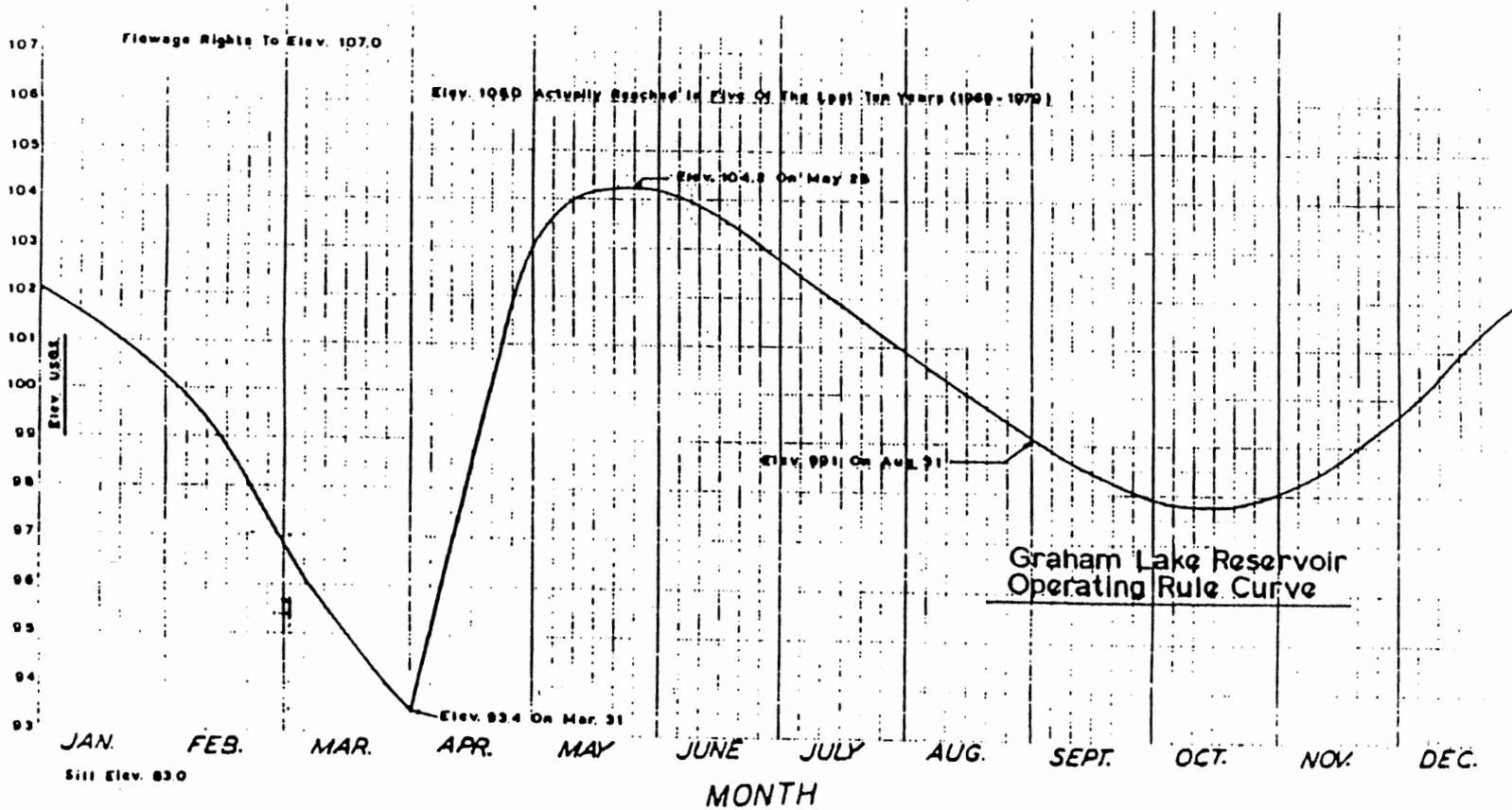
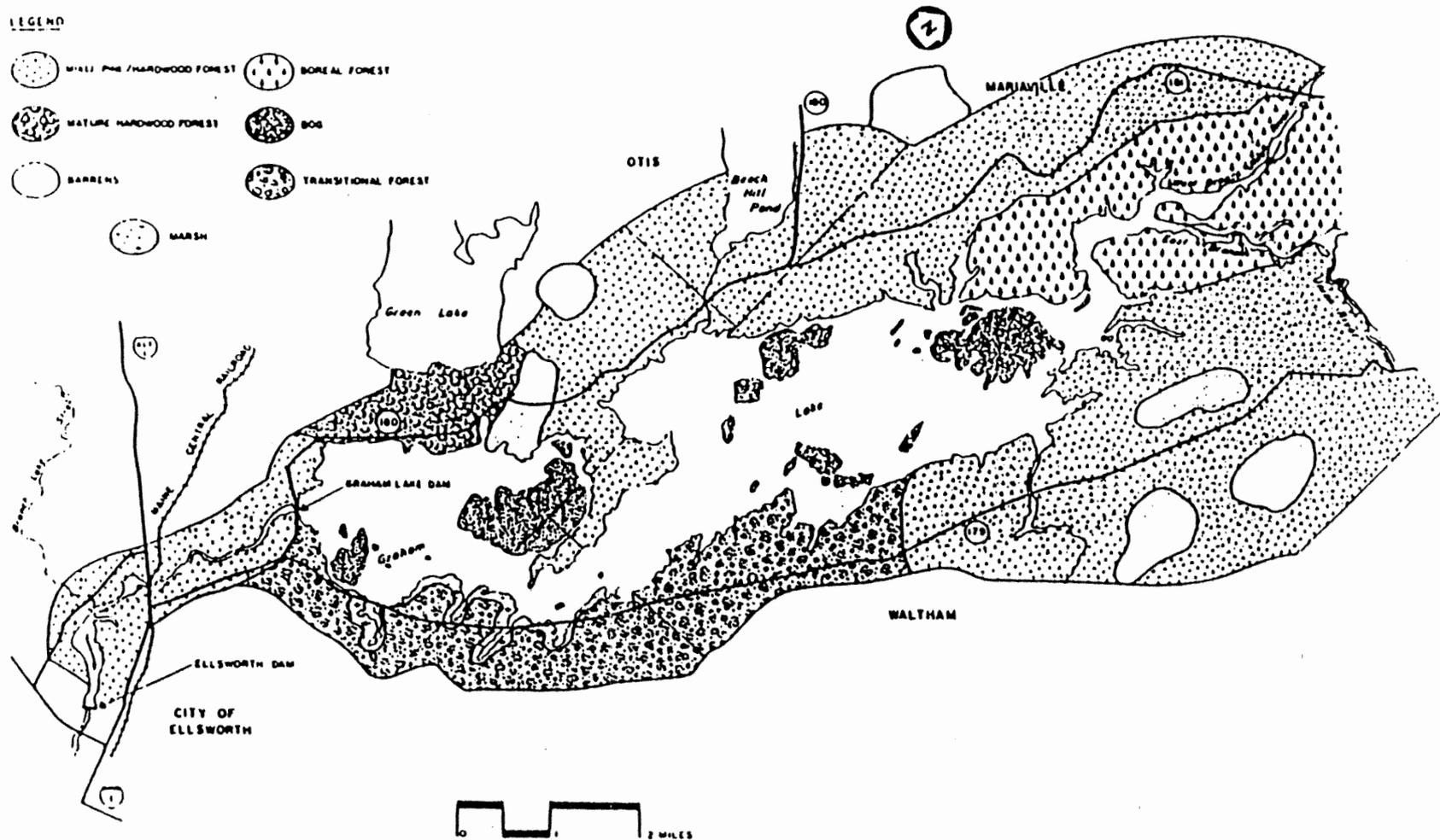


Figure 3. Proposed rule curve for operation of the Ellsworth Project, FERC No. 2727, Maine (Source: the staff, modified from Bangor Hydro-Electric Company, 1984).

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Figure 4. Vegetation types in the vicinity of the Ellsworth Project, FERC No. 2727, Maine (Source: the staff, modified from Bangor Hydro-Electric Company, 1984).

SAFETY AND DESIGN ASSESSMENT
ELLSWORTH HYDROELECTRIC PROJECT
FERC NO. 2727-003 - ME
(RELICENSING)

DAM SAFETY

The Ellsworth Hydroelectric Project is located on the Union River, in the City of Ellsworth, Hancock County, Maine.

The initial license was issued in 1977, with an effective date of January 1, 1938 and expiration date of December 31, 1987. The Bangor Hydro-Electric Company (Bangor) filed the application for a new license for the continued operation of the project on December 19, 1984.

The Ellsworth Hydroelectric Plant and its two dams, the lower Ellsworth Dam and the upper Graham Dam, which are owned by the applicant, were inspected by the Commission's New York Regional Office (NYRO) on May 7, 1987. The Regional Director reported that both dams are classified as high hazard. The Ellsworth Dam is an Ambursen reinforced concrete dam, and would be overtopped by 19 feet of water during a Probable Maximum Flood (PMF) of 252,900 cfs. Field inspection and stability analysis made by the applicant indicates that the forebay wall would fail during the early stages of dam overtopping. The Graham Dam is an earthen structure, and would be overtopped by 8.5 feet of water during a PMF of 252,000 cfs. The applicant is assuming that the Graham Dam would also fail due to overtopping by the PMF.

The second consultant's safety inspection report filed on March 21, 1984, is currently under review by staff. Several questions regarding the safety of the project have been addressed. The consultant has determined that failure of Graham Lake Dam under PMF flows would not cause a hazard downstream. However, the appropriate inflow design flood for this development has not yet been determined. In addition, the consultant has identified the need for field explorations to define the embankment strength parameters. If the spillway of the Graham Lake Dam cannot accommodate the inflow design flood, or if revised stability analyses based on the actual embankment strength parameters indicate the embankment does not have adequate safety factors under all credible loading conditions, the licensee will be required to propose and construct appropriate remedial measures. With regard to Ellsworth Dam, the consultant determined that the forebay walls would be unstable if overtopped and recommended that the walls be post-tensioned. The post-tensioning proposal is considered acceptable and the final design and plans and specifications are forthcoming. With the resolution of these dam safety concerns and the implementation of the necessary remedial measures the project would continue to be safe and adequate.

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The Regional Director also reported that the project's impoundment structures appear to be in fair condition.

The basic design of the project would remain unchanged.

WATER RESOURCE PLANNING

The project is operated as a peaking plant. The applicant does not plan to modify the existing project facilities or change the operation of the project.

There are no current contracts or constraints which affect the manner in which the project is operated. A minimum flow of 90 cfs is released from the project to dilute the discharge from the Ellsworth municipal waste water treatment plant. The leakage flow from the Ellsworth Dam is 33 cfs, and is 22 cfs from the Graham Dam.

The hydraulic capacity of 2,300 cfs corresponds to the flow equalled or exceeded 4% of the time on the flow duration curve for the Union River. No additional increase of capacity is planned.

No specific State or Federal agency comments or recommendations were made addressing flood control, navigation, water supply, or irrigation requirements in the basin.

The New England Coastal Area Planning Status Report includes no projects, either proposed or constructed on the Union River that this project would impact. The project would not conflict with any pending applications for exemption, license, or preliminary permit.

Based on the above, Staff concludes that the Ellsworth Project adequately utilizes the available flow and head at the site and would not conflict with any existing or planned water resource developments in the basin.

CONSUMPTION EFFICIENCY IMPROVEMENT PROGRAM - Section 10(a)(2)(C)

Bangor Hydro-Electric Company first formed its Energy Conservation Department in 1980; and in 1985 reorganized this Department as the Energy Management Department, with broadened responsibilities which included procedures and programs designed to reduce peak demands for capacity as well as end-use conservation of energy. The goal of the Energy Management Department is to maintain existing conservation programs while working to find ways to actively manage the electricity consumption patterns for the utility's customers. The objective of this effort is to make more efficient use of existing generating capacity, to reduce or eliminate the need to increase costly generating capacity, and improve the value of the product to the customer.

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The applicant has on-going and planned programs which include a comprehensive list of those programs which have been found to be cost-effective by many utilities. Thirteen of the applicant's conservation and demand-reduction programs are described in applicant's response to staff request for information on Applicant's Electricity Consumption Efficiency Improvement Program. The response is entitled "Bangor Hydro-Electric Company Energy Management Report," and is dated April 1987.

Based on a review of the above cited Report and a review of Section 6 (at page 45) of the "Annual Report of the Maine Public Utilities Commission" (dated February 2, 1987), Staff concludes that the applicant has made an acceptable good-faith effort to conserve electric energy, reduce the demand for new generating capacity and to comply with the objectives of Section 10(a)(2)(C).

EXHIBITS

The following portion of Exhibit A and the following Exhibit F drawings should be included in the new license:

Exhibit A. Pages A-2, A-4 through A-6 and Appendix A-1 consisting of 15 pages from A-7 through A-21, describing the mechanical, electrical and transmission equipment filed December 19, 1984.

<u>Exhibit F Drawings</u>	<u>FERC No. 2727-</u>	<u>Description</u>
1	1	Ellsworth Powerhouse and Dam Plan and Sections
2	2	Ellsworth Powerhouse and Dam Sections
3	3	Graham Lake Dam Plan and Sections

Form L-3
(Revised October, 1975)

FEDERAL ENERGY REGULATORY COMMISSION

TERMS AND CONDITIONS OF LICENSE FOR CONSTRUCTED
MAJOR PROJECT AFFECTING NAVIGABLE
WATERS OF THE UNITED STATES

Article 1. The entire project, as described in this order of the Commission, shall be subject to all of the provisions, terms, and conditions of the license.

Article 2. No substantial change shall be made in the maps, plans, specifications, and statements described and designated as exhibits and approved by the Commission in its order as a part of the license until such change shall have been approved by the Commission: Provided, however, That if the Licensee or the Commission deems it necessary or desirable that said approved exhibits, or any of them, be changed, there shall be submitted to the Commission for approval a revised, or additional exhibit or exhibits covering the proposed changes which, upon approval by the Commission, shall become a part of the license and shall supersede, in whole or in part, such exhibit or exhibits theretofore made a part of the license as may be specified by the Commission.

Article 3. The project area and project works shall be in substantial conformity with the approved exhibits referred to in Article 2 herein or as changed in accordance with the provisions of said article. Except when emergency shall require for the protection of navigation, life, health, or property, there shall not be made without prior approval of the Commission any substantial alteration or addition not in conformity with the approved plans to any dam or other project works under the license or any substantial use of project lands and waters not authorized herein; and any emergency alteration, addition, or use so made shall thereafter be subject to such modification and change as the Commission may direct. Minor changes in project works, or in uses of project lands and waters, or divergence from such approved exhibits may be made if such changes will not result in a decrease in efficiency, in a material increase in cost, in an adverse environmental impact, or in impairment of the general scheme of development; but any of such minor changes made without the prior approval of the Commission, which in its judgment have produced or will produce any of such results, shall be subject to such alteration as the Commission may direct.

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Article 4. The project, including its operation and maintenance and any work incidental to additions or alterations authorized by the Commission, whether or not conducted upon lands of the United States, shall be subject to the inspection and supervision of the Regional Engineer, Federal Power Commission, in the region wherein the project is located, or of such other officer or agent as the Commission may designate, who shall be the authorized representative of the Commission for such purposes. The Licensee shall cooperate fully with said representative and shall furnish him such information as he may require concerning the operation and maintenance of the project, and any such alterations thereto, and shall notify him of the date upon which work with respect to any alteration will begin, as far in advance thereof as said representative may reasonably specify, and shall notify him promptly in writing of any suspension of work for a period of more than one week, and of its resumption and completion. The Licensee shall submit to said representative a detailed program of inspection by the Licensee that will provide for an adequate and qualified inspection force for construction of any such alterations to the project. Construction of said alterations or any feature thereof shall not be initiated until the program of inspection for the alterations or any feature thereof has been approved by said representative. The Licensee shall allow said representative and other officers or employees of the United States, showing proper credentials, free and unrestricted access to, through, and across the project lands and project works in the performance of their official duties. The Licensee shall comply with such rules and regulations of general or special applicability as the Commission may prescribe from time to time for the protection of life, health, or property.

Article 5. The Licensee, within five years from the date of issuance of the license, shall acquire title in fee or the right to use in perpetuity all lands, other than lands of the United States, necessary or appropriate for the construction, maintenance, and operation of the project. The Licensee or its successors and assigns shall, during the period of the license, retain the possession of all project property covered by the license as issued or as later amended, including the project area, the project works, and all franchises, easements, water rights, and rights of occupancy and use; and none of such properties shall be voluntarily sold, leased, transferred, abandoned, or otherwise disposed of without the prior written approval of the Commission, except that the Licensee may lease or otherwise dispose of interests in project lands or property without specific written approval of the Commission pursuant

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to the then current regulations of the Commission. The provisions of this article are not intended to prevent the abandonment or the retirement from service of structures, equipment, or other project works in connection with replacements thereof when they become obsolete, inadequate, or inefficient for further service due to wear and tear; and mortgage or trust deeds or judicial sales made thereunder, or tax sales, shall not be deemed voluntary transfers within the meaning of this article.

Article 6. In the event the project is taken over by the United States upon the termination of the license as provided in Section 14 of the Federal Power Act, or is transferred to a new licensee or to a non-power licensee under the provisions of Section 15 of said Act, the Licensee, its successors and assigns shall be responsible for, and shall make good any defect of title to, or of right of occupancy and use in, any of such project property that is necessary or appropriate or valuable and serviceable in the maintenance and operation of the project, and shall pay and discharge, or shall assume responsibility for payment and discharge of, all liens or encumbrances upon the project or project property created by the Licensee or created or incurred after the issuance of the license: Provided, That the provisions of this article are not intended to require the Licensee, for the purpose of transferring the project to the United States or to a new licensee, to acquire any different title to, or right of occupancy and use in, any of such project property than was necessary to acquire for its own purposes as the Licensee.

Article 7. The actual legitimate original cost of the project, and of any addition thereto or betterment thereof, shall be determined by the Commission in accordance with the Federal Power Act and the Commission's Rules and Regulations thereunder.

Article 8. The Licensee shall install and thereafter maintain gages and stream-gaging stations for the purpose of determining the stage and flow of the stream or streams on which the project is located, the amount of water held in and withdrawn from storage, and the effective head on the turbines; shall provide for the required reading of such gages and for the adequate rating of such stations; and shall install and maintain standard meters adequate for the determination of the amount of electric energy generated by the project works. The number, character, and location

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of gages, meters, or other measuring devices, and the method of operation thereof, shall at all times be satisfactory to the Commission or its authorized representative. The Commission reserves the right, after notice and opportunity for hearing, to require such alterations in the number, character, and location of gages, meters, or other measuring devices, and the method of operation thereof, as are necessary to secure adequate determinations. The installation of gages, the rating of said stream or streams, and the determination of the flow thereof, shall be under the supervision of, or in cooperation with, the District Engineer of the United States Geological Survey having charge of stream-gaging operations in the region of the project, and the Licensee shall advance to the United States Geological Survey the amount of funds estimated to be necessary for such supervision, or cooperation for such periods as may be mutually agreed upon. The Licensee shall keep accurate and sufficient records of the foregoing determinations to the satisfaction of the Commission, and shall make return of such records annually at such time and in such form as the Commission may prescribe.

Article 9. The Licensee shall, after notice and opportunity for hearing, install additional capacity or make other changes in the project as directed by the Commission, to the extent that it is economically sound and in the public interest to do so.

Article 10. The Licensee shall, after notice and opportunity for hearing, coordinate the operation of the project, electrically and hydraulically, with such other projects or power systems and in such manner as the Commission may direct in the interest of power and other beneficial public uses of water resources, and on such conditions concerning the equitable sharing of benefits by the Licensee as the Commission may order.

Article 11. Whenever the Licensee is directly benefited by the construction work of another licensee, a permittee, or the United States on a storage reservoir or other headwater improvement, the Licensee shall reimburse the owner of the headwater improvement for such part of the annual charges for interest, maintenance, and depreciation thereof as the Commission shall determine to be equitable, and shall pay to the United States the cost of making such determination as fixed by the Commission. For benefits

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provided by a storage reservoir or other headwater improvement of the United States, the Licensee shall pay to the Commission the amounts for which it is billed from time to time for such headwater benefits and for the cost of making the determinations pursuant to the then current regulations of the Commission under the Federal Power Act.

Article 12. The United States specifically retains and safeguards the right to use water in such amount, to be determined by the Secretary of the Army, as may be necessary for the purposes of navigation on the navigable waterway affected; and the operations of the Licensee, so far as they affect the use, storage and discharge from storage of waters affected by the license, shall at all times be controlled by such reasonable rules and regulations as the Secretary of the Army may prescribe in the interest of navigation, and as the Commission may prescribe for the protection of life, health, and property, and in the interest of the fullest practicable conservation and utilization of such waters for power purposes and for other beneficial public uses, including recreational purposes, and the Licensee shall release water from the project reservoir at such rate in cubic feet per second, or such volume in acre-feet per specified period of time, as the Secretary of the Army may prescribe in the interest of navigation, or as the Commission may prescribe for the other purposes hereinbefore mentioned.

Article 13. On the application of any person, association, corporation, Federal agency, State or municipality, the Licensee shall permit such reasonable use of its reservoir or other project properties, including works, lands and water rights, or parts thereof, as may be ordered by the Commission, after notice and opportunity for hearing, in the interests of comprehensive development of the waterway or waterways involved and the conservation and utilization of the water resources of the region for water supply or for the purposes of steam-electric, irrigation, industrial, municipal or similar uses. The Licensee shall receive reasonable compensation for use of its reservoir or other project properties or parts thereof for such purposes, to include at least full reimbursement for any damages or expenses which the joint use causes the Licensee to incur. Any such compensation shall be fixed by the Commission either by approval of an agreement between the Licensee and the party or parties benefiting or after notice and

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opportunity for hearing. Applications shall contain information in sufficient detail to afford a full understanding of the proposed use, including satisfactory evidence that the applicant possesses necessary water rights pursuant to applicable State law, or a showing of cause why such evidence cannot concurrently be submitted, and a statement as to the relationship of the proposed use to any State or municipal plans or orders which may have been adopted with respect to the use of such waters.

Article 14. In the construction or maintenance of the project works, the Licensee shall place and maintain suitable structures and devices to reduce to a reasonable degree the liability of contact between its transmission lines and telegraph, telephone and other signal wires or power transmission lines constructed prior to its transmission lines and not owned by the Licensee, and shall also place and maintain suitable structures and devices to reduce to a reasonable degree the liability of any structures or wires falling or obstructing traffic or endangering life. None of the provisions of this article are intended to relieve the Licensee from any responsibility or requirement which may be imposed by any other lawful authority for avoiding or eliminating inductive interference.

Article 15. The Licensee shall, for the conservation and development of fish and wildlife resources, construct, maintain, and operate, or arrange for the construction, maintenance, and operation of such reasonable facilities, and comply with such reasonable modifications of the project structures and operation, as may be ordered by the Commission upon its own motion or upon the recommendation of the Secretary of the Interior or the fish and wildlife agency or agencies of any State in which the project or a part thereof is located, after notice and opportunity for hearing.

Article 16. Whenever the United States shall desire, in connection with the project, to construct fish and wildlife facilities or to improve the existing fish and wildlife facilities at its own expense, the Licensee shall permit the United States or its designated agency to use, free of cost, such of the Licensee's lands and interests in lands, reservoirs, waterways and project works as may be

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reasonably required to complete such facilities or such improvements thereof. In addition, after notice and opportunity for hearing, the Licensee shall modify the project operation as may be reasonably prescribed by the Commission in order to permit the maintenance and operation of the fish and wildlife facilities constructed or improved by the United States under the provisions of this article. This article shall not be interpreted to place any obligation on the United States to construct or improve fish and wildlife facilities or to relieve the Licensee of any obligation under this license.

Article 17. The Licensee shall construct, maintain, and operate, or shall arrange for the construction, maintenance, and operation of such reasonable recreational facilities, including modifications thereto, such as access roads, wharves, launching ramps, beaches, picnic and camping areas, sanitary facilities, and utilities, giving consideration to the needs of the physically handicapped, and shall comply with such reasonable modifications of the project, as may be prescribed hereafter by the Commission during the term of this license upon its own motion or upon the recommendation of the Secretary of the Interior or other interested Federal or State agencies, after notice and opportunity for hearing.

Article 18. So far as is consistent with proper operation of the project, the Licensee shall allow the public free access, to a reasonable extent, to project waters and adjacent project lands owned by the Licensee for the purpose of full public utilization of such lands and waters for navigation and for outdoor recreational purposes, including fishing and hunting: Provided, That the Licensee may reserve from public access such portions of the project waters, adjacent lands, and project facilities as may be necessary for the protection of life, health, and property.

Article 19. In the construction, maintenance, or operation of the project, the Licensee shall be responsible for, and shall take reasonable measures to prevent, soil erosion on lands adjacent to streams or other waters, stream sedimentation, and any form of water or air pollution. The Commission, upon request or upon its own motion, may order the Licensee to take such measures as the Commission finds to be necessary for these purposes, after notice and opportunity for hearing.

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Article 20. The Licensee shall clear and keep clear to an adequate width lands along open conduits and shall dispose of all temporary structures, unused timber, brush, refuse, or other material unnecessary for the purposes of the project which results from the clearing of lands or from the maintenance or alteration of the project works. In addition, all trees along the periphery of project reservoirs which may die during operations of the project shall be removed. All clearing of the lands and disposal of the unnecessary material shall be done with due diligence and to the satisfaction of the authorized representative of the Commission and in accordance with appropriate Federal, State, and local statutes and regulations.

Article 21. Material may be dredged or excavated from, or placed as fill in, project lands and/or waters only in the prosecution of work specifically authorized under the license; in the maintenance of the project; or after obtaining Commission approval, as appropriate. Any such material shall be removed and/or deposited in such manner as to reasonably preserve the environmental values of the project and so as not to interfere with traffic on land or water. Dredging and filling in a navigable water of the United States shall also be done to the satisfaction of the District Engineer, Department of the Army, in charge of the locality.

Article 22. Whenever the United States shall desire to construct, complete, or improve navigation facilities in connection with the project, the Licensee shall convey to the United States, free of cost, such of its lands and rights-of-way and such rights of passage through its dams or other structures, and shall permit such control of its pools, as may be required to complete and maintain such navigation facilities.

Article 23. The operation of any navigation facilities which may be constructed as a part of, or in connection with, any dam or diversion structure constituting a part of the project works shall at all times be controlled by such reasonable rules and regulations in the interest of navigation, including control of the level of the pool caused by such dam or diversion structure, as may be made from time to time by the Secretary of the Army.

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Article 24. The Licensee shall furnish power free of cost to the United States for the operation and maintenance of navigation facilities in the vicinity of the project at the voltage and frequency required by such facilities and at a point adjacent thereto, whether said facilities are constructed by the Licensee or by the United States.

Article 25. The Licensee shall construct, maintain, and operate at its own expense such lights and other signals for the protection of navigation as may be directed by the Secretary of the Department in which the Coast Guard is operating.

Article 26. If the Licensee shall cause or suffer essential project property to be removed or destroyed or to become unfit for use, without adequate replacement, or shall abandon or discontinue good faith operation of the project or refuse or neglect to comply with the terms of the license and the lawful orders of the Commission mailed to the record address of the Licensee or its agent, the Commission will deem it to be the intent of the Licensee to surrender the license. The Commission, after notice and opportunity for hearing, may require the Licensee to remove any or all structures, equipment and power lines within the project boundary and to take any such other action necessary to restore the project waters, lands, and facilities remaining within the project boundary to a condition satisfactory to the United States agency having jurisdiction over its lands or the Commission's authorized representative, as appropriate, or to provide for the continued operation and maintenance of nonpower facilities and fulfill such other obligations under the license as the Commission may prescribe. In addition, the Commission in its discretion, after notice and opportunity for hearing, may also agree to the surrender of the license when the Commission, for the reasons recited herein, deems it to be the intent of the Licensee to surrender the license.

Article 27. The right of the Licensee and of its successors and assigns to use or occupy waters over which the United States has jurisdiction, or lands of the United States under the license, for the purpose of maintaining the project works or otherwise, shall absolutely cease at the end of the license period, unless the Licensee has obtained a new license pursuant to the then existing laws and regulations, or an annual license under the terms and conditions of this license.

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Article 28. The terms and conditions expressly set forth in the license shall not be construed as impairing any terms and conditions of the Federal Power Act which are not expressly set forth herein.

UNITED STATES OF AMERICA 58 FERC 62, 014
FEDERAL ENERGY REGULATORY COMMISSION

Bangor Hydro-Electric Company
Maine

Project No. 2727-024

ORDER AMENDING LICENSE
(ISSUED JANUARY 8, 1992)

On February 25, 1991, and amended on August 5, 1991, the licensee, Bangor Hydro-Electric Company, filed a request to revise the authorized project boundary of the Ellsworth Project, FERC No. 2727.

The licensee proposes to modify the authorized project boundary to include an additional 2 acres of land located downstream of the existing Graham Lake Dam. The change in the project boundary, which is shown on the revised exhibit G drawing filed on August 5, 1991, is necessary due to the required reconstruction of the Graham Lake Dam. The revised exhibit G drawing conforms to the Commission's rules and regulations.

Remedial repairs at the Graham Lake Dam are required to resolve instability problems in the western embankment and spillway section. The licensee proposes to extend the existing dam by constructing a concrete flood control structure along the downstream toe of the existing embankment and west of the existing gate structure. The proposed structure will act as an emergency spillway to back-up the existing unstable western embankment if the embankment is overtopped by flood waters in Graham Lake. The downstream extension would consist of a 300-foot-long overflow spillway, a 100 foot-long non-overflow spillway section, and a 450-foot-long embankment connecting the spillway to the west bank. The concrete flood control structure would be connected to the existing Graham Lake outlet gates by a wing wall extension and a permanent cofferdam cell, and to the existing embankment by an earthen berm and fill.

The licensee's construction of the proposed extension of Graham Lake Dam would require a 4.5-acre site (2.5 acres of land within the existing project boundary and 2 acres of adjacent private land) to accommodate the structure. The licensee's proposed project boundary revision would include the 2-acres of

private land. To accomplish the remedial repairs, the licensee also requires the temporary use of a construction laydown site, up to 11 acres in size. The licensee initially proposed to use a site adjacent to Graham Lake Dam, but is investigating other sites within a 2-mile radius of the dam. The temporary construction laydown site will not be incorporated into the project boundary.

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Public notice of the filing was issued on March 22, 1991, with May 10, 1991, as the last day to file comments or motions to intervene. The U.S. Department of the Interior (Interior) and the Maine Historic Preservation Commission (SHPO) filed comments on May 17, 1991 and April 12, 1991, respectively. Kenneth J. LaFlamme and Corda W. LaFlamme (LaFlammes) filed a timely motion to intervene on May 9, 1991. No protests or other motions to intervene were filed in this proceeding.

Intervention

The LaFlammes intervened because of their concern that the Commission's action on the licensee's proposed project boundary amendment would directly affect their interests. The LaFlammes own the 2-acre area proposed for inclusion in the project boundary, and the adjacent land area proposed for a construction laydown site. Specifically, the LaFlammes indicate that if the amendment is necessary for public safety reasons and a loss of property to the project is inevitable, they wish the development to go forward with a loss of as little land as possible. They also state that the proposed structure should be designed and built to have the least effect on the surrounding environment. Further, the LaFlammes indicate that the taking of 14 acres of their land for construction laydown would have a severe adverse environmental impact, diminish the value of their remaining land, and is not essential but merely a convenience.¹

The proposed remedial measures at Graham Lake Dam have been designed to limit the amount of additional land needed to the 2 acres proposed in this amendment. The licensee's proposed measures to restore the site following construction, and wetland mitigative measures being required herein, will minimize the environmental effects of constructing remedial measures. The proposed laydown site is no longer included in the amendment of project boundary.

1 The Laflamme's intervention states that the licensee needs 14 acres for construction related activities (i.e., a construction laydown site). The licensee, in its initial application filed on February 25, 1991, included an additional 14-acre adjacent area within its proposed revised project boundary. On August 5, 1991, the licensee amended its application to exclude the laydown site, and also revised the size of the laydown area to 11 acres. The laydown area is proposed to be located within 2 miles of the project site.

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Summary of Findings

After considering the environmental information in the application for amendment of license, the staff's independent environmental assessment (EA)², and other public comments, I find that issuance of this amendment is not a major federal action significantly affecting the quality of the human environment. The EA contains background information, analysis of impacts, support for related license articles, and the basis for a finding of no significant impact on the environment.

The Director orders:

(A) The following exhibit G drawing is approved and made a part of the license.

Exhibit	FERC No.	Title	Superseding
G-4	2727-23	Project Boundary Map	2727-21

(B) The superseded exhibit G drawing is eliminated from the license.

(C) The erosion and sedimentation control plan and measures for restoration of disturbed areas for the amendment of the Ellsworth Project, included in the licensee's filing dated September 26, 1991, are approved.

(D) The following article is added to and made a part of the project license:

Article 410. Within one year from the date of issuance of this order amending license, the licensee shall file with the Commission for approval, a wetlands mitigation plan to restore and replace wetland habitat disturbed and lost as a result of construction of the flood control structure.

The plan shall include, at a minimum:

- (a) details of the final plan to restore and replace the wetlands affected by the project;
- (b) a plan for monitoring the effectiveness of restoration and replacement measures, which

2 Environmental Assessment, Ellsworth Hydroelectric Project, Amendment of License, FERC Project No. 2727-024, Federal Energy Regulatory Commission, dated December 4, 1991. This document is available in the Commission's public files associated with this proceeding and is attached to this order.

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include steps to be taken in the event the measures are not effective, such as, but not necessarily limited to, modifying the techniques used for restoration and replacement, or establishing or enhancing additional wetlands; and

- (c) schedules for the proposed restoration and replacement of wetlands, for filing the results of the monitoring program, and for filing recommendations for alternative wetland mitigation.

The licensee shall prepare the plan after consultation with the U.S. Fish and Wildlife Service and the Maine Department of Environmental Protection. The licensee shall include with the plan documentation of consultation with the agencies before preparing the plan, copies of agency comments or recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how all the agency comments were accommodated by the plan. The licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations prior to filing plans with the Commission. If the

licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

(E) Within 90 days of the date of issuance of this order, the licensee shall file an original of the approved exhibit G drawing reproduced on silver or gelatin 35mm microfilm mounted on a Type D (3 1/4" x 7 3/8") aperture card. In addition, the licensee shall file two duplicate Diazo-type aperture cards. The original and one duplicate aperture card should be filed with the Secretary of the Commission. The remaining duplicate aperture card should be filed with Commission's New York Regional Office. The FERC drawing number (2727-23) shall be shown in the margin below the title block of the microfilmed drawing and also in the upper right corner of each aperture card. The top line(s) of the aperture cards shall show the FERC exhibit (e.g., F-1, G-1, L-1), Project Number, Drawing Title, and date of this order.

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(F) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. 385.713.

J. Mark Robinson
Director, Division of Project
Compliance and Administration

ENVIRONMENTAL ASSESSMENT
APPLICATION FOR AMENDMENT OF LICENSE

Ellsworth Hydroelectric Project

FERC Project No. 2727-024

Maine

Federal Energy Regulatory Commission
Office of Hydropower Licensing
Division of Project Compliance and Administration
825 N. Capitol Street, NE
Washington, D.C. 20426

December 4, 1991

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ENVIRONMENTAL ASSESSMENT

FEDERAL ENERGY REGULATORY COMMISSION OFFICE OF HYDROPOWER LICENSING DIVISION OF PROJECT COMPLIANCE AND ADMINISTRATION

Project Name: Ellsworth Hydroelectric Project

FERC No. 2727-024

A. APPLICATION

1. Application type: Amendment of License
2. Date filed: February 25, 1991; revised on August 5, 1991, and supplemented on September 26, 1991
3. Applicant: Bangor Hydro-Electric Company (licensee)
4. Water body: Union River
5. County and state: Hancock County, Maine

B. PURPOSE AND NEED FOR ACTION

Field observations, investigative programs, and engineering analyses conducted at the Ellsworth Hydroelectric Project's Graham Lake Dam show that the western embankment and spillway have several instability problems. The spillway has inadequate capacity, could potentially liquefy during seismic loading, and has uncontrolled localized seepage at the downstream toe.

A report entitled "Inflow Flood Determination for Graham Dam" submitted to the Commission on November 30, 1989, indicated that a hypothetical breaching of the embankment structure at Graham Lake during the Probable Maximum Flood (PMF) event would pose a hazard to 110 structures in the downstream area.

Subsequent to the aforementioned investigations and determinations, the licensee developed remedial measures for the dam. The Commission, in a February 7, 1991 letter, directed the licensee to file an amendment of license to revise the project boundary to include the necessary land needed to undertake the remedial work on the dam. In response, the licensee submitted a February 25, 1991 filing showing a revision of the project boundary (i.e., revised exhibit G drawing) to add 16 acres to the project, 2 acres for a new dam site and 14 acres for a temporary construction laydown site.

At the request of the Commission in a letter dated July 12, 1991, the licensee on July 26, 1991 revised the project boundary to exclude the laydown area, since it did not conform to the

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Commission's regulations 3 for lands to be included in the project boundary. The Commission also advised the licensee in the July 12, 1991 letter that it believed the 14-acre laydown area was excessive, and requested the licensee to file a report on the minimum area needed for construction laydown and to provide alternative laydown sites. The licensee responded that, until it could access the site to conduct soil/rock borings, it could not calculate the minimum size of the laydown area. The licensee believes, however, that a maximum of 11 acres would be needed. Further, the licensee was not able to locate any alternative laydown sites within the existing project boundary, and is investigating several parcels within a 2-mile radius of the dam site. However, no specific alternative sites have been identified.

C. PROPOSED ACTION AND ALTERNATIVES

1. Description of the proposed action

The licensee proposes to extend the existing dam by constructing a concrete flood control structure along the downstream toe of the existing embankment and west of the existing gate structure. The proposed structure would function as an emergency spillway to back-up the existing unstable western embankment if overtopped by flood waters in Graham Lake. The

downstream extension would consist of an overflow spillway about 300 feet long, about a 100-foot-long non-overflow spillway section, and a 450-foot-long embankment connecting the spillway to the west bank. The concrete flood control structure would be connected to the existing Graham Lake outlet gates by a wing wall extension and a permanent cofferdam cell, and to the existing embankment by an earthen berm and fill.

Construction of the proposed structure would require about 4.5 acres plus a maximum of 11 acres adjacent to the site for a temporary construction laydown area. The 11-acre laydown site and 2 acres of the new dam site are privately owned by one individual. The remaining 2.5 acres of the dam site are on project lands.

Because of the opposition of the landowner to the use of its lands for the proposed development, the licensee has not been able to access the site to conduct soil and bedrock borings. The

3 The Commission regulations at 4.51(h)(2) of 18 C.F.R. states that "the boundary must enclose only those lands necessary for operation and maintenance of the project and for other project purposes, such as recreation, shoreline control, or protection of environmental resources."

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results of such explorations are needed to identify the depth to bedrock at the proposed construction site for determining the amount of spoil to remove and stockpile during construction. This information would dictate the exact size of the construction laydown area, which would vary from a minimum of about 8 acres to a maximum of 11 acres. Therefore, the worst-case scenario, that of an 11-acre site, will be evaluated.

Mitigation

In its September 26, 1991 filing, the licensee submitted a plan for erosion and sedimentation control and restoration of disturbed areas. The plan contains non-structural and structural measures to control erosion during the construction period, which is expected to take approximately one year. Measures to restore disturbed areas after construction are also described in the plan.

The licensee has minimized impacts on wetlands by designing the new structure to the minimum size allowable by federal safety standards and sound engineering practices. The wetlands impacted by the temporary cofferdam would be restored after completion of construction.

2. Alternatives to the proposed action

Licensee

Because of the landowner's opposition to the use of its land for the proposed construction laydown, the licensee has been investigating offsite parcels within a 2-mile radius of the proposed site. Although no specific alternative offsite parcels have been located, the licensee is expected to select a site similar to the proposed onsite parcel (i.e., an 8- to 10-acre, upland, nonforested site).

Agencies

In a letter dated May 13, 1991, the U.S. Department of the Interior (Interior) recommended that the licensee examine the alternative of replacing the existing dam in its present location, modifying the existing drawdown of Graham Lake, and permanently maintaining the lake at a lower level.

3. The no action alternative

The no action alternative is to retain the existing dam in its present unstable condition.

If proposed remedial measures are not implemented at Graham Lake Dam, the instability problems would persist and likely

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increase. The dam could fail if subjected to high floods, which would pose a hazard to 110 structures located downstream. Failure of the dam would also dewater the 9,025-acre Graham Lake causing significant adverse environmental effects and loss of the project's electric power production. Because of safety and environmental problems posed by the instability of the dam, the no action alternative is not considered a reasonable alternative requiring further analysis.

D. CONSULTATION

After the Commission issued a public notice of the

application on March 22, 1991, the following entities commented on the application.

Commenting entity	Date of letter
Maine Historic Preservation Commission	April 8, 1991
U.S. Department of the Interior	May 13, 1991

Kenneth J. LaFlamme and Corda W. LaFlamme filed a motion to intervene dated May 6, 1991. The licensee responded to Interior's letter on June 18, 1991.

E. AFFECTED ENVIRONMENT

The licensee estimates that a maximum of 15.5 acres is needed for constructing the new flood control dam. The flood control dam would occupy about 4.5 acres, and the construction laydown area would require up to 11 acres. Construction and construction laydown are proposed in an area west of and adjacent to the existing Graham Lake Dam outlet works.

Bedrock in the project area consists of a wide zone of schist and gneiss intruded by great masses of granite. Soils consist mainly of clays in the low-lying areas and glacial tills in the upland areas.

The proposed construction site is characterized by about a 1-acre back water section of the Union River and about a 2-acre emergent wetland of sedges and grasses along the shoreline of the Union River, bordered by a narrow, shrub wetland of alder and willow. Emergent wetlands bordered by shrub wetlands are common along the eastern shorelines of Graham Lake and the downstream Leonard Lake. The construction site also includes about a 1.5-acre upland area of project lands characterized by an existing access road bordered by shrub and herbaceous vegetation. Most of the area being considered for construction laydown is an open

field vegetated by grasses, shrubs, and a few scattered trees. A wild blueberry field occurs along the eastern portion of the proposed construction laydown site.

Wildlife species of the area are generally those that occur in forest-edge and shrub-wetland type habitat. Typical species include the white-tailed deer, raccoon, red fox, and a variety of songbirds and amphibians.

The back water area is flooded during periods when water is released from Graham Dam for peaking operation, which occurs daily for 2 to 4 hours during the summer, 6 to 8 hours in winter, and up to 24 hours during high flows in the spring and fall. Because of the daily fluctuating water levels in the back water area, this area provides minimal habitat for aquatic biota, waterfowl, and shorebirds.

According to the Maine Historic Preservation Commission (SHPO) in an April 8, 1991 letter to the Commission, there are no known structures of historic or archeological significance within the project area. But because the project area has not been surveyed by a professional archaeologist, and the general topographic setting is likely to have attracted prehistoric settlement, the SHPO is recommending that an archeological survey be conducted.

Anadromous Fish

The Union River is included in plans for restoration of the Atlantic salmon under direction of the Atlantic Sea Run Salmon Commission (ASRSC). Until recently, the ASRSC managed the Union River with a goal to produce up to 250 adult salmon broodstock a year and to support a limited sport fishery below Ellsworth Dam. The ASRSC owns a fish-trapping facility at the base of Ellsworth Dam. Adult salmon trapped at the facility were used as broodstock at the Green Lake and Craig Brook National Fish Hatcheries. Because of the low rate of return of salmon at Ellsworth Dam and budget constraints, the ASRSC announced in September 1991 that it has discontinued active involvement in the Union River program.

The Maine Department of Marine Resources (DMR), the ASRSC, and the City of Ellsworth conduct an alewife trapping and trucking operation at the Ellsworth Project. Alewife are trapped below the Ellsworth Dam and trucked upstream to Graham Lake, the 9,025-acre impoundment formed by Graham Lake Dam. Graham Lake is located 4 miles upstream of Ellsworth Dam. Alewife produced in Graham Lake migrate downstream during May and June through the outlet gates at Graham Lake Dam, into Leonard Lake, the 125-acre lake formed by Ellsworth Dam, and through the outlet gates at Ellsworth Dam into the tidal portion of the Union River.

The DMR's goal is to maximize alewife production in Graham Lake to support a commercial harvest. During the 1980's, harvest

numbers below Ellsworth Dam ranged from a low of 4,700 in 1983 to a high of 1,026,200 in 1986. Numbers of trucked alewife ranged from a low of 4,560 in 1983 to a high of 22,200 in 1981.

Threatened and Endangered Species

Bald eagles, a federally listed endangered species, nest at two locations on Graham Lake, 3.5 and 6.5 miles from Graham Dam. During field investigations at Graham Lake and along the Union River from Graham Dam to the Union River estuary, eagles have been observed flying along the river, but not feeding. Eagles have been observed feeding in the estuary, about 4 miles downstream of the Graham Lake Dam. No observations of eagles feeding immediately below Graham Dam have been made.

F. ENVIRONMENTAL IMPACTS

The instream activities associated with installation and removal of cofferdams proposed for the construction of the new flood control structure would cause short-term turbidity in the Union River. Proposed construction would also cause the permanent removal of about 1.4 acres of wetlands, about 1 acre of intermittent back-water habitat, and 1.5 acres of predominately disturbed land.

Construction laydown of the area adjacent to the construction site would cause a minor short-term adverse effect on the limited vegetation and wildlife resources. Construction effects on alternative laydown sites are expected to be similar to those for the proposed site since similar sites (i.e., open fields with limited shrubs and trees) would likely be selected. The construction laydown site would be restored immediately following completion of construction. A minor short-term adverse visual effect on the area residents that use the adjacent state Route 180 for access would occur during construction.

G. ISSUES AND RECOMMENDATIONS

Alternatives to the proposed action

Interior, in a May 13, 1991 letter, comments that structural and operational alternatives to the proposed action should have been considered. Interior's suggested alternatives include replacing the existing dam in its present location; modifying the existing drawdown of Graham Lake; and permanently maintaining the lake at a lower level to increase the ability to capture runoff and prevent overtopping of the dam.

The licensee indicates that its final selection of remedial measures to upgrade the dam to safely pass the inflow design flood was based on a detailed comparison of various options. It maintains that its proposal was the best option for addressing the dam safety concerns. The licensee states that replacing the dam in its present location would have greater environmental effects and would cost over \$3 million more than its proposal.

The licensee states that modifying the existing drawdown would provide additional reservoir capacity to accommodate smaller inflow events but not necessarily larger inflows that are likely to occur periodically at the project. Because the existing outlet gates allow limited discharge capacity, large inflow events would result in rapid filling of the lake, overtopping of the dam, and possible dam failure. The suggested changes to Graham Lake's operating mode would adversely impact the storage capacity of the lake, reducing the value of the project as a peaking source of energy to the licensee's system and customers.

The licensee's proposal to construct a flood control structure immediately downstream of the existing structure is environmentally, economically, and engineeringly superior to the alternative suggested by Interior. Replacing the existing dam at the present location has environmental impact at least as great as the licensee's proposal and would be significantly more costly. Modifying the existing drawdown of Graham Lake or permanently maintaining the lake at a lower level would not provide the necessary protection during high flows. Further, permanent maintenance of the lake at a lower level and the resultant reduction in project operation would be contrary to the finding in the project's license order of December 28, 1987 (41 FERC 62,304) that the project would be best adapted to comprehensive development of the waterway for beneficial public uses.

Fish Passage and Migration

Interior recommends that the Commission not take final action on the amendment until resolution of the fish passage plan required by article 406 of the license. Further, Interior suggests seasonal construction restrictions and other measures to limit erosion, sedimentation, and high levels of turbidity during peak periods of fish migration.

The licensee objects to Interior's recommendation to withhold action on the amendment pending resolution of the fish passage plan. Also, the licensee responds that construction work would not adversely affect downstream passage of alewives since alewives approach the Graham Lake Dam from upstream and construction activities would not affect waters upstream of the dam.

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Implementation of remedial measures at the Graham Lake Dam would not preclude resolution of fish passage measures, if required. Any required fish passage facility would be installed at the existing outlet structure, which is separate from the proposed new facility. Further, by letter dated November 6, 1991, the Commission requested that the licensee revise its fish passage plan and schedule with consideration given to the subject amendment and recent fishery management developments in the basin with respect to Atlantic salmon. A response is due in May 1992. Although the fish passage plan has not been revised, implementation of proposed remedial measures with this amendment would not preclude the installation of fish passage facilities concurrent with construction of the new flood control structure or at a later date.

Construction of the proposed flood control structure would occur in the dry, generally precluding sedimentation and turbidity effects on Graham Lake and the downstream Union River. The construction site will be separated from the Union River by a series of temporary cofferdams to be installed along the western shore prior to construction. The cofferdams will consist of about 100 feet of braced sheetpile, 200 feet of sheetpile cells, and 400 feet of riprapped earthen embankment. The sheetpile cofferdams will extend downstream and parallel to the river to protect the construction site from the erosive flows downstream of the Graham Lake outlet gates. The sheetpile cofferdams will be constructed within the Union River; the riprapped embankment will be located partially in a backwater area of the Union River, and will connect the sheetpile cellular cofferdams to the above-water western shore at about the 90-foot mean sea level elevation. The embankment cofferdam will be riprapped to protect the cofferdam from up to a 10-year flood.

In addition to the cofferdams, a series of drainage control measures and sedimentation basins will be installed within the construction site to control seepage waters and rainfall. These facilities will be designed to handle the 10-year frequency, 24-hour duration storm. Sedimentation basins will be designed to provide an overall detention period of at least 24 hours, and will be equipped with an outlet pipe to discharge clarified water directly to the river.

While the proposed cofferdams would protect water quality during construction, installation and later removal of the

cofferdams, however, would increase turbidity levels in the Union River downstream of Graham Lake Dam. Adams and Fawcett (1989) found that migration of juvenile alewives occurs during periods of increased flow rates and relative decreases in water temperature and that increases in turbidity may act as a visual or chemical stimulus to initiate migratory activity. They also

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found the majority of juveniles migrate prior to the end of July. While there is no information available relating turbidity levels with migratory behavior of juvenile alewives, it is not expected that short term turbidity spates that may result from cofferdam installation or removal would have a noticeable effect on outmigration of juvenile alewives in the short reach of the Union River below the construction site. The licensee's erosion and sedimentation control plan is adequate to minimize construction-related turbidity events and eliminate any possible effects toward outmigrating juvenile alewives.

Bald eagles

Interior comments that there is active bald eagle nesting on Graham Lake in the project area, and that bald eagles use the area below Graham Lake, particularly for feeding. Interior also states that project construction could affect eagles and that possible seasonal restrictions in construction activities may be needed to avoid adverse effects on eagles.

The licensee responds that the bald eagle nesting territory nearest to the project dam site is 3.5 miles away; a second nest is located 6.5 miles away. Further, the licensee states that a preliminary review by the Maine Department of Inland Fisheries (MDIF) did not identify the immediate Graham Lake Dam area as a feeding area for bald eagles. Eagles have been observed flying along the Union River below the dam, but not feeding. The only observed eagle feeding has been in the Union River estuary, several miles downstream of the dam.

The noise produced by equipment and other construction-related activities at the proposed development site adjacent to Graham Lake Dam would not have an adverse effect on bald eagles. The eagle nest, located 3.5 miles from the site, and eagle feeding area, located 4 miles downstream, are located at sufficient distances to protect the eagles from the effects of construction.

Wetlands

Interior states that the proposed development would cause the removal and disturbance of several acres of wetlands. Because of the wetland effects, Interior expressed concern that no precise calculation of loss had been made, and that mitigation had not been addressed. Further, Interior states that in order to satisfy the President's policy calling for "no net loss in wetlands", the U.S. Army Corps of Engineers and the Commission must strive to minimize impacts and provide full compensation for unavoidable losses.

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The licensee responds that, although it has not been able to access the site, it has calculated from aerial photos that approximately 1.4 acres of wetlands would be permanently impacted, and another 1 acre would be temporarily impacted during construction. To minimize the amount of wetland removal, the licensee has reduced the size of the flood control structure and cofferdams to the extent allowable by federal safety standards and sound engineering practices. Further, the licensee proposes to restore the wetlands impacted by the cofferdam, but does not propose to develop final mitigation plans until after it obtains access to the area. The licensee does not propose additional mitigation of wetland impacts through compensation.

Wetlands provide habitat valuable to fish and wildlife resources. Impacts to wetlands should be avoided or minimized if possible, and unavoidable impacts mitigated. The licensee's attempts to minimize the removal of wetlands to the extent possible, and its proposal to restore impacted wetlands after completion of construction are acceptable. Although the licensee does not propose to compensate for the 1.4-acre loss of wetlands, the licensee should be required to compensate for the loss of this wetland area. The licensee should, therefore, develop a restoration and compensation plan to mitigate for impacts to wetlands from construction of the proposed flood control structure.

Archeological resources

The SHPO has recommended that the project area be surveyed by a professional archaeologist, since the area has not been surveyed and the topographic setting is likely to have attracted prehistoric settlement.

Article 407 of the license requires that the licensee, before starting any land-clearing or land-disturbing activities

within the project boundaries, other than those activities specifically authorized in the license, consult with the SHPO and file a cultural resources management plan, prepared by a qualified cultural resource specialist. In order to provide protection for any undiscovered archeological resources in the project area, the licensee should have the proposed construction site and laydown area surveyed by a professional archaeologist and should prepare a cultural resources management plan if significant archeological resources are found. Further, if any new historic or archeological properties are found during the course of construction, article 407 requires that the licensee stop all land-clearing and land-disturbing activities in the vicinity of the properties, consult with the SHPO, and file with the Commission a cultural resource management plan, prepared by a qualified cultural resource specialist.

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H. CONCLUSIONS

The licensee should be authorized to make the proposed remedial modifications to safeguard human life and property downstream of Graham Lake Dam. Approval of the proposed amendment, with the mitigative measures proposed by the licensee and staff, would not constitute a major federal action significantly affecting the quality of the human environment.

I. LITERATURE CITED

Adams, D. and R. Fawcett. 1989. The timing of seaward migration by juvenile alewives (*Alosa pseudoharengus*) in coastal New Concord, NH.

Prepared by Patrick K. Murphy, Wildlife Biologist
Robert Grieve, Fishery Biologist

86 FERC ¶62,221

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Bangor Hydro-Electric Company)

Project No. 2727-057

ORDER AMENDING LICENSE

MAR 22 1999

On November 19, 1998, Bangor Hydro-Electric Company (Bangor), licensee for the Ellsworth Project (FERC 2727) filed an application to amend its license. 1/ The Ellsworth Project is located on the Union River, in Hancock County, Maine.

BACKGROUND

Bangor filed the application to amend its license to correct the project description, revise exhibit A, and change the project boundary to exclude land underlying a substation not a part of the project.

Ordering paragraph (B)(2)(g) of the license states that the project has three 2.3/34.5-kV transformers. Page A-5 of exhibit A, approved as part of the license, states that the project includes three 3,333kVA, single phase 2.3kV to 34.5 kV transformers. The project actually has a single three-phase 2.3-kV to 34.5-kV transformer.

Bangor also requests that pages A-10 through A16 of exhibit A be deleted and that pages identified as A10R, A114, A12R and A13R of the application to amend, attachment H, be substituted for the deleted pages.

Also, Bangor proposes to modify the project boundary by removing part of the project land underlying a 34.5-kV substation on a hill to the southwest of the project's powerhouse.

REVIEW

The project description in ordering paragraph (B)(2)(g) will be revised to correct the description of the transformers. Page A-5 of exhibit A will be corrected to reflect the single, three phase transformer. Pages A-10 through A-16 will be deleted from exhibit A. Pages A-10R, A-11R, A-12R and A-13R of the amendment application, attachment H, describing the operating equipment for the project will be approved as part of the license.

1/ 41 FERC ¶62,304 Order Issuing New License issued December 28, 1987.

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FERC - DOCKETED

MAR 22 1999

Project No. 2727-057

-2-

The licensee must file revised exhibit G drawings for approval showing the course and distance of the revised project boundary.

The Director orders:

(A) The license for the Howland Project, FERC Project No. 2721 is amended as described below effective the issuance date of this order.

(B) The project description given in ordering paragraph (B)(2) of the license is revised to read as follows:

Project works consisting of (a) Graham Dam, an earthfill dam with concrete core walls, about 750 feet long and 30 feet high and having a gated concrete spillway; (b) Graham Lake, a reservoir extending approximately 15 miles above Graham Dam having a surface area of 12,200 acres at normal water surface elevation 104.2 feet U.S.G.S. datum; (c) Ellsworth Dam, a concrete buttress dam located about 4 miles downstream of Graham Dam, approximately 377 feet long and 60 feet high with 26-inch-high flashboards on the spillway; (d) Lake Leonard, a forebay reservoir extending approximately 1 mile above Ellsworth Dam and having a surface area of 125 acres at normal water surface elevation 66.67 feet U.S.G.S. datum; (e) a reinforced concrete and concrete block masonry powerhouse containing one 2,500-kW generating unit, two 2,000-kW generating units, and one 2,400-kW generating unit; (f) the generator leads; (g) a three phase 10/11.2 MVA 2.3/34.5-kV step-up transformer; (h) the 34.5-kV transmission line connecting the step-up transformer to the 34.5-kV bus of the Ellsworth substation; and (i) appurtenant facilities.

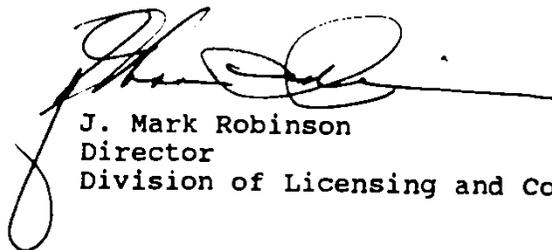
(C) Pages A-10 through A16 of exhibit A are deleted and pages A-10R, A-11R, A-12R, and A-13R of the amendment application, attachment H, are approved as part of the license.

(D) Within 90 days of the date of this order the licensee shall file for Commission approval, revised exhibit G drawing(s) showing the revised project boundary, and describing the course and distance for the revision to project boundary.

Project No. 2727-057

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(E) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. § 385.173.

A handwritten signature in black ink, appearing to read "J. Mark Robinson", is written over the typed name and title. The signature is fluid and cursive, with a long horizontal stroke extending to the right.

J. Mark Robinson
Director
Division of Licensing and Compliance

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Bangor Hydro-Electric Company)

Project No. 2727-057

ERRATA NOTICE

ORDER AMENDING LICENSE
(Issued March 22, 1999)

The order amending license issued March 22, 1999, in ordering paragraph (A) used the incorrect project name and number, Howland FERC Project No. 2721. This errata notice corrects ordering paragraph (A) to read:

"The license for the Ellsworth Project, FERC No. 2727 is amended as described below effective the issuance date of this order."


J. Mark Robinson
Director
Division of Licensing and Compliance

9904130139-3

FERC - DOCKETED
APR 9 1999

98 FERC ¶ 62,076

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Penobscot Hydro, LLC
PPL Maine, LLC

Project Nos. 2403-028, 2534-040
2666-016, 2710-022
2712-032, 2721-018
2727-067 & 10981-006

ORDER AMENDING LICENSES¹

(Issued October 31, 2000)

Penobscot Hydro, LLC² has requested that its licenses for the Veazie Project, FERC No. 2403,³ Milford Project, FERC No. 2534,⁴ Midway Project, FERC No. 2666,⁵ Orono Project, FERC No. 2710,⁶ Stillwater Project, FERC No. 2712,⁷ Howland Project, FERC No. 2721,⁸ Ellsworth Project, FERC No. 2727,⁹ and the Basin Mills Project, FERC No. 10981,¹⁰ be amended to reflect its new name PPL Maine, LLC. The licensee

¹To reflect new name of licensee.

²On April 1, 1999, the Commission issued an Order Approving Transfer of Licenses for seven hydroelectric projects from Bangor Hydro-Electric Company to Penobscot Hydro, LLC (87 FERC ¶ 62,001).

³83 FERC ¶ 61,040 (1998).

⁴83 FERC ¶ 61,037 (1998).

⁵6 FERC ¶ 61,287 (1979).

⁶The Orono Project license expired on September 26, 1990. The relicense application for the Orono Project (part of the Basin Mills Project, FERC No. 10981 proposal) was issued on April 20, 1998 (83 FERC ¶ 61,039).

⁷83 FERC ¶ 61,038 (1998).

⁸12 FERC ¶ 62,207 (1980).

⁹41 FERC ¶ 62,304 (1987).

¹⁰On April 20, 1998, the Commission issued an Order on Applications for New
(continued...)

001101-02903

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Project No. 2403-028, *et al.*

-2-

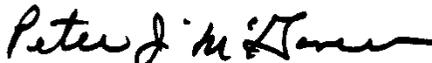
states that there is no change in the legal entity that is the licensee, and this is a change in name only. Project Nos. 2403, 2534, 2710, and 2712 are located on the Penobscot River, in Penobscot County, Maine, between the towns of Veazie and Old Town. Project No. 2666 is located on the Penobscot and Stillwater Rivers in Penobscot County, Maine. Project No. 2721 is located on the Piscataquis River in Penobscot County, Maine. Project No. 2727 is located on the Union River in Hancock, Maine.

The name change does not affect the licensee's qualifications to be a licensee under the Federal Power Act. The request to approve a change in the name of the licensee will, therefore, be approved.

The Director orders:

(A) The licenses for the for the Veazie Project, FERC No. 2403, Milford Project, FERC No. 2534, Midway Project, FERC No. 2666, Orono Project, FERC No. 2710, Stillwater Project, FERC No. 2712, Howland Project, FERC No. 2721, and the Ellsworth Project, FERC No. 2727 are amended to change the licensee's name from Penobscot Hydro, LLC to PPL Maine, LLC.

(B) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. § 385.713.


Peter J. McGovern
Division of Hydropower
Administration and Compliance

¹⁰(...continued)

and Original Licenses, which among other things, denied the license application of Bangor Hydro-Electric Company (Bangor) for the Basin Mills Project No. 10981 (83 FERC ¶ 61,039). Bangor filed for rehearing and also requested that Penobscot Hydro, LLC be substituted for Bangor in the rehearing proceeding. On June 9, 1998, the Commission issued an Order Granting Rehearing For Further Consideration (Unpublished). Subsequently, the licensee and other parties filed a joint request asking the Commission to delay issuing its order on rehearing until or after February 2, 2001. As the Commission has not acted on the substitution request for Basin Mills Project No. 10981, we cannot act on the amendment request as it relates to this project.

UNITED STATES OF AMERICA 100 FERC ¶ 62,209
FEDERAL ENERGY REGULATORY COMMISSION

PPL Maine, LLC

Project No. 2727-066

ORDER AMENDING LICENSE

(Issued September 27, 2002)

On August 7, 2000, PPL Maine, LLC (PPL Maine or licensee) and the U.S. Department of the Interior (Interior) jointly filed a Comprehensive Fishery Management Plan for the Union River Drainage (management plan). PPL Maine and Interior state that they are filing this plan pursuant to Article 406 of PPL Maine's license for the Ellsworth Project No. 2727, located on the Union River in Hancock County, Maine. The licensee and Interior request that the Commission rescind its 1994 approval of an earlier upstream fish passage plan filed pursuant to Article 406 and approve the management plan in its stead. They also request that the Commission delete the current Article 406 from the project license and substitute a new Article 406 requiring the licensee to comply with those provisions of the management plan that are applicable to it and reserving the Commission's authority to require future prescribed fishways.

Because the management plan represents the current approach for the management of fisheries, including fish passage, in the Union River, the licensee's responsibilities under the management plan now constitute a more appropriate response to fish passage needs at the project than do the requirements of Article 406. Accordingly, Article 406 will be modified to reflect the licensee's responsibilities specified in the management plan, as described below.

BACKGROUND

The Ellsworth Project consists of an upper and a lower impoundment. Ellsworth Dam impounds Lake Leonard and, four miles upstream, Graham Dam impounds Graham Lake. There is a powerhouse at Ellsworth Dam.

In the early 1970's, a fish trap was constructed just below Ellsworth Dam. The trap was cooperatively funded by the U.S. Fish and Wildlife Service (FWS), the Maine Atlantic Sea run Salmon Commission, and Bangor Hydroelectric Company. The trap

Project No. 2727-066

was used to collect Atlantic salmon for brood stock and restoration stocking, and to collect alewives for harvest as lobster bait and transport of a spawning escapement to Graham Lake.¹

On April 12, 1977, the Commission issued an initial license for the project to Bangor Hydro-Electric Company (Bangor).² In that license, the Commission required fish passage facilities at Graham Dam along with assurances that the fish trap at the Ellsworth Dam would remain operational. However, no fish passage facilities were constructed during the term of that license.

A new license for the project was issued on December 28, 1987.³ Article 406 of the new license required Bangor to develop a plan and schedule for fish passage installation, consistent with any prescription made by the Secretary of the Interior pursuant to Section 18 of the Federal Power Act (FPA).⁴ The plan was required to include functional design drawings, flow quantifications, construction and operation schedules, monitoring program descriptions, and provisions for maintaining the collection of Atlantic salmon broodstock, to include modifications to and operation of the existing fish collection facilities. However, by order issued July 29, 1988, the Director, Division of Project Compliance and Administration (Director) revised the article to permit modifications to the existing trap facility so that it could serve as an interim upstream passage facility for at least five years.⁵

On January 3, 1989, Bangor filed a plan and schedule under Article 406. The plan proposed extensive reliance on trap and truck operations, with fish passage facilities to

¹The trap is owned by the Maine Atlantic Salmon Commission (MASC), which has an access agreement with the licensee. The MASC leases harvest /operating rights to the City of Ellsworth.

² 58 FPC 212 (1977).

³ 41 FERC ¶ 62,304 (1987).

⁴Under Section 18, the Commission must require the construction, operation, and maintenance of any fishways prescribed by the Secretaries of the Interior or Commerce. In an October 14, 1987 letter, Interior reserved its authority to prescribe fishways at the project. See 41 FERC at p. 63,751.

⁵44 FERC ¶ 62,080.

20020927-3042 Received by FERC OSE~~3~~₆_09/27/2002 in Docket#: P-2727-066

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be constructed only as Atlantic salmon runs increased. In comments on the plan, Interior's Fish and Wildlife Service (FWS) stated that it could not support any plan which relied on the extended use of trap and truck operations instead of fishways at the two dams, and that its comments should be construed as an exercise of Interior's Section 18 prescription authority. In a November 6, 1991 letter, the Director required Bangor to modify its plan to reflect a recent fishery management decision to discontinue the Union River salmon program and Interior's insistence that fish passage facilities be constructed regardless of whether salmon runs reached the levels specified in the plan.

On May 4, 1992, Bangor filed a revised plan, which, however, again proposed to delay the construction of upstream fish passage facilities until certain specified salmon runs were achieved. Bangor also indicated that, in 1989, it had constructed downstream fish passage facilities at Ellsworth Dam. Noting that the revised plan still failed to conform to Interior's prescription, which the Commission was required to respect, the Director, in a February 16, 1994 order, modified the plan to require the filing of detailed design drawings for proposed fish passage facilities at Ellsworth and Graham Dams and a schedule for their installation, in conformance with Interior's prescription, and pursuant to Article 406. The Director approved the plan with these modifications.⁶

The Commission denied rehearing of the Director's order,⁷ and Bangor submitted the required design drawings and construction schedules, which the Director approved.⁸ However, Bangor also petitioned the U.S. Court of Appeals for the District of Columbia for review of the Director's order modifying and approving the fish passage plan and the Commission's order on rehearing. On Bangor's request, the Commission stayed, pending completion of the court proceedings, the requirement that Bangor proceed with the

⁶ 66 FERC ¶ 62,079 (1994). The Director also required Bangor to file drawings of the downstream passage facilities at Ellsworth Dam, since those facilities had yet to be approved by the Commission as part of the overall fish passage plan. 66 FERC at pp. 64,255-56.

⁷70 FERC ¶ 61,078 (1995).

⁸70 FERC ¶ 62,043 (1995).

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installation of the fish passage facilities in accordance with the approved schedules.⁹ On March 15, 1996, in Bangor Hydro-Electric Company v. FERC, the court of appeals found that Interior had not provided reasonable support for its fishway prescription and vacated the Commission's orders requiring compliance with the prescription.¹⁰

After the court decision, Bangor, FWS, state fishery agencies, and other interested entities (collectively the Union River Stakeholder Group (stakeholders))¹¹ began discussions to resolve the upstream fish passage issues at the project and to manage the fishery resources in the Union River drainage. After the license was transferred to PPL Maine, PPL Maine replaced Bangor as a participant.¹² Those discussions resulted in the management plan, as described below.

THE MANAGEMENT PLAN

It was the intention of the stakeholders, in developing the management plan, to develop a comprehensive, biologically-based plan to support future decisions on fishery management in the Union River, including a commitment to install permanent fish passage facilities at the Ellsworth Project. The stakeholders agreed that the management plan would identify agency goals for diadromous and resident fisheries populations, would describe the various tasks and responsibilities related to the restoration and management of those fisheries resources, and would serve as the basis for decisions on long-term fish passage measures at the project.

⁹70 FERC ¶ 61,216 (1995).

¹⁰ 78 F.3d 659 (D.C. Cir. 1996).

¹¹ Stakeholders include PPL Maine, FWS, Maine Department of Marine Resources, Maine Department of Inland Fisheries and Wildlife, Maine Atlantic Salmon Commission, City of Ellsworth, Maine Council of the Atlantic Salmon Federation, Union Salmon Association, and (unspecified) interested members of the public.

¹² In April 1999, the Commission issued an order approving the transfer of the project license from Bangor to Penobscot Hydro, LLC (87 FERC ¶ 62,001), now PPL Maine, LLC (93 FERC ¶ 62,076).

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The management plan consists of a description of the Union River drainage, its fishery resources, the status of its diadromous and resident fish populations, management goals and objectives for the drainage, and recommended measures and activities to be implemented by a Union River Fisheries Coordinating Committee (URFCC). The management plan identifies issues that must be addressed through studies and other activities, including potential conflicts between restored and resident fish populations, in order to accomplish identified management objectives. The management plan initially focuses on fish restoration for the period 2000-2005, with the understanding it will be reviewed and adjusted annually.

The management plan's overall goal is to manage all sport and commercial fish species in the Union River drainage for optimum habitat utilization, abundance, and public benefit. To accomplish this, the stakeholders divided the watershed into six subdivisions and developed objectives for each subdivision. For the initial 2000-2005 period, the management plan focuses on the development of self-sustaining runs of river herring (alewife and blueback herring) and Atlantic salmon above Ellsworth Dam. Returning adults will be collected and transported into suitable habitat along with stocking of juvenile, hatchery-reared salmon. The optimum river herring escapement at the project, the locations, quantity, quality, and accessibility of Atlantic salmon habitat, and the effectiveness of the existing interim upstream fish passage measures (that is, the trap and truck operation) at the project in accommodating current and projected fish runs, including American eels, will be determined.

Actual studies and activities are proposed to be carried out by the licensee, the FWS, and the Maine state fishery agencies under the supervision of the URFCC. The licensee will be responsible for convening the URFCC, running its meetings, and preparing its reports. In addition, the licensee will be responsible for operating the existing upstream fish passage facilities at the project and providing the resources to achieve an initial annual escapement of 100,000 alewife spawning escapement into Graham Lake. The licensee will also continue to operate existing downstream fish passage facilities.

The management plan is proposed to serve as the interim fish passage plan at the project until sufficient information is developed from the studies and activities outlined in the management plan to allow for resolution of the issue of permanent upstream fish passage measures at the project.

Project No. 2727-066

DISCUSSION

From the time of the issuance of the new license through the Bangor court decision, efforts to implement fish passage at the project pursuant to Article 406 have been marked by the disagreement between the licensee and Interior about the need for, and the timing of the installation of, upstream fish passage facilities of a permanent nature. The licensee's position has been, essentially, that runs of Atlantic salmon and alewives in the Union River have not yet developed to the point that trap and truck operations are insufficient, and that it should not have to undergo the significant expenditures that would be required to install permanent fishways before a need for such facilities is shown. Interior has insisted on limited reliance on trap and truck and on the earlier construction of fishways.

The management plan resolves that disagreement, in that it provides for the operation of existing fish passage facilities and measures until studies conducted under the management plan determine the need for permanent fish passage facilities. The management plan indeed goes beyond the specific issue of fishway types and construction timing by addressing overall fisheries management in the basin. Among other things, the management plan will provide an increase in the escapement of alewives to Graham Lake, an evaluation of the efficacy of achieving restoration goals using a stocking rate of 100,000 alewives, and an assessment of whether there are conflicts between the numbers of alewives stocked in Graham Lake and the lake's smallmouth bass fishery. In addition, the management plan addresses restoration of Atlantic salmon, blueback herring, American eel, and other migratory fishes, interim and permanent fish passage, and management strategies for resident fishes throughout the Union River basin. In light of the management plan's potential for resolving fish passage and management issues, as well as the long-standing dispute between the licensee and Interior, it would be in the public interest to require the licensee's adherence to the pertinent provisions of the management plan.

The licensee and Interior request rescission of the Director's approval of the 1992 plan filed under Article 406. Because the court in Bangor vacated the Director's order modifying and approving the plan, and the Commission order affirming it, no further action with regard to that plan is necessary. The licensee and Interior request that the management plan be approved in lieu of the 1992 plan. The management plan encompasses fishery management directives for areas outside the project and establishes responsibilities of entities other than the licensee. Because the Commission cannot

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require actions by any other such entities, approval of the entire management plan goes beyond the scope of the Commission's authority.

Nevertheless, it is possible to accomplish essentially what the licensee and Interior seek. They request that present Article 406 be replaced by a new Article 406 that requires the licensee to comply with the provisions of the management plan that are applicable to it. Since Article 406, as now worded, requires the filing of functional design drawings, construction schedules, and monitoring plans for fish passage facilities whose construction the licensee and Interior now agree should be deferred, the present Article 406 requirements do not reflect the revised approach to managing the Union River fishery, as determined by the fishery agencies in the management plan. Therefore, replacement of the existing Article 406 by a new article as described by the licensee and Interior would reflect the changed fishery goals and would be an appropriate method of implementing the licensee-related provisions of the management plan.

The parties request that the new Article 406 require the licensee to comply with the directions of the URFCC pertaining to fish passage measures at the project, to the extent that such compliance would not be inconsistent with the requirements of the FPA and the rules, regulations, and orders of the Commission. Article 406 will require the licensee to comply with these directions, as requested, but any directions to construct or install new project fish passage facilities would necessitate an application to amend the license.¹³ To avoid uncertainty about the scope of the licensee's responsibilities under the revised article, the article will, insofar as practical, specify those particular responsibilities of the licensee that are set out in the management plan. This will include a requirement to maintain and continue operating existing upstream and downstream fish passage facilities or measures at the project.

The parties request that the Commission reserve its authority to require the licensee to construct, operate, and maintain, or to provide for the construction, operation, and maintenance of, such upstream fishways as the Secretary of the Interior might prescribe under Section 18 of the FPA. The right of Interior to prescribe fishways in the future was, in effect, observed in Article 406 through the article's requirement that the

¹³Since requiring such compliance cannot be construed as authorizing actions that would be inconsistent with the FPA, Commission regulations, or other Commission requirements, there is no need to specify this reservation in the revised article.

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licensee's fish passage plan be consistent with any prescription made by Interior. Moreover, the understanding that the present fish passage measures at the project are only interim measures and that circumstances might eventually require the substitution of permanent upstream fishways is central to the management plan to which the licensee and Interior have agreed. Therefore, the revised Article 406 will reserve the Commission's authority to require fishways in the future.

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The Director orders:

(A) Article 406 of the license for the Ellsworth Project is revised to read:

The licensee shall comply with those provisions of the Comprehensive Fishery Management Plan for the Union River Drainage (Plan), prepared by the Union River Stakeholder Group and filed with the Commission on August 7, 2000, that pertain to the restoration of anadromous and catadromous fishes and their effects on resident fishes within the lower reaches of the Union River up to, and including Graham Lake and its environs during the five-year period, 2000-2005. The provisions shall include, but not be limited to: (1) evaluating impacts of stocking 100,000 alewives in Graham Lake on smallmouth bass; (2) determining annual alewife escapement needed at the Ellsworth Dam to achieve stated restoration goals for the Union River; (3) collecting and updating information on anadromous Atlantic salmon habitat in the Union River drainage; and (4) evaluating upstream and downstream fish passage needs at the Ellsworth Project and determining the need for additional fish passage for American eel.

During the period, 2000-2005, the licensee shall be responsible for convening the Union River Fisheries Coordinating Committee (URFCC), as identified in the Plan, running its meetings and preparing its reports. The licensee shall comply with the directions of the URFCC as to fish passage measures at the project and shall file an application for amendment of this license when those directions require the construction or installation of additional fish passage facilities. The licensee shall be responsible for operating the existing upstream and downstream fish passage facilities at the project in accordance with the provisions of the Plan and providing the resources to achieve an initial annual spawning escapement of 100,000 alewife into Graham Lake.

Because the Plan is proposed to serve as the interim fish passage plan at the project until sufficient information is developed from the studies and activities outlined in the Plan to allow for resolution of the issue of permanent upstream fish passage measures at the project, the licensee shall also be responsible for providing to the Commission annual reports on the progress towards those goals and for resolution of the permanent fish passage issue at the project. The licensee shall file annual progress reports by March 1 of 2003, 2004, and 2005, with a final report due by March 1, 2006. Each report shall outline progress towards meeting

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the goals of the management measures implemented the previous year and proposed activities for the following year. The final report shall contain management measures and activities proposed under the Plan for the following 5-year period.

The Commission reserves the right to require changes to the licensee's responsibilities under the Plan as appropriate after review of each of the annual progress reports or the final progress report, to include the operational schedule and handling protocol for fish trapping at the project.

Authority is reserved to the Commission to require the licensee to construct, operate, and maintain, or to provide for the construction, operation, and maintenance of, such fishways, as may be prescribed by the Secretary of the Interior under Section 18 of the Federal Power Act.

(B) The licensee shall file an original and eight copies of any filing required by this order with:

The Secretary
Federal Energy Regulatory Commission
Mail Code: DHAC, PJ-12.3
888 First Street, N.E.
Washington, D.C. 20426

(C) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. § 385.713.

George H. Taylor
Chief, Biological Resources Branch
Division of Hydropower Administration
and Compliance

20020927-3042 Received by FERC OSE on 09/27/2002 in Docket#: P-2727-066

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Project No. 2727-066

128 FERC ¶ 62,212
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

PPL Maine, LLC	Project Nos. 2727-085
Black Bear Hydro Partners, LLC	2666-032
	2534-091
	2710-053
	2712-072

ORDER APPROVING TRANSFER OF LICENSE

(Issued September 17, 2009)

1. By application filed July 24, 2009, PPL Maine, LLC (transferor) and Black Bear Hydro Partners, LLC (transferee) seek Commission approval to transfer the licenses for the Ellsworth Project No. 2727, the Medway Project No. 2666, the Milford Project No. 2534, the Orono Project No. 2710, and the Stillwater Project No. 2712, from transferor to transferee. The Ellsworth Project is located on the Union River near the city of Ellsworth. The Medway Project is located on the West Branch Penobscot River near the city of Medway. The Milford Project is located on the Penobscot River near the city of Old Town. The Orono and Stillwater Projects are located on the Stillwater Branch of the Penobscot River near the city of Orono. The Ellsworth Project is located in Hancock County, Maine and all other projects included in this application are located in Penobscot County, Maine.

2. Public notice of the application was issued on August 5, 2009, setting September 4, 2009, as the deadline for filing comments, protests, and motions to intervene. No comments, protests, or motions to intervene were filed.

3. Transferee has agreed to accept all of the terms and conditions of the licenses and to be bound by the licenses as if it were the original licensee.

4. Transferor has generally complied with the terms and conditions of the license and agrees to pay annual charges that have accrued to the date of the transfer. Transferee will be required to comply with the requirements of the license as though it were the original licensee. Transfer of the licenses for these projects is consistent with the Commission's regulations and is in the public interest.

The Director orders:

(A) Transfer of the licenses for the Ellsworth Project No. 2727, the Medway Project No. 2666, the Milford Project No. 2534, the Orono Project No. 2710, and the

Project No. 2727-085 *et al.*

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Stillwater Project No. 2712 from PPL Maine, LLC to Black Bear Hydro Partners, LLC is approved.

(B) PPL Maine, LLC shall pay all annual charges that accrue up to the effective date of the transfer.

(C) Approval of the transfer is contingent upon: (1) transfer of title of the properties under license and delivery of all license instruments to Black Bear Hydro Partners, LLC, which shall be subject to the terms and conditions of the license as though it were the original licensee; and (2) Black Bear Hydro Partners, LLC acknowledging acceptance of this order and its terms and conditions by signing and returning the attached acceptance sheet. Within 60 days from the date of this order, the transferee shall submit certified copies of all instruments of conveyance and the signed acceptance sheet.

(D) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 CFR §385.713.

M. Joseph Fayyad
Engineering Team Lead
Division of Hydropower Administration
and Compliance

Project No. 2727-053 *et al.*

IN TESTIMONY of its acknowledgment of acceptance of all of the terms and conditions of this order, _____ this _____ day of _____, 20____, has caused its corporate name to be signed hereto by _____, its President, and its corporate seal to be affixed hereto and attested by _____ its Secretary, pursuant to a resolution of its Board of Directors duly adopted on the _____ day of _____, 20____, a certified copy of the record of which is attached hereto.

By _____

Attest:

Secretary
(Executed in quadruplicate)

20090917-3008 FERC PDF (Unofficial) 09/17/2009

Document Content(s)

P-2727-085.DOC.....1-3

**ATTACHMENT 5
FINAL LICENSE APPLICATION
DECEMBER 30, 2015**

December 30, 2015

VIA E-FILING

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

Ellsworth Hydroelectric Project FERC No. 2727-086
Application for New License for Major Water Power Project – Existing Dam

Dear Secretary Bose:

In accordance with 18 CFR § 5.18, the Licensee for the Ellsworth Hydroelectric Project, Black Bear Hydro Partners LLC (Black Bear or Licensee), respectfully submits for filing the *Application for New License for Major Water Power Project – Existing Dam for the Ellsworth Hydroelectric Project* (Application). The Application contains the information and Exhibits required by the pertinent Federal Energy Regulatory Commission (FERC) regulations and, with particular emphasis on the results from the Integrated Licensing Process (ILP), reflects the Licensee's strong commitment to maintain the developmental values of the Project, in particular the benefits provided to electric generation, while preserving and enhancing the non-developmental resources associated with the Project and its immediate surroundings for the foreseeable future. Notification via email that the application has been filed and a link to download associated electronic files through FERC's eLibrary are being provided to entities listed on the attached Service List.

Black Bear filed a Notice of Intent (NOI) and Pre-Application Document (PAD) for the relicensing of the Project on October 24, 2012 pursuant to the Commission's ILP rules, 18 CFR Part 5. A Proposed Study Plan (PSP) was filed with FERC on April 8, 2013. A Revised Study Plan (RSP) was filed with FERC on August 5, 2013 that contained modifications intended to address written comments provided by stakeholders. The Study Plan was approved with specific revisions by FERC in its Study Plan Determination (SPD) issued on September 4, 2013. An Initial Study Report (ISR) was filed with FERC on September 4, 2014. A Draft License Application (DLA) was filed on July 10, 2015. The Updated Study Report (USR) was filed with FERC on August 21, 2015. Stakeholder comments on the DLA were received by October 8, 2015. The responses to comments filed regarding the DLA are included in the Application.

The Ellsworth Project is located on the Union River, in Hancock County, Maine. The four turbine-generator units contained in the Ellsworth powerhouse have a total FERC-authorized nameplate capacity of 8.9 megawatt (MW). By definition, under FERC's regulations the project

Kimberly D. Bose, Secretary
Ellsworth Application for New License
December 30, 2015

is an existing dam that has a total installed capacity of more than 5 megawatts (18 CFR § 4.50). Accordingly, the accompanying application has been prepared in conformance with 18 CFR § 4.51. The contents of the Application include the following:

- Initial Statement
- Exhibit A – Project Description
- Exhibit B – Project Operation and Resource Utilization
- Exhibit C – Construction History and Proposed Construction Schedule
- Exhibit D – Statement of Costs and Financing
- Exhibit E – Environmental Report and Appendices
- Exhibit F – General Design Drawings and Supporting Design Report
- Exhibit G – Project Map
- Exhibit H – Description of Project Management and Need for Project Power

As part of the National Historic Preservation Act Section 106 consultation process and in accordance with 18 CFR § 4.32(b)(3)(ii), Black Bear is filing with the Commission under separate cover, the report *Phase II Archaeological Investigations of Precontact Period Sites: 58.29, 58.30 and 58.31 Leonard Lake - Ellsworth, Hancock County, Maine*, and a Draft Historic Properties Management Plan, which contain privileged cultural resources information and are only being provided to the Maine Historic Preservation Commission, representatives of the area Native American Tribes, and FERC.

In accordance with the Commission's Order No. 630 (68 FR 9857), Exhibit F, including the Supporting Design Report, contains Critical Energy Information (CEII) and is being submitted under separate cover for the Commission's non-public file. Exhibit F contains sensitive and detailed engineering information that, if used incorrectly, may compromise the safety of the Project and those responsible for its proper operation. Members of the public requesting CEII information for the Ellsworth Project must comply with the Commission's procedures for obtaining access to CEII as required under CFR § 388.113. All public requests for CEII should be made to the Commission's CEII Coordinator.

Also it should be noted that the Commission, over the course of reviewing and commenting on the study plans, ISR, USR, and DLA, and in its Determination on Requested Study Modifications (December 8, 2015) has either authorized, or required the continuance of, several studies into 2016. These studies include:

- Atlantic Salmon Smolt Downstream Passage Study, to be conducted in the spring of 2016;
- Graham Lake, Lake Leonard, and Union River Tributary Access Study, to be conducted in the summer/fall of 2016;
- Adult American Eel Downstream Passage Study (year two), to be conducted in the fall of 2016.

The Study Reports for the above studies are to be submitted to FERC by December 31, 2016.

Kimberly D. Bose, Secretary
Ellsworth Application for New License
December 30, 2015

If you have any questions regarding this filing, please contact me by phone at (207) 755-5603 or by email at Frank.Dunlap@BrookfieldRenewable.com.

Sincerely,

A handwritten signature in blue ink, appearing to read "Frank H. Dunlap". The signature is fluid and cursive, with a large, sweeping flourish at the end.

Frank H. Dunlap
Licensing Specialist

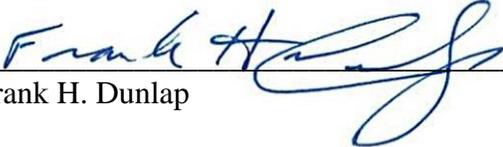
Attachment: Application for New License for the Ellsworth Hydroelectric Project No. 2727

cc: Distribution List
K. Maloney, Brookfield Renewable Energy Group
T. Wynn, Brookfield Renewable Energy Group

Distribution List
Ellsworth Application for New License
December 30, 2015

CERTIFICATE OF SERVICE
Ellsworth Hydroelectric Project (FERC No. 2727)
Final License Application

I, Frank H. Dunlap, Licensing Specialist, Brookfield Renewable Energy Group, hereby certify that a link to the foregoing document on the Commission website has been transmitted to the following parties on December 30, 2015.


Frank H. Dunlap

One copy, via e-filing to:
Ms. Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street N.E., Dockets Room
Washington DC 20426

Via email, or one copy on compact disk,
Regular mail, postage paid to:

Federal Agencies

John T. Eddins
Advisory Council on Historic Preservation
The Old Post Office
1100 Pennsylvania Ave NW Ste 809
Washington, DC 20004-2501

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Distribution List
Ellsworth Application for New License
December 30, 2015

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Distribution List
 Ellsworth Application for New License
 December 30, 2015

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Distribution List
Ellsworth Application for New License
December 30, 2015

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Lamoine, ME 04605

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Downeast Salmon Federation
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Columbia Falls, ME 04623

George Leinbaugh
Downeast Salmon Federation
P.O. Box 201
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Administrative Assistant
City of Ellsworth
1 City Hall Plaza
Ellsworth, ME 04605

Town Clerk
Town of Mariaville
1686 Mariaville Road
Mariaville, ME 04605

Town Clerk
Town of Waltham
1520 Waltham Road
Waltham, ME 04605

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131 Cony Street
Augusta, ME 04330

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Ellsworth Application for New License
December 30, 2015

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Mariaville, ME 04605

Licensee

Frank Dunlap
Brookfield Renewable Energy Group
Black Bear Hydro Partners LLC
150 Main Street
Lewiston, ME 04240

Kelly Maloney
Brookfield Renewable Energy Group
Black Bear Hydro Partners LLC
150 Main Street
Lewiston, ME 04240

Dave Dominie
TRC
14 Gabriel Drive
Augusta, ME 04330

Black Bear Hydro Partners LLC

Before the
Federal Energy Regulatory Commission

Application for New License
for Major Water Power Project – Existing Dam

Ellsworth Hydroelectric Project
(FERC No. 2727)



Initial Statement and Exhibits A, B, C, D, E, F, G, and H

Submitted by:

Black Bear Hydro Partners LLC
150 Main Street
Lewiston, ME 04240

December 2015

Brookfield

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

CONTENTS

This Application for New License for the Ellsworth Hydroelectric Project (FERC No. 2727) consists of the following exhibits:

Initial Statement

Exhibit A – Project Description

Exhibit B – Project Operation and Resource Utilization

Exhibit C – Construction History and Proposed Construction Schedule

Exhibit D – Statement of Costs and Financing

Exhibit E – Environmental Report

Exhibit F – General Design Drawings and Supporting Design Report
(CEII; to be filed with FERC under separate cover)

Exhibit G – Project Maps

Exhibit H – Description of Project Management and Need for Project Power

Exhibit E – Appendices

Appendix E-1 Consultation Summary

Appendix E-2 Consultation Documentation

Appendix E-3 2015 Macroinvertebrate Sampling Study

Appendix E-4 Flow Study Report – Additional Information

Appendix E-5 Turbine Intake and Fishway Entrance Water Velocity
Measurements

Appendix E-6 Upstream Atlantic Salmon Passage Study 2015

Appendix E-7 Upstream Fish Passage Alternatives Study - Revised

Appendix E-8 2015 Adult American Eel Downstream Passage Study

Appendix E-9 Recreation Facilities Management Plan

Appendix E-10 Phase II Archaeological Investigations and Draft Historic
Properties Management Plan

Appendix E-11 Draft Operations Monitoring Plan

Appendix E-12 Draft Biological Assessment for Atlantic Salmon, Atlantic
Sturgeon, and Shortnose Sturgeon

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INITIAL STATEMENT

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**BEFORE THE
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION**

Black Bear Hydro Partners, LLC)
)
)

Project No. 2727
Ellsworth Hydroelectric Project

**APPLICATION FOR NEW LICENSE
FOR MAJOR WATER POWER PROJECT – EXISTING DAM**

INITIAL STATEMENT

1. Black Bear Hydro Partners, LLC (hereinafter “Applicant”, “Licensee” or “Black Bear”) applies to the Federal Energy Regulatory Commission (hereinafter FERC) for a New License for the Ellsworth Hydroelectric Project (FERC No. 2727) (Project), an existing licensed major project, as described in the attached exhibits. The current license for the Ellsworth Project was issued by order dated December 28, 1987. The license was for a period effective January 1, 1988 and has a termination date of December 31, 2017. The Applicant is the only entity that has or intends to obtain and will maintain any proprietary right or interest to construct, operate, or maintain the Project.

2. The location of the Project is:

State or territory:	Maine
County:	Hancock County
Townships or nearby towns:	Ellsworth, Waltham, Mariaville, Fletchers Landing Township
Stream or other body of water:	Union River

3. The exact name, business address, and telephone number of the Applicant are:

Black Bear Hydro Partners, LLC
 150 Main Street
 Lewiston, Maine 04347
 ATTN: C. Todd Wynn, Vice President
 Telephone: (857) 755-5622

The exact name and address of each person authorized to act as agent for the Applicant in this application are:

Kelly Maloney, Manager of Licensing and Compliance
Brookfield Renewable Energy Group
150 Main Street
Lewiston, Maine 04240
Telephone: (207) 755-5606

The Applicant requests that copies of all correspondence pertaining to this application be provided to:

Frank Dunlap
Brookfield Renewable Energy Group
150 Main Street
Lewiston, Maine 04240
E-mail: Frank.Dunlap@BrookfieldRenewable.com
Telephone: (207) 775-5603

It is requested that copies of all correspondence pertaining to this application also be provided to:

David Dominie
TRC Companies, Inc.
14 Gabriel Drive
Augusta, Maine 04330
E-mail: ddominie@trcsolutions.com
Telephone: (207) 620-3835

4. The Applicant is:

Black Bear Hydro Partners, LLC, a Delaware limited liability company, is Licensee for the water power project designated as Project No. 2727 in the records of the Federal Energy Regulatory Commission¹. The Licensee is not claiming preference under section 7(a) of the Federal Power Act. See 16 U.S.C. 796.

5. (i) The statutory or regulatory requirements of the State of Maine, in which the project is located, which would, assuming jurisdiction and applicability, affect the project as proposed with respect to bed and banks and the appropriation, diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing,

¹ Black Bear Hydro Partners LLC, a Delaware limited liability company, is a member of Brookfield Renewable Energy Group.

transmitting, and distributing power and in any other business necessary to accomplish the purposes of the license under the Federal Power Act are:

- (1) Maine Waterway Development and Conservation Act, 38 M.R.S.A. §§ 630 *et. seq.*
- (2) Mill and Dam Act, M.R.S.A. Title 38 § 651 *et. seq.*

(ii) The steps which the Applicant has taken or plans to take, to comply with each of the laws cited above are:

- (1) The Maine Waterway Development and Conservation Act (MWDCA), enacted in 1983, regulates certain construction or reconstruction of hydropower projects which change water levels or flows above or below a dam. The Applicant is not proposing as part of the relicensing any construction or changes in water levels that would require approval under the MWDCA.
- (2) The Mill Act, essentially enacted in 1821, allows riparian owners to maintain dams and raise water. The statute does not require any permits and has been interpreted by the Maine Supreme Judicial Court to apply to hydroelectric generating plants. See *Veazie v. Dwinel*, 50 Me. 479 (1862). Maine case law has also held that owners of the riverbed have the right to the natural flow of a stream as it passes through their land, *Wilson & Son v. Harrisburg*, 107 Me. 207 (1910). Licensee either owns or has an easement or flowage rights to all Project lands and waters.

6. The Ellsworth Hydroelectric Project is located on the lower reach of the Union River in the City of Ellsworth, and the towns of Waltham and Mariaville and Fletchers Landing Township in Hancock County, Maine. The Project consists of a lower dam with a small (90-acre) impoundment (Lake Leonard) and an upper dam with a large (10,000-acre) storage reservoir (Graham Lake). Integral to the lower dam, known as Ellsworth Dam is a powerhouse and appurtenant facilities. The powerhouse contains four (4) turbine-generator units with a total FERC-authorized capacity of 8.9 MW. A transmission line of approximately 320 feet conducts generator voltage to the Project's step-up transformers located in Emera Maine's adjacent substation (non-Project). See Exhibit A, Project Description and Exhibit F, General Design Drawings for a complete description of the Project.
7. No lands of the United States are affected by the Project.
8. This is an existing Project and no new generating facility construction is planned in association with this relicensing.
9. Black Bear Hydro Partners LLC owns, and, as Licensee for the project, will maintain any proprietary right necessary to construct, operate, and maintain the Project.

10. The names and mailing addresses of:

- (i) *Every county in which any part of the project, and in which any Federal facility that is used or to be used by the project, is located;*

The Project is located entirely within Hancock County.

Hancock County Government
50 State Street, Suite 7
Ellsworth, Maine 04605

There are no Federal facilities used by the Project.

- (ii) *Every city, town, or similar local political subdivision in which the project is located, and in which any Federal facility that is used by the project is located, or that is within 15 miles of the project dam and has a population of 5,000 or more people is:*

The Project is located in municipalities of Ellsworth, Mariaville, and Waltham:

Ellsworth City Hall
1 City Hall Plaza
Ellsworth, Maine 04605

Mariaville Town Office
1686 Mariaville Road
Mariaville, Maine 04605

Waltham Town Office
1520 Waltham Road
Waltham, Maine 04605

The Project impoundment is also partially located in the unorganized territory of Fletchers Landing Township, which falls under the jurisdiction of the Maine Land Use Planning Commission, which was created by the Maine Legislature in 1971 and is defined as an agency which serves “as the planning and zoning authority for areas of the state that do not have the capacity to administer land use controls (principally, townships and plantations) (LURC, 2012²).”

Maine Land Use Planning Commission
22 State House Station
Augusta, Maine 04333

² Land Use Regulation Commission (LURC). 2012.

The Town of Bar Harbor, Maine is located within 15 miles of the Project and has a population greater than 5,000 residents

Bar Harbor Town Office
93 Cottage Street
Suite 1
Bar Harbor, Maine 04609

- (iii) *Every irrigation district, drainage district or similar special purpose political subdivision in which any part of the project is located, and in which any Federal facility that is used by the project is located, or that owns, operates, maintains or uses any project facility:*

There are no irrigation, drainage or special purpose political subdivisions associated with the Project.

- (iv) *Every other political subdivision in the general area of the project that there is some reason to believe would be likely to be interested in, or affected by, the notification:*

There are no other political districts or subdivisions that are likely to be interested in or affected by the notification.

- (v) *All Indian tribes that may be affected by the project:*

There are no Native American tribes affected by the Project. The following Native American tribes may have some level of interest in the region surrounding the Project and have been included in the distribution list for the Project; Aroostook Band of Micmacs, Passamaquoddy Tribe, Houlton Band of Maliseet Indians, Penobscot Indian Nation.

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12 Wabanaki Way
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Chris Sockalexis
THPO
Cultural and Historic Preservation Program
Natural Resources Department
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(207) 827-7471

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8 Northern Road
Presque Isle, ME 04769
(207)764-1972

Tribal Governor
Passamaquoddy Tribe
Pleasant Point Reservation
P.O. Box 343
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Perry, ME 04667
(207) 853-2600

Donald Soctomah
Tribal Historic Preservation Officer
Passamaquoddy Tribe
Indian Township Reservation
P.O. Box 343
Route 190
Perry, ME 04667
(207) 796-2301

Chief
Houlton Band of Maliseet Indians
88 Bell Road
Littleton, ME 04730
(207) 532-4273 ext. 218

11. The Applicant has in accordance with 18 CFR Section 5.18 (a)(3)(i) made a good faith effort to notify, by certified mail, the following entities of the filing of this application:

- (i) *Every property owner of record of any interest in the property within the bounds of the project; and*
- (ii) *The entities identified in paragraph (10) above, as well as other Federal, state, municipal or other local government agencies that would likely be interested in or affected by the application.*

A Certificate of Service is attached to the transmittal letter for this Application for New License.

12. In accordance with 18 CFR Sections 4.51 and 16.10 of the Commission's regulations, the following Exhibits are attached to and made a part of this application:

Exhibit A – Project Description

Exhibit B – Project Operation and Resource Utilization

Exhibit C – Construction History and Proposed Construction Schedule

Exhibit D – Statement of Costs and Financing

Exhibit E – Environmental Report

Exhibit F – General Design Drawings and Supporting Design Report
(CEII; filed under separate cover)

Exhibit G – Project Maps

Exhibit H – Description of Project Management and Need for Project Power

SUBSCRIPTION

This Application for New License for the Ellsworth Hydroelectric Project, FERC No. 2727 is executed in the State of Maine, County of Androscoggin, by C. Todd Wynn, Vice President, Black Bear Hydro Partners, LLC, 150 Main Street, Lewiston, Maine 04240, who, being duly sworn, deposes and says that the contents of this application are true to the best of his knowledge or belief and that he is authorized to execute this application on behalf of Black Bear Hydro Partners LLC. The undersigned has signed this application this 30th day of December, 2015.

BLACK BEAR HYDRO PARTNERS LLC

By 
C. Todd Wynn
Vice President
Black Bear Hydro Partners LLC

VERIFICATION

Subscribed and sworn to before me, a Notary Public of the State of Maine this 30th day of December, 2015.


(Notary Public)

(My Commission Expires Dec 21, 2019)/seal

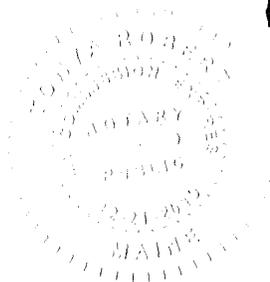
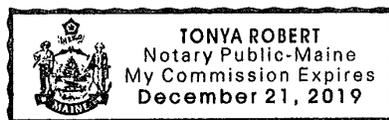


EXHIBIT A
PROJECT DESCRIPTION

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

EXHIBIT A

PROJECT DESCRIPTION

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT A
PROJECT DESCRIPTION**

1.0 INTRODUCTION

The Ellsworth Hydroelectric Project (Project) is owned and operated by Black Bear Hydro Partners, LLC (Black Bear) and is located on the lower reach of the Union River in the City of Ellsworth, the Towns of Waltham and Mariaville, and the Township of Fletchers Landing, an unincorporated township, in Hancock County, Maine. The Project consists of two developments, the Ellsworth Development and the Graham Lake Development.

The Ellsworth Development consists of the Ellsworth Dam, which forms the 90-acre Lake Leonard, and the associated generating facilities. The Ellsworth Dam forms the upper limit of tidal influence of the Union River. The Graham Lake Development consists of a dam with a large storage reservoir (Graham Lake). There are no generating facilities at the Graham Lake Development.

The Project is operated for water storage and power generation. Operationally, the Project is typically run as a peaking facility, with water being released from the Graham Lake reservoir and then used to generate electricity at the downstream Ellsworth powerhouse. Black Bear is not proposing any changes to operations.

2.0 PROJECT DESCRIPTION

The Ellsworth Project is located in Downeast Maine on the Union River, approximately 3 miles upstream of the Union River Bay, which flows into the Atlantic Ocean. The Project includes Graham Lake, Graham Lake Dam, a 3-mile stretch of the Union River, Lake Leonard, and Ellsworth Dam and powerhouse.

2.1 Project Facilities

Ellsworth Development

Construction of the Ellsworth Dam was completed in 1907. The Ellsworth Dam is an Ambursen-style dam that was filled in part with concrete in the early 1990s. The non-overflow

section includes a gatehouse; turbine-generator Unit No. 1 is served by a 10-foot diameter vertical penstock contained in the gatehouse. The non-overflow section is connected to an intake structure containing three additional penstocks: two 8-foot diameter penstocks serving turbine-generator Units No. 2 and 3, and one 12-foot diameter penstock serving turbine-generator Unit No. 4. The four units contained in the Ellsworth powerhouse have a total FERC-authorized nameplate capacity of 8.9 megawatts (MW) and an average annual generation of 30,511 megawatt hours (MWh).

Graham Lake Development

The Graham Lake Dam was completed in 1924. Graham Lake Dam is a non-generating facility located about four miles upstream from the Ellsworth Dam. Graham Lake Dam consists of an earthen dike and concrete gate structure. There is a flood control structure immediately downstream of Graham Lake Dam. No powerhouse is associated with the Graham Lake Dam and reservoir. A summary of Project structures and features associated with the Ellsworth Project is provided in Table A-1.

Table A-1: Ellsworth Project Specifications

GENERAL INFORMATION
Owner and Operator: Black Bear Hydro Partners, LLC
FERC Project Number: 2727
Current License Term: January 1, 1998 to December 31, 2017
County: Hancock County
Nearest Town: Ellsworth, Maine
Watershed: Union River
River: Union River
Drainage Area: 547 square miles at the Ellsworth Dam

Ellsworth Development	Graham Lake Development
Normal Maximum Water Surface Elevation	
Lake Leonard	Graham Lake
66.7' ¹ (includes 1.7 foot flashboards)	104.2'
Normal Tailwater Elevation	
Varies with tidal fluctuations	80.5'
Reservoir Length	
1 mile	10 miles
Shoreline Length	
4.4 miles	80 miles (not including islands)

¹ All elevations are relative to National Geodetic Vertical Datum 1929.

Surface Area at Maximum Water Surface	
Lake Leonard	Graham Lake
90 acres	Approximately 10,000 acres
Gross Storage Lake Leonard 0.107 billion cubic feet	Useable Storage Graham Lake – 5.4 billion cubic feet between elevations 104.2’ and 93.4’
Structures	
Ellsworth Dam	Graham Lake Dam
Concrete buttress dam	Earth fill dam with concrete core walls
Total Length 377 feet	Total Length 750 feet
Penstock: 10-foot diameter vertical penstock serving Unit 1; two 8-foot diameter penstocks serving powerhouse Units No. 2 and 3, and a 12-foot diameter penstock serving Unit No. 4	N/A
Dam height 60 feet	Dam height 58 feet
Unit 2 – 4 Powerhouse: reinforced concrete and concrete block masonry structure 52.5 feet x 68 feet with an attached 15 feet x 30 feet switch house annex	N/A
Unit 1 Powerhouse: approximately 26 feet by 28 feet integral to the concrete non-overflow section of the dam.	
Turbine Rated Capacity:*	
Unit 1 – 3,800 hp (2,850kW) (vertical shaft propeller)	
Unit 2 – 2,900 hp (2,175 kW) (Kaplan)	N/A
Unit 3 – 2,900 hp (2,175 kW) (Kaplan)	
Unit 4 – 3,800 hp (2,850 kW) (vertical shaft propeller)	
Generator Rated Capacity:**	
Unit 1 – 3,125 kVA @ power factor 0.8; 2,500 kW	
Unit 2 – 2,500 kVA @ power factor 0.8; 2,000 kW	N/A
Unit 3 – 2,500 kVA @ power factor 0.8; 2,000 kW	
Unit 4 – 3,000 kVA @ power factor 0.8; 2,400 kW	

*The total combined maximum hydraulic capacity of the turbines is estimated to be 2,460 cfs.

**The total FERC authorized nameplate capacity of the facility, based on the limiting unit components, is 8.9 MW.

Table A-2: Additional Ellsworth Project Specifications

Additional Facility Data (Note: Dimensions are estimated using best available information through scaling from Exhibit F drawings.)

Respective Heights and Lengths of Project Structures

Ellsworth Dam

Right Retaining Wall (Abutment)	26 feet high
<i>Intake</i>	
Units 2 – 4 Intake Structure	32 feet high; 88 feet – 4 ¾ inches long
Units 2 – 4 Trashracks	1 inch clear spacing for first 14 feet of depth, then 2.37 inch clear spacing
Unit 2 Penstock	164 feet long; 8 foot diameter
Unit 3 Penstock	195 feet long; 8 foot diameter
Unit 4 Penstock	225 feet long; 12 foot diameter
Non-Overflow Wall (Between Units 2 through 4 Intake Section and Bulkhead Section)	71 feet high; 85 feet long
Unit 1 Trashracks	2.44 inch clear spacing
Intake (Unit 1) Penstock	74 feet long; 10 foot diameter
Bulkhead Section	62 feet – 9 inches high; 102 feet long
Spillway Section	57 feet high; 275 feet long

Graham Lake Dam

Earthen Embankment and Concrete and Sheet Pile Core Wall	45 feet high; 550 feet long
Gated Spillway	58 feet high; 80 feet long
Concrete Gravity Flood Control Structure	58 feet high; 720 feet long
Stone-filled Sheet Pile Cell	55 feet high; 65 feet diameter
Southwest Wingwall (Between Cell and Gate Structure)	36 feet – 6 inches high; 71 feet long
Tainter Gates	22 feet – 6 inches high; 20 feet wide

2.1.1 Dams

Ellsworth Development

The Ellsworth Dam is a concrete structure with a maximum height of 60-feet (the majority of it being 57 feet high) and 377 feet long including a 275-foot spillway. The overflow spillway and non-overflow section are comprised of a reinforced concrete buttress dam with 22 bays. These were partially filled in 1993 to create a concrete gravity dam. The overflow spillway has a flashboard crest elevation of 66.7'. A fish passage facility consisting of a vertical slot fishway and trap is operated at the Ellsworth Dam providing for upstream fish passage and the commercial harvest of river herring by the City of Ellsworth under a cooperative management agreement with the Maine Department of Marine Resources.



Photo A-1: Ellsworth Dam Spillway and Powerhouse

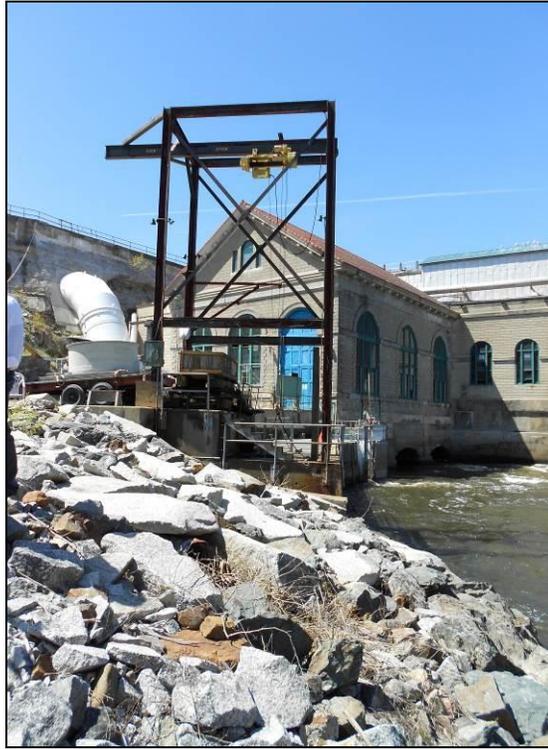


Photo A-2: Ellsworth Dam Powerhouse and Fish Lift



Photo A-3: Ellsworth Development - Lake Leonard

Graham Lake Development

The Graham Lake Dam is 58 feet high and consists of 670-foot-long earth dike and an 80-foot-long concrete gate structure plus abutments. The concrete gate structure contains three 20-foot-wide radial gates and an eight-foot wide sluice that is used for downstream fish passage. There is a concrete flood control structure associated with the Graham Lake Dam. The flood control structure consists of a concrete flood wall approximately 720 feet long, a 65-foot diameter steel cell (formerly part of the construction coffer dam) and a 71-foot-long wing wall extension that connects to the gate structure and serves as an emergency overflow spillway.



Photo A-4: Graham Lake Dam Gate Structure



Photo A-5: Graham Lake Dam Flood Control Structure

2.1.2 Impoundments

The Ellsworth Project has a drainage area of approximately 547 square miles at the Ellsworth Dam. The lake impounded by the Ellsworth Dam, Lake Leonard, has a surface area of 90 acres at its normal maximum elevation of 66.7' and a length of one mile. Normal water levels in Lake Leonard vary between 65.7' and 66.7' over the course of the year. The upper reservoir, Graham Lake, has a normal maximum surface area of approximately 10,000 acres and a maximum length of approximately 10 miles. Annual water levels in Graham Lake are managed between elevations 93.4' and 104.2'. Drawdown of Graham Lake in the summer/fall and more extensively at the beginning of the year provides significant downstream flood control benefits. The ability to store a large water volume when the lake is drawn down is a particularly valuable asset given the location of downtown Ellsworth just below the Ellsworth Dam. Drawdown of Graham Lake also can provide important flow augmentation during dry periods so that minimum flows can be maintained in the Union River below Graham Lake Dam.

2.1.3 Transmission

A transmission line of approximately 320 feet conducts generator voltage to the Project step-up transformers located in the adjacent non-Project substation owned by the local utility.

2.1.4 Appurtenant Equipment

The Project also has appurtenant facilities such as cranes, trash racks, and other equipment necessary for day-to-day operations and maintenance.

3.0 LANDS OF THE UNITED STATES

There are no federal lands within the Project boundary.

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EXHIBIT B

PROJECT OPERATION AND RESOURCE UTILIZATION

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT B
PROJECT OPERATION AND RESOURCE UTILIZATION**

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT B
PROJECT OPERATION AND RESOURCE UTILIZATION**

1.0 PROJECT OPERATION

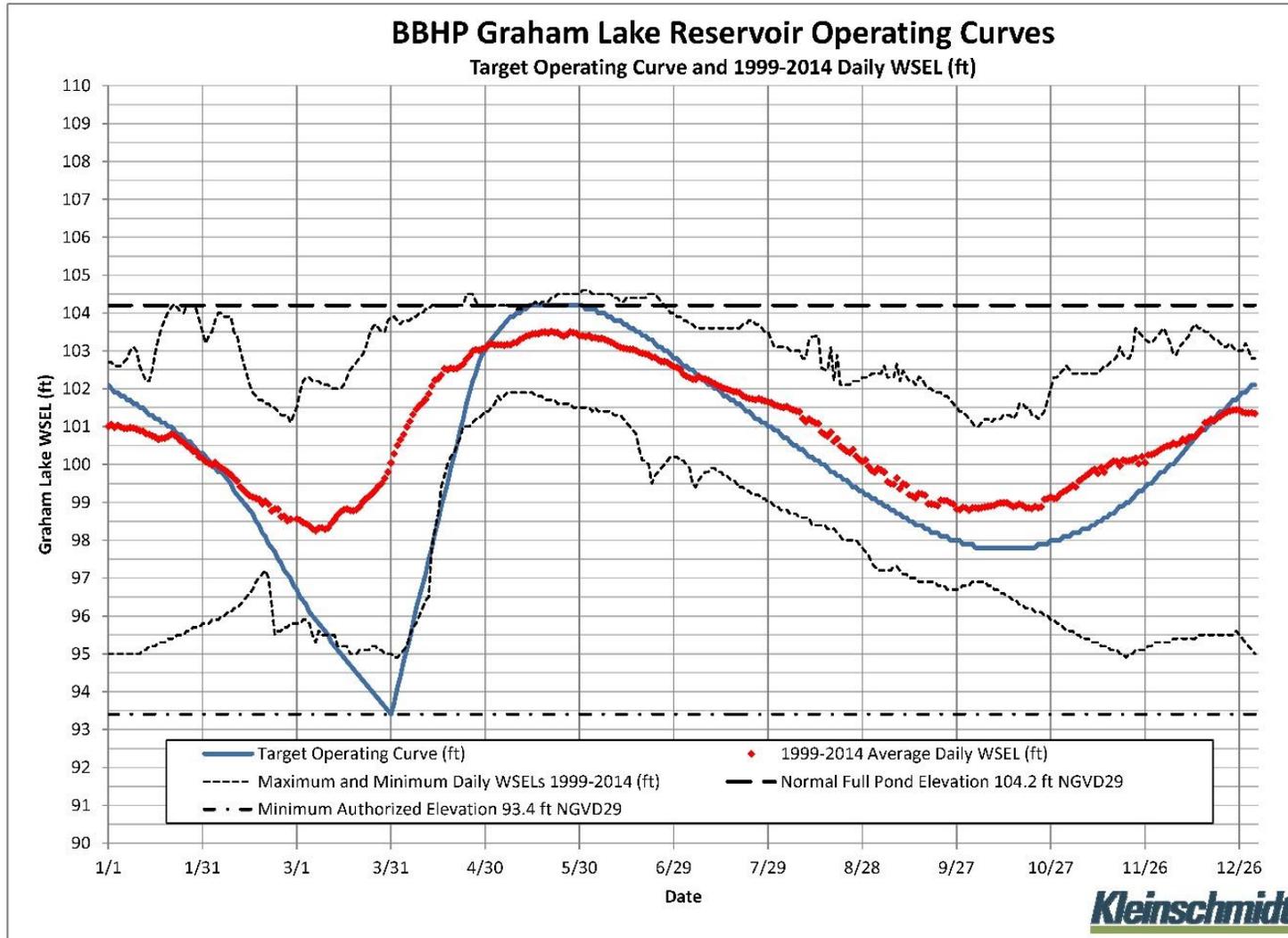
The Ellsworth Hydroelectric Project (Project or Ellsworth Project) consists of a lower dam with a small impoundment (Leonard Lake) and an upper dam with a large storage reservoir (Graham Lake) separated by a 3-mile stretch of the Union River. The FERC-authorized nameplate rated capacity of the Ellsworth Project is 8.9 MW. The Project generated an average of 30,511, MWh per year for the period 1994-2014. The rated dependable capacity for ISO-New England is 9.050 MW, based on the ISO-NE Winter Claimed Capacity as of December 7, 2015.

1.1 Existing Operating Mode

The Ellsworth Project operates both as a water storage facility and as a peaking generation facility, depending on available inflows and storage, while maintaining minimum flows. The Project is comprised of two developments: the Graham Lake Development and the Ellsworth Development. The Graham Lake Development consists of a dam (the development has no power generations facilities) and the approximately 10,000 acre storage reservoir, Graham Lake. The allowable annual operating range of Graham Lake is 10.8 feet, between the elevations of 104.2' and 93.4'. The operation of Graham Lake generally follows the historic operating curves included as Figure B-1. The Ellsworth Development operates in a run-of-river mode automatically via pond level control. Timed releases at Graham Lake are used at Ellsworth Dam for power production and may result in minor (up to approximately 1 foot) surface elevation changes (65.7' – 66.7') in Lake Leonard.

The Union River has an average annual flow of 958 cubic feet per second (cfs). As part of the current license requirements the Licensee is required to release a continuous minimum flow of 105 cfs from the Graham Lake Development and the Ellsworth Development from July 1 through April 30 and 250 cfs from May 1 through June 30 (FERC 1987b). Black Bear is proposing no changes to the current minimum flow requirements. The ability to store and release water at Graham Lake allows the Ellsworth plant to operate in a peaking mode during periods of high electric demand.

Figure B-1: Graham Lake Historic Operating Curves



1.1.1 Normal Operations

The Ellsworth Project is operated automatically via a Programmable Logic Controller (PLC) system. This system monitors and controls project operations including headpond levels at each development. The Project is monitored by Black Bear on a 24-hour basis and is typically visited at least 3-5 times each week by a roving operator. Daily logs of elevation and flow data, as well as any outages are maintained for the Project.

1.1.2 Adverse and High Water Condition Operations

Low Flow

Under the current license the Ellsworth Project is required to release a continuous minimum flow of 105 cfs from July 1 through April 30 and 250 cfs from May 1 through June 30. The minimum flow requirements from the Project developments have been developed to maintain fish habitat, to facilitate fish migration, and to protect downstream water quality. Drawdown of Graham Lake provides important flow augmentation during dry inflow periods so that minimum flows can be maintained in the Union River below Graham Lake Dam. This capacity benefits both water quality and aquatic habitat and organisms in the river.

High Flow

The Ellsworth Project is normally operated as a peaking plant, with water being released from the Graham Lake reservoir and then used to generate electricity at the downstream Ellsworth powerhouse. During periods of high inflows, primarily in the spring and fall, the project may generate at full load up to 24 hours a day.

The ability to store large volumes of inflow in the spring is also valuable given the location of downtown Ellsworth just below the Ellsworth Dam. In a potential flood situation, Black Bear dam operators manage water levels along the Union River in order to minimize risk and flood damage.

1.1.3 Annual Plant Factor

The nameplate rated capacity of the Ellsworth Project is 8.9 MW. The Ellsworth Dam generates an average annual energy output of 30,511 MWh at a plant factor of 39 percent.

1.2 Proposed Operating Mode

The Licensee plans to continue the current licensed mode of operation and proposes that the following operating conditions with respect to minimum flows and impoundment levels be included as articles in the new license:

- Minimum Flows

Except as temporarily modified by (1) approved maintenance activities, (2) extreme hydrologic conditions, as defined below, (3) emergency electrical system conditions, as defined below, or (4) agreement between the Licensee, the Maine DEP, and appropriate state and/or federal fisheries management agencies, the Licensee shall release a continuous minimum flow of 105 cubic feet per second (cfs) from the Graham Lake development and the Ellsworth development from July 1 through April 30, and a continuous minimum flow of 250 cfs from May 1 through June 30, for the protection of fishery resources.

- Impoundment Levels

Except as temporarily modified by (1) approved maintenance activities, (2) extreme hydrologic conditions, as defined below, (3) emergency electrical system conditions, as defined below, or (4) agreement between the Licensee, the Maine DEP, and appropriate state and/or federal fisheries management agencies, the Licensee shall operate the project so that water levels in Lake Leonard are maintained between the elevations of 65.7' and 66.7' (flashboard crest) during normal operation, and water levels in Graham Lake are maintained between 104.2' and 93.4'.

"Extreme Hydrologic Conditions" means the occurrence of events beyond the Licensee's control such as, but not limited to, abnormal precipitation, extreme runoff, flood conditions, ice conditions or other hydrologic conditions such that the operational restrictions and requirements contained herein are impossible to achieve or are inconsistent with the safe operation of the Project.

"Emergency Electrical System Conditions" means operating emergencies beyond the Licensee's control which require changes in flow regimes to eliminate such emergencies which may in some circumstances include, but are not limited to, equipment failure or other temporary abnormal operating conditions, generating unit operation or third-party mandated interruptions under power supply emergencies, and orders from local, state, or federal law enforcement or public safety authorities.

2.0 DEPENDABLE CAPACITY AND AVERAGE ANNUAL ENERGY PRODUCTION

The rated dependable capacity for ISO-New England is 9.050 MW, based on the ISO-NE Winter Claimed Capacity as of December 7, 2015.

The ISO- NE determines the monthly capacity values for the developments. The values are called "seasonal claim capacity" (SCC) and are divided in to the summer (June 1 through

September 30) and winter (October 1 through May 31) periods. The current claimed values are presented in Table B-1.

Table B-1: Seasonal Claimed Capacity Values at Ellsworth Dam

Summer SCC (MW)	Winter SCC (MW)
9.044	9.050

2.1 Summary of Project Generation Records

The Ellsworth Project generated an average annual energy output of 30,511 MWh for the period 1994-2014. Table B-2 shows historical monthly generation at the Project for the period January 1994 through December 2014.

Table B-2: Summary of Project Generation

ELLSWORTH PROJECT GENERATION 1994 - 2014													
(MWh)													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1994	4,022	4,064	4,521	5,031	3,370	1,730	644	649	519	757	585	1,744	
1995	2,941	3,517	4,870	1,733	3,252	2,193	134	447	465	538	4,295	3,601	
1996	2,737	4,836	3,275	4,876	5,095	2,261	4,321	2,257	1,775	1,092	834	4,258	
1997	4,768	2,464	2,364	3,549	5,051	2,033	2,100	999	811	707	626	845	
1998	1,156	4,035	5,576	2,863	2,091	2,206	2,976	968	442	1,186	647	480	
1999	2,984	4,697	6,011	4,083	1,358	1,072	516	347	981	2,626	2,646	4,398	
2000	3,702	2,839	4,891	5,412	3,342	1,838	710	1,037	981	1,125	563	986	
2001	1,644	2,177	1,776	2,525	1,613	1,049	511	600	496	500	281	203	
2002	237	604	4,737	5,555	3,036	1,301	1,343	918	577	417	1,548	3,993	
2003	3,873	1,443	3,342	5,215	3,093	2,256	440	554	1,488	2,193	6,050	5,616	
2004	3,380	948	2,130	2,350	2,618	1,440	679	1,917	2,025	768	654	3,145	
2005	4,070	1,538	4,306	5,058	6,175	3,604	1,304	1,275	607	4,550	4,241	4,171	
2006	5,324	4,992	1,678	1,059	3,510	4,330	680	DNA	DNA	2,761	4,120	4,000	
2007	4,202	1,426	3,841	5,397	3,169	2,177	664	735	DNA	215	2,991	3,270	
2008	4,161	4,597	6,335	4,856	2,921	1,290	1,011	2,296	2,614	3,959	2,880	6,436	
2009	2,949	2,888	2,775	5,540	2,322	3,680	3,771	1,084	1,175	2,892	4,235	3,364	
2010	3,326	4,127	3,261	3,303	1,483	1,284	1,040	1,121	619	736	4,893	5,225	
2011	2,638	2,979	4,903	4,805	3,820	1,091	858	1,826	1,724	2,116	1,680	3,034	
2012	2,958	1,144	1,550	2,563	4,976	2,736	1,356	696	1,803	3,621	4,421	1,805	
2013	2,864	3,405	3,451	2,247	2,376	3,300	1,928	1,887	4,422	1,305	625	1,908	
2014	5,341	3,481	2,486	5,141	2,802	2,642	2,961	1,881	857	676	2,418	5,021	
Average	3,299	2,962	3,718	3,960	3,213	2,167	1,426	1,175	1,283	1,654	2,440	3,214	Average Annual Generation 30,511

DNA – data not available

2.2 Flow Data

Flow statistics for the Project area were calculated from generation data for Ellsworth Dam collected at the facility, as there is no USGS Gage associated with the project area. Generation data is recorded in megawatts which is converted to flow using a 1 kW/3.62 cfs relationship for the project (i.e., 8900 kW with a hydraulic capacity of 2,460 cfs). Hourly plant generation records for the period 2001-2012 were reduced to daily flow values using a time weighted average analysis for each day. These data were trended into an annual flow duration curve for the project. In addition, the mean daily flow data from the Narraguagus River at Cherryfield (USGS Gage 01022500) were pro-rated to the site based on the ratio of the respective drainage areas (gage vs. site). The annual flow duration curve developed from the 2001-2012 trended plant generation records data aligns closely with the pro-rated annual curve for the Narraguagus River gage data. Because this comparison shows that the 2001-2012 trended Generation Log Data provides a reasonable approximation of flow at the site, these data were used to derive the monthly flow duration curves for the Project.

Table B-3 provides the monthly minimum, average and maximum out flows from Ellsworth Dam based upon the plant data. Annual and monthly outflow duration curves for the Project are presented in Appendix B-1.

Table B-3: Annual and Monthly Maximum, Average and Minimum Flow (cfs) for the Ellsworth Dam

Ellsworth Dam Monthly Minimum, Average, and Maximum Flows - 1994-2014 (cfs)												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Maximum	1984	2053	2353	2132	2294	1662	1605	853	1698	1690	2323	2391
Average	1226	1209	1377	1520	1194	832	530	416	446	615	937	1194
Minimum	88	248	576	407	504	403	50	129	170	80	108	76

Table B-4: Monthly Average River Flow

CALCULATED DAILY RIVER FLOW - 1994 - 2014 (cfs)													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Average (Year)
1994	1494	1672	1680	1931	1252	664	239	241	199	281	225	648	877
1995	1093	1447	1809	665	1208	842	50	166	179	200	1649	1338	887
1996	1017	1921	1217	1872	1893	868	1605	838	681	406	320	1582	1185
1997	1771	1013	878	1363	1876	781	780	371	311	263	240	314	830
1998	430	1660	2072	1099	777	847	1105	359	170	441	248	178	782
1999	1109	1932	2233	1568	504	412	192	129	377	976	1016	1634	1007
2000	1376	1127	1817	2078	1242	706	264	385	377	418	216	366	864
2001	611	896	660	969	599	403	190	223	191	186	108	76	426
2002	88	248	1760	2132	1128	500	499	341	221	155	594	1483	762
2003	1439	594	1241	2002	1149	866	163	206	571	815	2323	2086	1121
2004	1256	376	791	902	973	553	252	712	777	285	251	1168	691
2005	1512	633	1510	1942	2294	1384	485	474	233	1690	1628	1550	1278
2006	1978	2053	623	407	1304	1662	253	DNA	DNA	1026	1582	1486	1031
2007	1561	587	1427	2072	1177	836	247	273	DNA	80	1148	1215	885
2008	1546	1826	2353	1864	1085	495	376	853	1003	1471	1106	2391	1364
2009	1096	1188	1031	2127	863	1417	1401	403	451	1074	1626	1250	1161
2010	1236	1697	1211	1268	551	493	386	416	238	273	1878	1941	966
2011	980	1226	1822	1845	1419	419	319	678	662	786	645	1127	994
2012	1099	454	576	984	1849	1050	504	259	692	1345	1697	671	932
2013	1064	1400	1282	863	883	1267	716	701	1698	485	240	709	942
2014	1984	1432	924	1973	1041	1014	1100	699	329	251	928	1865	1128
Average (month)	1226	1209	1377	1520	1194	832	530	416	446	615	937	1194	958

DNA – data not available
 Installed generator capacity: 8.9 MW
 Installed Hydraulic capacity: 2460 cfs
 kW/cfs = 3.618

2.3 Project Storage

The usable storage capacity of Graham Lake is 5.4 billion cubic-feet.

2.4 Hydraulic Capacity of the Project

The Ellsworth turbine units have a combined estimated maximum hydraulic capacity of 2,460 cfs.

The Graham Lake Dam contains no generating equipment.

2.5 Tailwater Rating Curve

Tailwater rating curves for the Ellsworth Dam are provided in Appendix B-2.

2.6 Power Plant Capability versus Head

A capacity versus head curve for the Ellsworth plant is provided in Appendix B-3. The curve is based upon a total station capacity versus gross head curve developed in 1940 for Units 1-4 of the Ellsworth development. Several major maintenance projects have occurred since that time, including unit rebuilds, generator rewinds, and intake replacement/penstock extensions. The major maintenance projects may have influenced capacity versus gross head values, however it is likely that any difference would be nominal. The curve provided in Appendix B-3 is based upon best available information and is a reasonable representation of the Project capability.

3.0 UTILIZATION OF POWER PROJECT

The Licensee is an independent power producer and, as such, does not provide electric service to any particular group or class of customers, or prepare and submit load and capability forecasts or resource plans to any regulatory body.

The Project generates renewable power for Maine and the regional power pool administered by ISO New England. Currently, output is sold on the open market through bidding into the New England Power Pool (NEPOOL) market administered by ISO New England, the non-profit independent system operator for New England. ISO New England administers all significant aspects of the NEPOOL power market.

4.0 PLANS FOR FUTURE DEVELOPMENT

Black Bear has not proposed any new generating development as part of the application for a new license.

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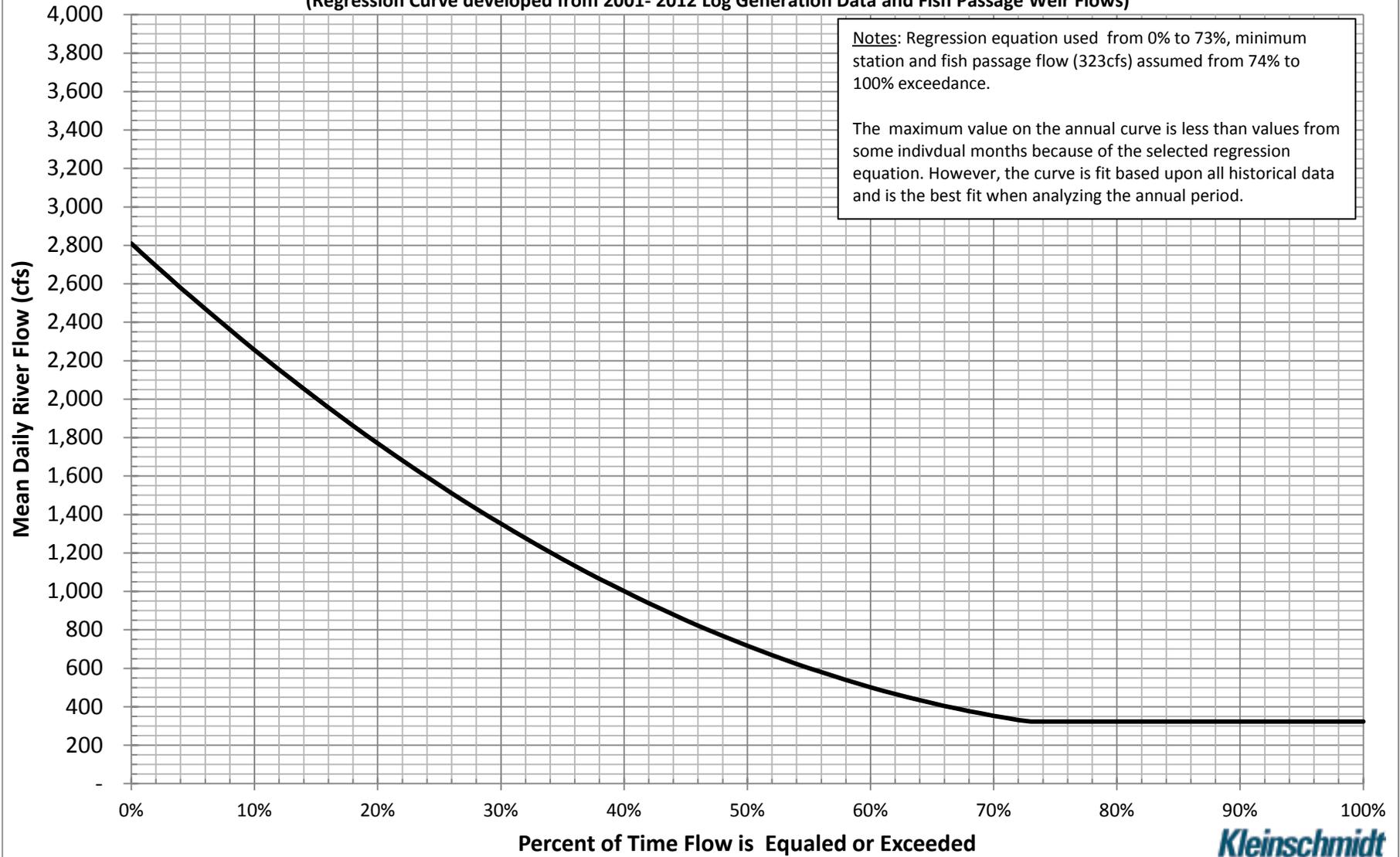
APPENDIX B-1

ANNUAL and MONTHLY FLOW DURATION CURVES

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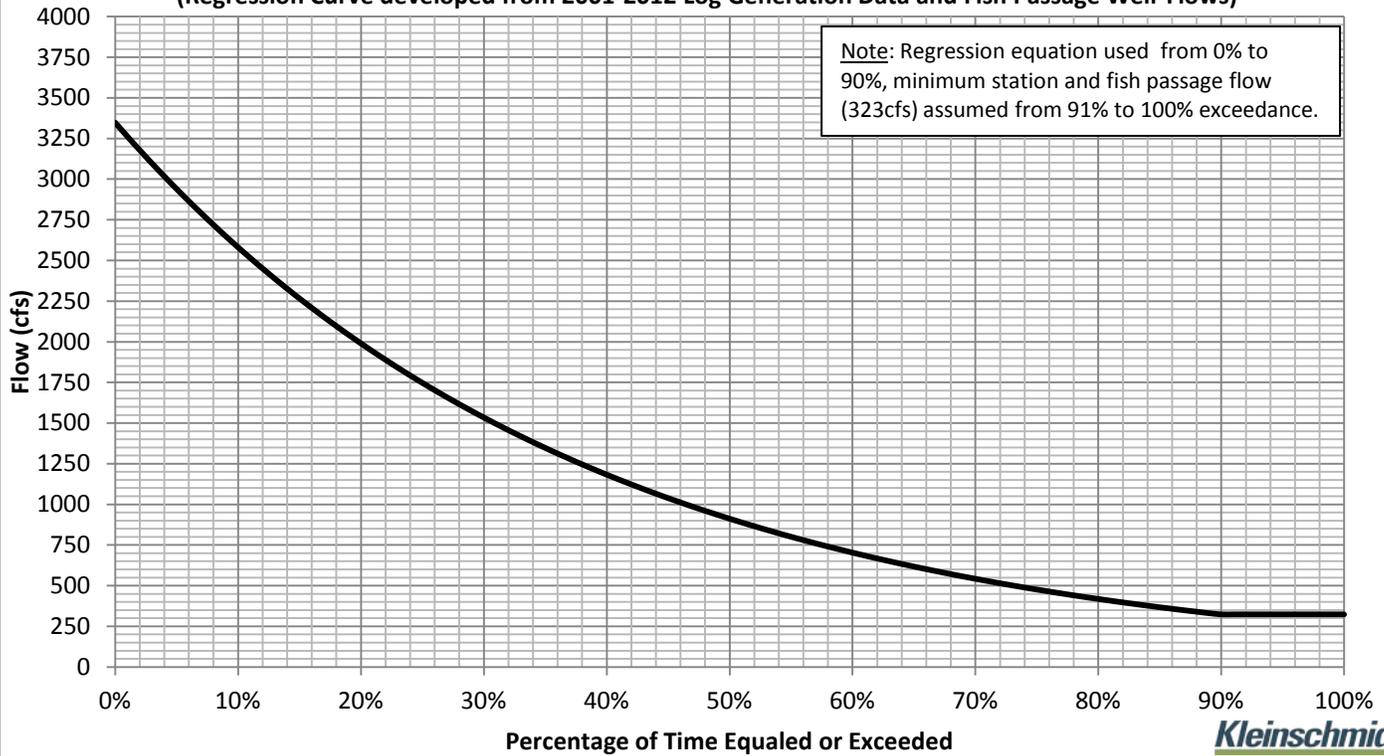
Outflow at Ellsworth Dam Annual Flow Duration Curve

(Regression Curve developed from 2001- 2012 Log Generation Data and Fish Passage Weir Flows)



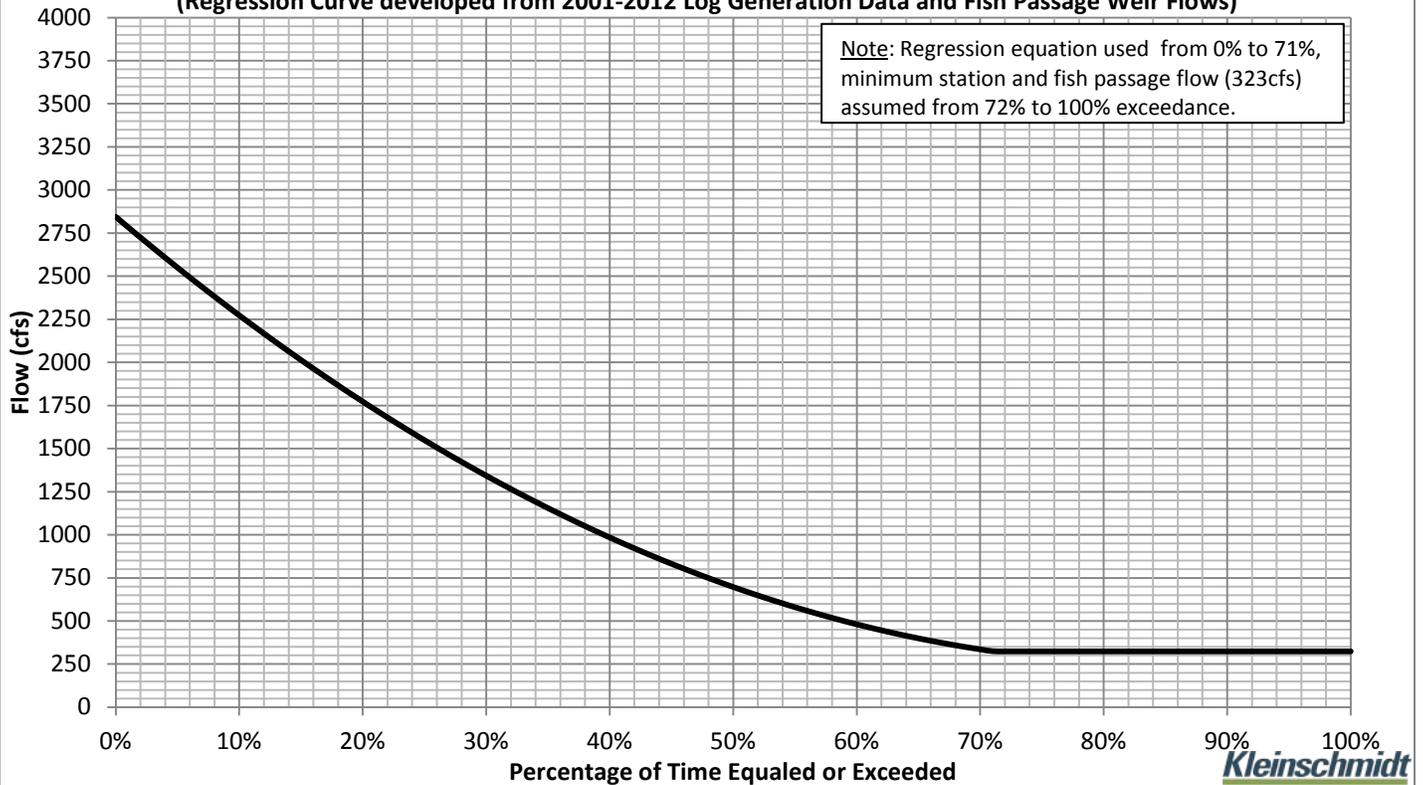
Outflow at Ellsworth Dam January Flow Duration Curve

(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



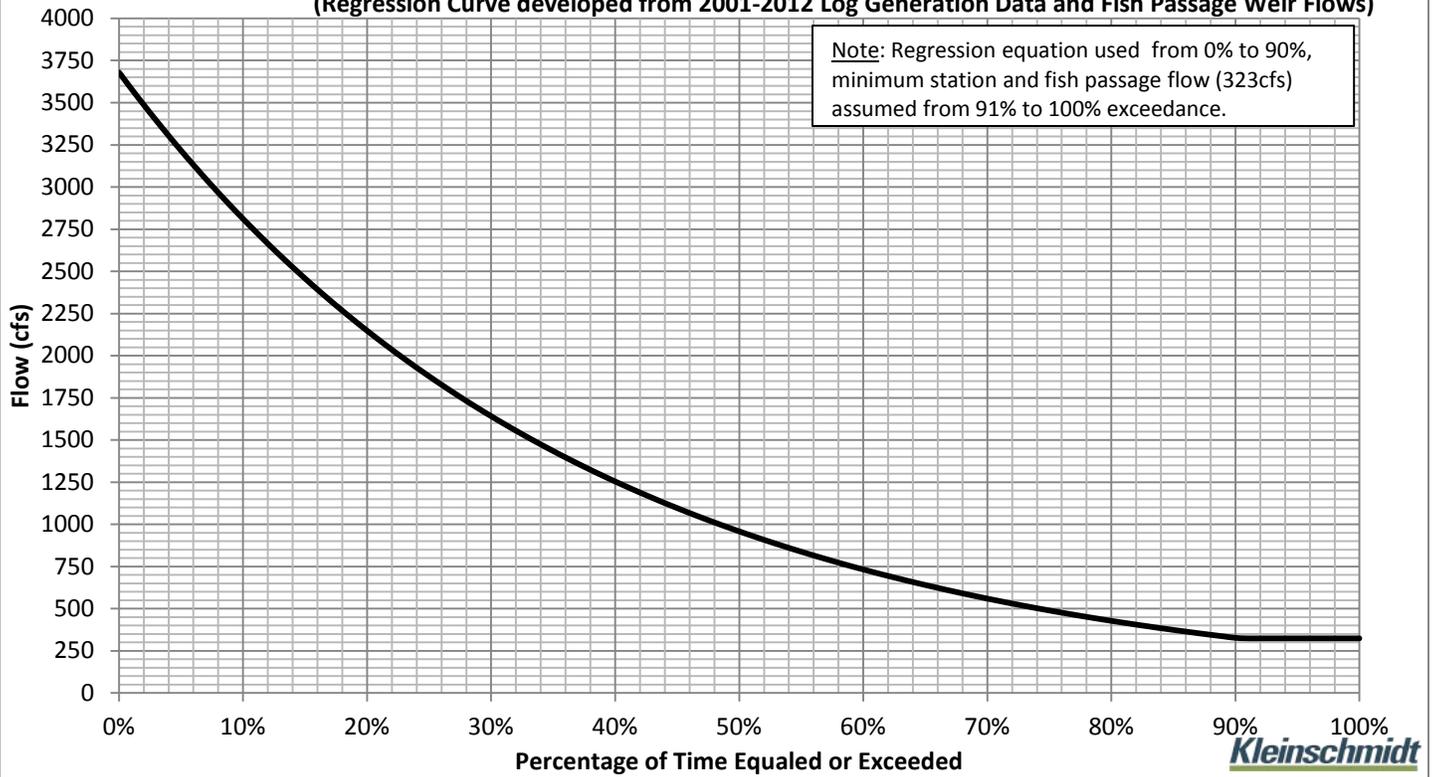
Outflow at Ellsworth Dam February Flow Duration Curve

(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



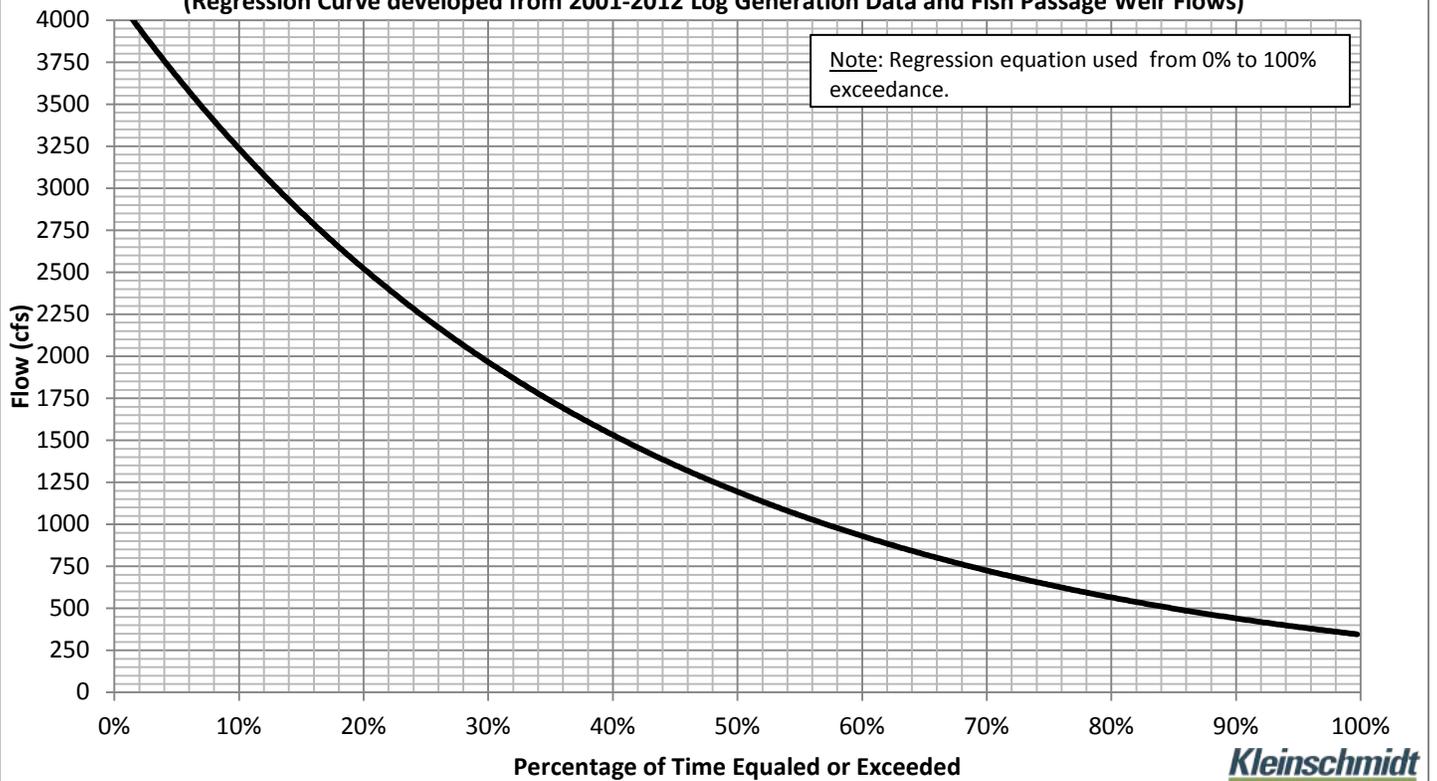
Outflow at Ellsworth Dam March Flow Duration Curve

(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



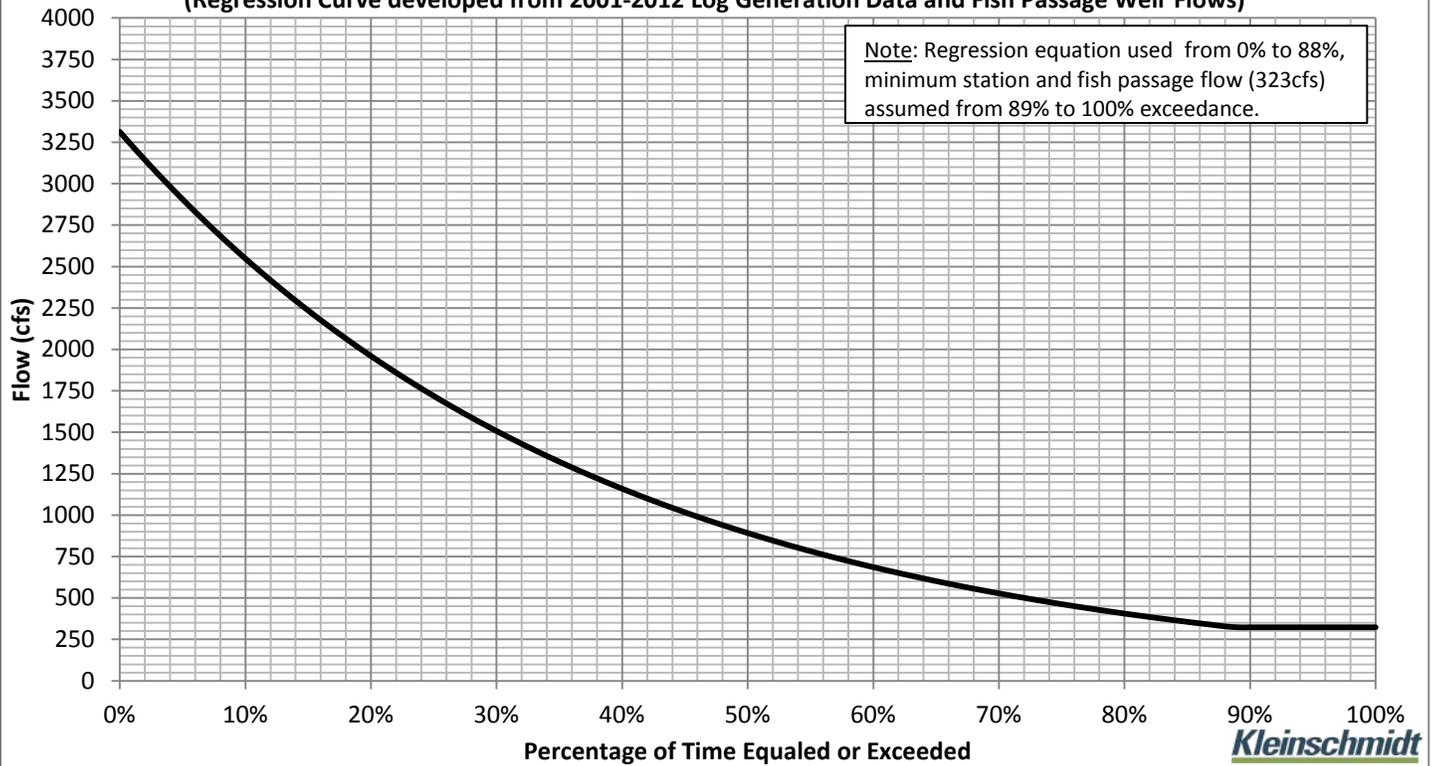
Outflow at Ellsworth Dam April Flow Duration Curve

(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



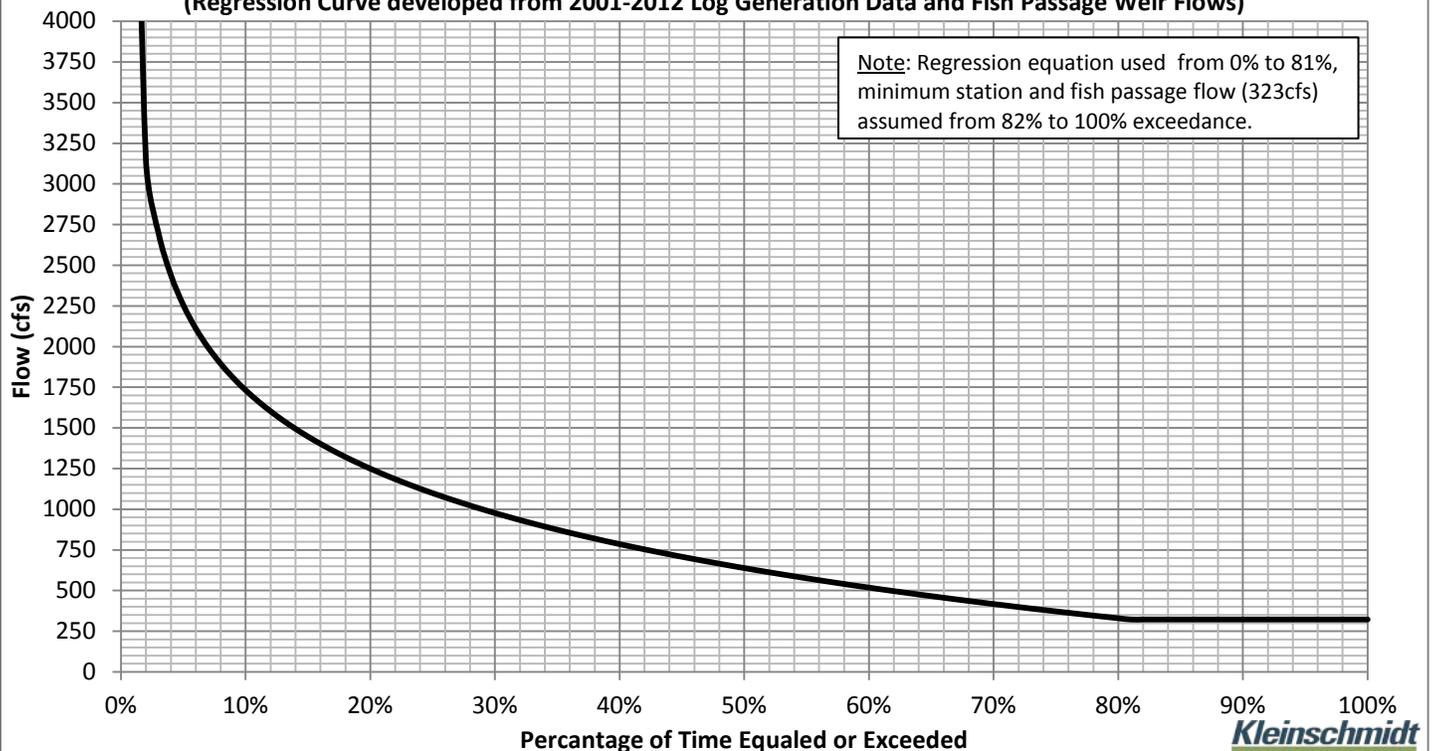
Outflow at Ellsworth Dam May Flow Duration Curve

(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



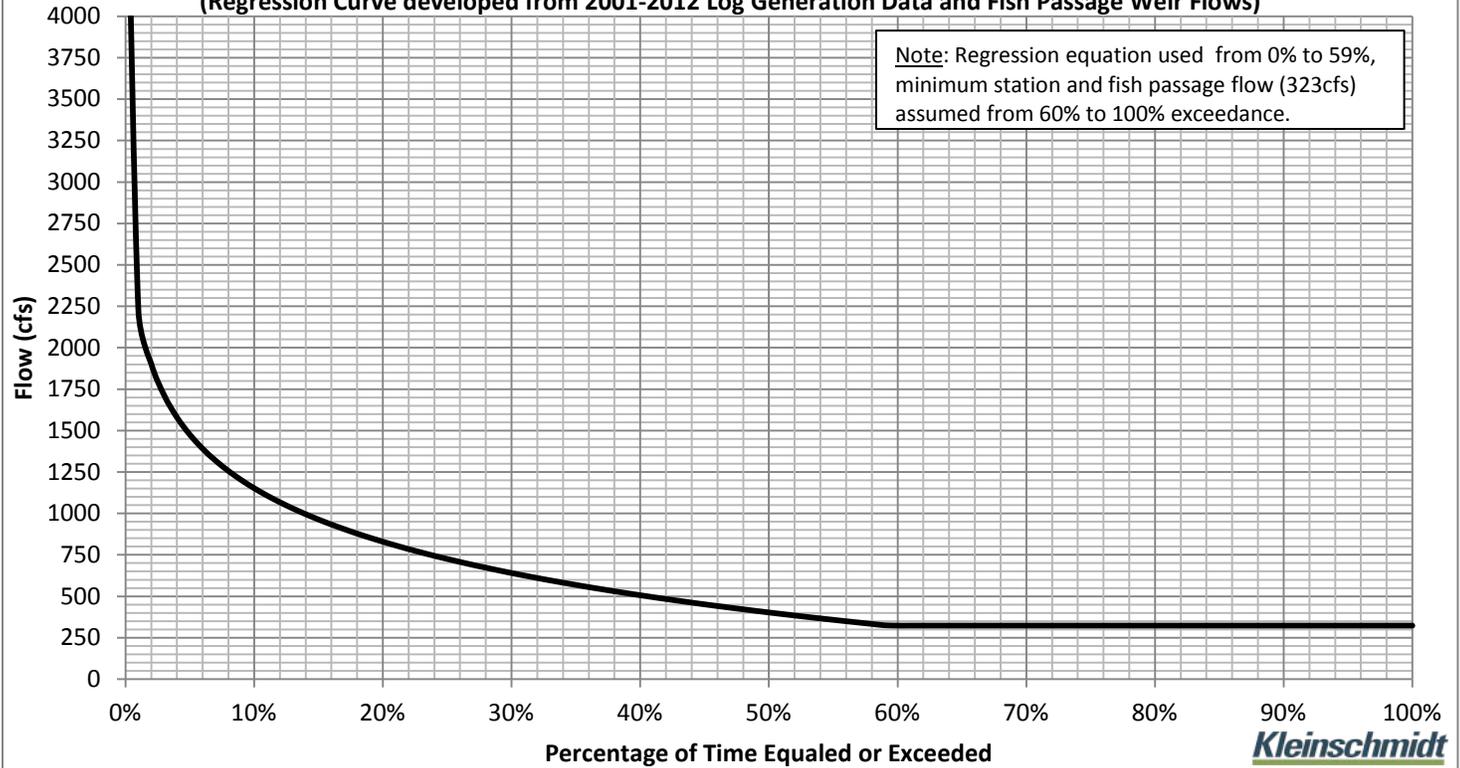
Outflow at Ellsworth Dam June Flow Duration Curve

(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



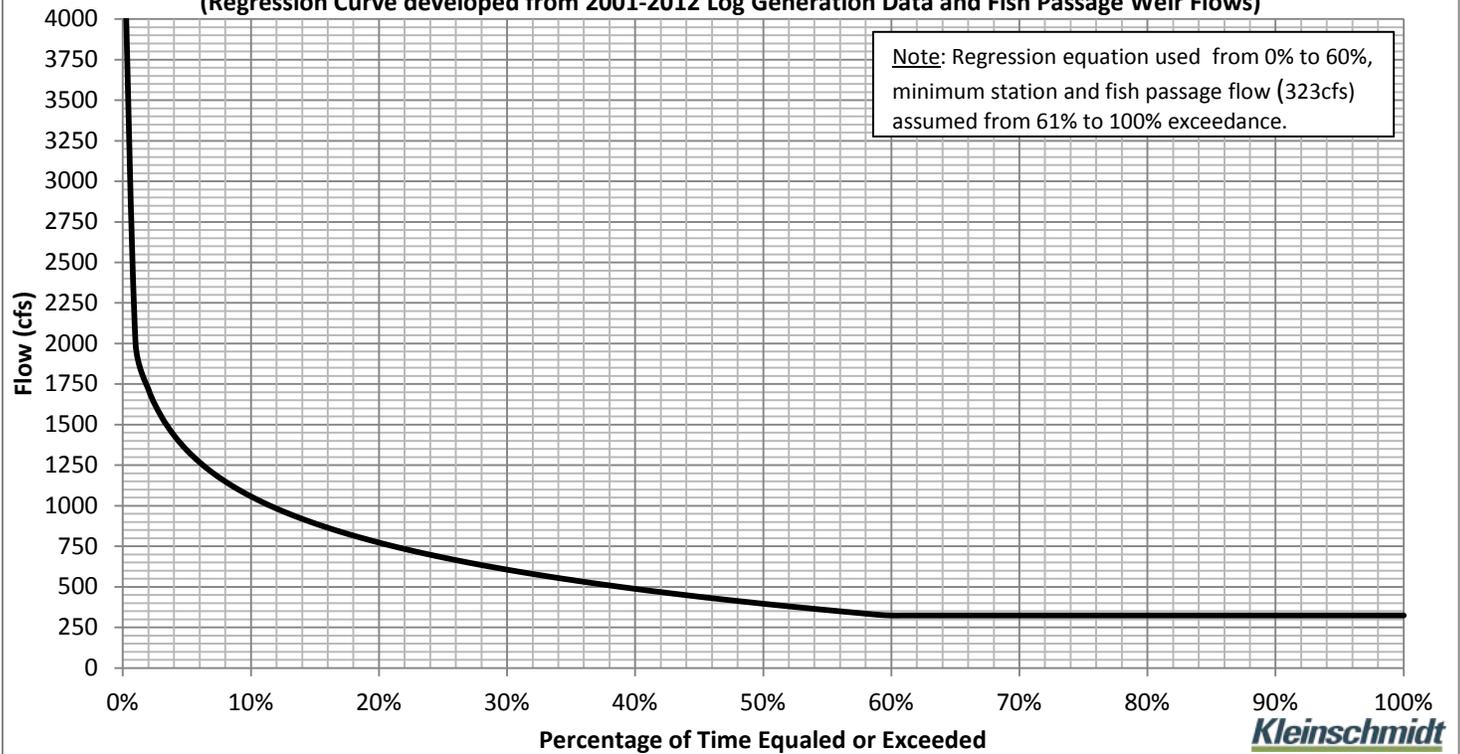
Outflow at Ellsworth Dam July Flow Duration Curve

(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



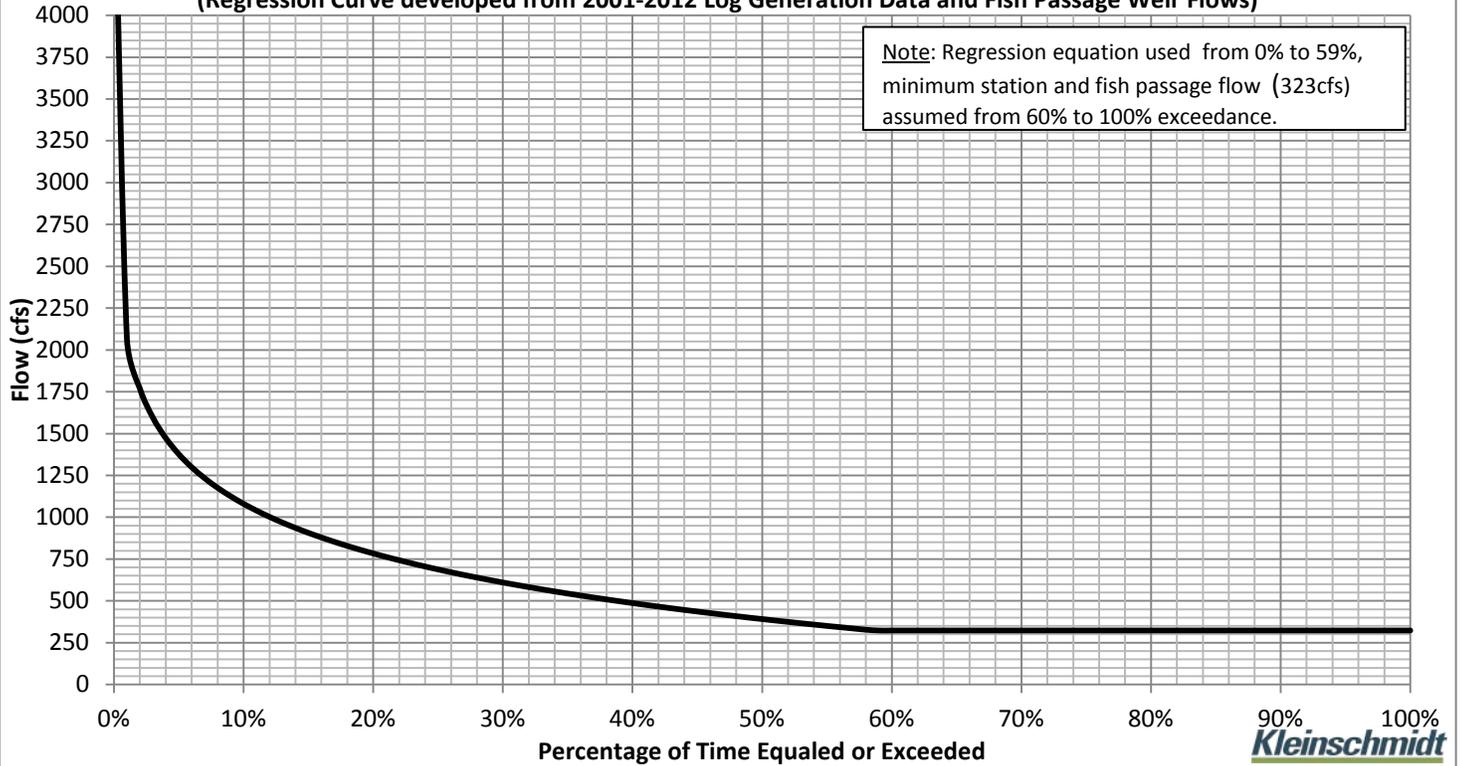
Outflow at Ellsworth Dam August Flow Duration Curve

(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



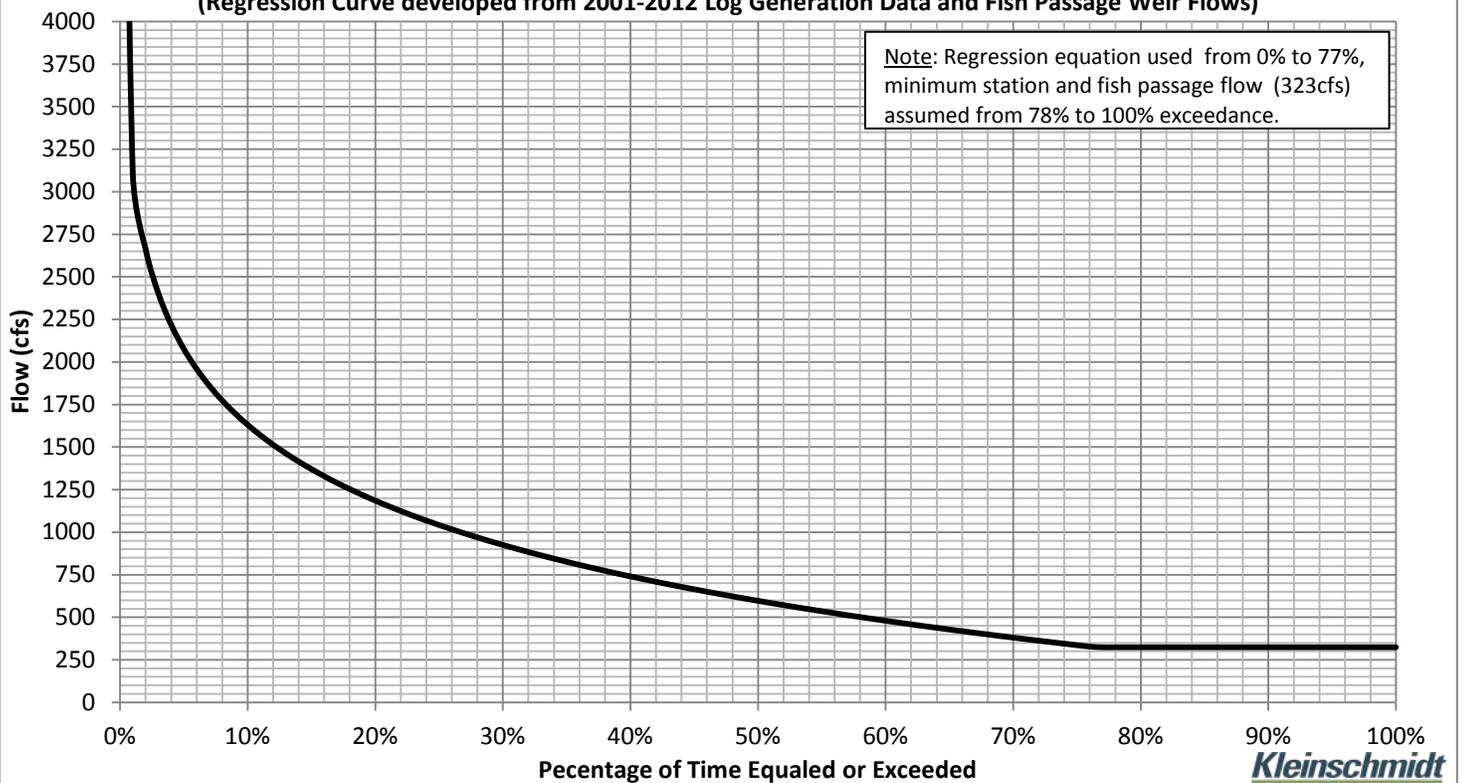
Outflow at Ellsworth Dam September Flow Duration Curve

(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



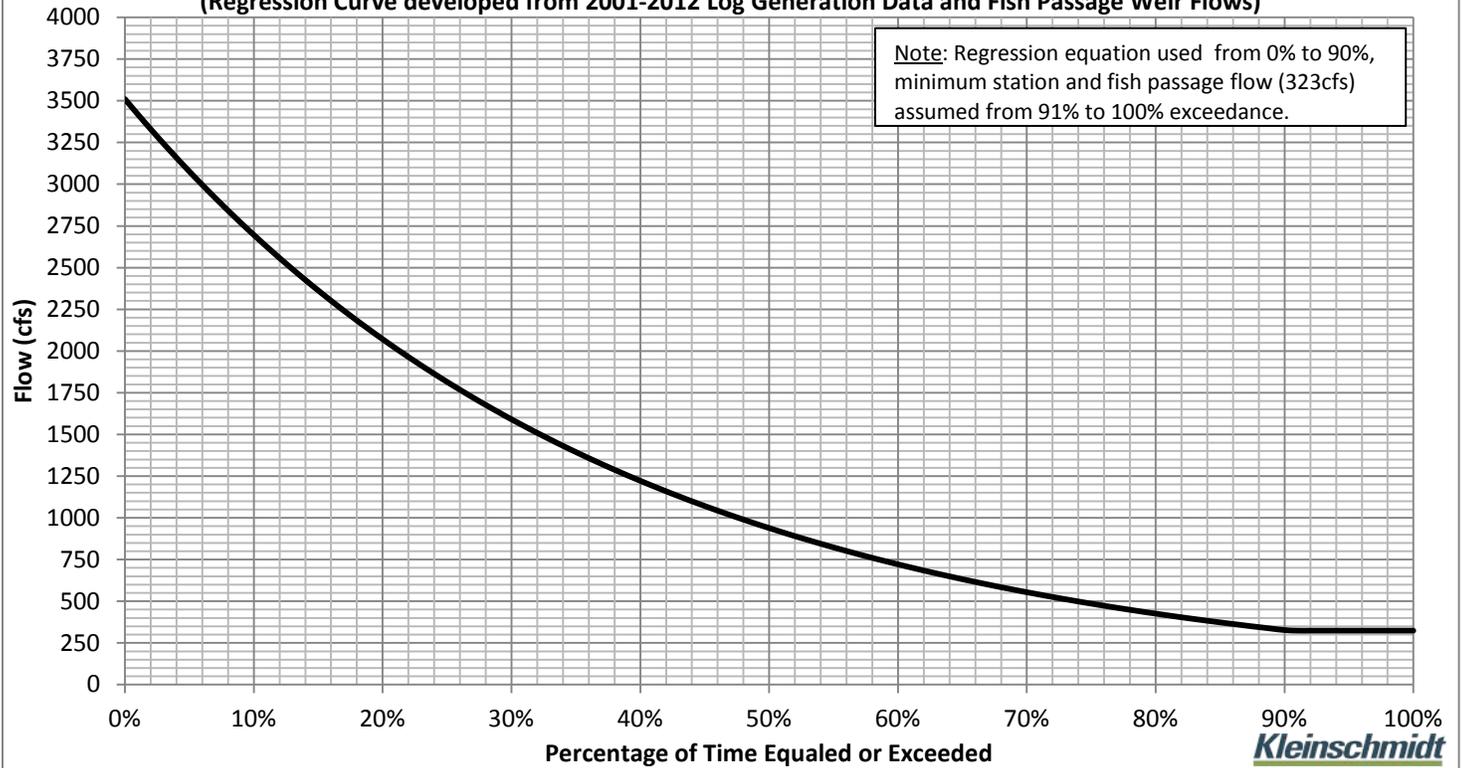
Outflow at Ellsworth Dam October Flow Duration Curve

(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



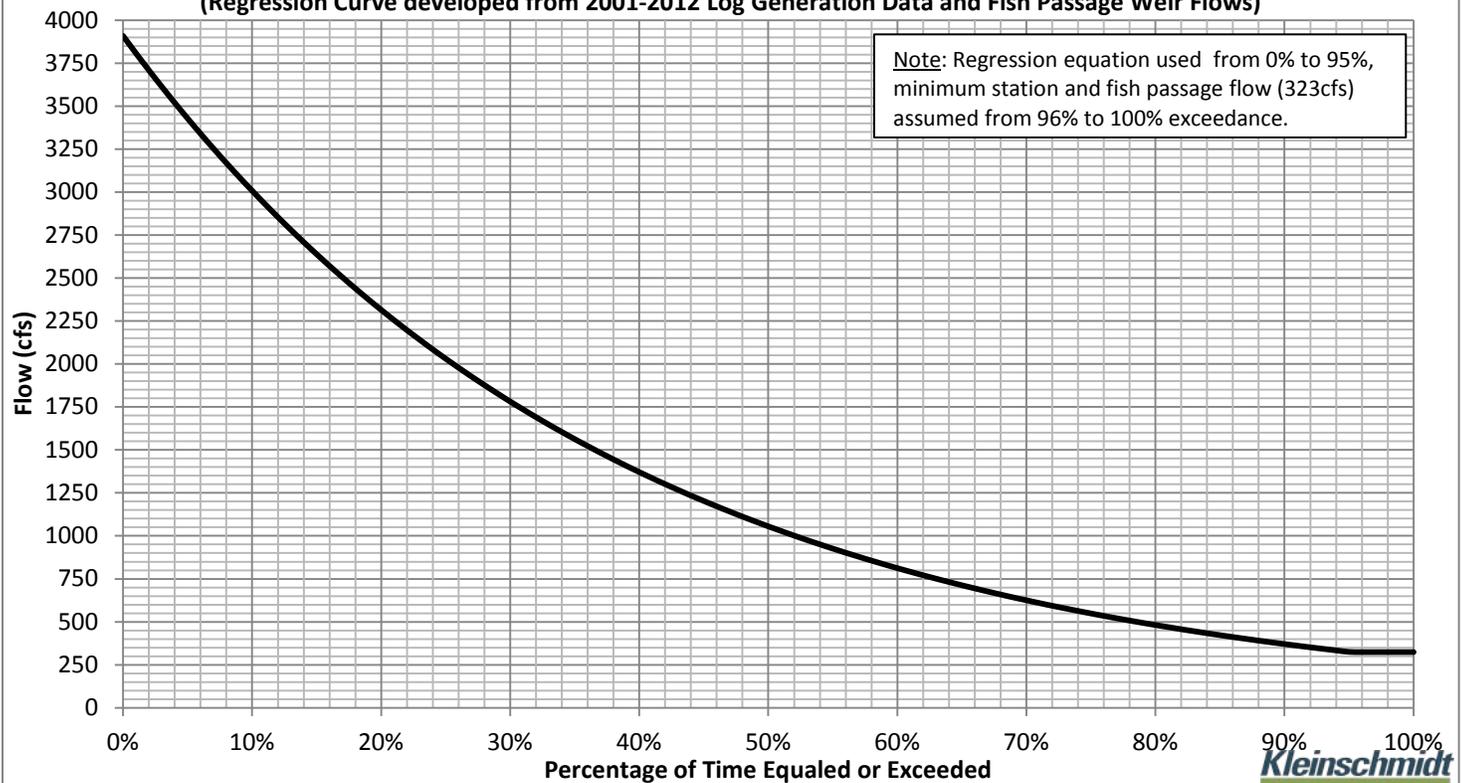
Outflow at Ellsworth Dam November Flow Duration Curve

(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



Outflow at Ellsworth Dam December Flow Duration Curve

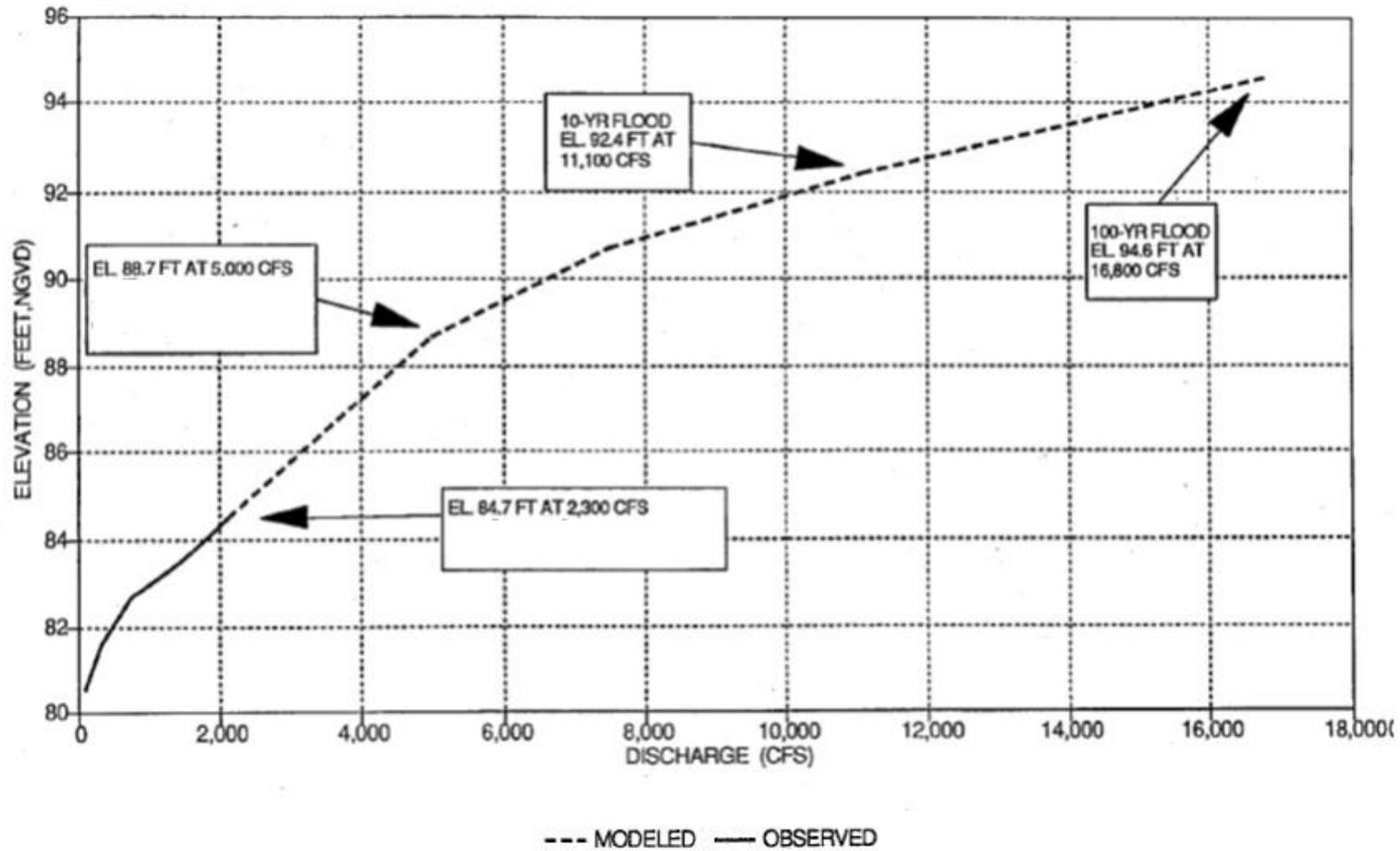
(Regression Curve developed from 2001-2012 Log Generation Data and Fish Passage Weir Flows)



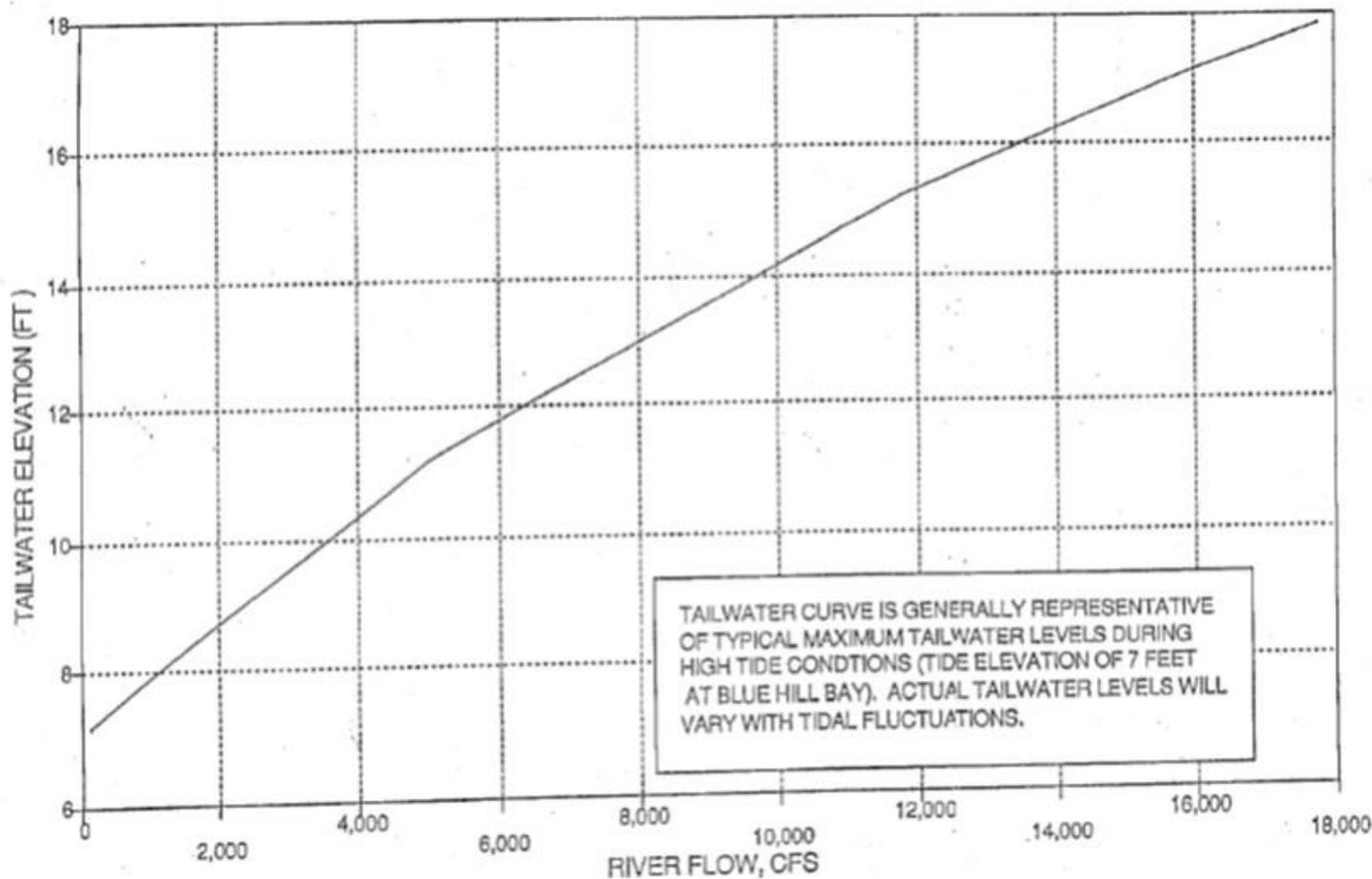
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APPENDIX B-2
TAILWATER RATING CURVES

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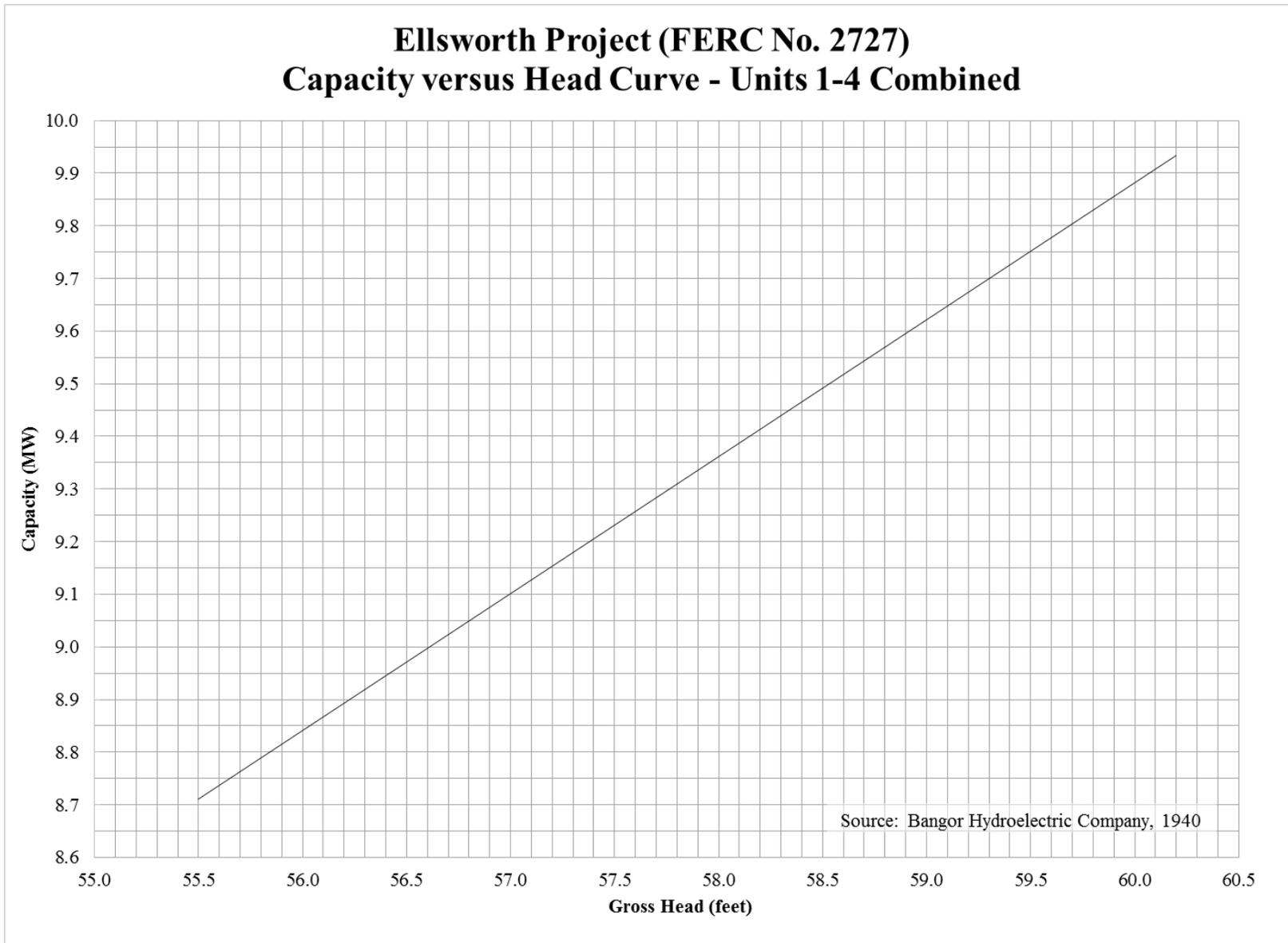
Graham Lake Dam Tailwater Rating Curve (Source: *Graham Lake Dam Remedial Measures Project Geotechnical Report* Northrop, Devine & Tarbell, Inc. 1992)



Ellsworth Dam Tailwater Rating Curve (Source: Ellsworth Project EAP – Appendix B. 1994)

APPENDIX B-3
CAPACITY VS. HEAD CURVE

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EXHIBIT C

**CONSTRUCTION HISTORY AND
PROPOSED CONSTRUCTION SCHEDULE**

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT C
CONSTRUCTION HISTORY AND PROPOSED CONSTRUCTION SCHEDULE**

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT C
CONSTRUCTION HISTORY AND PROPOSED CONSTRUCTION SCHEDULE**

1.0 INTRODUCTION

Black Bear Hydro Partners, LLC (Black Bear) is filing an application with the Federal Energy Regulatory Commission (FERC) for a new license for the Ellsworth Hydroelectric Project (Project or Ellsworth Project) located on the Union River in Hancock County, Maine. The following provides construction history information for the Project required under 18 CFR § 4.51(d).

2.0 CONSTRUCTION HISTORY

Bar Harbor and Union River Power Company constructed the Ellsworth Dam in 1907. The Graham Lake Dam, and the resulting Graham Lake reservoir were completed in 1924. Maintenance and repair activities at each of the developments has continued since their origination with major activities noted below.

The original facilities of the Ellsworth Dam consisted of two generation units (now termed Units No. 2 and 3). A third generation unit (now termed Unit No. 1) was added in 1919 and a fourth unit (Unit No. 4) was added in 1923 at the same time as construction of Graham Lake Dam. The horizontal turbines for Units No. 2 and 3 were replaced with vertical turbines in 1938, and the majority of the associated penstocks were also replaced at that time. In 1990 the open forebay was replaced with a new intake structure and longer penstocks.

Graham Lake Dam was constructed between 1922 and 1923. The original gate structure was found to have been constructed on soil and failed during a flood at the time of the initial filling of the reservoir. The gate structure was replaced with a structure founded on bedrock, and the dam was put into service in 1924. In response to the 1984 FERC Safety Inspection and subsequent studies, the site was dewatered from 1993-1994 and extensive remedial measures (including the construction of a downstream flood control structure) were implemented to address the high hazard potential and embankment stability of the structure.

Year	Ellsworth Dam	Graham Lake Dam
1907	Construction of dam and a two unit powerhouse completed and made operational	
1919	Third unit added	
1922		Dam construct initiated
1923	Fourth unit added	Dam failed during initial filling
1924		Dam rebuilt and put into service
1938	Units No. 2 and 3 replaced with vertical turbines and penstocks replaced	
1939	Crane trolley replaced with a motorized geared trolley	
1950	Spillway and non-overflow structures refaced with shotcrete	
1957	Rebuilt section of enclosure between buttresses four and six	
1982	All four turbines rebuilt and the generators rewound	
1985	Brake systems and cooling waters systems on Units No. 2 and 3 upgraded	
1986	Rip rap installed on downstream river bank to prevent erosion	
1986	Gatehouse replaced; fish passage facility installed	
1989		Temporary seepage control measures installed in one area of the downstream toe
1990	New intake structure constructed and penstock bays extended to the intake structure and buried	
1991	Headgate hoist installed	
1993	The buttress sections of the spillway and non-overflow structure partially filled with mass concrete and post-tensioned anchors installed	Site dewatered and site underwent extensive remedial repairs including construction of flood control structure, permanent cell, and southwest wingwall
1994		Major rehabilitation of radial gates.
1995	Repair of undermining of Unit No. 4 piers	
1995	Video cameras and high water alarms installed, the powerhouse automated	Video cameras and high water alarms installed

Year	Ellsworth Dam	Graham Lake Dam
2004	Sluice gate replaced with a stop log system used for downstream passage of migratory fish	
2005	Unit 4 rewind	
2006	Repairs completed on the downstream wall and tailrace flume piers of the powerhouse	
2007	No. 4 penstock replaced between the old forebay wall and powerhouse	

3.0 CONSTRUCTION SCHEDULE FOR NEW DEVELOPMENT

Black Bear proposes to install new upstream eel passage facilities at both the Ellsworth and Graham Lake dams within two years of the effective date of a new license. Black Bear also proposes to relocate the Graham Lake canoe portage within two years of the effective date of a new license.

Black Bear is not proposing any new capacity-related developments to the Ellsworth Project at this time.

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EXHIBIT D
STATEMENT OF COSTS AND FINANCING

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT D
STATEMENT OF COSTS AND FINANCING**

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**ELLSWORTH HYDROELECTRIC PROJECT
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**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT D
STATEMENT OF COSTS AND FINANCING**

1.0 ORIGINAL COST OF EXISTING UNLICENSED FACILITIES

This section is not applicable to the Ellsworth Hydroelectric Project (Project or Ellsworth Project) because Black Bear Hydro Partners, LLC (Black Bear) is not applying for an initial (original) license.

**2.0 ESTIMATED AMOUNT PAYABLE UPON TAKEOVER PURSUANT TO
SECTION 14 OF THE FEDERAL POWER ACT**

Under Section 14(a) of the Federal Power Act (FPA), the Federal government may take over any project licensed by the FERC upon the expiration of the original license. FERC may also issue a new license in accordance with Section 15(a) of the FPA. If such a takeover were to occur upon expiration of the current license, Black Bear would have to be reimbursed for the net investment, not to exceed fair value, of the property taken, plus severance damages. To date, no agency or interested party has recommended a federal takeover of the Project pursuant to Section 14 of the Federal Power Act.

2.1 Fair Value

The fair value of the Project is dependent on prevailing power values and license conditions, both of which are subject to change. The best approximation of fair value would likely be the cost to construct and operate a comparable power generating facility. Because of the high capital costs involved with constructing new facilities and the increase in fuel costs associated with operation of such new facilities (assuming a fossil fueled replacement), the fair value would be considerably higher than the net investment amount. If a takeover were to be proposed, Black Bear would calculate fair value based on then-current conditions.

2.2 Net Investment

The net book investment for the Project was approximately \$50,591,000 as of the end of 2014¹. Table D-1 shows original costs, accumulated depreciation, cost of relicensing² and net investment, under the Commission’s Uniform System of Accounts.

Table D-1: Data Used to Determine the Net Book Investment of the Project

FERC		Original Cost (\$)	Accumulated Depreciation	Net Investment
C	Production Plant			
330	Land and Water Rights	16,500	800	15,800
331	Structures and Improvements Reservoirs, Dams and	5,016,200	107,100	4,909,100
332	Waterways Waterwheels, Turbines and	41,743,200	745,000	40,998,200
333	Generators Accessory Electrical	3,874,000	136,700	3,737,300
334	Equipment	894,600	73,300	821,300
335	Misc. Power Plant Equipment	94,800	3,600	91,200
336	Roads, Railroads and Bridges	18,600	600	18,000
	Totals	51,657,900	1,067,100	50,590,900
302	Relicensing Costs	1,394,000	0	1,394,000
	Total Including Relicense Costs	53,051,900	1,067,100	51,984,900

2.3 Severance Damages

Severance damages are determined either by the cost of replacing (retiring) equipment that is “dependent for its usefulness upon the continuance of the License” (Section 14, Federal Power Act), or the cost of obtaining an amount of power equivalent to that generated by the Project from the least expensive alternative source, plus the capital cost of constructing any facilities that would be needed to transmit the power to the grid, minus the cost savings that would be realized from not operating the Project. As discussed above, these values would need to be calculated based on power values and license conditions at the time of project takeover.

¹ Black Bear’s fiscal year is the calendar year; therefore, 2015 financial information is not yet available. 2014 information is considered a reasonable representation

² The cost of relicensing presented is the total cost to date through November 2015.

3.0 ESTIMATED COST OF NEW DEVELOPMENT

3.1 Land and Water Rights

Black Bear is not proposing to expand land or water rights as a consequence of this license application.

3.2 Cost of New Facilities

Black Bear is not proposing any capacity-related developments at the Project. Black Bear proposes to install new upstream eel passage facilities at both the Ellsworth and Graham Lake dams within two years of the effective date of a new license. Black Bear also proposes to relocate the Graham Lake canoe portage within two years of the effective date of a new license. The cost to construct and maintain these facilities is provided in Exhibit E – Section 4.5.

4.0 ESTIMATED AVERAGE ANNUAL COST OF THE PROJECT

This section describes the annual costs of the Project as proposed. The estimated average cost of the total Project is approximately \$813,000 per year, based on a full 2014 year period of record³. This estimate includes costs associated with existing and projected project operations and maintenance⁴, as well as local property and real estate taxes, but excludes income taxes, depreciation, and costs of financing.

4.1 Capital Costs

Black Bear uses a 12% rate to approximate its average cost of capital. Actual capital costs are based on a combination of funding mechanisms that includes stock issues, debt issues, revolving credit lines, and cash from operations.

4.2 Taxes

Property taxes for the 2014 fiscal year were approximately \$161,000. Income taxes for the Project are incorporated into costs of Black Bear's consolidated business and are not separated out for the Project.

4.3 Depreciation and Amortization

The annualized composite rate of depreciation for the Project is approximately 2.25%.

³ Full 2014 year period of record has been determined to be representative of the Annual Cost of the Project.

⁴ Including major maintenance costs. Costs for individual PME measures are provided in Exhibit E- Section 4.5.

4.4 Operation and Maintenance Expenses

The estimated annual operation and maintenance expense at the Project was approximately \$652,000 including corporate support costs, but excludes property and real estate taxes.

4.5 Costs to Develop License Application

The approximate cost through November 2015 to prepare the application for a new license for the Project is approximately \$1,394,000.

4.6 Costs of Proposed Environmental Measure

Black Bear is proposing the following environmental measures in this application:

- implement erosion controls at the Graham Lake boat launch facility;
- develop a new portage trail at the west end of Graham Lake Dam;
- improve a fisherman's downstream access trail on the east side of Graham Lake Dam;
- develop and install in consultation with fisheries agencies, upstream eel passage at both the Ellsworth and Graham Lake Dams;
- implement the final Historic Properties Management Plan to provide for management of historic properties throughout the term of the license;
- implement the final Recreation Management Plan to provide for the management of recreation facilities throughout the term of the license.

The costs to develop and maintain the proposed measures is discussed in Exhibit E – Section 4.5.

5.0 ESTIMATED ANNUAL VALUE OF PROJECT POWER

Power generated by the project is sold through the Independent System Operator of New England (ISO NE) at prevailing market rates. Black Bear estimates gross annual energy production of about 30,511 megawatt-hour (MWh). The average market clearing price for energy can be estimated based on the ISO NE web site.

6.0 SOURCES AND EXTENT OF FINANCING

Black Bear's current financing needs are generated from internal funds. Financing of major enhancements will likely be made through earnings retention, equity contributions and/or loans made by the corporate parent.

EXHIBIT E
ENVIRONMENTAL REPORT

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT E
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Appendix E-12	Draft Biological Assessment for Atlantic Salmon, Atlantic Sturgeon, and Shortnose Sturgeon

LIST OF ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
APE	Area of Potential Effects
BA	Biological Assessment
Black Bear	Black Bear Hydro Partners, LLC
CEII	Critical Energy Infrastructure Information
CFR	Code of Federal Regulations
cfs	cubic feet per second
CWA	Clean Water Act (Federal)
CZMA	Coastal Zone Management Act (Federal)
DLA	Draft License Application
DO	dissolved oxygen
DPS	Distinct Population Segment
DWA	Deer Wintering Area
EFH	Essential Fish Habitat
EP	Ephemeroptera, Plecoptera
EPT	Ephemeroptera, Plecoptera, Trichoptera
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FLA	Final License Application (for new FERC license)
FPA	Federal Power Act
FT	Federal Threatened
GIS	Geographic Information System
GOM	Gulf of Maine
GPS	Global Positioning System
HBN	Hilsenhoff's Biotic Index
HPMP	Historic Properties Management Plan
ILP	Integrated Licensing Process
ISR	Initial Study Report
IWWH	Inland Waterfowl and Wading-bird Habitat
kW	kilowatt
KWh	Kilowatt hour
LAA	likely to adversely affect (in reference to federal endangered species)
Licensee	Black Bear Hydro Partners, LLC
LUPC	Land Use Planning Commission (Maine)
LURC	Land Use Regulation Commission (Maine)
Maine DEP	Maine Department of Environmental Protection
Maine DIFW	Maine Department of Inland Fisheries and Wildlife

Maine DMR	Maine Department of Marine Resources
mg/l	Milligrams per liter
Maine HPC	Maine Historic Preservation Commission
Maine NAP	Maine Natural Areas Program
MOA	Memorandum of Agreement
Maine SPO	Maine State Planning Office
MWDCA	Maine Waterway Development and Conservation Act
MW	megawatt
MWh	megawatt hours
NEPA	National Environmental Policy Act
NGO	non-governmental organization
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NLAA	not likely to adversely affect (in reference to federal endangered species)
NMFS	United States National Marine Fisheries Service (Part of NOAA)
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NRPA	Natural Resources Protection Act
NWI	National Wetlands Inventory
PAB	Palustrine Aquatic Bed
PAD	Pre-Application Document
PCE	primary constituent elements
PEM	Palustrine Emergent Wetland
PFO	Palustrine Forested Wetland
PLP	Preliminary Licensing Proposal
PME	protection, mitigation, and enhancement
PPM	parts per million
PSP	Proposed Study Plan
PSS	Palustrine Scrub-Shrub Wetland
PUB	Palustrine Unconsolidated Bottom
REA	Ready for Environmental Analysis
RMP	Recreation Facilities Management Plan
RPS	Renewable Portfolio Standards
RSP	Revised Study Plan
RTE	rare, threatened, or endangered
SD1	Scoping Document 1

SHPO	State Historic Preservation Officer
SPD	Study Plan Determination
SPP	Species Protection Plan
ST	State Threatened
SVP	Significant Vernal Pool
µg/l	micrograms per liter
URFCC	Union River Fisheries Coordinating Committee
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USR	Updated Study Report

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT E
ENVIRONMENTAL REPORT**

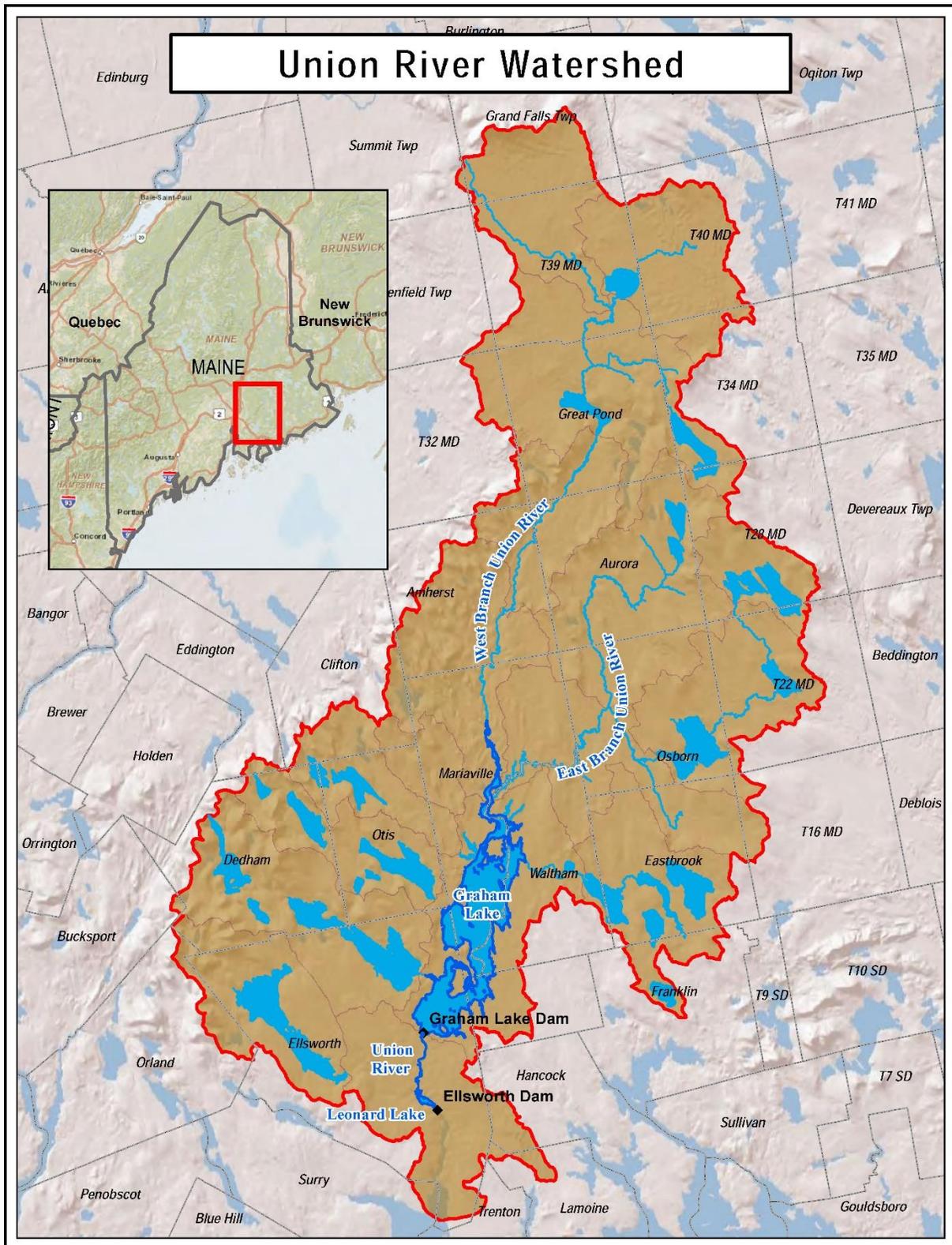
1.0 INTRODUCTION

Black Bear Hydro Partners, LLC (Black Bear) is the owner, operator, and licensee of the Ellsworth Hydroelectric Project (FERC No. 2727) (Project). The Project is located on the lower reach of the Union River in the City of Ellsworth, the towns of Waltham and Mariaville, and the township of Fletchers Landing in Hancock County, Maine (Figure E-1). Black Bear is using the Federal Energy Regulatory Commission's (FERC) Integrated Licensing Process (ILP) for the relicensing of the Project. Pursuant to the process and schedule requirements of the ILP (CFR Part 5), Black Bear is filing with FERC its Final License Application (FLA) for a new license for the Project. The FLA is being provided to participating agencies, tribes, non-governmental organizations (NGOs), local governments and the public.

The Project consists of two developments, the Ellsworth Development and the Graham Lake Development. The Ellsworth Development consists of the Ellsworth Dam, which forms the 90-acre Lake Leonard, and the associated generating facilities having an authorized installed nameplate capacity of 8.9 MW. The Ellsworth Dam forms the upper limit of tidal influence of the Union River; below Ellsworth Dam the Union River flows into the Union River Bay approximately three miles downstream from the Project. The Graham Lake Development consists of a dam with an approximately 10,000-acre storage reservoir (Graham Lake). There are no generating facilities at the Graham Lake Development.

Construction of the Ellsworth Dam was completed in 1907 and the Graham Lake Dam was completed in 1924. The current license was issued by FERC in 1987. The license has been amended three times since then; in 1992, 1999, and 2002. In 1992, the project boundary was modified to include an additional 2 acres of land located downstream of the existing Graham Lake Dam. In 1999; the project description was corrected, Exhibit A was revised and the project boundary was changed to exclude land underlying a substation not a part of the project. In 2002, the approval of an upstream fish passage plan filed pursuant to Article 406 in 1994 was rescinded and the Comprehensive Fishery Management Plan for the Union River was filed in its stead. The license was transferred to Black Bear Hydro Partners, LLC by FERC Order Approving Transfer of License dated September 17, 2009 (128 FERC ¶ 62,212).

Figure E-1: Project Location



The lower impoundment, Lake Leonard impounded by the Ellsworth Dam, has a surface area of 90 acres at its normal maximum elevation of 66.7' and a length of one mile. Graham Lake, the upper reservoir of the Project, has a normal maximum surface area of approximately 10,000 acres and a maximum length of approximately 10 miles. Graham Lake holds approximately 5.4 billion cubic feet of useable storage. Water levels in Graham Lake are typically managed between elevations of 93.4' and 104.2' (NGVD 1929).

The Project Developments are collectively operated as a peaking project utilizing stored water released at Graham Lake for power production at Ellsworth Dam. The Graham Lake Development provides storage and has no power facilities. The Ellsworth development is operated in a run-of-river mode, where water levels at Lake Leonard (Ellsworth Dam) are kept within a one foot fluctuation range during normal project operations (i.e. inflows to Lake Leonard are passed through equally at Ellsworth Dam). As part of the current license requirements the Licensee is required to release a continuous minimum flow of 105 cfs from the Graham Lake Dam and the Ellsworth Dam from July 1 through April 30 and 250 cfs from May 1 through June 30. The Union River has an average flow of 958 cubic feet per second (cfs) at the Ellsworth Development.

1.1 Purpose of Exhibit E

The purpose of Exhibit E, as defined in 18 CFR § 5.18, is to describe the following: 1) the existing and proposed project facilities, including project lands and waters; 2) the existing and proposed project operation and maintenance, to include measures for protection, mitigation and enhancement (PME), if appropriate, with respect to each resource affected by the Project proposal; and 3) the effects of issuing a new license for the continued operation and maintenance of the Project, including direct, indirect, and cumulative impacts based on information generated during relicensing studies.

The environmental analysis in this Exhibit E (Section 4.4) presents the assessment of effects associated with proposed Project operations and facilities and the expected benefits of proposed PME measures. This analysis is based in large part on the results of studies conducted by Black Bear in consultation with participating agencies, Tribes, and public and under the FERC approved and revised Study Plans. As discussed herein, there are several relicensing studies that will continue in 2016, and be reported in December 2016, as approved by the Commission.

The results of the continuing studies, as well as the resource analyses contained in this Exhibit E will provide the foundation for FERC's National Environmental Policy Act (NEPA) analysis.

1.2 Document Organization

In organizing this Exhibit E, Black Bear relied on FERC’s Revised Scoping Document for the Project, FERC’s regulations for Exhibit E – Environmental Report (18 CFR § 5.18[b]), and FERC’s guidance document, *Preparing Environmental Documents, Guideline for Applicants, Contractors, and Staff* (FERC, 2008).

This Exhibit E is divided into four sections: 1) Introduction, 2) Consultation (a summary of consultation is provided in Appendix E-1), 3) Proposed Action and Alternatives and 4) Environmental Analysis. Following a general description of the basin, Section 4 describes each of the following for each resource area: Affected Environment (brief description of the existing environment based on information from the Pre-Application Document (PAD) and study reports included in the ISR and USR), Environmental Analysis (description of the effects of the Project under proposed operations), Proposed PME (description of Black Bears proposed PME measures), Cumulative Effects (for those resources identified in the Scoping Document as ones that could be cumulatively affected, a description of whether the Proposed Action would contribute to such cumulative effects), and Unavoidable Adverse Impacts (description of any adverse impacts that will occur despite the implementation of proposed PMEs).

2.0 CONSULTATION

Black Bear initiated consultation with federal and state agencies, tribes, NGOs and other interested parties in October 2012, with the issuance of the Notice of Intent (NOI) and PAD. The NOI and PAD for the Ellsworth Project were issued to stakeholders and filed with FERC on October 24, 2012. FERC subsequently issued Scoping Document 1 (SD1) on December 20, 2012. Public scoping meetings were held January 15/16, 2013. Black Bear developed study plans, filed with FERC on April 8, 2013, that addressed written comments provided by stakeholders, as well as study scope changes resulting from comments and discussions that occurred at the public scoping meetings. After FERC conducted the Proposed Study Plan meetings and Agency Meetings in the spring of 2013, a Revised Study Plan was filed with FERC on August 5, 2013.

The Study Plan was approved with specific revisions by FERC in its Study Plan Determination issued on September 4, 2013. Study results were filed with FERC on September 4, 2014 in an Initial Study Report and shared with stakeholders at an Initial Study Report Meeting held on September 18, 2014. A Modified Study Plan was approved with specific revisions by FERC in a Determination on Requests for Study Modifications and New Studies letter dated December 30, 2014. The Updated Study Report, with additional study results from the second year of studies was filed with FERC on August 21, 2015. The USR public review meeting was conducted on September 3, 2015. The USR Meeting Summary was filed on September 9, 2015. FERC issued its Determination on Requested Study Modifications on December 8, 2015.

Stakeholders contacted as part of the ongoing consultation process are included in Table E-1. Appendix E-1 provides a summary of consultation over the course of the relicensing process.

Table E-1: List of Consulted Parties

Federal Agencies	
ACHP	Advisory Council on Historic Preservation
USACE	U.S. Army Corps of Engineers
FERC	Federal Energy Regulatory Commission
NMFS	U.S. National Marine Fisheries Service
NOAA	U.S. National Oceanic & Atmospheric Administration
NPS	U.S. Department of the Interior National Park Service
BIA	U.S. Department of the Interior Bureau of Indian Affairs
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
State Agencies	
Maine DMR	Maine Department of Marine Resources
Maine DIFW	Maine Department of Inland Fisheries & Wildlife
Maine DEP	Maine Department of Environmental Protection
Maine BPL	Maine Bureau of Parks and Lands (Department of Agriculture, Conservation and Forestry)
Maine HPC	Maine Historic Preservation Commission
Maine LUPC	Maine Land Use Planning Commission
Maine NAP	Maine Natural Areas Program
Maine DACF	Maine Department of Agriculture, Conservation, and Forestry
Local Governments	
Ellsworth	
Waltham	
Mariaville	
Non-Governmental Agencies	
ASF	Atlantic Salmon Federation
URWC	Union River Watershed Coalition
USA	Union Salmon Association
PERC	Penobscot East Resource Center
DSF	Downeast Salmon Federation
FBC	Frenchman’s Bay Conservancy
FTB	Friends of Taunton Bay
COA	College of the Atlantic
SC	Sierra Club
Tribes	
	Aroostook Band of Micmacs

Federal Agencies	
	Houlton Band of Maliseet Indians
	Passamaquoddy Tribe
	Penobscot Indian Nation
Individuals	
	Doug Watts
	Andrea Perry
	Toby Stephenson
	Peter Laplant
	Terry Carlisle
	Tom Folsem
	Peter Ober
	Anne Clarke
	Todd Little-Siebold
	Joe Minutolo
	Alan Atherton
	Jennifer Fortier

2.1 Response to Draft License Application Comments

Black Bear filed the Draft License Application (DLA) with FERC and stakeholders on July 10, 2015. Written comments on the DLA are summarized in Appendix E-2, with an explanation of how comments are addressed in the FLA.

2.2 REA Notice

This Environmental Report summarizes the results of studies conducted and reported to date. The FERC, over the course of reviewing and commenting on the study plans, ISR, USR and DLA, and in its Determination on Requested Study Modifications (December 8, 2015) has either authorized or required the continuance of several studies into 2016. These studies include:

- Atlantic Salmon Smolt Downstream Passage Study, to be conducted in the spring of 2016;
- Graham Lake, Lake Leonard, and Union River Tributary Access Study, to be conducted in the summer/fall of 2016;
- Adult American Eel Downstream Passage Study (year two), to be conducted in the fall of 2016.

The Study Reports for the above studies are to be submitted to FERC by December 31, 2016.

Once FERC has determined that Black Bear’s FLA and additional study reports meet all filing requirements, any deficiencies with the application have been resolved, and no additional information is required, FERC will issue the Notice of Acceptance and Ready for Environmental Analysis (REA). When the application is accepted, FERC issues the public notice in the Federal Register, local newspapers, and directly to resource agencies and Indian tribes.

The Acceptance/REA notice solicits comments, protests, and interventions- along with recommendations, preliminary terms and conditions, and preliminary fishway prescriptions by mandatory conditioning agencies- including all supporting documentation. Comments, protests, and interventions must be filed within 60 days of notice. Black Bear will then have 45 days to respond to submitted comments (105 days from the REA notice).

3.0 PROPOSED ACTION AND ALTERNATIVES

FERC issued a new license for the Project by order dated December 28, 1987. The license was for a term effective January 1, 1988 and terminating December 31, 2017. On September 17, 2009, the Commission issued an order approving the transfer of the Project license from PPL Maine, LLC, to Black Bear Hydro Partners LLC (Black Bear). The proposed action consists of the issuance of a new FERC license to Black Bear for the continued operation and maintenance of the Project with appropriate PME measures as described in Section 3.3.4 below.

3.1 No Action Alternative

No action means that the Project would continue to operate as authorized by the current license. Existing facilities would remain in place and existing resource measures would continue, but there would be no additional protection or enhancement of resources. If the Project were to operate as currently authorized, Black Bear would continue to produce energy in the present manner and the environmental effects of its operation would remain unchanged. Any ongoing effects of the Project would continue. The no action alternative represents the baseline Project energy production and environmental conditions for comparison with other alternatives.

3.1.1 Existing Project Facilities

The Project consists of two developments with associated dams and impoundments. The Ellsworth Development has a concrete dam 65 feet high and 377 feet long (with a 275-foot long section of spillway) and a powerhouse with four generation units having a total authorized installed nameplate capacity of 8.9 MW. The overflow spillway has a flashboard crest elevation of 66.7'. Unit No. 1 is served by a 10-foot diameter vertical penstock contained in the non-overflow section of the dam. The non-overflow section is connected to an intake structure containing three penstocks; two 8-foot diameter penstocks serving powerhouse units No. 2 and 3 and one 12-foot diameter penstock serving powerhouse unit No. 4. A fish passage facility is operated at the Ellsworth Dam providing for upstream fish passage, and the commercial harvest of river herring by the City of Ellsworth, under a cooperative management agreement with the Maine Department of Marine Resources (Maine DMR).

The Graham Lake Dam is a non-generating facility located about four miles upstream from the Ellsworth Dam. The structure is 30 feet high and consists of a 670-foot long earth dike and an 80 foot long concrete gate structure. The concrete gate structure contains three 20-foot-wide radial gates and an eight-foot-wide sluice that is used for downstream fish passage. There is a concrete flood control structure associated with the Graham Lake Dam. The flood control structure consists of an approximately 720-foot long flood wall, which is connected to the existing Graham Lake Dam gate structure by a wing wall extension and a permanent cofferdam cell.

The Ellsworth Project has a drainage area of approximately 547 square miles. The reservoir impounded by the Ellsworth Dam, Lake Leonard, has a surface area of 90 acres at its normal maximum elevation of 66.7’ and a reservoir length of one mile. Water levels in Lake Leonard vary between 65.7’ and 66.7’ during normal project operations.¹ The upper reservoir, Graham Lake, has a full pond surface area of approximately 10,000 acres and a maximum length of approximately 10 miles.

Table E-2: Ellsworth Project Specifications

GENERAL INFORMATION
Owner and Operator: Black Bear Hydro Partners LLC
FERC Project Number: 2727
Current License Term: January 1, 1998 to December 31, 2017
County: Hancock County
Nearest Town: Ellsworth, Maine
Watershed: Union River
River: Union River
Drainage Area: 547 square miles

Ellsworth Development

Graham Lake Development

Normal Maximum Water Surface Elevation	
Lake Leonard	Graham Lake
66.7’ (includes 1.7 foot flashboards)	104.2’
Normal Tailwater Elevation	
Varies with tidal fluctuations	80.5’
Reservoir Length	
1 mile	10 miles
Shoreline Length	
4.4 miles	80 miles (not including islands)
Surface Area at Maximum Water Surface	
Lake Leonard	Graham Lake
90 acres	Approximately 10,000 acres
Gross Storage Lake Leonard 0.107 billion cubic feet	Useable Storage Graham Lake – 5.4 billion cubic feet between elevations 104.2’ and 93.4’
Structures	
Ellsworth Dam	Graham Lake Dam
Concrete buttress dam	Earth fill dam with concrete core walls
Total Length 377 feet	Total Length 750 feet

¹ All elevations are in reference to NGVD 1929.

Structures (continued)	
Ellsworth Dam	Graham Lake Dam
Penstocks: 10-foot diameter vertical penstock serving Unit 1; two 8-foot diameter penstocks serving powerhouse Units No. 2 and 3, and a 12-foot diameter penstock serving Unit No. 4	N/A
Dam height 65 feet	Dam height 30 feet
Powerhouse: reinforced concrete and concrete block masonry structure 52.5 feet x 68 feet with an attached 15 feet x 30 feet switch house annex	N/A
Turbine Rated Capacity:* Unit 1 – 3,800 hp (2,850 kW) (vertical shaft propeller); minimum generating capacity unknown, approximately 685 cfs maximum hydraulic capacity Unit 2 – 2,900 hp (2,175 kW) (Kaplan); approximately 87 cfs minimum generating capacity and 545 cfs maximum hydraulic capacity Unit 3 – 2,900 hp (2,175 kW) (Kaplan); approximately 87 cfs minimum generating capacity and 545 cfs maximum hydraulic capacity Unit 4 – 3,800 hp (2,850 kW) (vertical shaft propeller); minimum generating capacity unknown, approximately 685 cfs maximum hydraulic capacity	N/A
Generator Rated Capacity:** Unit 1 – 3,125 kVA @ power factor 0.8; 2,500 kW Unit 2 – 2,500 kVA @ power factor 0.8; 2,000 kW Unit 3 – 2,500 kVA @ power factor 0.8; 2,000 kW Unit 4 – 3,000 kVA @ power factor 0.8; 2,400 kW	N/A

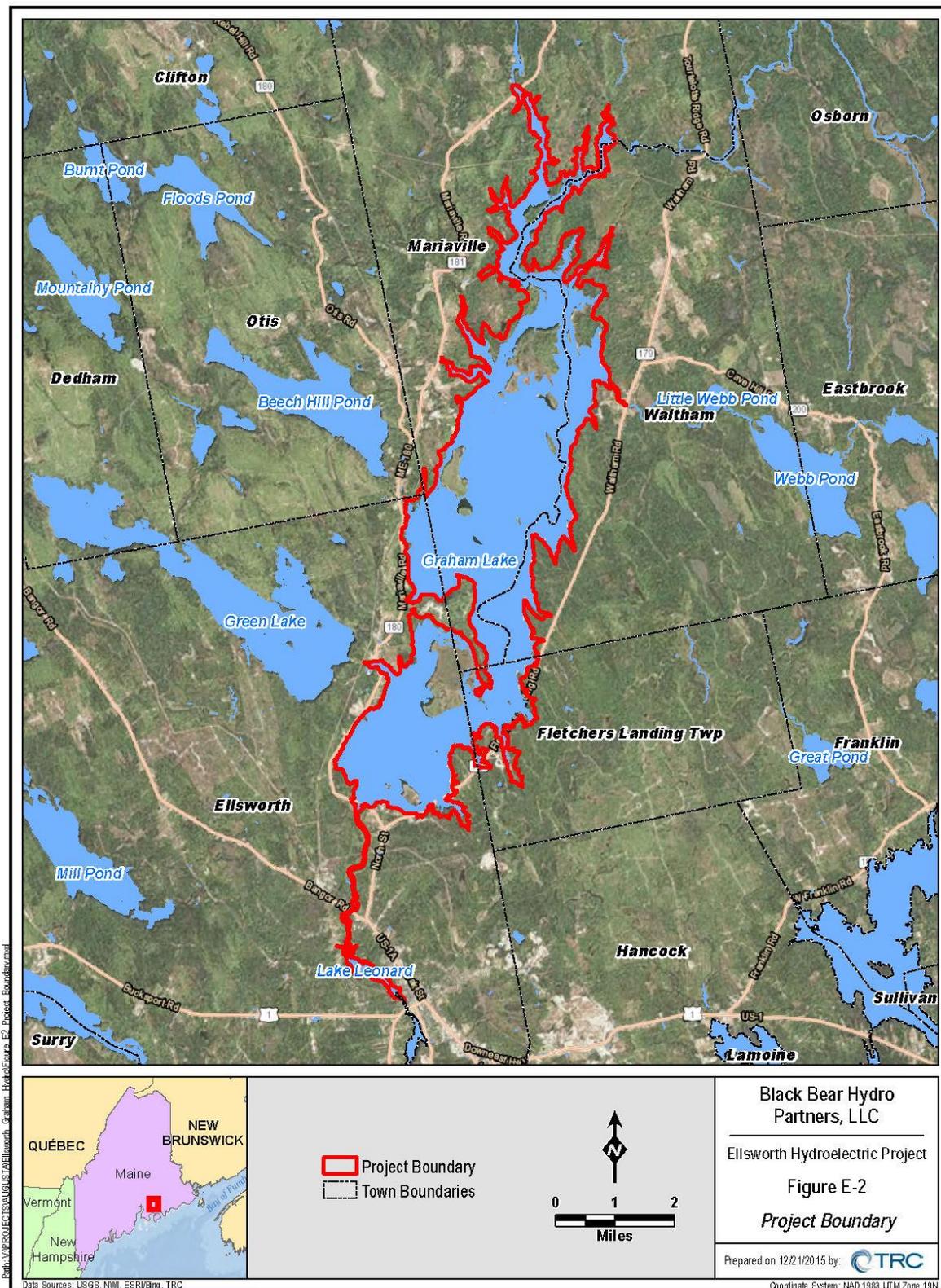
*The total combined maximum hydraulic capacity of the turbines is estimated to be 2,460 cfs.

**The total FERC authorized nameplate capacity of the facility, based on the limiting unit components, is 8.9MW.

3.1.2 Existing Project Boundary

The Project boundary generally follows elevation 66.7' on Lake Leonard and elevation 107' on Graham Lake. The Project boundary extends downstream from Ellsworth Dam approximately 800 feet. The project boundary also follows metes and bounds delineations surrounding the project facilities as shown on Exhibit G. There are no federal lands within the Project boundary.

Figure E-2: Project Boundary



3.1.3 Project Safety

The Project is classified as a high hazard dam and is subject to the Commission's Emergency Action Plan requirements. The Licensee's engineering or operations staff conducts an inspection annually, and routine repairs are performed as needed. Exhibit H, *Description of Project Management and Need for Power*, provides additional detail regarding the Licensee's safety programs.

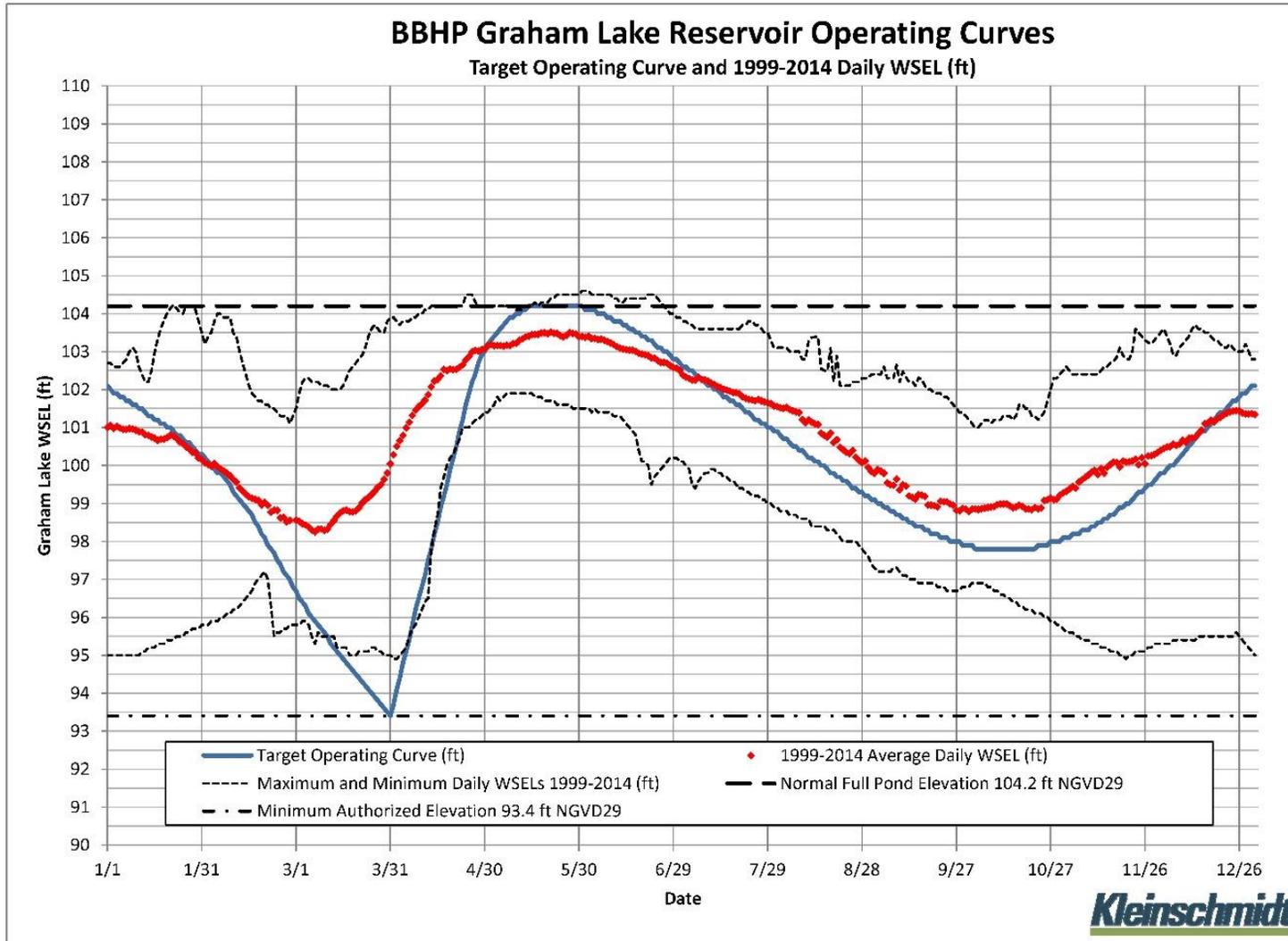
3.1.4 Existing Project Operations

The Project Developments are collectively operated as a peaking project utilizing stored water released at Graham Lake for power production at Ellsworth Dam. The four units contained in the Ellsworth powerhouse have a total FERC-authorized capacity of 8.9 megawatts (MW) with an estimated total hydraulic capacity of approximately 2,460 cubic feet per second (cfs). The Project generated an annual average of 30,511 MWh during the period 1994 – 2014.

The Union River has an average annual flow of 958 cubic feet per second (cfs). Minimum flows and water levels are maintained as per Articles 401 and 402 of the 1987 License. Article 401 specifies a continuous minimum flow release of 105 cfs from the Ellsworth Dam and Graham Dam from July 1 through April 30 and a continuous minimum flow release of 250 cfs from May 1 through June 30 for the protection of fishery resources (FERC 1987). The flows can be temporarily modified if required by operating emergencies beyond the control of Licensee, and for short periods upon on agreement among Licensee, USFWS and Maine DEP.

Article 402 of the current FERC license requires Licensee to operate the Project so that water levels in Lake Leonard are maintained between the elevations of 65.7' and 66.7' during normal project operations, and water levels in Graham Lake are maintained between elevations 104.2' and 93.4'. The requirements can be temporarily modified if required by operating emergencies beyond the control of Licensee, and for short periods upon agreement among Licensee, USFWS and Maine DEP. Timed releases at Graham Lake are used at Ellsworth Dam for power production. Graham Lake generally follows an operating curve that has historically resulted in fluctuations approaching 11 feet over the course of a year (Figure E-3). The normal operation of the Ellsworth facility maintains Lake Leonard to within a foot of normal full pond (i.e. normal variation between elevation 65.7' and 66.7'). Drawdown of Graham Lake in the fall and more extensively at the beginning of the year provides significant downstream flood control benefits. The ability to store large inflows when the lake is drawn down is a particularly valuable asset given the location of downtown Ellsworth just below the Ellsworth Dam. Drawdown of Graham Lake also provides important flow augmentation during dry periods so that minimum flows can be maintained in the Union River below Graham Lake Dam.

Figure E-3: Graham Lake Historic Operating Curves



3.1.5 Existing Environmental Measures

The Licensee currently provides the following PME measures for recreational and aquatic resources:

- Black Bear maintains a continuous minimum flow release of 105 cfs from the Ellsworth Dam and Graham Dam from July 1 through April 30 and a continuous minimum flow release of 250 cfs from May 1 through June 30 for the protection of fishery resources.
- Black Bear operates the Project so that water levels in Lake Leonard are maintained between the elevations of 65.7' and 66.7' during normal project operations, and water levels in Graham Lake are maintained between elevations 104.2' and 93.4'.
- Black Bear maintains a boat launch facility at Graham Lake;
- Black Bear maintains a portage/fisherman's access trail at Graham Lake
- Black Bear maintains a carry-in boat launch facility at Lake Leonard;
- Black Bear cooperatively manages an upstream fish passage facility at the Ellsworth Dam and provides downstream passage facilities at both Graham and Ellsworth dams.

3.2 Alternatives Considered but Eliminated from Detailed Study

3.2.1 Federal Government Takeover of the Project

No party has suggested that federal takeover of the Project would be appropriate and no federal agency has expressed an interest in operating the Project. The federal takeover of the Project would require congressional approval. Moreover, there is no evidence that indicates a federal takeover should be recommended to Congress. Thus, the federal takeover of the Project is not a reasonable alternative and has not been considered in detail in this analysis.

3.2.2 Issuance of Non-Power License

No party has sought a non-power license and there is no basis for concluding that the Project should no longer be used to produce power. Thus, a non-power license is not a reasonable alternative to a new license with PME measures and has not been considered in detail in this analysis.

3.2.3 Project Decommissioning

Decommissioning of the Project could be accomplished with or without dam removal. Either alternative would require denying the request for a new power license and surrender or termination of the existing license with appropriate conditions.

The Project provides a viable, safe, and clean renewable source of power to the region; therefore, replacement power would need to be identified. The Project contributes to flood control and seasonal water storage in the Union River basin and provides the public with recreational access. If the Project were decommissioned, its contribution to flood control and seasonal water storage in the Union River basin would end and the public would no longer have access to the Project's recreation facilities. In addition, dam removal would lead to the loss of a significant amount of alewife habitat upstream of Graham Lake Dam. The cost of decommissioning as an alternative means of providing for fish passage was generally considered in the Upstream Fish Passage Alternatives Study. However, Project decommissioning is not a reasonable alternative to relicensing the Project with appropriate PME measures and has not been considered in detail in this analysis.

3.3 Proposed Action

3.3.1 Proposed Project Facilities

Black Bear is proposing no power-related modifications of the existing Ellsworth Project facilities. The existing dams, powerhouse, spill gates, and appurtenant features are all well maintained and in good working order. No changes of these facilities that are outside normal maintenance practices or the Commission's safety requirements are required or proposed. Black Bear is, however, proposing to consult with the agencies on appropriate fish passage facilities or measures as described below.

3.3.2 Proposed Project Boundary

Black Bear is proposing no changes to the existing Project boundary, which encloses the project works and impoundments and lands necessary for Project purposes.

3.3.3 Proposed Project Operation

Black Bear is proposing no changes in the way the Ellsworth Project is currently operated. The Project will continue to operate to generate electricity. Black Bear is proposing to maintain the current flow regime, whereby it will provide a seasonally variant minimum flow of 105 cfs or inflow, whichever is less, and 250 cfs or inflow, whichever is less, from the Project. Black Bear is also proposing to operate the impoundments within existing pond level limits. Periodically, the Licensee may be required to modify Project operations, including flows and impoundment levels in order to maintain or repair the Project, consistent with FERC requirements. However, any such planned changes in Project operation would be conducted in accordance with FERC's requirements for notification and consultation, consistent with the new Project license and the final Operations Monitoring Plan (OMP). The draft OMP is attached as Appendix E-11.

The Licensee proposes that the following operating conditions with respect to minimum flows and impoundment levels be included as articles in the new license:

- Minimum Flows

Except as temporarily modified by (1) approved maintenance activities, (2) extreme hydrologic conditions, as defined below, (3) emergency electrical system conditions, as defined below, or (4) agreement between the Licensee, the Maine DEP, and appropriate state and/or federal fisheries management agencies, the Licensee shall release a continuous minimum flow of 105 cubic feet per second (cfs) from the Graham Lake Development and the Ellsworth Development from July 1 through April 30, and a continuous minimum flow of 250 cfs from May 1 through June 30, for the protection of fishery resources.

- Impoundment Levels

Except as temporarily modified by (1) approved maintenance activities, (2) extreme hydrologic conditions, as defined below, (3) emergency electrical system conditions, as defined below, or (4) agreement between the Licensee, the Maine DEP, and appropriate state and/or federal fisheries management agencies, the Licensee shall operate the project so that water levels in Lake Leonard are maintained between the elevations of 65.7' and 66.7' (flashboard crest) during normal operation, and water levels in Graham Lake are maintained between 104.2' and 93.4'.

"Extreme Hydrologic Conditions" means the occurrence of events beyond the Licensee's control such as, but not limited to, abnormal precipitation, extreme runoff, flood conditions, ice conditions or other hydrologic conditions such that the operational restrictions and requirements contained herein are impossible to achieve or are inconsistent with the safe operation of the Project.

"Emergency Electrical System Conditions" means operating emergencies beyond the Licensee's control which require changes in flow regimes to eliminate such emergencies which may in some circumstances include, but are not limited to, equipment failure or other temporary abnormal operating conditions, generating unit operation or third-party mandated interruptions under power supply emergencies, and orders from local, state, or federal law enforcement or public safety authorities.

3.3.4 Proposed Environmental Measures

Black Bear is proposing the following PME measures for the management of resources:

- Implement the following recreation proposals:
 - Implement erosion control measures at the existing Graham Lake boat launch facility;
 - Develop a new portage trail at the west end of Graham Lake Dam;
 - Improve a fisherman’s downstream access trail on the east side of Graham Lake Dam;
 - Implement a Recreation Facilities Management Plan (RMP) to include the above measures and management of recreational facilities at the Project;
- Develop, in consultation with fisheries management agencies, plans for upstream eel passage at Ellsworth and Graham Lake Dams;
- Consult with the fisheries management agencies on the need for and, if necessary, the design of downstream eel passage measures pending the results of downstream eel passage studies;
- Consult with the agencies on the need for and, if necessary, the design of upstream and downstream anadromous fish passage improvements pending the results of ongoing studies;
- Finalize and implement a Historic Properties Management Plan to provide for management of historic resources throughout the term of the license;
- Finalize and implement an Operations Monitoring Plan (OMP) specifying the methods the Licensee will use to monitor and report the provision of minimum flows and pond levels, to confirm that the Project is operated in compliance with the new FERC license.

4.0 ENVIRONMENTAL ANALYSIS

4.1 General Description of the River Basin

The Union River Watershed—located in Hancock and Penobscot Counties, in eastern Maine—has a drainage area of approximately 547 square miles above the Ellsworth Dam. The Union River is composed of three main tributaries: the East, West, and Middle Branches. The total length of these branches includes 484 miles of streams and 81 miles of lakes and ponds (URSG 2000).

The river forms at the north end of Graham Lake at the confluence of the river's East and West branches, on the border of the towns of Mariaville and Waltham. It runs south 10 miles through Graham Lake to the dam at the lake's outlet, then continues south through Ellsworth, flowing through Leonard Lake and passing over its outlet dam just above the downtown. The Ellsworth Dam, built in 1907, spans the Union River and forms Lake Leonard. It houses a powerhouse with four generating units that combined produce 30,511 MWh per year, enough to power about 3,000 households. At downtown Ellsworth, the river reaches tidewater, and flows south as an estuary (Union River Bay) for 5 miles (8 km) to the Atlantic Ocean.

4.1.1 Hydrology

The calculated mean annual flow for the Project at the Ellsworth Dam is 958 cfs. Annual and monthly flow duration curves are provided in Appendix A of Exhibit B. These curves were calculated based on daily generation records at the Project.

4.1.2 Topography

The Union River basin is characterized by numerous flat or gently rolling plains, a few high bedrock ridges and monadnocks, and a variety of lakes, ponds, and streams. The basin topography has been shaped primarily by glaciation and marine invasion. Elevations throughout the basin range from sea level to a maximum of 1,300 feet.

The bedrock of the basin consists of highly altered metamorphic rock in the northern portion, and a wide zone of schist and gneiss intruded by great masses of granite along the southern section near the coast. The overburden throughout the basin consists of glacial till aqueo-glacial outwash, and marine sediments. While the glacial till covers most of the bedrock in the region, extensive areas of till have, in turn, been buried by subsequent glacial outwash and marine materials. These materials, consisting of sand and gravel, form numerous and extensive outwash plains, deltas, kames, and eskers. Many of the flat, swampy areas in the basin are largely the result from graded material washed out by the retreating glacier (Bangor Hydro-Electric Company 1984).

4.1.3 Climate

The Ellsworth Project is located in Maine's coastal climatological division, which extends for about twenty miles inland along the length of the coast. The coastal division is tempered by the ocean, resulting in lower summer and higher winter temperatures than are typical of interior zones. In the Ellsworth Project area, the average daily temperature maximum in July is 78° F (26°C) and the average daily minimum is 58° F (14°C). In January the average daily maximum is 30° F (-1°C) and the average daily minimum is 11° F (-12°C). The average annual precipitation in the Project area is 46.8 inches which is typically distributed evenly throughout the year (3-4 inches/month), although some flooding may occur in late winter/early spring due to rain/snowmelt events. Annual snowfall averages approximately 63 inches in the Project area.

4.1.4 Land Uses and Economic Activity

The Ellsworth Project is located in Hancock County, the seventh largest county in terms of land area. Hancock County is rural and sparsely populated, ranking eighth out of 16 in population. Hancock County's population density is 34.3 persons per square mile, which is lower than the state of Maine average of 43.1 persons per square mile (U.S. Census Bureau, 2015h).

Approximately 90.2 percent of Hancock County is comprised of forested land (USDA, 2005). The City of Ellsworth, Towns of Mariaville and Waltham, and Fletchers Landing Township are in the Northeast Maine nonmetropolitan area (BLS, 2013). While lands within the Project vicinity are predominately undeveloped forest lands and wetlands, the city of Ellsworth is an area of relatively dense population (7,741 in 2010) within the County. Forestry is a common land use in the area, while agricultural uses include apple orchards and blueberry barrens (Ellsworth Comprehensive Planning Committee, 2004, Mariaville Comprehensive Planning Committee, 2006).

There were an estimated 24,355 households in Hancock County, which was approximately 4.4 percent of the state's households based upon the Census 2009-2013 American Community Survey Estimate values. The median household income in Hancock County was \$47,460. Approximately 14.0 percent of the population of Hancock County was below the poverty level, while the percent of the state's population living below poverty level was lower at 13.6 percent (US Census Bureau, 2015h). Hancock County had a higher unemployment rate (7.8 percent) as compared to the overall state (5.5 percent) in December 2014 based upon the data derived from the Local Area Unemployment Statistics (LAUS) program (Maine CRWI, 2015).

In Hancock County, as well as the entire state of Maine, the top two sources of employment are in education and health services (7,336 people employed) and in the retail trade industry (3,286 people employed) (US Census, 2015b and 2015c). The largest employer in Hancock County is Jackson Laboratory, which employed over 1,000 people in 2014 (MDOL, 2014).

4.1.5 Dams and Diversions

Other than the Ellsworth and Graham Lake Dams, there are no other dams or diversions on the main stem Union River². The Ellsworth Dam is at the head-of-tide of the Union River which empties into Union River Bay in the Atlantic Ocean approximately three miles downstream from the Project.

4.2 Cumulative Effects

4.2.1 Resources that could be Cumulatively Affected

In SD1, the Commission identified migratory fish (i.e., alewife, American eel, American shad, Atlantic salmon, Atlantic sturgeon, blueback herring, and striped bass) and water quality as resources that could be cumulatively affected by the proposed continued operation and maintenance of the Ellsworth Project in combination with other hydroelectric projects and other activities in the Union River Basin. The effects analyses for the resources identified as having the potential to be cumulatively affected appear in the applicable resource area sections.

4.2.2 Geographic Scope of Cumulative Effects Analysis

The geographic scope of the analysis for cumulatively affected resources is defined by the physical limits or boundaries of (1) the proposed action's effect on the resources, and (2) contributing effects from other hydropower and non-hydropower activities within the Union River Basin. In SD1 the Commission identified the geographic scope for migratory fish species to include the Union River Basin from Union River Bay upstream to Great Pond on the West Branch Union River, to Alligator Lake on the Middle Branch Union River, and to Rocky Pond on the East Branch Union River. The Commission chose this geographic scope because operation and maintenance of the Ellsworth Project, in combination with other hydroelectric projects and activities in the Union River Basin, may directly affect migratory fish species or affect access to and quantity of migratory fish habitat.

4.2.3 Temporal Scope of Cumulative Effects Analysis

The temporal scope of the environmental analysis includes the past, present, and reasonably foreseeable future actions and their effects on migratory fish and water quality. Based on the potential term of the new license for the Ellsworth Project, the temporal scope will look 30 to 50 years into the future, concentrating on the effect on resources of reasonably foreseeable actions. The historical discussion will, by necessity, be limited to the amount of available information for each resource.

² The Green Lake Project, FERC No. 7189 is located on Reeds Brook, a tributary of Graham Lake.

4.3 Applicable Laws

4.3.1 Section 401 of the Clean Water Act

Pursuant to Section 401 of the Federal Water Pollution Act, Public Law 92-500 as amended, Black Bear is required to apply for Water Quality Certification for the federal licensing of the continued operation of the Project.

As part of the ILP, Black Bear consulted with the Maine Department of Environmental Protection (Maine DEP) throughout the relicensing process. Black Bear will file an Application for Water Quality Certification with Maine DEP subsequent to the FERC notice of Ready for Environmental Analysis (REA).

4.3.2 Endangered Species Act

The federal Endangered Species Act (ESA) (16 U.S.C. 1531-1544 – Public Law 93-205) provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The lead federal agencies for implementing the ESA are the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS). The USFWS maintains a nationwide list of endangered species. The law requires federal agencies, in consultation with the USFWS or NOAA to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. Section 9 of the ESA prohibits taking endangered species of fish and wildlife. The regulations implementing ESA define “take” as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct.

As part of the ILP, Black Bear consulted with the USFWS and the NOAA throughout the relicensing process to assess potential Project effects on federally listed threatened and endangered species in the Project area. Rare, threatened and endangered species at the Project are listed in Section 4.4.6 of this Exhibit E and described in detail in relevant sections of this Exhibit E. The federally listed Atlantic salmon is documented in the project area. A draft Biological Assessment for Atlantic salmon is included in Appendix E-12.

4.3.3 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 mandated that habitats essential to federally managed commercial fish species be identified, and that measures be taken to conserve and enhance habitat. In the amended Act, Congress defined essential fish habitat (EFH) for federally managed fish species as “those waters and substrate

necessary to fish for spawning, breeding, feeding, or growth to maturity”. The designation and conservation of EFH seeks to minimize adverse effects on habitat caused by fishing and non-fishing activities.

Before a Federal agency proceeds with an activity that may adversely affect a designated EFH (e.g., relicensing of a hydro project), the agency must: 1) consult with NOAA Fisheries and, if requested, the appropriate Council for the recommended measures to conserve EFH and 2) reply within thirty days of receiving EFH recommendations. The agency response must include proposed measures to avoid or minimize adverse impacts on the habitat, or alternatively an explanation if the agency cannot adhere to the recommendation from NOAA Fisheries.

Essential fish habitat for Atlantic salmon is described 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). The EFH designated habitat for all life stages of Atlantic salmon (eggs, larvae, juveniles, and adults) in Maine includes the Union River and Union River Bay, including the Project area. Black Bear provides its EFH assessment in Section 4.5

4.3.4 Coastal Zone Management Act

Under section 307(c) (3) (A) of the Coastal Zone Management Act (CZMA), the Commission cannot issue a license for a project within or affecting a states’ coastal zone unless the state CZMA agency concurs with the license applicant’s certification of consistency with the states’ CZMA program, or the agency’s concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant’s certification.

The Ellsworth Project is located in the City of Ellsworth at the head of tide of the Union River, within the Maine Coastal Zone. Black Bear will, subsequent to the FERC issuance of the REA, submit a certificate of consistency to the Maine Coastal Program in the Maine Department of Agriculture, Conservation and Forestry for their review and concurrence.

4.3.5 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, requires FERC to take into account the effect of its undertakings on historic properties. In this case the undertaking includes the issuance of a federal license for the continued operation of the Ellsworth Project. Section 106 of the NHPA is implemented through the Advisory Council on Historic Preservation (Council regulations “Protection of Historic Properties” (36 CFR Part 800). For hydropower licensing actions, FERC typically completes Section 106 by entering into a Programmatic Agreement or Memorandum of Agreement (MOA) with the licensee, the Advisory Council on Historic Preservation (ACHP), and the state and tribal historic preservation

office. FERC typically requires the licensee to develop and implement a Historic Properties Management Plan (HPMP) as a license condition. Through an approved HPMP, FERC can require consideration and management of effects on historic properties for the license term; thus, meeting the requirements of Section 106 for its undertakings.

As part of the relicensing process, Black Bear consulted with the State Historic Preservation Officer (SHPO) and the Tribes that may have an interest in the Project, as appropriate, regarding the Phase I archaeological survey, Phase II archaeological testing and the historic architectural survey of the Project area. A draft HPMP is attached as Appendix E-10 and proposes the process and measures to be taken by Black Bear to protect and preserve the historic properties identified at the Project over the term of the new license. With the implementation of an approved HPMP, the continued operation of the Project as proposed by Black Bear will have no significant adverse impacts on cultural resources at the Project.

4.3.6 Wild and Scenic Rivers and Wilderness Acts

The National Wild and Scenic Rivers System was created by Congress in 1968 (Public Law 90-542; 16 U.S.C. 1271 et seq.) to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. Rivers are classified as wild, scenic, or recreational.

The Wilderness Act of 1964 [Public Law 88-577 (16 U.S.C. 1131-1136)] was enacted to establish a National Wilderness Preservation System for the permanent good of the whole people, and for other purposes.

There are no nationally designated wild and scenic rivers or wilderness areas within the Project boundary or in the vicinity of the Project.

4.4 Proposed Action

4.4.1 Geology and Soils

4.4.1.1 Affected Environment

The Ellsworth Project is located within the eastern coast of Hancock County in an area of the State that was modified heavily by glacial activity. The majority of the landscape in the vicinity of the Project is gently sloping valleys draining into the coastal lowlands of the southern portion of the county. Elevations throughout the basin range from sea level to a maximum of 1300 feet.

Geological Features

The Project area is contained within three biophysical regions in the State of Maine: Central Interior, the Eastern Lowlands, and Penobscot Bay regions (Figure E-4). The Central Interior biophysical region is characterized by sedimentary and metamorphic bedrock overlain by deep, well to moderately drained, coarse sandy loam soils. The Penobscot Bay Region is distinguished by granitic plutons and granite. The Eastern Lowlands Biophysical Region is comprised of mineral soils that are generally wet and dense with glaciolacustrine deposits and glaciomarine clays. Depressions within this region are commonly filled with organic soils, mucks, clays, and silts (Maine DIF&W, 2005).

The underlying bedrock within the region is complex with alternating bands of metasedimentary and metavolcanic rocks (Maine DIF&W, 2005). Geologic formations dating from the Ordovician and Cambrian periods consist of stratified rocks including Penobscot formation of schist and pelitic slate and unnamed volcanic rocks and the Ellsworth Schist, a type of quartz-feldspar-muscovite-chlorite schist (MGS, 2008).

Soils

Soils within the Union River Basin consist mainly of marine clays in the low-lying areas, and glacial tills above. The tills are of a coarse sandy or stony nature, are well to excessively drained, and contain hardpan about two to three feet below the surface. The soils in the Project area fall into four dominate soil association units: Lamoine-Lyman-Dixfield; Hermon-Dixfield-Lyman; Colton-Sheepscot-Adams; and Dixfield-Marlow-Brayton. Table E-3 lists the soil series known to occur in the Project area.

The majority of the Project lies within the Lamoine-Lyman-Dixfield unit, which is comprised of loamy and clayey soils deposited over bedrock (Ferwerda, 1997). Drainage ranges from the somewhat excessively drained Lyman soil to the somewhat poorly drained Lamoine soil (NRCS, 1988).

The second general soil group within the Project area is the Hermon-Dixfield-Lyman unit, located on the west side of Graham Lake. These soils are characterized by sandy loams that are very stony to extremely bouldery on upland till ridges surrounding lakes, ponds, and valleys. Drainage classes within the general unit range from somewhat excessively drained to moderately well drained Dixfield soil (NRCS, 1988).

The third general soil group is the Colton-Sheepscot-Adams unit, located on the west side of Graham Lake. Soils here are very deep and range from steep slope to relatively flat with moderately well drained to excessively drained soils formed in glaciofluvial sand and gravel. These soils are poorly to very poorly drained.

Figure E-4: Biophysical Regions

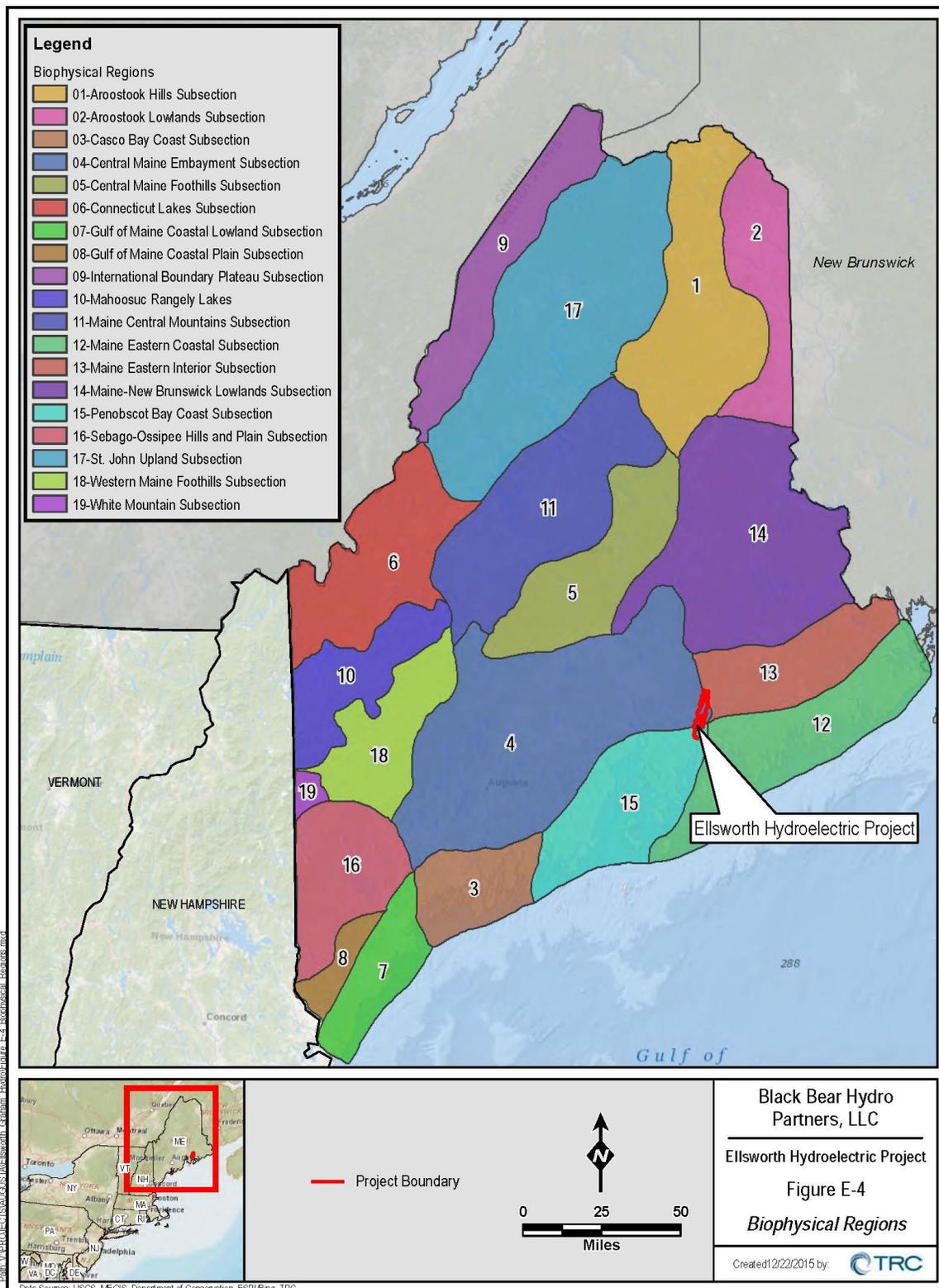


Figure E-5: Hancock County General Soil Map

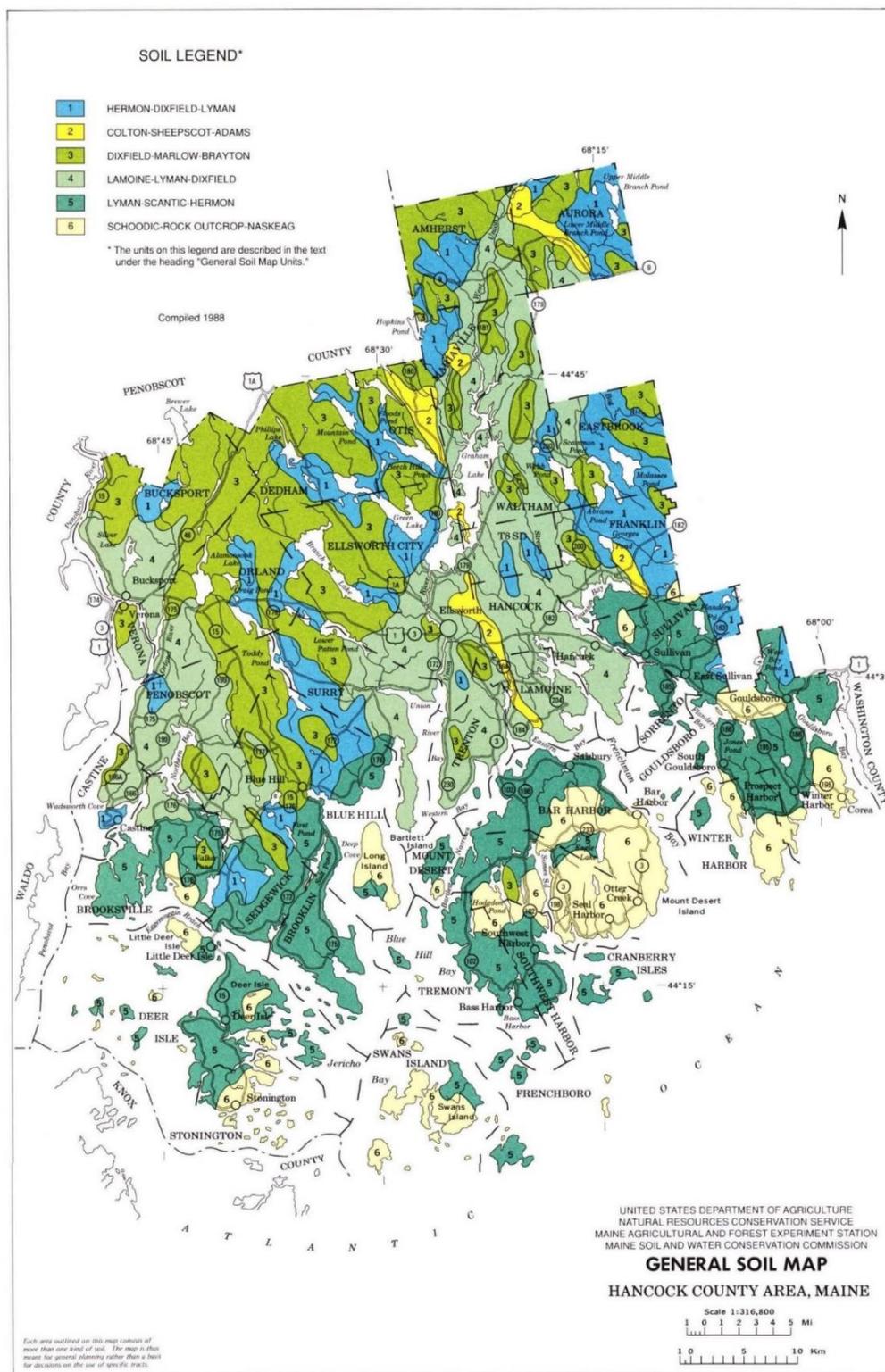


Figure E-6: Project Area Soils

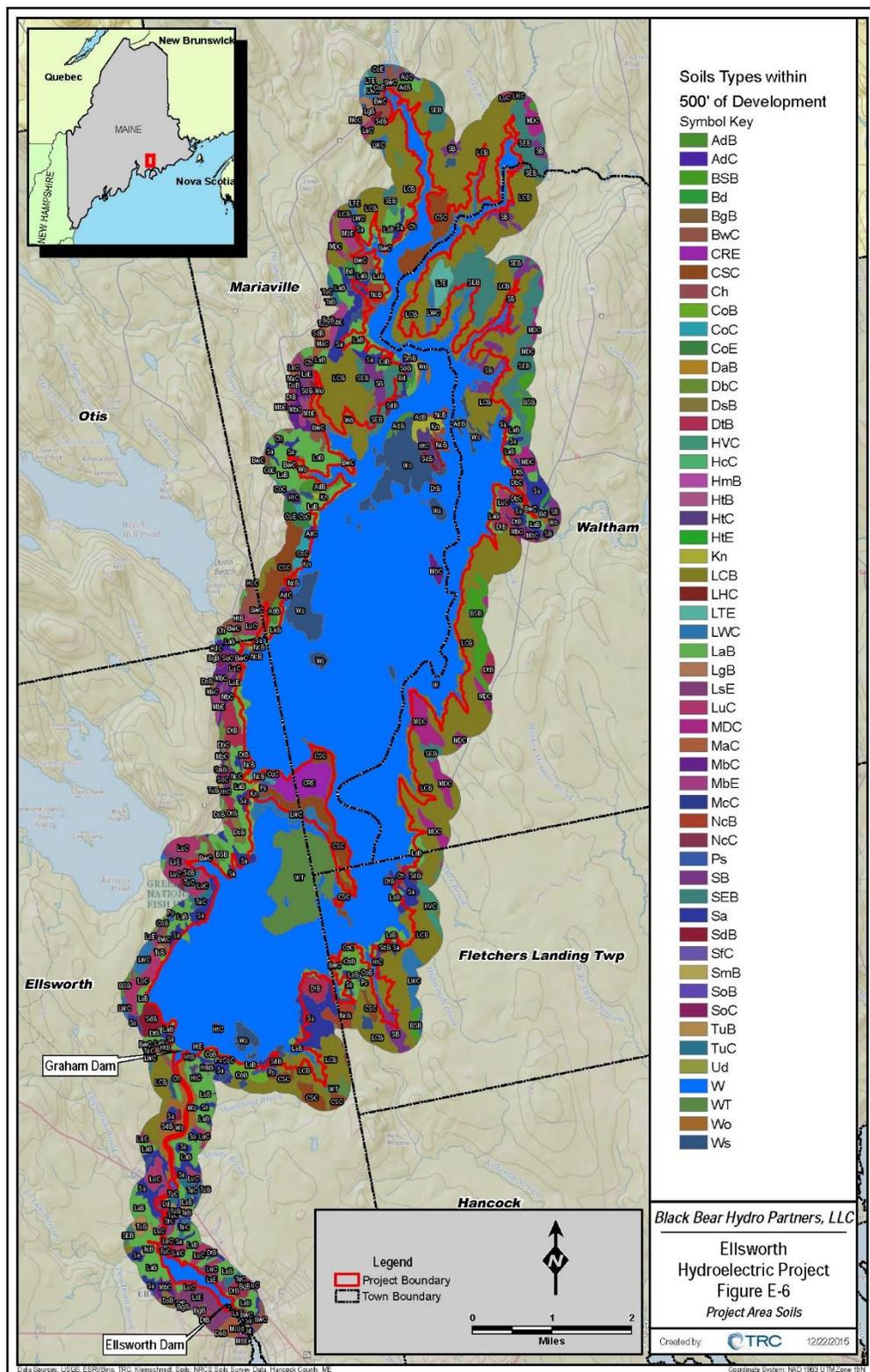


Table E-3: Soils Series Occurring within the Ellsworth Project Area

Soils Unit Symbol	Soils Unit Name
AdB	Adams loamy sand, 0 to 8 percent slopes
AdC	Adams loamy sand, 8 to 15 percent slopes
Bd	Biddeford mucky peat, 0 to 3 percent slopes
BgB	Brayton fine sandy loam, 0 to 8 percent slopes, very stony
BSB	Brayton-Colonel association, gently sloping, very stony
BwC	Buxton silt loam, 8 to 15 percent slopes
Ch	Charles silt loam, 0 to 2 percent slopes, occasionally flooded
CoB	Colton gravelly sandy loam, 0 to 8 percent slopes
CoC	Colton gravelly sandy loam, 8 to 15 percent slopes
CoE	Colton gravelly sandy loam, 15 to 45 percent slopes
CRE	Colton-Adams association, steep
CSC	Colton-Adams-Sheepscot association, strongly sloping
DaB	Dixfield fine sandy loam, 3 to 8 percent slopes
DbC	Dixfield fine sandy loam, 8 to 15 percent slopes, very stony
DsB	Dixfield-Colonel complex, 3 to 8 percent slopes
DtB	Dixfield-Colonel complex, 3 to 8 percent slopes, very stony
HcC	Hermon-Colton-Rock outcrop complex, 3 to 15 percent slopes, very stony
HmB	Hermon-Monadnock complex, 3 to 8 percent slopes
HtB	Hermon-Monadnock complex, 3 to 8 percent slopes, very stony
HtC	Hermon-Monadnock complex, 8 to 15 percent slopes, very stony
HtE	Hermon-Monadnock complex, 15 to 45 percent slopes, very stony
HVC	Hermon-Monadnock-Dixfield complex, strongly sloping, very stony
Kn	Kinsman loamy sand
LaB	Lamoine silt loam, 3 to 8 percent slopes
LCB	Lamoine-Scantic-Buxton association, gently sloping
LgB	Lyman-Brayton complex, 3 to 15 percent slopes, very stony
LHC	Lyman-Brayton-Schoodic complex, 3 to 15 percent slopes , rocky
LsE	Lyman-Schoodic complex, 15 to 35 percent slopes, rocky
LTE	Lyman-Schoodic-Rock outcrop complex, 15 to 35 percent slopes, very stony
LuC	Lyman-Tunbridge complex, 0 to 15 percent slopes, very stony
LWC	Lyman-Tunbridge-Schoodic complex, 8 to 15 percent slopes, very stony
MaC	Marlow fine sandy loam, 8 to 15 percent slopes
MbC	Marlow fine sandy loam, 8 to 15 percent slopes, very stony

Soils Unit Symbol	Soils Unit Name
MbE	Marlow fine sandy loam, 15 to 45 percent slopes, very stony
McC	Marlow fine sandy loam, 3 to 15 percent slopes, extremely bouldery
MDC	Marlow-Dixfield association, strongly sloping, very stony
NcB	Nicholville very fine sandy loam, 3 to 8 percent slopes
NcC	Nicholville very fine sandy loam, 8 to 15 percent slopes
Ps	Pits, gravel and sand
Sa	Scantic silt loam, 0 to 3 percent slopes
SB	Scantic-Biddeford complex, 0 to 3 percent slopes
SdB	Scantic-Lamoine complex, 0 to 8 percent slopes, very stony
SEB	Scantic-Lamoine-Dixfield complex, gently sloping, very stony
SfC	Schoodic-Rock outcrop complex, 0 to 15 percent slopes
SmB	Sheepscot sandy loam, 0 to 8 percent slopes
SoB	Sheepscot sandy loam, 3 to 8 percent slopes, very stony
SoC	Sheepscot sandy loam, 8 to 15 percent slopes, very stony
TuB	Tunbridge-Lyman complex, 3 to 8 percent slopes, rocky
TuC	Tunbridge-Lyman complex, 8 to 15 percent slopes, rocky
Ud	Udorthents-Urban land complex
W	Water bodies
Wo	Wonsqueak muck, flooded
Ws	Wonsqueak and Bucksport mucks
WT	Wonsqueak, Bucksport, and Sebago soils

Source: NRCS 2015

The final general soil group is the Dixfield-Marlow-Brayton unit, located west of Lake Leonard. These soils consist of very deep compact upland glacial till that is poorly to well drained with steep to nearly flat topography.

Exposed boulder/ledge substrate is limited in, and around, Graham Lake. Boulder/cobble substrate mixed with sand and gravel is the most common substrate along the east shore of Graham Lake and the islands. The western shore of Graham Lake is made up of varying ratios of clay and finer sands as well as medium to coarse sands and some fine gravel. Some small areas (predominantly in the southwest area of Graham Lake) have boulder and cobble areas. A combination of clay, sand, gravel, and organic substrates are present where the Union River enters the northern portion of Graham Lake (Northrop, Devine & Tarbell, Inc., 1990).

Portions of the shoreline along Graham Lake are comprised of highly erodible soils, including sand and gravel. Erosion has been observed in select areas along the shoreline of Graham Lake, including bank slumps located primarily along the western shore of the impoundment. The shoreline of Lake Leonard is composed of ledge and stony glacial soils with gentle to moderate slopes. The Ellsworth Dam is located in a gorge of solid bedrock.

4.4.1.2 Environmental Effects

Potential Project effects to geology and soil resources are limited to the possibility that water level fluctuations may impact soils and geologic resources through shoreline erosion. Shoreline erosion is present along portions of Graham Lake. The combination of wave and ice action, erodible soils, and water level fluctuations may contribute to this erosion within Graham Lake (FERC, 1987). Much of the shoreline is heavily vegetated with forest and wetland habitats, which reduce the potential for erosion along the shoreline.

During prior relicensing proceedings, the Maine DEP was cited as stating that the existing full pond elevation limit of 104.2 feet appears adequate for managing shoreline erosion, and recommended that the Graham Lake surface elevation be maintained between elevation 104.2 feet and 93.4 feet (FERC 1987). To minimize shoreline erosion and turbidity in Lake Leonard, DEP recommended that the lake level of Lake Leonard be maintained within 1 foot of the crest of the Ellsworth Dam flashboards; that is, 65.7 feet and 66.7 feet (FERC 1987). FERC's 1987 Environmental Assessment indicated that an unavoidable adverse impact of the Project, "...would be some increase in suspended sediment from wave and ice action on shoreline areas."

The Licensee developed a study plan in 1990 to determine the effectiveness of the water elevation management plan in controlling shoreline erosion, protecting water quality, and providing for enhancement of fish and wildlife resources in response to Article 403 of the 1987 FERC license. This study, conducted by Northrup, Devine and Tarbell, Inc. 1990, concluded that, "The observations made as part of the study of the effectiveness of the present water elevation management plan confirmed that a majority of the shoreline at Graham Lake has been subject to erosion forces since the establishment of the original impoundment. The majority of the soils that exist at the Graham Lake site are silt, sand, and clay and tills which are all susceptible to erosion forces. Observations confirm that the present operating rule curve has reduced the erosion conditions and reduced the risk of erosion damage to camp owners bordering the lake. Minor erosion continues to take place along some sections of the shoreline. These shoreline areas are predominantly effected by wave action under the maximum water levels that occur in the spring."

Stakeholders did not express concerns, provide comments, or submit study plan requests to address soil erosion or suspended sediments during the scoping phase of this current relicensing

process. However, during relicensing studies the Licensee noted that the Graham Lake boat launch site is sloped such that runoff from the site concentrates along the east side of the launch ramp. During periods of high runoff erosion has occurred along the edge of the launch. Black Bear proposes to regrade the parking area such that runoff is more evenly dispersed off the site thereby reducing the erosive capacity in the area of the ramp.

Black Bear is proposing no changes of operations; therefore, Black Bear anticipates that continued operation of the Ellsworth Project will not significantly affect geological and soil resources.

4.4.1.3 Proposed Environmental Measures

Black Bear is proposing to continue operating the Project under the current operating regime. Black Bear is proposing remedial measures to address erosion occurring at the public boat launch. These measures are discussed in Section 4.4.1.2.

4.4.1.5 Unavoidable Adverse Effects

Some small amounts of erosion and sedimentation may occur within the Project boundary as a result of continued Project operation. However, Black Bear has demonstrated that operation of the Ellsworth Project has a limited effect on geological resources and soil; therefore, PME measures are not warranted.

4.4.2 Water Resources

4.4.2.1 Affected Environment

Water Resources Overview

The Project area is located within the Union River watershed and encompasses portions of the Union River, Lake Leonard, and Graham Lake. The Union River watershed encompasses approximately 547 square miles in Hancock and Penobscot Counties in Maine (Maine DEP, MDIF&W, and MEGIS, 2010) and includes 484 miles of streams and 81 miles of lakes and ponds) (College of the Atlantic, 2004). The Union River watershed is bordered by coastal rivers and by the Gulf of Maine to the south, the Penobscot River basin to the west and north, and the Narraguagus River basin to the east (FERC, 1987a).

The Project creates two impoundments on the Union River, Lake Leonard which is a small impoundment, and Graham Lake which is a larger storage reservoir. Ellsworth Dam, the lower dam, is located at the upper limit of tidal influence of the Union River, impounds Lake Leonard, and is the site of power generation. Lake Leonard has a surface area of approximately 90 acres

at its normal maximum elevation of 66.7', a width of up to 0.3 miles and a maximum length of approximately 1.0 mile. Lake Leonard has a volume of 751 acre-feet (Mohler, 2012a).

Graham Lake is the storage reservoir formed by the Graham Lake Dam. The Graham Lake Dam is located approximately four miles upstream of the Ellsworth Dam. Graham Lake has a surface area of approximately 10,000 acres at a normal full pond surface elevation of 104.2'; a maximum width of 2.75 miles; and a maximum length of approximately 10 miles. Graham Lake has a volume of approximately 124,000 acre-feet.

Drainage Area

The Union River at the Ellsworth Dam has an average annual flow of approximately 958 cfs from a drainage area of approximately 547 square miles (Maine DEP, 1987 and Maine DEP, MDIF&W, and MEGIS, 2010). The total drainage area at Graham Dam is approximately 499 square miles (Maine DEP, MDIF&W, and MEGIS, 2010).

The Union River originates from the following sources: Great Pond (West Branch) in Great Pond Township approximately 18 miles north of Graham Lake; Upper Middle Branch Pond (Alligator Lake) (Middle Branch) approximately 14 miles northeast of Graham Lake; and Rocky Pond (East Branch) approximately 24 miles northeast of Graham Lake. The Union River is approximately 65 miles long. Topographically, the watershed is hilly, but also has numerous flat or gently rolling plains, a few high bedrock ridges and monadnocks, and a variety of lakes, ponds, and streams with associated marshes, bogs and forested wetlands (FERC 1987b, College of the Atlantic 2004). The Union River flows into Union River Bay in the Atlantic Ocean, approximately three miles downstream from the Project (FERC, 1987a).

In addition to the East and West Branches of the Union River, Graham Lake receives flow from the outlets of Beech Hill Pond, Webb Pond (Webb Brook), and Green Lake (Reed's Brook) (USFWS, 2005). Other tributaries to Graham Lake include Little Meadow Brook, Rocky Brook, Jordan Brook, Dumb Brook, Tannery Brook, Rankin Brook, Day Brook, Hapworth Brook, Archer Brook, Cyreno Brook, and several unnamed tributaries.

Lake Leonard receives flow from the outlet of Branch Lake (Branch Lake Stream) and two unnamed tributaries. Furthermore, Grey, Shackford, Moore and Gilpatrick Brooks and some unnamed tributaries, flow into the Union River downstream of Graham Lake and upstream of Lake Leonard.

Streamflow, Gage Data and Flow Statistics

Black Bear uses the waters of the Union River for water storage at the Graham Lake Dam and for power generation at the Ellsworth Dam. Operationally the Project is typically run as a

peaking project, with water being released from the Graham Lake reservoir and then used to generate electricity at the downstream Ellsworth powerhouse. Water levels in Lake Leonard vary very little over the course of the year. Water levels in Graham Lake are managed between elevations 93.4’ (end of March in order to provide storage capacity for spring rains and snow melt runoff) and 104.2’ (typically in late May after spring runoff). This provides significant downstream flood control benefits. Water levels then gradually decline over the summer months down to approximately 98’ in mid-October after which the lake is partially refilled at the first of the year.

Black Bear operates the Project as a peaking facility, depending on available inflows. Under Article 401 of the FERC license, Licensee is required to release a continuous minimum flow of 105 cubic feet per second (cfs) from the Ellsworth Dam and the Graham Lake Dam from July 1 through April 30, and a continuous minimum flow of 250 cfs from May 1 through June 30, for the protection of fishery resources (FERC 1987b). Timed releases from Graham Lake storage are used at the Ellsworth Dam for power production. Figure E-7 depicts the historic Graham Lake Reservoir Operating Curves.

Table E-4: Annual and Monthly Maximum, Average and Minimum Flow (cfs) for the Ellsworth Dam

Ellsworth Dam Monthly Minimum, Average, and Maximum Flows - 1994-2014 (cfs)												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Maximum	1984	2053	2353	2132	2294	1662	1605	853	1698	1690	2323	2391
Average	1226	1209	1377	1520	1194	832	530	416	446	615	937	1194
Minimum	88	248	576	407	504	403	50	129	170	80	108	76

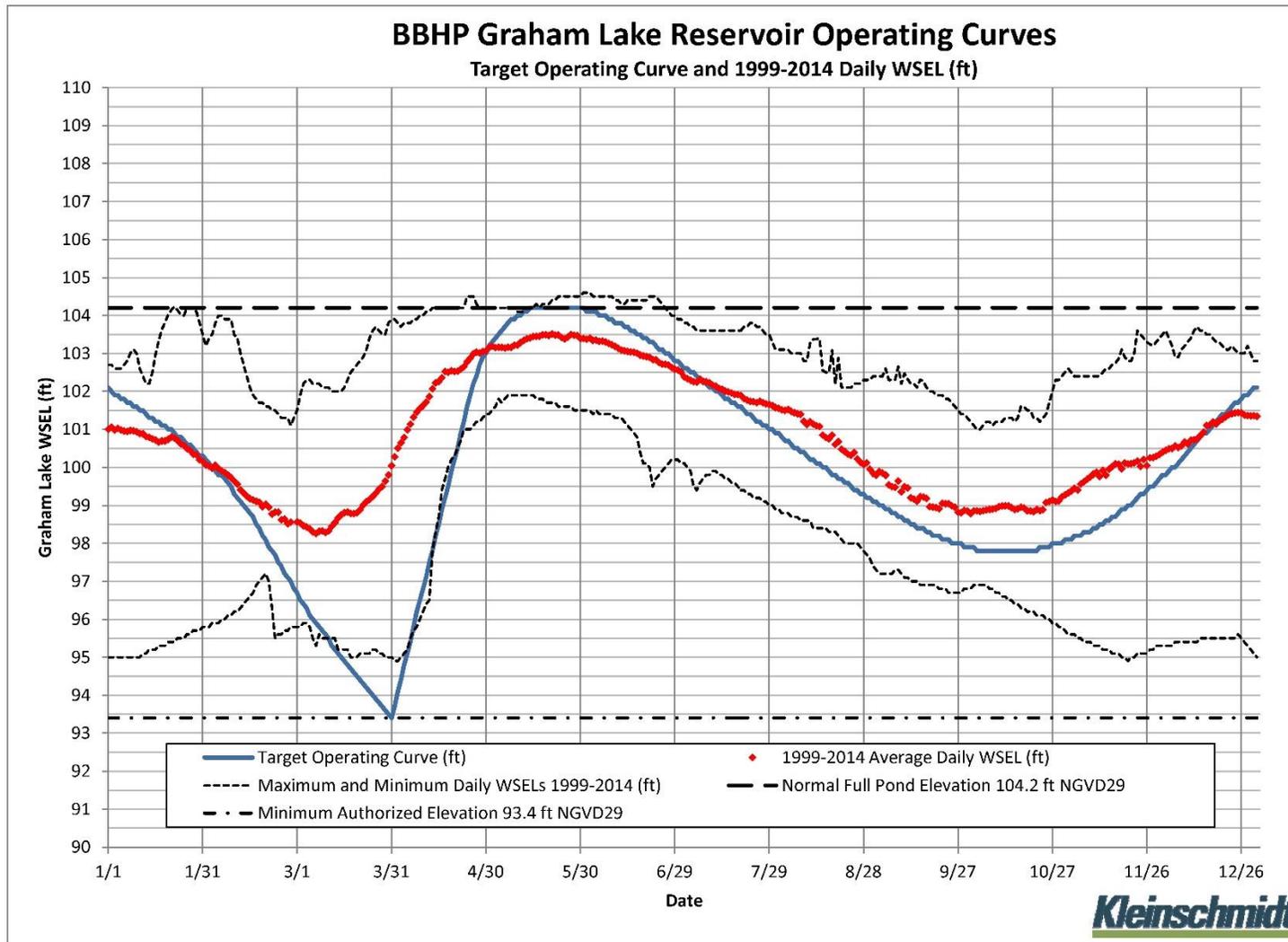
Existing and Proposed Uses of Water

Water within the Project area is not used for major consumption, irrigation, municipal water supply, or industrial purposes, although some seasonal residential use does occur. There are no known major withdrawals of water from the Project impoundments.

Potential sources of non-point source discharge into the Union River watershed include agricultural run-off, road salt, and sediment inputs due to land use activities. Permitted point source discharges to the Project impoundment include effluent from the U.S. Fish and Wildlife Service’s Green Lake National Fish Hatchery, which discharges to Reed’s Brook, the outlet stream of Green Lake and a tributary to Graham Lake (USFWS, 2005).

Black Bear currently proposes to continue the operational pattern of the Project and does not propose to modify the existing uses of water at the Project.

Figure E-7: Graham Lake Historic Operating Curves



Existing Instream Flow Uses

The primary developmental uses of inflows to the Project are water storage and hydroelectric generation, and to a limited extent recreation. Recreational uses include boating and fishing.

Upstream from the Project, there are five retired, unlicensed hydroelectric projects and one operating, licensed project (the Green Lake Dam). Branch Lake, which is an impoundment of Branch Lake Stream, a tributary of Lake Leonard, provides water to the Ellsworth Water Company for domestic use (Bangor Hydro-Electric Company, 1984).

The City of Ellsworth's municipal waste water treatment plant discharges into the Union River estuary approximately 0.5 miles downstream from the Ellsworth Dam (Maine DEP, 1987).

Existing Water Rights

Currently, no major withdrawals are made from Graham Lake, Lake Leonard, or the Union River within the Project boundary. Black Bear has all the ownership or flowage easements necessary to operate the Project. There is no commercial development and there are no residences within the Project boundary along Lake Leonard or the Union River. There is existing residential development within the Project boundary on Graham Lake, most of which are seasonal dwellings.

Impoundment Bathymetry

Graham Lake is oriented in a north-south direction and flow is from north to south. The lake is divided into two large basins (a north and a south basin) by a peninsula that originates from the western shore (USFWS, 2005). The lake is irregular in shape with numerous coves and inlets. The mean depth of Graham Lake is 17 feet, and the maximum depth is 47 feet. Figure E-8 depicts the bathymetry of Graham Lake. This figure was developed from ortho-photo based shape files of the Graham Lake shoreline at known dates (August 22, 2007, and May 19, 2004) and lake elevations (99.0' and 103.9' respectively). A third elevation, 102.5' was interpolated between the 99.0' and 103.9 elevations. Figure E-9 is a sounding map of Graham Lake developed by the Maine Department of Inland Fisheries and Wildlife (revised 1980). Lake Leonard runs northwest to southeast with flow in the same direction, has a mean depth of 25 feet and a maximum depth of 55 feet. Figure E-10 is a sounding map of Lake Leonard developed by the Maine Department of Inland Fisheries and Wildlife (1960). Morphometric information for Lake Leonard and Graham Lake is presented in Table E-5 below.

Figure E-8: Graham Lake Bathymetry Map

Graham Lake

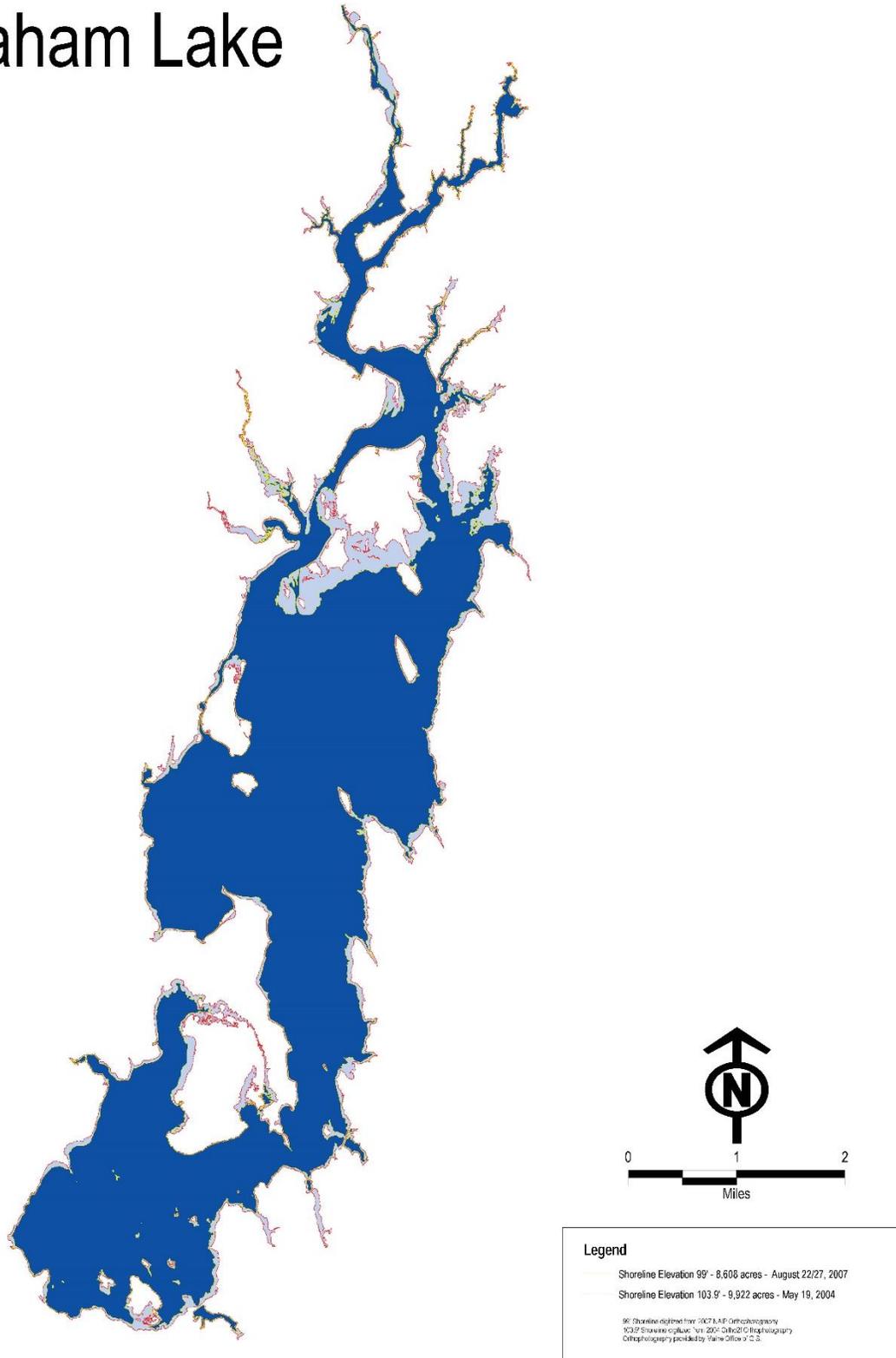


Figure E-9: Graham Lake Maine DIFW Bathymetry Map

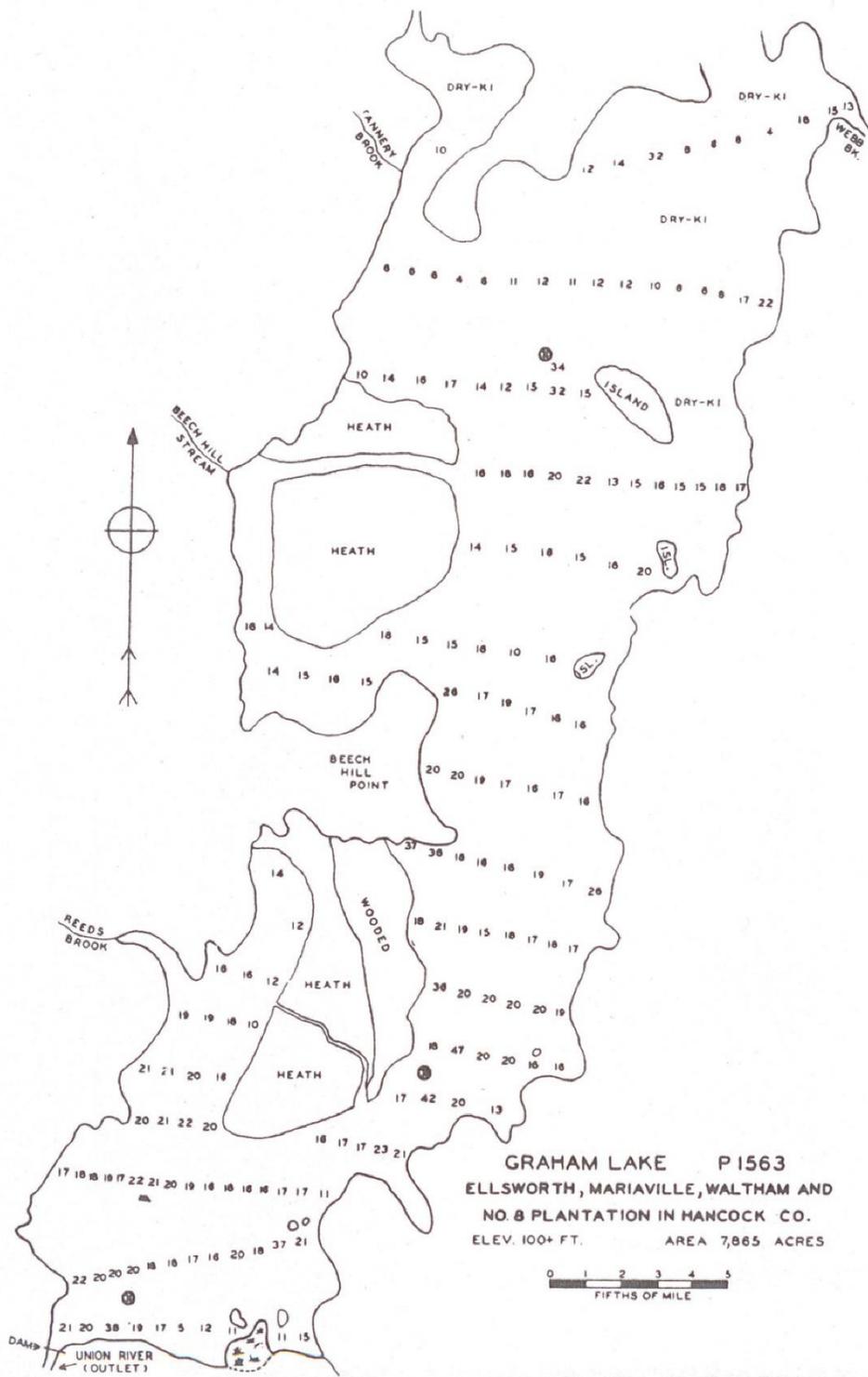
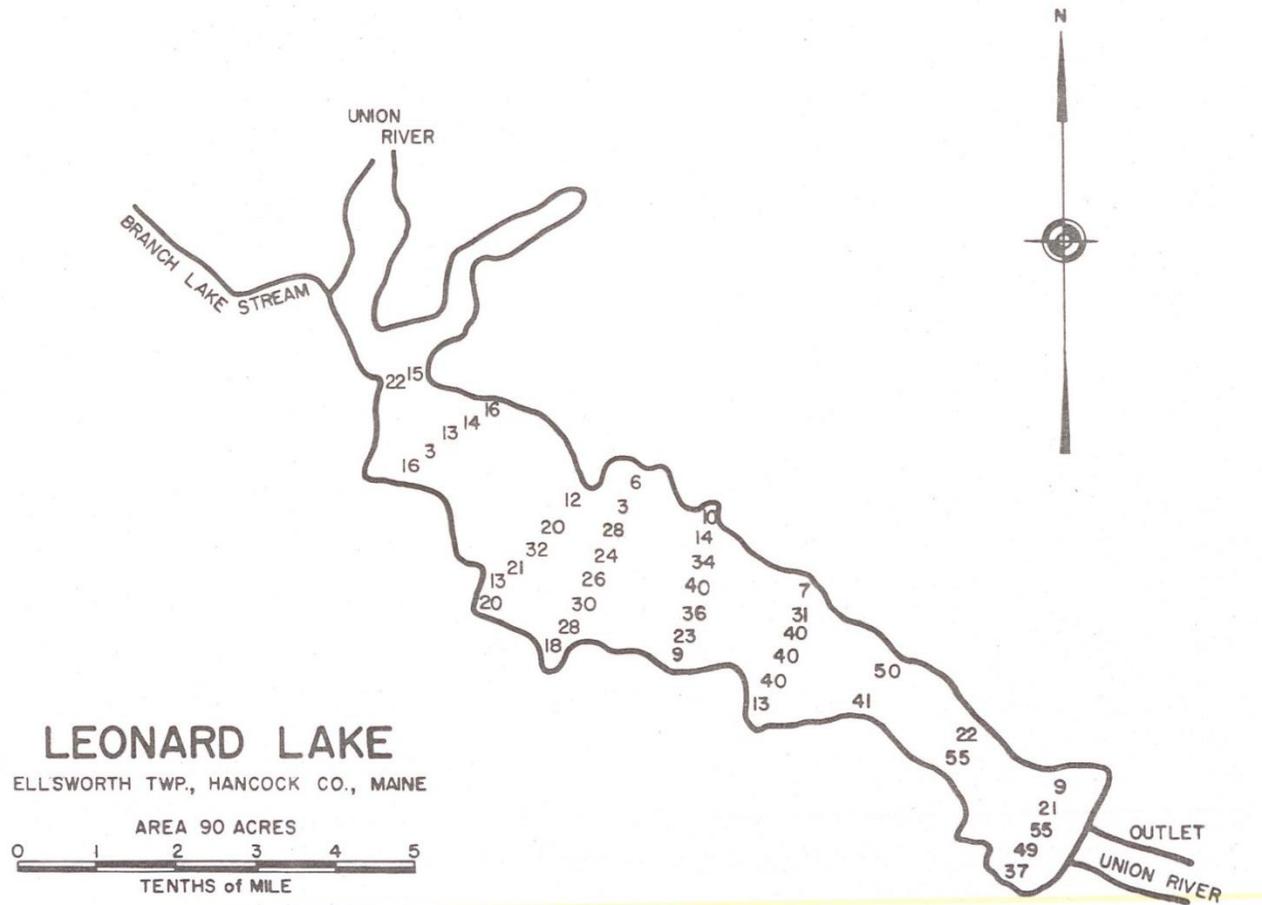


Figure E-10: Leonard Lake Bathymetry Map



**Table E-5: Morphometric Information for the
Lake Leonard and Graham Lake Impoundments**

	Lake Leonard	Graham Lake
Area (ac)	90	10,000
Perimeter (miles)	4.4	80
Mean Depth (ft)	25	17
Maximum Depth (ft)	55	47
Flushing Rate (flushes per year)	288	4.06
Total Volume (ac-ft)	751	124,000
Direct Drainage Area (sq. mi)	12	48.56
Total Drainage Area (sq. mi)	547	499
Elevation at full pond (ft)	66.7	104.2

Gradient of Downstream Reaches

The Project is located in the southern portion of the Union River watershed; the Union River flows into the Union River Bay approximately three miles downstream from the Project. The Ellsworth Dam is located at the upper limit of tidal influence of the Union River.

Water Quality Standards

Maine statute 38 MRSA (§464-470) establishes the basis for the State's classification system of surface waters. The State has one water quality standard for lakes and great ponds (GPA) which includes inland bodies of water artificially formed or increased that have a surface area greater than 30 acres. Graham Lake is included in this classification. The Maine DEP currently interprets the water quality statutes to classify Lake Leonard as a GPA water (K. Howatt, Maine DEP personal communication, June 16, 2015). There are four standards for the classification of fresh surface waters which are not classified as great ponds: Class AA, A, B, and C waters. With the exception of Lake Leonard impoundment, which is classified as GPA, the Union River from the outlet of Graham Lake to tidewater is classified as Class B (Maine Revised Statute, 2012a).

Designated uses for Class GPA water include: drinking water supply after disinfection; recreation in and on the water; fishing; agriculture, industrial process and cooling water supply; hydroelectric power generation; navigation; and habitat for fish and aquatic life. The habitat must be characterized as natural (Maine Revised Statute, 2012c).

Maine’s water quality standards provide that, with certain exceptions, “all hydropower projects with impoundments in existence on June 30, 1992 that remain classified under Section 465-A after June 30, 1992 and that do not attain the habitat and aquatic life criteria of that section must, at a minimum, satisfy the aquatic life criteria contained in section 465, subsection 4, paragraph C.” 38 M.R.S.A. § 464(9-1)(D). In other words, if the impoundment habitat is not characterized as natural, then the impoundment must meet Class C habitat and aquatic life criteria.

The Class C habitat and aquatic life criteria provide that: “[d]ischarges to Class C waters may cause some change to aquatic life, except that the receiving waters must be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community.” 38 M.R.S.A. § 465(4)(C). The term “resident biological community” is defined to mean “aquatic life expected to exist in a habitat which is free from the influence of the discharge of any pollutant.” 38 M.R.S.A. § 466(10). Because Graham Lake was in existence on June 30, 1992 and remains classified as GPA, the applicable aquatic life standard for Graham Lake is that the receiving waters be of sufficient quality to support all species of fish indigenous to the receiving water and maintain the structure and function of the resident biological community.

Designated uses for Class B waters are the same as those for Class GPA waters and are described above, except in outstanding river segments (as defined under Title 12, section 403) where hydroelectric power generation is prohibited. The Union River is not designated as an outstanding river segment. The habitat in Class B waters must be characterized as unimpaired (Maine Revised Statute, 2012b).

The water quality standard for Class B waters (Table E-6) requires that dissolved oxygen (DO) concentrations be maintained at not less than 7 parts per million (ppm) or 75 percent saturation whichever is higher.

Table E-6: Maine Water Quality Standards for Select Parameters for Class B and GPA Waters

Parameter	Standard Class B	Standard GPA
DO (mg/L)	7 ppm or 75% of saturation, whichever is higher, except from Oct. 1 st to May 14 th , the 7-day mean DO concentration may not be less than 9.5 ppm and the 1-day minimum DO concentration may not be less than 8.0 ppm in identified fish spawning areas	No Numeric Standard
pH (su)	6.0 to 8.5	6.0 to 8.5
E. coli	Between May 15 th and Sept, 30 th , not to exceed a geometric mean of 64 per 100 milliliters or an instantaneous level of 236 per 100 milliliters	Not to exceed a geometric mean of 29 per 100 mL or an instantaneous level of 194 per 100 mL
Aquatic Life Habitat	Unimpaired	Maintain the structure and function of the resident biological community

Sources: Maine Revised Statute, 2012b and 2012c

The State of Maine Department of Environmental Protection 2012 Integrated Water Quality Monitoring and Assessment Report, approved by the US Environmental Protection Agency, classified Graham Lake as Category 4c: aquatic life drawdown (impairment not caused by a pollutant, but impaired by habitat modification). The Union River main stem in Ellsworth is classified as having insufficient data or information to determine if designated uses are attained; one or more uses may be impaired (Maine DEP, 2012). In communications with the Maine DEP, staff stated that historically the main stem of the Union River, outside of the Project area had some transient isolated pockets of marginal dissolved oxygen non-attainment associated with discharge from the Ellsworth municipal wastewater treatment plant more than a mile below the Ellsworth Dam. New construction at the plant, including a new discharge location more than a mile below the previous discharge point, has recently been implemented. Maine DEP feels that these changes have satisfactorily resolved the downstream dissolved oxygen issue (R. Mohler, personal communication February 2015).

Existing Water Quality

Impoundment Sampling

Impoundment water quality sampling was conducted in accordance with Maine DEP’s Lake Trophic State Sampling Protocol for Hydropower Studies on a bi-weekly basis in Graham Lake

from April 23 through October 24, 2013, and in Lake Leonard from June 13 through October 24, 2013.

Graham Lake

Graham Lake is a large (approximately 10,000 acres), shallow lake (average depth 17 feet; maximum depth 47 feet). Sampling on Graham Lake was conducted at the three historic sampling locations (north, central, and south). In general there was little variation in sampling results between the three locations. Water in the lake is turbid (average 3.3 NTU) and colored (average 75.2 PCU) resulting in low visibility. The average Secchi disk transparency is less than two meters (average 1.7 meters). Algal production, as indicated by chlorophyll *a* levels, (average 2.3 µg/l) is low.

Graham Lake weakly stratifies during the summer months, but due to the shallowness of the lake and long fetch from multiple directions, the stratification often breaks down during windy periods that prevail on the lake. Thermal stratification was first documented on June 27 and occurred at all three of the sampling stations in Graham Lake. This was the only date on which thermal stratification was documented at Station 1 (central). Thermal stratification was documented one other time (July 18) at sampling Station 3 (north) when the top of the thermocline was at 3 meters. At sampling Station 2 (south), thermal stratification was also documented on July 2, July 18, August 1, and August 28. The top of the thermocline on June 27 and July 18 was at 3 and 4 meters respectively. The top of the thermocline on July 2 and for two dates in August was at 10 to 11 meters

The results of the 2013 sampling for Graham Lake are consistent with previous sampling efforts dating back to the 1970's.

Lake Leonard

Lake Leonard is a small (approximately 90 acres), though moderately deep lake (average depth 25 feet; maximum depth 55 feet) for its size. Sampling on Lake Leonard was conducted at the deep hole, a mid-channel location, slightly north of the buoy barriers at the Ellsworth Dam. Water quality in Lake Leonard is similar to Graham Lake, though slightly less turbid (average 2.59 NTU) and less colored (average 67.8 PCU). These differences are reflected in a slightly higher Secchi disk transparency (average 2.1 meters) in Lake Leonard. The improvements in Lake Leonard water quality over Graham lake water quality is likely in part due to intervening tributary inputs between the two developments, especially from Branch Lake Stream which enters toward the upper end of Lake Leonard. Algal production, as indicated by chlorophyll *a* levels, (average 2.4 µg/l) is low.

Riverine Sampling

River water quality sampling was conducted in the Union River in the tailwater area of Graham Lake Dam in accordance with Maine DEP's River Sampling Protocol on a weekly basis from July 2 through September 12, 2013 in both the early morning (before 7:00 AM) and afternoon (after 1:00 PM) on each sampling day. Sampling was not conducted in the Ellsworth Dam tailwater as the Union River is subject to tidal fluctuations at that point.

The Union River sampling was conducted mid-channel, approximately 450 feet downstream of the Graham Lake Dam. Water depth was 3-4+ meters on each sampling day. Sampling results showed only minor variation in vertical profile, and between the morning and afternoon periods on individual sampling days. Over the course of the 11 week sampling period, temperatures ranged from 19.1 – 26.6°C and DO levels ranged from 8.3 and 10.4 mg/l (96 – 114% saturation).

Secchi disk transparency and chlorophyll *a* levels averaged 2.1 meters and 3.3µg/l respectively. These values are similar to the sampling results for both Graham Lake and Lake Leonard.

As per the approved study plan, benthic macroinvertebrate sampling was conducted at one location in the Union River approximately 450 feet downstream of Graham Lake Dam in 2014. Moody Mountain Environmental conducted the field sampling and laboratory procedures in accordance with the Maine DEP's Methods for Biological Sampling and Analysis of Maine's Inland Waters (Davies and Tsomides 2002). The samplers were placed in the Union River on July 24, 2014 and were retrieved on August 22, 2014.

The macroinvertebrate community sampled below the Graham Lake Dam was abundant and rich in taxa (Leeper 2014). The community was populated with 29 different taxa with a Mean Total Abundance of 640. The community was dominated by filter-feeding caddisflies which represented more than 79% of Total Abundance. The Diversity value for the community was correspondingly low at 1.75.

Indices measuring the tolerance to poor water quality conditions revealed that sensitive caddisflies dominated the community. The EPT richness index showed that sensitive mayfly and caddisfly taxa represented 41% of the taxa identified. No stoneflies were collected. Of those 3 orders, the stoneflies and mayflies are generally more sensitive to environmental stressors. Two (2) mayfly taxa were found representing 7% of the taxa richness. In terms of numbers (Total Abundance), mayflies made up 1% of the community. Hilsenhoff's Biotic Index value, 4.91, indicated good water quality (Hilsenhoff 1987).

The community structure and function found in the tailwater section of the Graham Lake Dam on the Union River shows evidence of organic enrichment and filter-feeder dominance which is

a common phenomenon below lake outlets and impoundments (Hynes 1970, Spence and Hynes 1970, Parker and Voshell 1983).

Following consultation with Maine DEP, additional macroinvertebrate sampling was conducted in the summer of 2015. Three sites in the Union River were sampled. Site 1 was located at the downstream end of the “pool” below the Graham Lake Dam. This site was approximately 950 ft downstream of the dam. Site 2 was located approximately 1750 ft downstream of the dam. Site 3 was located approximately 1.92 miles downstream of the dam, approximately 850 ft upstream of the railroad crossing. Site 3 was just downstream of a bedrock hydraulic constriction that changed the character of the river from slow moving meandering flat water to rapids. The samplers were placed in the Union River on July 15, 2015 and were retrieved on August 11, 2015.

The sampler at Site 1 was disturbed and was not analyzed. For sites 2 and 3 the macroinvertebrate communities sampled downstream of the Graham Lake Dam were abundant but not very rich in taxa. The community at Site 2 was populated with 26 different taxa with a Mean Total Abundance of 355. The Site 3 community was much more numerous (Total Abundance of 2430), but was less rich with 15 taxa. Both communities were dominated by filter-feeding caddisflies, representing over 67% of Total Abundance at Site 2 and over 93% at Site 3. The Diversity values were correspondingly low at 1.70 (Site 2) and 1.76 (Site 3).

Indices measuring the tolerance to poor water quality conditions revealed that sensitive caddisflies dominated the community. The EP index of sensitive mayflies and stoneflies showed 3 and 2 taxa respectively. These insect orders represented less than 4% of the communities. No stoneflies were collected at either sampling site. The Hilsenhoff Biotic Index values, 4.30 (Site 2) and 4.36 (Site 3), indicated good water quality.

The community structure and function found in the tailwater section of the Graham Lake Dam on the Union River shows evidence of organic enrichment and filter-feeder dominance which is a common phenomenon below lake outlets and impoundments (Hynes 1970, Spence and Hynes 1970, Parker and Voshell 1983). The communities sampled are influenced by the food suspended in the water. This resource allows the aquatic caddisfly filter feeders to flourish. However, the lack of stoneflies in the community, and the small proportion of mayflies, indicates changes to the resident biological community. Based on the Maine DEP linear discriminant model used to assess attainment with state water quality standards, the Union River downstream of Graham Lake Dam achieves a Class C aquatic life standard.

The 2015 Macroinvertebrate Sampling Study is presented in Appendix E-3.

Impoundment Aquatic Habitat

Graham Lake, the upper reservoir of the Project, has a full pond surface area of approximately 10,000 acres and a maximum length of approximately 10 miles. In accordance with Article 402 of the current FERC license, water levels in Graham Lake are managed between elevations of 93.4' and 104.2'. Generally Graham Lake is filled in the spring reaching full pond in mid-April following spring snow melt and runoff. The lake is gradually drawn down over the summer into the early fall as reservoir storage is used to augment downstream river flows. There is a partial refill during the late fall followed by a winter drawdown under the ice, typically reaching its lowest levels in late winter. Refill then re-occurs during the spring. Figure E-7 shows the historic operating curve for Graham Lake.

The lower impoundment, Lake Leonard is impounded by the Ellsworth Dam, has a surface area of 90 acres and a length of one mile. Water levels in Lake Leonard are normally maintained between the elevations of 65.7' and 66.7' as per the current FERC license.

Impoundment Tributary Connectivity

An assessment of impoundment tributary connectivity for the single Lake Leonard and seven Graham Lake tributaries (Figure E-11) designated in FERC's Study Plan Determination was based on field observations and photo documentation during low water conditions on October 5 and 6, 2014 when Graham Lake water level elevations were at 97.9', and on October 6, 2014 when Lake Leonard was between elevations 65.7' and 66.7'.

In accordance with the FERC's Study Plan Determination (September 4, 2013), the impoundment Connectivity Study was conducted in October 2014. The target normal fall drawdown for Graham Lake is elevation 97.8 and occurs in mid-October. The Graham Lake elevation during the study was 98.0' only 0.2 feet above the normal target elevation and 1.1 foot below the 1999-2014 long term average of 98.9'.

At the Graham Lake water levels investigated, the surface area of the lake was reduced from a full pond area of approximately 10,000 acres to approximately 8,340 acres. This change in lake surface area resulted in areas of dewatered shoreline around the lake. These areas were investigated to determine the effect of drawdown on lake access to the seven designated tributaries.

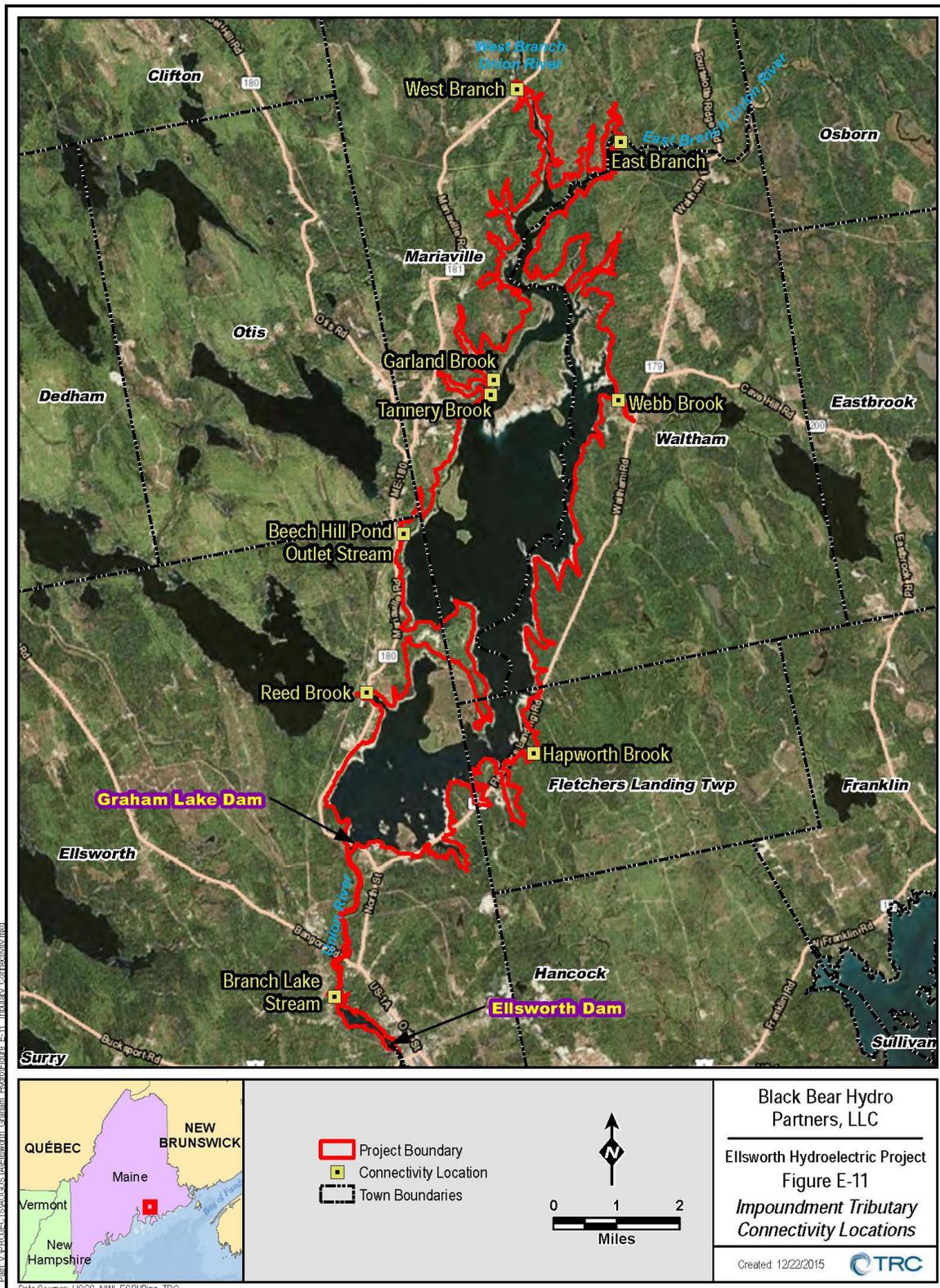
1. Hapworth Brook flows into Graham Lake via two culverts under Route 179, which are located adjacent to the lake's eastern shore. One of the culverts was completely dry, but the second culvert was fully submerged with a water depth in excess of 5 feet connecting Hapworth Brook and the lake.
2. Webb Brook entered Graham Lake via a 20-50 foot wide quick-flowing stream. Slightly upstream of the lake two beaver dams created runs and pools in the stream. Water depths

ranged from a few inches to a few feet in the quick-flowing sections and up to several feet deep behind the beaver dams.

3. The East Branch of the Union River is a large, quick-flowing boulder strewn stream that ranged in depth from a few inches to a few feet deep across its 50-100 foot width where it enters the lake.
4. The West Branch of the Union River entering Graham Lake is a broad (100+ feet) run that is several feet deep at its center.
5. Garland Brook enters Graham Lake via a long (0.7 miles), broad inlet with a well-defined channel. The gradient is very flat and the brook flows in wide meanders. The brook channel is 30-75 feet wide through most of its length, is quick-flowing, and is as much as 5+ feet deep.
6. Tannery Brook is somewhat smaller, but otherwise very similar to Garland Brook, and the two brooks are located in close proximity to one another. The brook channel is 25-50 feet wide through most of its length, is quick-flowing and is 0.5 to 2+ feet deep.
7. Beech Hill Stream enters Graham Lake by an approximately 1,600-foot long, broad, flat inlet. Just upstream of the inlet area is a small beaver dam and approximately 200 feet upstream of the beaver dam is a cascade with a vertical drop of about 8 feet. The stream is quick-flowing in the inlet area and is 0.5 to 2+ feet deep. At the water levels observed, tributary connectivity exists through the dewatered shoreline areas of Graham Lake for all of the tributaries investigated.
8. Only one tributary to Lake Leonard, Branch Lake Stream was investigated. Branch Lake Stream is dammed by a small concrete dam at its confluence with Lake Leonard. The dam has two approximately 4-foot wide stop log sections. It was difficult to determine if there were any engaged stop logs, though the openings were clogged with logs, sticks, and debris.

The results of the 2014 investigation were reported in the 2015 USR. Stakeholder comments received in response to the USR stated that the tributary connectivity investigation should have included 1) evaluation of tributary connectivity at full drawdown conditions at Graham Lake, 2) consideration of more specific zone-of-passage criteria, and 3) more specific gradient information for the tributaries. The Commission considered the stakeholder comments on the study, and Licensee's November 9, 2015 response and issued a December 8, 2015 Determination on Requested Study Modifications finding that additional information is required for the study. As required in the December 8, 2015 Determination, Licensee will conduct additional field work in 2016 to provide gradient profiles above el. 97.8' for the Graham Lake tributaries and will assess zone of passage based on more detailed criteria at tributaries selected in consultation with the fisheries agencies. Black Bear will collect this information and file it with FERC by December 31, 2016 as additional information to the FLA.

Figure E-11: Impoundment Tributary Connectivity Locations



Riverine Aquatic Habitat

The outlet stream (Union River) downstream of the Graham Lake Dam was evaluated regarding the adequacy of habitat for aquatic organisms under current instream flow releases.

Article 401 of the current FERC license requires a continuous minimum flow release of 105 cfs from the Graham Lake Dam from July 1 through April 30 and 250 cfs from May 1 through June 30. Measurements were obtained of the wetted width and bankfull width on the Union River approximately 1,000 feet downstream of Graham Lake Dam under low flow conditions estimated to be 150 cfs based upon the actual gate setting at the time of the field study.

The Union River at the point of measurement is the beginning of a long run stretch of river. The bankfull width of the river is 242 feet at this point. At 150 cfs the wetted width was 203 feet or 83% of the bankfull width. The water depth at this transect was 12+ feet. The wetted width at a flow of 105 cfs was extrapolated for this transect based on measured data for four observed flows at additional downstream transects for the Instream Flow and Union River Tributary Access Study. There is very little difference in wetted width percent bankfull between the observed 150 cfs and the extrapolated minimum flow of 105 cfs (Appendix E-4).

As noted in the USR, the additional transect data collected further downstream as part of the Instream Flow and Tributary Access Study also indicated wetted width, and, coupled with the depth at the flow release at Graham Lake Dam of 150 cfs, provided adequate wetted zone of passage and habitat for aquatic organisms in the Union River, as discussed in detail for river herring and Atlantic salmon in the Habitat Suitability section of the Instream Flow and Tributary Access Study. For these seven transects, the wetted width was extrapolated for the target minimum flow of 105 cfs and is presented in Table E-7. This data demonstrates the wetted width under the minimum flow was near or exceeded $\frac{3}{4}$ of the bankfull width.

Table E-7: Minimum Flow Wetted Width for Instream Flow and Tributary Access Study Transects

Transect		Graham Dam Release Discharge (cfs)	Wetted Width (ft)	Wetted Width % Bankfull
Sub-Reach	Type			
Upper Reach	Riffle/Run	105 ¹	304.0	83
		150	310.0	85
		Bankfull	366.0	NA
	Pool	105 ¹	191.0	83
		150	191.0	83
		Bankfull	231.0	NA
Middle Reach	Riffle	105 ¹	178.8	74
		150	180.5	75
		Bankfull	240.6	NA
	Pool	105 ¹	172.0	73
		150	176.8	75
		Bankfull	236.1	NA
	Run	105 ¹	128.1	68
		150	134.3	71
		Bankfull	188.9	NA
Lower Reach	Riffle	105 ¹	173.1	73
		150	173.5	74
		Bankfull	235.9	NA
	Pool/Run	105 ¹	139.3	74
		150	139.4	74
		Bankfull	189.2	NA

Note: ¹ The wetted width and wetted width percent bankfull values for the minimum flow of 105 cfs were extrapolated from the field collected data from four flow observations of surveyed transects measured for and discussed in the *Instream Flow and Tributary Access Study* in Section 3.2.3.

4.4.2.2 Environmental Analysis

Effects of continued project operation on water quality

Impoundment Water Quality

As described above, impoundment water quality sampling was conducted in accordance with Maine DEP’s Lake Trophic State Sampling Protocol for Hydropower Studies on a bi-weekly basis in Graham Lake from April 23 through October 24, 2013, and in Lake Leonard from June 13 through October 24, 2013. Results of the sampling indicate that Graham Lake meets the

applicable Class GPA trophic state standards and is free of culturally induced algal blooms which might impair its use or enjoyment. Lake Leonard, to which Maine DEP has indicated the GPA standards apply, also meets the standards applicable to that classification. The water quality parameters typically sampled for Class B waters (riverine) were included in the Lake Leonard trophic state sampling conducted in 2013 as requested by the Maine DEP. Maine DEP has requested no additional sampling of Lake Leonard.

Riverine Water Quality

Tailwater water quality sampling downstream of Graham Lake Dam was conducted in accordance with Maine DEP's River Sampling Protocol on weekly basis from July 2 through September 12, 2013 in both the early morning (before 7:00 AM) and afternoon (after 1:00 PM) on each sampling day. Tailrace sampling was not conducted in the Ellsworth Dam tailrace as the Union River is subject to tidal fluctuations at that point. Results of the sampling indicate that Class B physical and chemical water quality standards were met in the tailwater downstream of Graham Lake Dam.

Effects of continued project operation on aquatic habitat

Impoundment Aquatic Habitat

Maine DEP considers aquatic life and habitat standards in determining whether a water body is meeting water quality standards. It is Maine DEP's position that there must be both sufficient quality and quantity of habitat for aquatic organisms to meet aquatic life and habitat standards. The Maine DEP has a hydropower policy which states that, generally, water levels providing wetted conditions for $\frac{3}{4}$ of the littoral zone of a lake or pond, as measure from full pond conditions, are sufficient to meet aquatic life and habitat standards.

Using a depth of twice the mean 2013 summer sampling Secchi disk transparency (1.77 meters or 5.8 feet) as a measure of the bottom of the littoral zone, the littoral zone depth at Graham Lake was approximately 11.6 feet during the sampling period. This calculates to an elevation of 92.6'. Extrapolating, at its deepest the littoral zone of Graham Lake at elevation 92.6' has an area of approximately 7,232 acres. Similarly extrapolating from known bathymetric data, Graham Lake at full pond elevation of 104.2 has a surface area of 10,042 acres. Thus the approximate area of the littoral zone is: 10,042 acres – 7,232 acres = 2,810 acres.

Lake Leonard is operated with a maximum normal pond fluctuation of one foot. As such Lake Leonard essentially maintains a fully wetted littoral zone.

Riverine Aquatic Habitat

Macroinvertebrate sampling in 2014 showed a hyperdominance of net spinning caddisflies in the Graham Lake tailwater, a phenomenon commonly seen in rivers below lakes and reservoirs. Following consultation with Maine DEP, additional macroinvertebrate sampling was conducted in the summer of 2015. The results of the additional sampling are similar to the sampling results from the 2014 sampling i.e., there was a hyperdominance of certain species that is common below both reservoirs and natural lakes. The 2015 Macroinvertebrate Sampling Study is presented in Appendix E-3. Based on the Maine DEP linear discriminant model used to assess attainment with state water quality standards, the Union River downstream of Graham Lake Dam achieves a Class C aquatic life standard. Regardless of how the Project is operated, it is likely that the riverine reach below Graham Lake will continue to support a macroinvertebrate community dominated by species that are responsive to the abundant food source provided downstream of a large lake.

The wetted width of the riverine reach below Graham Lake, coupled with the depth at the flow release of 150 cfs, provided adequate wetted habitat for aquatic organisms in the Union River. The estimated wetted width at a flow of 105 cfs demonstrates there is very little difference in wetted width compared to the observed 150 cfs and minimum flow (Appendix E-4). Given that 105 cfs flow is the minimum flow out of Graham Lake (July 1- April 30) and 250 cfs at other times, and that Black Bear is not proposing any operational changes, the wetted zone of passage and habitat for aquatic organisms will remain adequate in the future.

4.4.2.3 Proposed Environmental Measures

Black Bear proposes to continue to operate and maintain the Project generally under the existing licensed regime. Under the propose operation of the Project, there will be no significant changes to the magnitude or timing of seasonal minimum flow releases, or of Graham Lake or Leonard Lake water levels, from what currently occurs. As a result, the continued operation of the Project will have no impacts on existing water quality in Graham Lake, the Union River or Lake Leonard.

4.4.2.4 Cumulative Effects

In Scoping Document 1, the effects of continued Project operation on dissolved oxygen and water temperature in Lake Leonard, Graham Lake, and the Union River downstream of the Project were identified as an issue to be analyzed for both cumulative and site specific effects. Black Bear is proposing to continue to operate the Project with the same flow and water level restrictions that are in the current license. No new project effects and no other significant changes in the Union River watershed were identified, so no cumulative water quality effects are anticipated.

4.4.2.5 Unavoidable Adverse Impacts

The continued operation of the Ellsworth Project as proposed will result in no new impacts to Project water quality. The annual drawdown of Graham Lake for the purposes of enhanced generation at the Ellsworth Dam is managed within the licensed impoundment elevations of 104.2' and 93.4' while at the same time maintaining the seasonal minimum flow license conditions of 105 cfs (July 1 through April 30) and 250 cfs (May 1 through June 30). The drawdown results in portions of the littoral zone being dewatered. The greatest extent of the drawdown occurs early in the year under ice cover conditions.

4.4.3 Fish and Aquatic Resources

4.4.3.1 Affected Environment

The Union River watershed is inhabited by a diversity of coldwater and warmwater fish species (Baum 1982). Approximately 36 species of fish are known to occur in the Project area (Table E-8).

Long-term fishery management goals have been identified for reaches of the Union River in the *Comprehensive Fishery Management Plan for the Union River Drainage* (CFMP [URFCC 2015]). The river reach between Ellsworth Dam and Graham Lake Dam is managed for sustained production of brook trout and as a migratory pathway for Atlantic salmon, American shad, river herring and American eels. Graham Lake is managed for existing resident species including smallmouth bass, white perch and pickerel, as well as alewives and eels (URFCC 2015).

American shad, river herring and American eels, along with striped bass, are managed in accordance with the Atlantic States Marine Fisheries Commission's Interstate Fisheries Management Plans from the mouth of the Union River to Ellsworth Dam. This reach of the river is also managed for sustained production of resident and diadromous species.

Atlantic salmon, Atlantic sturgeon, and shortnose sturgeon are species listed under the Endangered Species Act (ESA) as discussed in the following sections.

Resident Species

Warmwater species such as smallmouth bass, chain pickerel, and white perch are resident species in Graham Lake and Lake Leonard (Black Bear 2012). Largemouth bass were introduced illegally into Graham Lake about five years ago, and are expanding rapidly (Greg Burr, Maine DIFW, personal communication July 3, 2014). Data collected at a bass tournament in Graham Lake showed the largest bass caught (species was not specified) weighed 5.2 pounds, and the average weight of the bass caught by each team ranged from 1.7 to 3.9 pounds, Table E-9 (USA Bassin 2014).

Table E-8: Fish Species Known to Occur in the Union River Watershed

Scientific Name	Common Name
Acipenseridae	
<i>Acipenser oxyrinchus</i>	Atlantic sturgeon
<i>Acipenser brevirostrum</i>	Shortnose sturgeon
Anguillidae	
<i>Anguilla rostrata</i>	American eel
Catostomidae	
<i>Catostomus commersoni</i>	White sucker
Clupeidae	
<i>Alosa aestivalis</i>	Blueback herring
<i>Alosa pseudoharengus</i>	Alewife
<i>Alosa sapidissima</i>	American shad
Centrarchidae	
<i>Lepomis gibbosus</i>	Pumpkinseed
<i>Lepomis auritus</i>	Redbreast sunfish
<i>Micropterus dolomieu</i>	Smallmouth bass
<i>Micropterus salmoides</i>	Largemouth bass
Cyprinidae	
<i>Luxilus cornutus</i>	Common shiner
<i>Notemigonus crysoleucas</i>	Golden shiner
<i>Notropis heterolepis</i>	Blacknose shiner
<i>Phoxinus eos</i>	Northern redbelly dace
<i>Semotilus atromaculatus</i>	Creek chub
<i>Semotilus corporalis</i>	Fallfish
Cyprinodontiformes	
<i>Fundulus diaphanus</i>	Banded killifish
<i>Fundulus heteroclitus</i>	Mummichog
Esocidae	
<i>Esox niger</i>	Chain pickerel
Gadidae	
<i>Microgadus tomcod</i>	Tomcod
Gasterosteidae	
<i>Gasterosteus ocleatus</i>	Threespine stickleback
<i>Pungitius pungitius</i>	Ninespine stickleback
Ictaluridae	
<i>Ameiurus nebulosus</i>	Brown bullhead (hornpout)
Osmeridae	
<i>Oxmerus mordax</i>	Rainbow smelt
Percichthyidae	
<i>Morone americana</i>	White perch
<i>Morone saxatilis</i>	Striped bass

Scientific Name	Common Name
Percidae	
<i>Perca flavescens</i>	Yellow perch
Petromyzontidae	
<i>Petromyzon marinus</i>	Sea lamprey
Salmonidae	
<i>Salvelinus alpinus</i>	Landlocked arctic char
<i>Salvelinus fontinalis</i>	Brook trout
<i>Savelinus namaycush</i>	Lake trout (togue)
<i>Salvelinus namaycush x S. fontinalis</i>	Splake
<i>Salmo salar</i>	Atlantic salmon
<i>Salmo salar sebago</i>	Landlocked salmon
<i>Salmo trutta</i>	Brown trout

Source: Black Bear 2012; Maine DIFW 2013a and 2013b; Baum 1982

Table E-9: Bass Tournament Results, Graham Lake, May 18, 2014

Group	No. of Bass	Total Weight (lbs)	Avg. Weight (lbs)*	Largest Fish Weight (lbs)
1	5	19.3	3.9	5.2
2	5	18.5	3.7	5.1
3	5	13.9	2.8	4.3
4	5	13.1	2.6	3.4
5	5	12.7	2.5	3.5
6	5	11.1	2.2	2.3
7	3	5.2	1.7	0
8	2	4.2	2.1	0

*Calculated. Source: USA Bassin 2014.

As reported in the Fish Community Study, contained in the September 4, 2014 Initial Study Report, the Maine DIFW started a study in 1997 to evaluate the effects of stocking alewives in Graham Lake on the smallmouth bass population in Graham Lake. Maine DIFW sampled the smallmouth bass population by angling for two years during two successive five year periods to monitor proportional stock density (PSD) and relative stock density (RSD)³ values (Table E-10)(URFCC 2010).

³ Proportional stock density is the percentage of a sample of “stock-length” fish that also are greater than or equal to “quality length”. Relative stock density is the percentage of “stock-length” fish that also are in a defined length interval of larger fish (larger length-classes are “quality”, “preferred”, “memorable”, and “trophy”). These length categories are species specific (Murphy and Willis 1996).

Table E-10: Proportional Stock Density (PSD) and Relative Stock Density (RSD) Values for Smallmouth Bass Collected in Graham Lake, 1997-1998, 2002-2003

Year	Proportional Stock Density	Relative Stock Density
1997	74	17
1998	41	<1
2002	68	7
2003	82	9

Source: URFCC 2010.

Maine DIFW concluded, using values from 1997 and 1998 as the baseline for comparative purposes, that neither PSD nor RSD values from 2002 and 2003 suggested any detrimental impact from the increased stocking rate of alewives to smallmouth bass (URFCC 2010).

White perch fishing exists at Graham Lake, which also has a productive pickerel (URFCC 2015) and brown bullhead fishery (Dick Fennelly, personal communication July 23, 2014). Given the connections and proximity between other adjacent lakes and ponds to Graham Lake and Lake Leonard, species likely drop down to the Project area; for example, in the spring, lake trout, brook trout, brown trout, and landlocked salmon are caught below Graham Lake Dam, but not in great numbers (Burr, G. Maine DIFW, personal communication, July 23, 2014). Fish that occur in Graham Lake and the Union River upstream of Lake Leonard would be expected to occur in Lake Leonard as well.

Stocking of brown trout still occurs at some lakes and ponds in the drainage, and wild brown trout still occur in the Union River (Greg Burr, Maine DIFW, personal communication July 23, 2014). Maine DIFW stocked brook trout in the riverine reach of the Union River between Graham Lake Dam and the Ellsworth Dam from approximately 2004 to 2007 (Burr, G. Maine DIFW, personal communication, March 7, 2013 and July 18, 2013), however, stockings were not successful and the efforts were cancelled (Burr, G. Maine DIFW, personal communication, July 3, 2014).

Diadromous Species

River Herring (Alewives and Blueback Herring)

Alewives are common in the Union River in May and June (Baum 1982). Alewives spawn about two or three weeks earlier in the spring than blueback herring. They migrate upstream entering rivers from the ocean in April and May, spawning in quiet areas with slow current or in still pools (Jenkins and Burkhead 1993). Similar to other herring species, they are fractional broadcast spawners, randomly releasing their small adhesive eggs over cobble, gravel, or other

bottom material on their way upstream. After spawning, alewives return to the river mouth and may live in the shallow estuary until fall before heading out to sea for the winter (Jenkins and Burkhead 1993). Juveniles remain in primary nursery areas until October and then begin migrating to shallow, high salinity estuaries for over-wintering (Jenkins and Burkhead 1993).

A small remnant stock of blueback herring is believed to exist in the Union River below the Ellsworth Dam. Blueback herring closely resemble alewives, but spawn in free-flowing rivers and streams rather than in lakes and ponds. The peak spawning period for blueback herring is also slightly later than that of alewives. The existence of blueback herring in the Union River is based on the river herring trapping data at Ellsworth Dam (URFCC 2015).

Alewives and blueback herring, collectively referred to as river herring, are managed by the Maine DMR in cooperation with the City of Ellsworth. The City of Ellsworth holds the commercial fishing rights for river herring on the Union River, and historically assumed responsibility for stocking adult fish in upstream spawning habitat under a cooperative agreement with the Maine DMR. The annual commercial harvest, which occurs at the trapping facility at the Ellsworth Dam, has ranged from 5,000 to 1,066,297 fish since 1974 (URFCC 2010, 2015), with the catch being sold as bait in the lobster fishery.

Black Bear operates the upstream passage facility at Ellsworth Dam, where river herring are trapped and transported to Lake Leonard and Graham Lake⁴. Lake Leonard and Graham Lake are the primary stocking locations for river herring in the Union River drainage, and contain the majority of potential spawning habitat. Based on the upstream fishway operations data, the alewife migration and trap and transport activity typically runs from early May to early/mid-June. For 2014, the upstream trap and transport started capturing alewives on May 8 and extended to June 11, with one additional trap and transport to Lake Leonard on June 14. For 2015, the operation of the trap began on May 1 and extended to October 31. The upstream trap and transport started capturing alewives on May 10th and extended into July. According to the fishway operator, the presence of river herring in the river near the fishway is typically sporadic after early June as the migration slows to an end. Table E-11 shows returns of river herring to the fishway since 1986.

⁴ The existing fish trap is owned by the Maine Department of Inland Fisheries and Wildlife and/or Atlantic Sea-Run Salmon Commission. However, the trap and truck facility is contained within the project boundary and is integral to the FERC approved Union River Comprehensive Fishery Management Plan. The Licensee's roles and responsibilities for the trap and truck facility are clearly laid out in the Plan and codified in the September 27, 2002 FERC Order Amending License Article 406 requiring compliance with the FERC approved Plan.

Table E-11: River Herring Fishway Counts, Union River at Ellsworth Dam

Year	Number	Year	Number
1986	1,038,920	2001	446,850
1987	473,840	2002	666,967
1988	526,911	2003	326,497
1989	559,676	2004	193,523
1990	368,400	2005	195,277
1991	192,720	2006	693,360
1992	390,210	2007	227,070
1993	111,139	2008	515,160
1994	117,158	2009	452,250
1995	183,634	2010	450,090
1996	301,253	2011	415,125
1997	279,145	2012	1,219,927
1998	441,923	2013	709,097
1999	277,425	2014	769,635
2000	389,610	2015	555,015

Source: URFCC 2015.

Efforts to restore river herring populations to the Union River drainage began in 1972 (UFCC 2015). Initially, brood stock were trapped in a nearby river and released in Graham Lake (UFCC 2015). Once the fish trapping facility at the Ellsworth dam was completed in 1974, fish were collected in the Union River trap and transported upstream of the dam (UFCC 2015). Annual trap and transport of adult spawners ranged from 600 to 63,585 fish from 1972 through 1999 (no fish were transported upstream in 1978 - 1980). Licensee had transported over 100,000 river herring (11.6 fish/acre) upstream annually since 2000, until increasing the spawning escapement to 125,000 in 2010 and 150,000 (18 fish/acre) in 2011. In addition, 1,600 river herring are transported to Lake Leonard after June 10 if available. This late season stocking is to enhance and expand the small population of blueback herring thought to consist primarily of the late run (URFCC 2015). The overall goal is to reach an annual alewife run size that would allow for harvest of two million fish plus the spawning escapement numbers (URFCC 2015). Starting in 2015, the planned river herring stocking number has been raised from 150,000 to 315,000. Another change included in the updated CFMP consists of stocking river herring in five additional lakes/ponds in the Union River drainage. Based on the target 35 fish/acre and a harvest of 2 million river herring, the calculated spawning escapement for all seven lakes is 357,151 alewives. Thus, Black Bear transported a sufficient number of river herring in 2015 to meet a minimum of 88 percent of the calculated spawning escapement for the watershed (final stocking numbers were 329,160, exceeding the target 315,000).

Black Bear operates downstream passage facilities at both the Ellsworth and Graham Lake Dams. The downstream fishways are operated from April 1 to December 31 annually, as river conditions allow. Fish passage facilities were designed and are operated in consultation with the agencies through the CFMP (URFCC 2015).

Atlantic Salmon

The Gulf of Maine (GOM) Distinct Population Segment (DPS) of Atlantic salmon was first listed as endangered under the ESA by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) (the Services) on November 17, 2000 (USFWS and NMFS 2000). The GOM DPS designation in 2000 included all naturally reproducing Atlantic salmon populations occurring in an area from the Kennebec River downstream of the former Edwards Dam site extending north to the international border between Canada and the United States at the mouth of the St. Croix River. This range includes the Union River. The GOM DPS also included river-specific hatchery fish that were being propagated at the Craig Brook Hatchery for release into the wild.

The Ellsworth Project falls within the designated critical habitat of the Downeast Coastal Salmon Habitat Recovery Unit for Atlantic salmon (NMFS 2009; Sean McDermott, NMFS, personal communication July 2, 2014). Black Bear has developed a draft Biological Assessment (BA) for Atlantic salmon, shortnose sturgeon, and Atlantic sturgeon (Appendix E-12), and more detailed information about these species is included in the draft BA.

Historically, hatchery raised salmonids have been stocked in most of the lakes and ponds of the Union River (Baum 1982). Annual releases of hatchery-reared Atlantic salmon smolts (one- and two-year old fish) began in the Union River in 1971, and were continued until 1991, when stocking was suspended due to funding reductions and a redirected focus on wild salmon rivers and the Penobscot River (USASAC 1992). Since 1993, there has been sporadic stocking of salmon parr, and annual stocking of fry since 2001, in the Union River (Table E-12).

In 2011, 282 excess captive-reared brood stock (pre-spawn) salmon were released into the West Branch, Union River. During a subsequent survey Maine DMR biologists documented over 200 completed redds produced by these salmon several miles upstream of the Project. Maine DMR expected that smolts produced from the captive-reared excess brood stock would migrate to the sea in 2014-2015 (Maine DMR letter to FERC, dated July 1, 2013).

Table E-12: Union River Atlantic Salmon Stocking History 1970-2014

Year	Fry	0 Parr	1 Parr	2 Parr	1 Smolt	2 Smolt	Adult
1971-2001	425,000	371,400	0	0	379,700	251,000	0
2002	5,000	0	0	0	0	0	0
2003	3,000	0	0	0	0	0	0
2004	3,000	0	0	0	0	0	0
2005	2,000	0	0	0	0	0	0
2006	2,000	0	0	0	0	0	0
2007	22,000	0	0	0	0	0	0
2008	23,000	0	0	0	0	0	0
2009	28,000	0	0	0	0	0	0
2010	19,000	0	0	0	0	0	0
2011	19,000	0	0	0	0	0	282
2012	Natural recruitment from 282 adult spawners stocked in September, 2011 – no fry stocking						
2013	Natural recruitment from 282 adult spawners stocked in September, 2011 – no fry stocking						
2014	23,000	0	0	0	0	0	0

Source: URFCC 2015.

Since 1999, the resource agencies have examined scale samples from each adult salmon returning to the Union River to determine origin. The assessments of salmon origin show that returns to the Union River since 1993 (i.e., following cessation of the broodstock program) consist of a few hatchery origin strays and a few wild or fry stocked salmon. The latter include salmon that originated from fry stocking, natural reproduction or wild/fry stocked strays from other rivers. Having a few strays into the Union River that originated from the Penobscot River, or from the other eastern Maine rivers, is consistent with the homing and straying behavior of Atlantic salmon and the typical rate of straying described in the Status Review (i.e., 2% [Fay et al. 2006]). Between 2006 and 2011, no salmon returned to the Union River. Since then, three aquaculture escapees returned in 2012, one salmon (wild) returned in 2013, and two (one wild and one hatchery) in 2014 (Table E-13) (URFCC 2015). The 2014 suspected hatchery stray was released downstream of the Project. In 2015, the upstream fishway was checked four times per day for an extended period from May 1 to October 31. As per the Maine DMR fishway protocols, the upstream fishway was not operated when temperatures exceeded 23°C (73°F), which occurred intermittently in July and September and throughout most of August. However, observations of the fishway entrance area and tailwaters continued on a routine basis; no Atlantic salmon were observed. Maine DMR noted in a letter to FERC dated July 1, 2013 that the lack of returning Atlantic salmon to the Union River is not unexpected given the recent stocking history and lack of spawning escapement.

Table E-13: Union River Atlantic Salmon Returns by Origin

Year	Aquaculture	Hatchery	Wild	Total
1973 - 1986	0	1892	4	1896
1987	undetermined	63	0	63
1988	undetermined	45	2	47
1989	undetermined	30	0	30
1990	undetermined	21	0	21
1991	undetermined	2	6	8
1992	undetermined	4	0	4
1993	undetermined	0	0	0
1994	undetermined	0	0	0
1995	undetermined	0	0	0
1996	undetermined	68	1	69
1997	undetermined	8	0	8
1998	undetermined	13	0	13
1999	63	6	3	72
2000	3	2	0	5
2001	2	0	0	2
2002	6	5	0	11
2003	0	1	0	1
2004	0	1	1	2
2005	4	0	0	4
2006	0	0	0	0
2007	0	0	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	3	0	0	3
2013	0	0	1	1
2014	0	1	1	2
2015	0	0	0	0
TOTAL 1995 - 2015	81	105	7	193

Source: URFCC 2015; Maine DMR 2015

Note: Salmon returns before 2000 included rod and trap captures.

NMFS and the University of Maine maintain an array of acoustic telemetry receivers along the coast of Maine. This array is used to detect passing fish that have been tagged by the University with acoustic tags. Species tagged include Atlantic salmon, as well as shortnose and Atlantic

sturgeon (Gayle Zydlewski, University of Maine, personal communication July 22, 2013). Acoustic receivers have been deployed in the Union River annually since 2008 (G. Zydlewski, University of Maine, personal communication July 9, 2014). One receiver is deployed about 0.7 km downstream of the boat launch in Ellsworth and the second, about 1.7 km downstream of the boat launch, close to Blue Hill Bay. The receivers are typically deployed in mid- or late-May and retrieved in late October or early November. No fish from the Union River have been captured and tagged for monitoring. One acoustically tagged shortnose sturgeon was detected in the Union on June 23 and 24, 2014. Otherwise, no acoustic tags have been detected in the Union River from fish tagged in other Maine rivers (G. Zydlewski, University of Maine, personal communication July 9, 2014 and August 25, 2015).

Essential Fish Habitat - The Magnuson-Steven Fishery Conservation and Management Reauthorization Act of 2006 mandated that habitats essential to federally managed commercial fish species be identified, and that measures be taken to conserve and enhance habitat. In the amended Act, Congress defined essential fish habitat (EFH) for federally managed fish species as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity”. Essential fish habitat for Atlantic salmon is described 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). The EFH designated habitat for all life stages of Atlantic salmon (eggs, larvae, juveniles, and adults) in Maine includes the Union River and Union River Bay, including the Project area.

The Project protects EFH for Atlantic salmon by providing upstream and downstream fish passage and migratory pathways to habitat, and ensuring suitable habitat downstream of each development through minimum flows.

Atlantic Sturgeon and Shortnose Sturgeon

On February 6, 2012, NOAA published notice in the Federal Register listing the Atlantic sturgeon as endangered in the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs, and as threatened in the Gulf of Maine DPS (77 FR 5880 and 77 FR 5914). The Atlantic sturgeon is a long-lived, late maturing, estuarine dependent, anadromous species. Information in the following subsections is taken from the 2007 Atlantic sturgeon status review (Atlantic Sturgeon Status Review Team 2007), unless otherwise noted. The species’ historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida. Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in the spring/early summer. Critical habitat has not been designated for the Atlantic sturgeon.

Shortnose sturgeon were listed as endangered on March 11, 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Although shortnose sturgeon are listed as endangered range-wide, in the final recovery plan NMFS recognized 19 separate populations occurring throughout the range of the species. These populations are in New Brunswick Canada; Maine; Massachusetts; Connecticut; New York; New Jersey/Delaware; Maryland and Virginia; North Carolina; South Carolina; Georgia; and Florida.

The shortnose sturgeon occurs in large coastal rivers of eastern North America. In the northern part of its range, the species is considered to be “freshwater amphidromous,” and it spawns in freshwater, but regularly enters seawater during various stages of its life (NMFS 1998). Shortnose sturgeon are occasionally found near the mouths of rivers, and coastal migrations between the lower Penobscot River and the Androscoggin/Kennebec estuary (i.e., Merrymeeting Bay) have been documented (Zydlewski 2011, Fernandes et al. 2010). Juveniles typically move upstream in rivers in spring and summer, and downstream in fall and winter, but inhabit reaches above the freshwater - saltwater interface. Adults may move into higher salinity areas on a more regular basis (NMFS 1998). Critical habitat has not been designated for the shortnose sturgeon.

According to state fishery personnel, Atlantic sturgeon have been observed in the Union River below Ellsworth Dam (URFCC 2015). The status of the population of Atlantic sturgeon and shortnose sturgeon, which may also occur in the river, is unknown at this time (URFCC 2015). In the Status Review of Atlantic sturgeon, it was noted that “The geomorphology of most small coastal rivers in Maine is not sufficient to support Atlantic sturgeon spawning populations, except for the Penobscot and the estuarial complex of the Kennebec, Androscoggin, and Sheepscot Rivers” though subadults may use the estuaries of smaller coastal drainages during the summer months (Atlantic Sturgeon Status Review Team 2007). Zydlewski et al. (2011) found that shortnose sturgeon use small coastal rivers as they migrate between the Kennebec and Penobscot Rivers. However, as noted above, only one shortnose sturgeon and no Atlantic sturgeon tagged at other locations have been detected by the acoustic receivers deployed in the lower Union River (G. Zydlewski, University of Maine, personal communication July 9, 2014 and August 20, 2015). From review of the limited bathymetry data of the original river channel that has been inundated by Lake Leonard there may be steep gradient reaches that would have historically kept Atlantic and shortnose sturgeon from accessing the Union River above the site of the Ellsworth Dam.

Black Bear has developed a draft Biological Assessment (BA) for Atlantic salmon, shortnose sturgeon, and Atlantic sturgeon (Appendix E-12), and more detailed information about these species is included in the draft BA.

American eel

American eel are present in the Union River estuary, and some are known to occur in inland waters above the Ellsworth Project dams. The USFWS recently reviewed a petition to list the American eel as a protected species under the ESA and determined that listing was not warranted (USFWS 2015). Specifically, the finding stated that “While sources of individual mortality still exist, there are no stressors (natural or human induced negative pressures affecting individuals or subpopulations of a species), individually or cumulatively, that rise to the level of threats (natural or human induced pressure affecting a species as a whole) to the American eel’s panmictic population”. The Atlantic States Marine Fisheries Commission’s (ASMFC) 2012 Benchmark Stock Assessment determined the stock is depleted (ASMFC 2012), while the most recent status review considered the eel abundance to be stable (Shepard 2015).

The American eel is a widely spread, catadromous fish that spends most of its life in fresh or estuarine water before migrating to the Sargasso Sea to spawn. Juvenile eel (elvers) enter river systems in the spring, migrating upstream. They are habitat generalists and may stay in the lower coastal river habitat or continue moving upstream to distant inland waters. American eel have multiple lifestages, including a larval stage (leptocephalus) that typically occurs offshore; young juvenile forms (glass eel and elver) that enter rivers; and older juveniles (yellow eel), and adult (silver eel). Research suggests that eels that migrate to headwater habitat are more likely to be female, while those that remain in downstream habitat are more likely to be male (Shepard 2015). Shepard (2015) also described males as maturing faster than females and are more abundant in the southern portion of their range while females tend to be larger, take longer to mature, and are more abundant in the northern range. They may take from as few as 8 to more than 20 years to mature, before migrating back out to sea to spawn. Spawning likely occurs from February through April, although spawning has never been observed (Boschung and Mayden 2004).

Maine manages three different eel fisheries, glass eel/elver fishery, yellow eel fishery, and mature adult silver eel fishery. There is an active elver fishery downstream of Ellsworth Dam. Maine DMR regulates the elver fishing industry in Maine with dip net and fyke net permits. Records of elver fishing from 2007 to 2014 in the Union River and the percent of the landing in comparison to total elver statewide landings are shown in Table E-14. During this period, landings of elvers in the Union River ranged from 173 to 1,501 pounds, and represented 6 to 10 percent of the state’s total elver catch (G. Wippelhauser, Maine DMR, personal communication July 15, 2014). Based on the 2012 benchmark assessment, ASMFC recommended eel conservation and management measures for states to reduce landings. In response to ASMFC discussions of quota management for glass eel fisheries, Maine voluntarily implemented a 2014 harvest management plan that included a quota of 11,749 pounds, which was a 35 percent reduction from 2012 levels (ASMFC 2014). Maine instituted a glass eel quota of 9,688 pounds

for the 2015-2017 commercial glass eel fishing seasons. This quota will be re-evaluated after three years (prior to the start of the 2018 fishing season). Additional ASMFC conservation measures include limits on yellow eel fishery and closure of silver eel fishery from September 1st through December 31st (ASMFC 2013).

Table E-14: 2007 to 2014, Union River Elver Landings

Year	Union River Elver Landing (Total Pounds)	Percent of Statewide Elver Landing
2007	306	10
2008	494	8
2009	424	9
2010	173	7
2011	436	6
2012	1,183	8
2013	1,501	10
2014	570	6

During the 2014 upstream eel migration season, Black Bear conducted nighttime eel surveys at Ellsworth Dam and Graham Lake Dam (Black Bear 2014). Eel observation surveys were conducted once per week from June to August. Each site was surveyed for approximately 1 hour between 21:00 hours and midnight. At the Ellsworth Dam, the number of eel observed during each night's survey ranged from approximately 10 to more than 700 (Table E-15). At Graham Lake Dam, the total number of eels observed per survey ranged from approximately 40 to more than 600. The highest eel densities were observed during the July 8th survey. Eel ranged from 2 to 5 inches in length at the Ellsworth Dam. At Graham Lake Dam, the length of eel generally ranged from approximately 3 to 6 inches long, but there were a few longer eel that ranged up to approximately 8 to 10 inches in length. The study, based on visual observations coupled with the known presence of the species in the Union River above Graham Lake, concluded that eel are able to migrate upstream through Project waters and facilities under existing conditions.

**Table E-15: Summary of 2014 Nighttime Juvenile Eel
Survey Results at Ellsworth Dam and Graham Lake Dam**

Date	Ellsworth Dam		Graham Lake Dam	
	Number of Eel	Size Class (inches)	Number of Eel	Size Class (inches)
06/10/2014	0	-	40 to 50	3 to 6
06/18/2014	0	-	200+	3 to 6
06/25/2014	10	-	70+	3 to 6
07/01/2014	100+	2 to 4	100+	3 to 6
07/08/2014	700+	2 to 4	20+	3 to 6
			600+	<3 to 10
07/22/2014	400+	2 to 5	150+	3 to 8
08/05/2014	200 to 300	3 to 4	50	3 to 6

Black Bear 2014

Other Diadromous Fish

Based on past incidental occurrence in the commercial river herring harvest, occasional catch by anglers, and historic reports by agency personnel that used to tend the fishway and trap, a residual population of American shad together with strays from other river systems is believed to exist in the Union River estuary below Ellsworth Dam. Based on a statewide assessment of habitat information, including historic distribution, the Union River contains 4.9 miles of potential habitat for American shad, compared to the total of 1,607 miles statewide (Maine DMR 2014). Of the total 4.9 miles of shad habitat within the Union river, only two miles occur above Ellsworth Dam. The major known American shad spawning and young-of-year rivers consist of the Saco, Androscoggin, Kennebec, and Penobscot rivers (Maine DMR 2014). Due to the lack of an available source of brood stock, there currently are no plans for active restoration of shad to the Union River (URFCC 2015). The Maine DMR plans to focus its shad restoration efforts on rivers other than the Union River from 2015 to 2017 as identified in the CFMP (URFCC 2015). Given the small amount of shad habitat mapped by Maine DMR (2014) in the Union River, restoration efforts are unlikely in this river any time in the foreseeable future.

Striped bass use the Union River estuary for feeding during the spring, summer and fall, and are attracted into the river by the presence of migrating river herring and eel. They are not known to

spawn in the Union River, but originate from other coastal migratory populations at major spawning rivers outside of the Gulf of Maine, including the Hudson and Delaware Rivers, and the tributaries to Chesapeake Bay. Striped bass are a popular sport fish in the lower Union River estuary downstream of Ellsworth Dam and are currently protected through the use of regulated size and creel limits (URFCC 2015).

Rainbow smelt occur in the Union River estuary downstream of Ellsworth Dam and continue to be managed in the Union River in accordance with statewide regulations governing recreational and commercial harvest (URFCC 2015). They support a small recreational fishery at the head of tide, which is limited to harvest by hook and line or dip net from March 15 to June 15 (URFCC 2015, Baum 1982). Anadromous rainbow smelt typically migrate a short distance into rivers and streams during their annual spawning migrations and cannot negotiate rapids or other significant natural barriers. It is unknown how far smelt migrated upstream in the Union River prior to the existence of the Ellsworth Dam (URFCC 2015), but it is unlikely that they ascended the steeper rock ledges at the Ellsworth Dam location.

Freshwater Mussels

Per the study request of the Maine DIFW, Black Bear performed a survey for the Brook Floater (*Alasmidonta varicosa*) freshwater mussel in the Union River downstream of the Graham Lake Dam in 2014 to provide more detailed information on the occurrences in Project waters. The Brook Floater freshwater mussel is listed as Threatened under Maine's Endangered Species Act. Black Bear performed surveys on July 24, August 22, and September 22, 2014, using a combination of widely used methodologies for determining presence/absence of freshwater mussels. The primary reference for the methodologies used was "A Guide to Sampling Freshwater Mussel Populations" (Strayer and Smith 2003).

Black Bear used aerial photography, coupled with the biologists' investigation of the Project's riverine areas and shoreline, to identify distinct river reaches in which to locate survey transects. The first field component of the survey effort consisted of a reconnaissance review around the perimeter of the river. This was conducted by boat using view tubes and on foot for shoreline investigations. Nineteen survey transect locations were selected based on observations made during the perimeter reconnaissance. Divers then swam bank-to-bank transects in each of the identified reaches of the river. In the lower part of the investigation area river rapids made it unsafe for SCUBA or snorkel investigations. In this reach investigators used view tubes and face masks and investigated wadeable portions of the reach.

In addition to in-water searches, Black Bear surveyed the shoreline for shell middens by boat and on foot. All surveys were performed in summer months, during low water levels and warm

water conditions. The water temperature was between 22°C and 24°C during the surveys. These parameters favor times when mussels are more likely to be visible at the substrate surface.

No Brook Floater mussels were observed in either the upper or lower survey reaches. Shell middens observed on the shore revealed no Brook Floater shells.

Fish Passage

Ellsworth Dam is equipped with a vertical slot upstream fishway and trap, which is managed in consultation with the agencies through the management plan. The upstream fishway and fish trapping facility were constructed at the Ellsworth Dam (Lake Leonard) in 1974, originally to provide a supplemental source of Atlantic salmon broodstock for use in the restoration of populations to the Penobscot and other rivers (Baum 1982). Atlantic salmon broodstock collection was discontinued and the upstream fishway has been used primarily during the river herring migration, but also to collect any salmon that might use the facility for potential upriver transport (depending on origin of fish) in the Union River. Maine DMR has annually directed Black Bear whether to transport any returning adult Atlantic salmon upstream of the Project. The trapping facility is also used for the commercial harvest of river herring by the City of Ellsworth under a cooperative management agreement with the Maine DMR. In 2014, the upstream fishway was operated for alewife stocking and harvesting beginning in early May through mid-June. Black Bear then continued to operate the fishway through November 4 for Atlantic salmon (URFCC 2015). In 2015, the upstream fishway was operated from May 1 through October 31 as part of an upstream salmon passage effectiveness study.

Black Bear operates downstream passage facilities at both the Ellsworth and Graham Lake Dams. Downstream measures at the Ellsworth Dam consist of two stop-log controlled surface weirs above Units 2 through 4 and a transport pipe leading to a plunge pool immediately downstream of the dam, as well as a third surface weir adjacent to the Unit 1 intake that discharges directly to the same plunge pool.

Black Bear operates a surface weir (within a former log sluice bay) to provide downstream passage of out-migrating Atlantic salmon and river herring on the west end of the Graham Lake Dam gate structure. The development of this passage route was completed in 2003, coinciding with increased upstream stocking of alewives. The weir is very similar to the downstream passage system at the Ellsworth Dam in that it is a surface weir that contains stoplogs, which enable Black Bear to adjust the opening to match the changes in water elevation of Graham Lake. The opening empties into a downstream plunge pool and provides migrants with another route of passage in addition to the existing Tainter gates, which are operated to pass minimum flows and for flows used for generation purposes at the Ellsworth Dam. The downstream fishways are operated from April 1 to December 31 annually, as river conditions allow.

The Project's upstream and downstream fish passage facilities are managed in consultation with the agencies through the CFMP (URFCC 2015). Black Bear developed a site specific operation and maintenance plan for the fishways in 2015. The plan, which is consistent with the original design criteria for the fishways, includes a daily checklist that was instituted at the beginning of the 2015 season, and will be employed in future seasons, to ensure that the upstream and downstream fishways are operating properly. The plan also includes both a list of spare parts critical to fishway operation and a checklist of proper fishway operating characteristics. In 2015, Black Bear hired dedicated staff to operate the project fish passage facilities; these staff were dedicated to fishway operations, oversight, fish trap tending, and transporting the fish upriver. These dedicated fishway staff completed the daily checklists and prepared weekly reports on fishway operations, which were provided to the fisheries management agencies throughout the fishway operational season.

Reservoir Fisheries Habitat

The diverse habitat within the vicinity of the Ellsworth Project provides for an abundant variety of fish. Water quality throughout the basin is considered high, and is for the most part suitable for fish and wildlife resources and recreational uses. Lake Leonard is about one mile long with a surface area of 90 acres at normal water surface elevation. Lake Leonard has a maximum depth of 55 feet and a mean depth of 25 feet. Graham Lake is about 10 miles long with a surface area of approximately 10,000 acres at normal water surface. Graham Lake is divided into two basins (a north and a south basin) by a large peninsula that originates from the western shore (USFWS 2005). The lake is irregular in shape with numerous coves and inlets. The maximum depth of Graham Lake is 47 feet, while the mean depth is 17 feet. The bathymetry of Graham Lake is described in Section 4.4.2.

Exposed boulder/ledge substrate is limited in and around Graham Lake. Boulder/cobble substrate mixed with sand and gravel is the most common substrate along the east shore and the islands in the lake. In general, these substrate types are present from the shoreline to at least 4 to 5 feet depths. The western shore of Graham Lake is made up of varying ratios of clay and finer sands as well as medium to coarse sands and some fine gravel. Some localized areas have boulder and cobble mixed in with the sand/gravel. The north end of the lake, where the Union River enters the lake also has clay/sand/gravel substrates with some organic substrate. This area tends to have somewhat coarser material than the lower west shore. Substrates surrounding the heath areas within Graham Lake are dominated by clay and fine sand (Northrop, Devine & Tarbell, Inc. 1990).

Lake Leonard and Graham Lake are the primary stocking locations for river herring in the Union River drainage, with Graham Lake containing the majority of potential spawning habitat in the watershed.

In Graham Lake, data were collected on fish habitat around the perimeter of the lake to determine if conditions were appropriate for spawning, and providing juvenile and adult habitat of primarily smallmouth bass and chain pickerel (Black Bear 2012). The eastern shore of the lake and around the islands was observed to provide suitable habitat for smallmouth bass. The riprap area along the shore offers juvenile and spawning habitat for the bass. It has previously been concluded that chain pickerel would utilize the heath areas where aquatic vegetation is present, though habitat for spawning pickerel has been documented as somewhat scarce (Northrop, Devine & Tarbell, Inc. 1990).

Riverine Fisheries Habitat

In order to assure water quality and to protect fishery resources in the lower river, a continuous minimum flow release of 105 cfs is maintained from the Graham Lake Dam and Ellsworth Dam from July 1 through April 30 and a continuous minimum flow release of 250 cfs is maintained from May 1 through June 30.

Black Bear conducted an Instream Flow and Union River Tributary Access Study in 2014 and evaluated habitat within the Union River between Graham Lake Dam and Lake Leonard at various flows (Black Bear 2015). Habitat in the Union River between Graham Lake and Lake Leonard primarily consists of runs with periodic pools and riffles upstream of Route 1A (Figure E-12). The section of the Union River between Graham Lake Dam and Lake Leonard was divided into three representative reaches (upper, middle, and lower); the upper reach was just downstream of Graham Lake Dam, the lower reach was just upstream of Lake Leonard, and the middle reach was located in between these reaches. Habitat parameters (depth, velocity, wetted width and substrate) were measured during a set flow to help characterize the habitat available at low flows. The lowest gate setting provided at the time of the field study was estimated to provide a flow of 150 cfs. The wetted width for a flow of 105 cfs (lowest required minimum flow) was extrapolated for each transect based on measured data for four observed flows at multiple transects established throughout the reach. The difference in wetted width and depth between the observed 150 cfs and the extrapolated minimum flow of 105 cfs is insignificant as illustrated by the profiles presented in Appendix E-4. The calculations used to extrapolate to 105 cfs, and all field data collected at each transect are provided in Appendix E-4 in tabular form.

Portions of the upper reach of the Union River were relatively wide and consisted of deeper pool/run, which is uncharacteristic of this reach. Most of this reach consisted of deep run habitat and instream cover was abundant, which included submerged woody debris, snags and vegetation. Substrate consisted of fine sediment, gravel, cobble, and bedrock. There is also a wetted remnant oxbow, which transitions into a shallower run/riffle habitat. Further downstream, the river deepens into a slower pool-type habitat with fish cover including submerged large woody debris and large boulders.

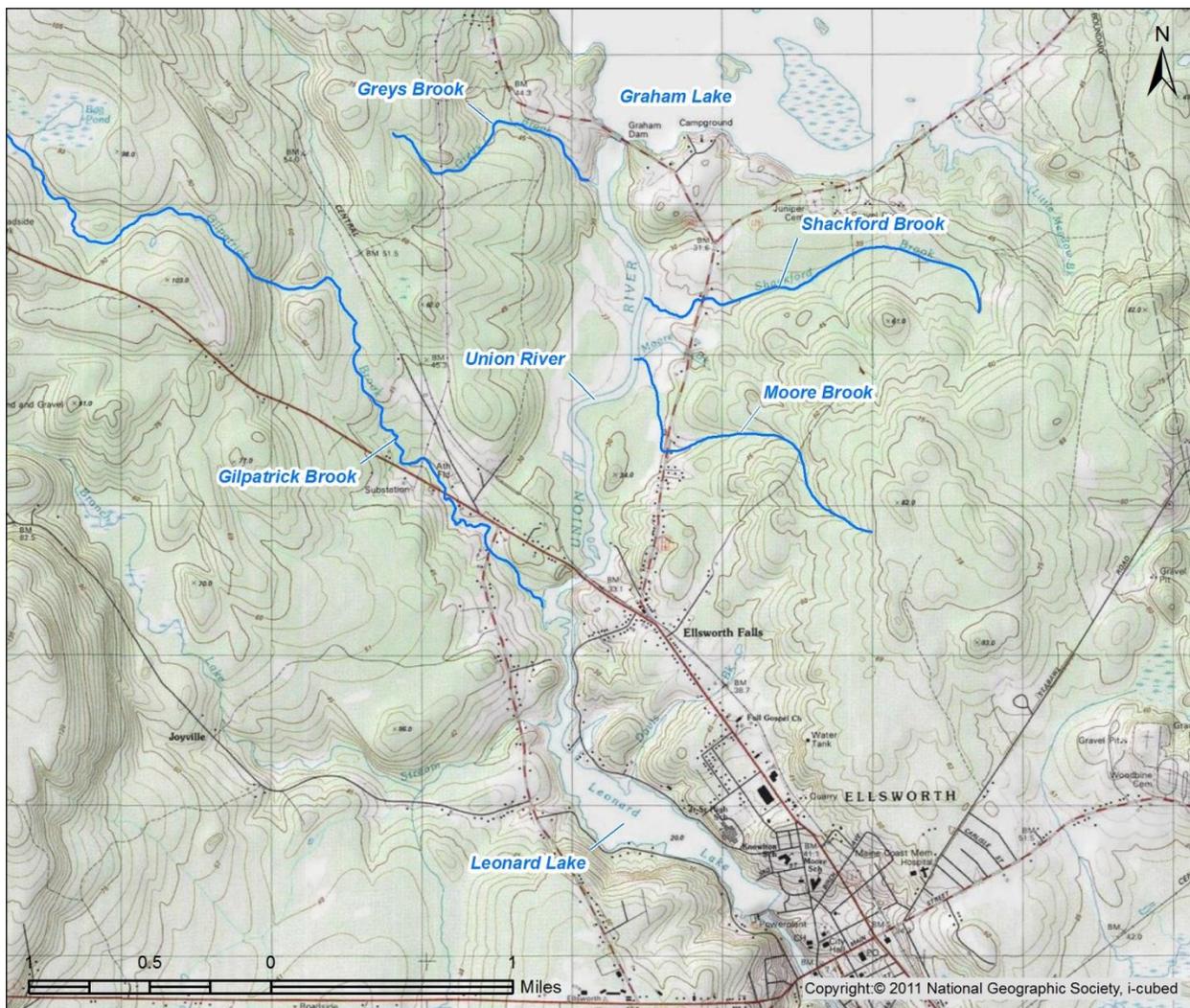
The middle reach of the study reach had distinct riffle, pool and run habitats. Riffle substrate consisted of gravel, cobble and large boulders. The pool substrate included silt, gravel and large boulders with submerged woody debris collecting along the left bank of the pool. The run substrate consisted of silt, gravel, and large boulders. All habitats had instream cover.

The lower reach was located at the upper extent of Lake Leonard. The lower reach had numerous large bedrock outcrops defining the channel where large boulders and woody debris provide instream cover. The habitat near Gilpatrick Brook (Figure E-12, Figure E-13) was a deep, run-type habitat with a large vegetated island located just downstream. Both sides of the island consisted of riffle habitat. Collectively, habitat information indicated the wetted width and depth at the estimated low flow release of 150 cfs, and extrapolated for the minimum flow of 105 cfs, provides an adequate wetted zone of passage for migratory fish and other aquatic species.

The Union River below the Ellsworth Dam is tidal water and as such the characteristics of the habitat changes with the tidal cycle and river flows. A large riffle area dominated by cobble and boulder substrates occurs downstream of the Project tailrace and is bound on one shore by large bedrock cliff.

Figure E-12: Habitat and Flow Study Transects,
Union River between Graham Lake and Lake Leonard



Figure E-13: Union River from Graham Lake Dam to Lake Leonard

4.4.3.2 Environmental Analysis

Water Level Fluctuations

An interest was identified by stakeholders during project scoping and study plan development regarding the effect of Project operations on the existing fish community and tributary connectivity. The Ellsworth Project currently operates with releases from Graham Lake development used to generate electricity at the Ellsworth development powerhouse. Water levels in Graham Lake are typically managed consistent with the target operating curve depicted in Figure E-7, though elevations vary annually. Graham Lake water levels are maintained between elevations 93.4' (late winter in order to provide storage capacity for spring rains and

snow melt) and the normal full pond elevation of 104.2' (typically in late May after spring runoff). This provides the ability to store and release water seasonally and also provides significant downstream flood control benefits. The Ellsworth development is operated such that nearly all inflows into the Ellsworth headpond are passed through the generating units, while the impoundment is maintained in a very stable state (i.e. within 1-foot of full pond during normal operations).

Warmwater species such as smallmouth bass, chain pickerel, and white perch provide sport fishing opportunities in Graham Lake (Black Bear 2012). Largemouth bass have been expanding rapidly (Burr, G. Maine DIFW, personal communication, July 3, 2014). A Project area resident and former Maine Guide who has fished Graham Lake extensively for many years, and who kept extensive catch records, which he submitted to Maine DIFW, noted that originally, largemouth bass were being caught primarily in the north part of the lake, and could reach two to three pounds; they are now found throughout the lake and in much higher abundance, and can reach five pounds. He noted that he had caught 80 bass on Graham Lake in a day (Fennelly, D. personal communication July 23, 2014). Bass fishing tournaments are hosted in Graham Lake, also indicating that there are abundant bass, and Maine DIFW (2015) reports that Graham Lake has good action for medium size bass. Good white perch fishing exists at Graham Lake, which also has a productive pickerel fishery (URFCC 2010), as well as a brown bullhead fishery (Fennelly, D. personal communication July 23, 2014).

Graham Lake provides a majority of the spawning and rearing habitat for river herring in the Union River watershed, and Black Bear's trap and transport efforts have allowed for development of one of the largest alewife runs in the country.

Instream Flows

Minimum flow releases from the Project dams have been developed to maintain fish habitat, to facilitate anadromous fish migration, and to protect downstream water quality. Resource agencies requested Black Bear evaluate the relationship between existing minimum flows, aquatic habitat and migratory fish behavior in the Union River below the Graham Lake Dam. Black Bear subsequently conducted an instream flow study (Black Bear 2014). Flows analyzed included two low flows (150 and 300 cfs), a mid-range flow (1,230 cfs) and a high level (2,460 cfs) generating capacity flow.

The study found aquatic habitat for river herring and Atlantic salmon is sufficient at all flows analyzed. In addition, a zone of passage for these species is provided throughout the Union River during the observed low flows. Tributaries to the Union River between Graham Lake and Lake Leonard (Greys, Shackford, Moore, and Gilpatrick brooks [Figure E-13]) maintained adequate connectivity for Atlantic salmon, river herring and other aquatic species during the

flows observed. Appendix E-4 contains the photographs of tributary connections under the minimum observed study flow of 150 cfs.

Mode of Operation

Comments provided on the DLA expressed concern for peaking flow effects to aquatic resources downstream of Graham Lake Dam specifically that studies conducted at other rivers suggest benthic macroinvertebrates may be adversely affected by peaking flows, and that any impact to macroinvertebrates may affect feeding by juvenile alosids and Atlantic salmon. Lake and impoundment outlet waters are known to provide abundant food sources, and typically exhibit hyperdominance by hydropsychids (Spence and Hynes 1971) and filter feeding caddisflies (Parker and Voshell 1983). The Union River macroinvertebrate data collected downstream of Graham Lake Dam was described as abundant (Black Bear 2015). Juvenile alosids feed primarily on zooplankton, fish eggs and larvae, crustaceans, and insects (Bozeman and Van Den Avyle 1989, USFWS 2001, Riley 2012), and juvenile Atlantic salmon feed primarily on drift items (Keeley and Grant 1997, Orlov et al. 2006). The productive impoundment outlet waters provide ample prey items to support feeding by juvenile alosids and salmon.

Comments on the DLA also expressed a concern regarding whether peaking flows affect aquatic habitat and upstream passage effectiveness downstream of the Ellsworth Dam. In regards to upstream passage effectiveness, the one consistent observation made throughout the upstream fish passage study (Black Bear 2014 and 2015) was that fish (river herring) occurrence and densities were higher in the afternoon and evening hours (prior to sunset), and on incoming tides. A review of project operations/ river flow data did not suggest the fish migration or fishway numbers responded to changes in flow from the Project. Because river herring can access the river below Ellsworth Dam, it is expected that turbine discharge would not affect other diadromous fish from accessing Ellsworth Dam. Observations below the dam indicate the river bed remains watered under minimum flow conditions with no evidence of areas of potential stranding.

There is very little, if any, adverse impact to the resident fish or diadromous fish from the current or proposed operating regime for the Ellsworth Project.

Fish Access to Tributaries

In October 2014, impoundment tributary connectivity was assessed for tributaries during low water conditions in Graham Lake (97.9') and in Lake Leonard (65.7' to 66.7'). Observations in Graham Lake indicated tributaries maintained connectivity at this elevation. Based on the Graham Lake historic operating curves (Figure E-7), the conditions of connectivity observed at 97.9' in Graham Lake were only 2 inches above the target elevation for October (target elevation increases late October through November), and one foot below the long term (1999-2014)

average elevation for October. Therefore, connectivity is expected to be maintained through the fall seasonal drawdown (Black Bear 2014). To address stakeholder comments on the USR, and in accord with FERC's December 8, 2015 Determination on Requested Study Modifications, Black Bear will provide gradient profiles for the Graham Lake and Lake Leonard tributaries as indicated in the Study Plan Determination and will collect zone of passage information from tributaries selected in consultation with the fisheries agencies. Black Bear will collect this information and file it with FERC by December 31, 2016 as additional information to the FLA.

A similar evaluation of tributary access for the streams entering the Union River between Graham Lake and Lake Leonard (Greys Brook, Shackford Brook, Moore Brook, and Gilpatrick Brook) was conducted in September 2014 during managed low flow conditions. All tributary confluences had adequate depths (> 6 inches) during the observed low flows that would allow Atlantic salmon access, see photographs provided in the USR and Appendix E-4 of each tributary confluence during the low flow observations. In addition, the tributary confluences had low velocities that would not preclude access by Atlantic salmon or river herring. Therefore, the confluence at each of the tributaries provide a zone of passage into the tributaries for Atlantic salmon to access any suitable spawning habitat that may be present upstream in these tributaries⁵. Natural low flows within the tributaries themselves were observed during the study, suggesting that low flows within the tributaries could potentially be a limiting factor for migratory fish accessibility further up in the tributaries.

It should be noted that migratory species typically migrate upstream into tributaries during instances of high runoff following rain events, rather than during the low flow period observed in this study. This further suggests that accessibility to these tributaries is available during the Atlantic salmon migratory season.

Stakeholder comments on the USR suggested that the evaluation of accessibility to tributaries should be based upon more detailed criteria. To further address stakeholder comments on the USR, and in accord with FERC's December 8, 2015 Determination on Requested Study Modifications, Black Bear will consult with agencies and collect additional zone of passage information in 2016 for select tributaries to the Union River between Graham Lake and Lake Leonard. Black Bear will file the results of this study with FERC by December 31, 2016 as additional information to the FLA.

⁵ This portion of the instream flow study (evaluation of tributary access) was conducted as required in the approved study plan: "To evaluate tributary access for diadromous fish, the confluence of the tributaries (pending accessibility) of Union River and Moore Brook, Gilpatrick Brook, Shackford Brook and Greys Brook will be observed during the various flow conditions to document with photographs there is reach connectivity to allow diadromous fish accesses to each of the tributaries."

Upstream Passage

Anadromous Species

The upstream fish passage facility at the Project is designed to trap Atlantic salmon and river herring, and to transport fish to suitable upstream habitat located above the Project dams. Resource agencies and stakeholders expressed interest regarding the effectiveness of the upstream fishway at Ellsworth Dam and the potential for migration delay for diadromous species.

In 2014, Black Bear conducted an upstream fish passage study to evaluate the effectiveness of the existing upstream trap and transport operations (Black Bear 2014). Black Bear evaluated the route and behavior of river herring approaching the fishway and trap, and the extent of any injury, stress or mortality during and after handling at the fishway and trap and release sites.

To evaluate the route and behavior of river herring approaching the fishway, Black Bear viewed the Union River from several stations at the base of the dam and powerhouse several times a day and prior to checking the fishway, as conditions allowed, to determine whether river herring were present and the approximate abundance. The 2014 alewife migration and trap and transport activity started on May 8 and extended to June 7 for Graham Lake, with an additional trap and transport to Lake Leonard on June 14. Observations of river herring presence and behavior as they approached the fishway indicated they use both sides of the river and occasionally, the middle of the river. The primary factor affecting alewife presence and abundance was the time of day, where the number of fish in the river as well as entering the fishway increased substantially during afternoon hours. There was no apparent pattern associated with river flows, Project operations, or weather conditions.⁶

To assess the extent of any injury, stress or mortality during and after handling at the fishway and trap and release sites, a total of 857 fish were held for 24 hours and evaluated during 4 net pen trials. The net pen trials resulted in a total of 21 mortalities (<2.5%), all of which resulted from net entanglement and did not appear to be related to delayed mortality from transport. Observations noted during the truck transport and release into Graham Lake and the results of

⁶ An Upstream Atlantic Salmon Passage Study was conducted in 2015 to evaluate whether operations at the trapping facility may affect the capture of adult Atlantic salmon. The study observations, including observations of river herring passage (intended to inform the potential for the presence of herring to affect the passage of salmon) are included in Appendix E-6. During observations of the river, it was noted that the river herring tended to run strongest in the evenings and moved stronger during an incoming tide. Increasing river temperature was also noted to increase river herring densities during warm sunny days. It was also noted that, on most evenings, river herring stopped entering the fishway and began dropping downriver around sunset. River flows did not seem to have as strong of a correlation to river herring densities as the previously mentioned environmental factors. During all flows, the river herring tended to migrate upstream on the fishway side of the river (deeper water is present here) and hold in front of the fishway entrance. During spill events, the river herring did not appear to migrate towards the dam face.

the net pen trials indicated that the transport and release does not result in observed or measured immediate or delayed mortality, injury or stress.

The upstream fish passage study also evaluated the trap and transport capacity for adult river herring. Observations during the study showed that when fish are abundant, the fish trap fills rapidly, transport trucks leave immediately, and fish are released into Graham Lake in 14 minutes or less 90 percent of the time. With two transport trucks running, as many as 25,920 (5,200 fish per hour) river herring were trapped and transported to Graham Lake during afternoon daylight hours in a single day.

In 2015, the Union River target alewife stocking number was increased from 150,000 to 315,000 fish. The trap and transport study concluded that the current fishway operation is more than sufficient to provide the 2015 to 2017 target management spawning escapement goal of 315,000. An increase in the annual river herring runs to two million fish is anticipated to occur 4 to 5 years after the 2015 escapement increase is implemented (URFCC 2015).

The full spawning escapement that would utilize additional habitat in five other pond/lakes targeted for alewife stocking is calculated at 357,151 (35/acre). Black Bear transported a sufficient number of river herring in 2015 to meet the minimum target of 88 percent⁷ of the calculated future spawning escapement for the watershed (315,000 stocked in 2015/357,151 revised spawning escapement), which represents a considerable increase over transporting 47 percent of the spawning escapement in prior years (150,000 stocked/315,000 spawning escapement calculated prior to 2015).

Collectively, these data indicate the operation of the current Ellsworth fish trap and transport facility has successfully developed and maintained a self-sustaining river herring population and commercial fishery. The Union River herring run has developed to be among the largest in the country. Further, the Atlantic States Marine Fisheries Commission (ASMFC) assessed the status of populations of river herring along the Atlantic Coast, and concluded that the population of alewife in the Union River had increased between 1975 to the early 2000s. The ASMFC also concluded that the Union River has exhibited a stable population of alewife for the past 10 years (ASMFC 2012 *cited in* FERC's September 4, 2013 Study Plan Determination).

Comments on the DLA requested that American shad upstream passage be evaluated. An analysis of upstream fish passage alternatives was conducted by Black Bear in 2015 and the initial report was presented in the USR (Black Bear 2015). The initial study report was revised to address several stakeholder comments, including a request to evaluate shad passage, and is included as Appendix E-7. As discussed previously, only a short reach of river above Ellsworth

⁷ The final 2015 numbers of river herring transported was 329,160, which equates to 92 % of the calculated future spawning escapement for the watershed.

Dam (to the top of Lake Leonard) is currently suitable for American shad. There is no information available on historical use of the river by shad and this species is not a conservation priority for the Maine DMR on the Union River (Maine DMR 2013). However, the upstream passage and alternatives analysis concluded the existing fishway should function with low to moderate effectiveness for shad. The fishway has the potential to be modified in the future for improved shad passage effectiveness if shad numbers and management goal priorities change.

The vertical slot upstream fish passage and trapping facility at the Project has a positive effect on the Atlantic salmon GOM DPS, as it increases habitat connectivity in the event migrating adults seek to enter the Union River searching for access to suitable spawning habitats. Some potentially negative effects from the trapping and transporting of adult Atlantic salmon include migration delay/interruption, and handling and holding stress or injury. While empirical studies of the upstream passage effectiveness for adult Atlantic salmon have not been specifically conducted at the site (primarily due to a lack of available study fish), an Upstream Atlantic Salmon Passage Study was conducted in 2015 to evaluate whether operations at the trapping facility may affect the capture of adult Atlantic salmon. The trap was operated from sunrise to sunset from May 1 to October 31 in 2015, checked at least four times a day, and observations made regarding the potential effects of fishway operations on salmon. As per the Maine DMR fishway protocols, the upstream fishway was not operated when temperatures exceeded 23°C (73°F), which occurred intermittently in July and September and throughout most of August. However, observations of the fishway entrance area and tailwaters continued on a routine basis. No Atlantic salmon were observed in the river or collected in the fishway in 2015. The study observations, including observations of river herring passage (intended to inform the potential for the presence of herring to affect the passage of salmon) are included in Appendix E-6.

Hydroelectric facilities may result in delays of both upstream and downstream migration of Atlantic salmon. Several studies on the Penobscot River have evaluated upstream passage behavior including the time needed for individual adult salmon to pass upstream of various dams once detected in the vicinity of a spillway or tailrace. These studies documented certain migratory behaviors that may contribute to migration delays, including frequent upstream and downstream movement, periods of holding in fast water, seeking thermal refuge in tributaries, attraction to spillage at dams, reduced migratory behavior in late summer, and inhibited movement at temperatures above 23°C (Power and McCleave 1980, Shepard 1995). However, upstream passage is site specific and passage studies conducted in the Penobscot River or other rivers may not be applicable to the Ellsworth Project.

As part of the ongoing relicensing of the Project, Black Bear reviewed historic information related to operations and environmental conditions during historic captures of Atlantic salmon to assist in evaluating the efficacy of the trap and transport facility and operations (Black Bear 2014). Recorded data on fishway operations when salmon were captured was available for years

2002 to 2005. There were no apparent trends in salmon captures and flow conditions as salmon were collected over a wide range of river flows, from summer flows as low as 48 cfs to the higher June flow of 937 cfs. Salmon were also captured over a range in temperatures up to 74°F. The fish trap was not operated when water temperatures were at or exceeded 77°F as per direction from Atlantic Sea-Run Salmon Commission and Maine DMR protocol. Temperatures in the upper seventies are more typical of late summer when salmon are not expected to be entering the river, or would be expected to be holding in thermal refugia. The current Maine DMR protocol is to not handle Atlantic salmon at fish passage facilities when the river temperature exceeds 73° F. While there is a low probability of salmon captures when water temperature exceeds 73° F (few salmon have been collected in the Union River at or above this temperature historically), Black Bear plans to modify its operational and handling procedures in case such a situation occurs in the future.

Using an assumed production of 3.0 smolts/100 square yards of stream bottom, and a marine survival of 1 - 3%, the habitat in the Union River upstream of Ellsworth could generate a self-sustaining run of about 250 to 750 salmon (Baum 1997 *cited in* URFCC 2010). It should be noted however, current marine survival has been estimated to be even lower, 0.09 to 1.02%, from 1995 to 2004 (ICES 2008 *cited in* USFWS and NMFS 2009) , which would result in a run of approximately 250 or less fish, given that this survival range is on the lower end or less than Baum (1997) used. Black Bear examined the Ellsworth fishway hopper capacity for salmon with regard to the estimated maximum self-sustained restored run size of 750 Atlantic salmon (Baum 1997 *cited in* URFCC 2010), and found that the Ellsworth lift hopper has more than four times the required capacity to pass a run of 750 Atlantic salmon (Black Bear 2014).

The upstream passage alternatives analysis also considered agency concern regarding effective passage of salmon during the river herring harvest operations and the potential for migration delay due to fishway crowding or infrequent trap and transport operation. Under current operations, the trap and hopper are visually inspected for Atlantic salmon and if one is spotted, the hopper is left in the water and the salmon is dip-netted out and placed in a holding tank. The salmon is then measured, examined for fin clips, fin wear, or other markings, a scale sample is taken, and the magnified scale image and fish photo is digitally captured. This information is transmitted to the Maine DMR who will then determine whether the Atlantic salmon caught in the fishway is to be released downstream of the Ellsworth Dam (hatchery or aquaculture escapees), moved via transport tank truck upstream (wild origin) and released in the West Branch of the Union River, approximately 17 miles upstream, or removed. Generally, this process takes one to two hours, and in the case of wild Atlantic salmon, they arrive in upstream habitat more quickly than they would if they had passed volitionally and swam the entire distance.

The current trap and transport facilities and operating protocols at Ellsworth have proven to be reliable and functional by handling river herring runs from 190,000 to 1,200,000 river herring and 0 to 8 Atlantic salmon annually from 2000 to 2015. Historically, this facility has handled up to 263 adult Atlantic salmon broodstock in a year. The trap and transport facility's original construction specifically targeted Atlantic salmon upstream passage. Trap and transport systems have been used successfully to pass other species such as shad on the Susquehanna River and river herring in the Sebasticook River. Sigourney et al. (2015) evaluated trap and transport of Atlantic salmon on the Penobscot River and found it was an effective means to increase migration success. However, the final upstream passage alternatives study report presents several options for increasing fish passage capacity in the future if necessary, discusses separation of river herring from Atlantic salmon passage, and examines alternative fishways (Appendix E-7). Black Bear will continue to consult with fisheries management agencies on the need for and, if necessary, the design of upstream fish passage improvements based upon the results of the relicensing studies and future management plans to be published by the fisheries management agencies.

There is a possibility that sturgeon could be encountered at the fish trap or during project maintenance activities (e.g., if the draft tubes need to be dewatered for maintenance activities). Black Bear has developed a draft protocol to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered at the Project. The protocol is attached to the draft Biological Assessment in Appendix E-12.

Catadromous Species

Juvenile eels are able to access upstream habitats by ascending the wetted surface of dams and adjacent ledges. Aggregations of juvenile eels moving upstream over the Ellsworth and Graham Lake Dams were observed during several nighttime eel surveys conducted in 2014, but their upstream passage success rate is unknown (URFCC 2015). Black Bear proposes to consult with fisheries management agencies to develop and install upstream eel passage facilities at the Project. The installation of such facilities will enhance upstream eel passage.

Downstream Passage

Anadromous Species

Black Bear operates downstream passage facilities at both Project dams to provide downstream passage of out-migrating Atlantic salmon and river herring. At Graham Lake dam passage is provided at a surface weir that is operated specifically for downstream passage; passage is also available through the minimum flow tainter gate. At the Ellsworth dam, downstream passage facilities consist of three surface weirs. These facilities have been in operation since approximately 1990.

Maine DMR has suggested post-spawn alewife are not surviving downstream passage of the Project. This is based on Maine DMR's principle components analysis and cluster analysis (Wards Method) that the agency conducted on the age composition and repeat spawning frequency data collected by harvesters and Maine DMR (combined) for the period 2008-2012 at 29 Maine harvesting sites. The Ellsworth harvest on the Union River had a low frequency of repeat spawning (i.e., a high proportion of fish had not previously spawned) and young spawners (age-3 and age-4). Maine DMR concluded that in the Union River "...alewives are only successfully spawning in one year" and offered two explanations "...either older, previous spawners are not able to reach the top of the upstream fish passage facility or post-spawn adults are not surviving downstream passage of the project" (Maine DMR letter to FERC, dated July 1, 2013). However, as FERC noted in its September 4, 2013 Study Plan Determination, in an analysis conducted by ASMFC (2012), ASMFC noted that high exploitation rates (the percentage of population that is harvested) can also reduce the number of older, repeat spawners in the population. Based on a review of the annual URFCC reports, FERC noted that the exploitation rate for alewives in the Union River ranged from 65 to 88 percent from 2000 to 2012, and the observed exploitation rates in the Union River overlap with the exploitation rate calculated by ASMFC (2012) that could cause population collapse (i.e., 62% to 80% depending upon the assumptions used regarding the population growth rate). Therefore, it is possible that the lower number of older, repeat spawners in the Union River is the result of high exploitation rates, rather than low downstream passage survival of post-spawned adult alewives.

In either case, the alewife run has maintained high numbers of returns and has been the second largest run of alewives in the state. This is further supported by high numbers of returns in 2012, 2013, and 2014 when the total river herring run size (including both river herring harvested and transported upstream) was 1.2 million, 709,097, and 769,635, respectively. Licensee transported over 100,000 river herring (11.6 fish/acre) upstream annually since 2000, until increasing the spawning escapement to 125,000 in 2010, 150,000 (18 fish/acre) in 2011, and 315,000 in 2015. While the number of alewife returning to the Union River clearly demonstrates that there has been adequate escapement of downstream migrants to support the expanding run, there has not been a site specific study to examine the effectiveness of the existing downstream passage facilities or available passage routes at Ellsworth.

In order to examine the effectiveness of the downstream passage facilities at Ellsworth, and in accordance with the December 30, 2014 Determination on Requests for Study Modifications and New Studies for the Ellsworth Hydroelectric Project by FERC, Black Bear developed a study plan in consultation with the agencies, to conduct a field study in 2016 to evaluate the effectiveness of downstream passage of Atlantic salmon smolts at the Ellsworth Project. The study plan was filed with FERC on March 31, 2015 and approved by Order from the FERC dated April 21, 2015. This study proposes to monitor tagged salmon smolts passage through the Project area (from upstream of Graham Lake) using radio telemetry tags and monitoring gear, and

passage survival at the Ellsworth Dam using acoustic tags and receivers (maintained by NFMS) downstream of the dam. The field study is planned for spring 2016, pending receipt of all required permits and approvals. Results of the study will be submitted to FERC by December 31, 2016.

Catadromous Species

There are no dedicated downstream fish passage measures for American eel at the Project. In response to a request by FERC in the Study Plan Determination dated December 30, 2014, Black Bear conducted a field study of downstream passage of eel at the Project in the fall of 2015. The preliminary study report is presented in Appendix E-8. Researchers tagged and tracked the movements of 47 adult American eels as they migrated downstream. The tagged eels were released by boat approximately 0.8 kilometers (0.5 miles) upstream of Graham Lake Dam at around sunset in three groups, starting on September 29; the last release was made on October 15 with monitoring continuing through November 12. Passage route and survival analyses were evaluated for both Graham Lake Dam and Ellsworth Dam. All 47 eels (100 percent) migrated through Graham Lake Dam and survived passage based on tag detections downstream at the Ellsworth Dam, a distance of approximately 7 river kilometers (4.3 miles). All 47 tagged eels continued downstream of the Ellsworth Project, with 43 detected passing through the turbines. No eels were detected using the downstream fish bypass or turbine Unit 1, but four passed the project through an unidentified route based on detections further downstream. Turbine passage survival was 25 percent for turbine Unit 2, 47 percent for Unit 3, and 86 percent for Unit 4. Overall, 53 percent of the tagged eels survived passage at the Ellsworth development.

The approved downstream eel passage study plan anticipates that the study will be conducted in two phases (2015 and 2016). The objectives and methodology of the second phase of the study, either to evaluate eel injury by passage route at the Ellsworth dam development, or to further evaluate passage routes and survival at the Ellsworth dam development, will be finalized after review of the se phase 1 study results and agency consultation regarding study needs. Final results of the study will be submitted to FERC by December 31, 2016 as required in the approved study plan.

Black Bear will continue to consult with fisheries management agencies on the need for and, if necessary, the design of downstream fish passage improvements, including downstream eel passage measures, pending the results of ongoing studies.

Predation

Atlantic salmon smolts and juvenile river herring face predation risk during their migration from freshwater to estuarine and marine environments. Anthropogenic factors may contribute to conditions that support known predators of Atlantic salmon, such as chain pickerel, smallmouth

bass, and double crested cormorants (Fay et al., 2006). Dams may increase predation risk due to outmigrant disorientation, injuries, congregating behavior, and decreased abundance of other diadromous fishes that historically acted as a prey buffer by providing a robust alternative food source for predators (Northeast Salmon Team 2011). Dam passage may also affect predator detection and avoidance by outmigrating fish (Raymond 1979, Mesa 1994).

Fish species such as brook trout and American eel are native to all major drainages in Maine and likely feed on salmon and river herring eggs and juveniles. Introductions of top predator fish (e.g., smallmouth bass, chain pickerel, and brown trout are non-native fish species that occur in the Union River watershed) negatively affect resident fish communities by disrupting normal feeding behavior (Bystrom et al. 2007), decreasing prey abundance (He and Kitchell 1990, Findlay et al. 2005), and through extirpation of native species (Findlay et al. 2005, Bystrom et al. 2007). Striped bass are also known predators of Atlantic salmon smolts (Blackwell and Juanes 1998). A restored run of river herring in the Union River drainage is expected to be beneficial to Atlantic salmon restoration efforts, because river herring provide a predation buffer, by providing predators with alternative, and potentially more abundant prey.

Birds known to prey upon Atlantic salmon throughout their life cycle include species such as mergansers, belted kingfisher, bald eagles, ospreys, double-crested cormorants, gulls, and gannets (Fay et al. 2006). The USFWS has concluded that avian predation poses a high-level threat to the survival and recovery of GOM DPS Atlantic salmon (NMFS and USFWS 2005). Blackwell et al. (1997) reported that salmon smolts were the most frequently occurring food items in cormorants sampled at main stem dam foraging sites. In a study in the Penobscot River, cormorants were present during the spring smolt migration as migrants, stopping to feed before resuming northward migrations, and as resident nesting birds using Penobscot Bay nesting islands (Blackwell 1996, Blackwell and Krohn 1997). Another study found Atlantic salmon comprised 26% of cormorant's diet during the smolt run (Hatch and Weseloh 1999). Meister and Gramlich (1967) studied salmon predation by cormorants in the Machias River estuary. The results of this study documented that cormorants consumed an estimated 8,000 tagged hatchery smolts during the period 1966-1967 in the Machias River. Predation rates on migrating hatchery-reared salmon smolts were found to be as high as 13.4% in the Machias River (Meister and Gramlich 1967).

Turbine Entrainment of Fish

While downstream passage facilities are operated at the Project, the potential to affect fisheries due to potential entrainment or impingement at the Ellsworth dam is discussed below.

As part of the relicensing process and consistent with the approved study plan, Black Bear conducted a desk-top assessment of downstream passage survival at the Project including the

potential for entrainment, turbine-induced mortality, migratory route selection, and whole station survival (Black Bear 2014). Downstream migrating fish must use the Project’s downstream weirs, or pass through the Project turbines, or during rare cases of spill, pass over the spillway to migrate downstream to the Union River estuary and Atlantic Ocean. The study incorporated various physical and operational aspects of the Project with empirical passage data collected at numerous regional projects and others across the U.S. The target fish species evaluated for this assessment consisted of adult silver phase American eel, adult and juvenile river herring (blueback herring and alewife), and adult and juvenile Atlantic salmon.

Fish impingement and intake avoidance were evaluated utilizing intake velocity calculations, fish burst swim speeds, and trashrack spacing. The trashrack clear spacing for the Ellsworth Dam turbine intakes vary with unit intake as described in Table E-16. The average approach velocities have been calculated as 1.16 feet/second at Unit 1, 2.97 feet/second at Units 2 and 3, and 2.79 feet/second at Unit 4 (Table E-16). Fish burst speeds were evaluated to predict the ability of target species to avoid entrainment (Table E-17). With the exception of juvenile river herring, the burst speed of fish species exceeded the intake velocity at all units.

Table E-16: Ellsworth Trashrack Spacing and Calculated Intake Velocities

Parameter	Unit 1	Unit 2*	Unit 3	Unit 4
Trashrack Clear Spacing (in)	2.44	1.00 (top)/2.37(bottom)		
Approach Intake Velocity (feet/s)	1.16	2.97	2.97	2.79

*The Unit 2 and 3 trashracks start 7.8 feet below the normal headwater elevation of 66.7’ (first 7.8 feet is concrete), then have 1-in clear-space trashracks between 7.8 and 14.0 feet before the trashrack clear-spacing increases to 2.37 inches below 14.0 feet deep. The Unit 4 trashracks start 5.7 feet below the normal headwater elevation of 66.7’ (first 5.7 feet is concrete), then has the same clear-spacing sizes at slightly different depths.

Table E-17: Target Species Burst Swimming Speeds

Life Stage	Target Species	Size Range (in)	Burst Swim Speed	
			feet/s	Reference
Adult	American Eel	24-30	3.1-4.4	Bell 1991
	Alewife	10-12	10.2-15.4	Clough et al. 2004
	Blueback Herring	9-10		
	Atlantic Salmon	25-32	16.5-19.7	Wolter and Arlinghaus 2003
Juvenile	Alewife	1-6	1.4-1.6	Griffiths 1979
	Blueback Herring	1-3		
	Atlantic Salmon Smolt	5-8	6.0	Peake et al. 1997

Black Bear collected field measurements in front of the trashracks at the Ellsworth Dam intakes to provide a more detailed understanding of intake velocities. Velocity measurements were also taken at the three entrances of the Ellsworth dam downstream fish bypass. Researchers took 240 water velocity measurements at 93 discrete positions in front of the trashracks at Units 2, 3, and 4 (Table E-16). Measurements were not taken in front of the Unit 1 intake because it is only accessible by diving. Velocity measurements at Unit 4 are considered to be representative of the velocity in front of Unit 1 because of the similarity between the units. Average water velocity ranged from -0.13 to 2.43 feet per second (fps). All velocity values in the upper 14 feet (with 1 inch spacing) were below 2 fps and 87% of all intake velocity values were less than 2 fps. Most of the higher velocity values were at water depths of 15 feet or more, below where most surface oriented fish would pass. The measurements were fairly uniform across the face of the racks, demonstrating that the variation in trashrack spacing combined with flows through the downstream fish bypass entrances does not create abnormal flow vectors in the intake area which is sometimes identified as an important threshold for evaluating entrainment risk for some fish species.

The field measurements of intake approach velocity were taken from the trash rake, which results in measurements at a position in front of the trash racks (approximately 3 feet in front of racks), while the calculated approach velocity was estimated at the trash rack face. Since approach velocity decreases with increasing distance from the racks the difference between calculated and field measured velocity is reasonable and suggests consistency between methods. The lower than estimated velocities in front of the 1-inch racks in the upper 14 feet of the intake are consistent with the reduced clear space for water to flow through the racks and should result in reduced entrainment levels for surface oriented fish. The technical memo detailing the field velocity measurements is included as Appendix E-5.

Table E-18: Velocities Measured at Ellsworth Trashracks

Unit Number	Unit 2	Unit 3	Unit 4	All Units
No. of positions on rack face	22	36	35	93
Minimum average velocity (fps)	0.10	-0.13	0.49	-0.13
Maximum average velocity (fps)	2.27	2.08	2.43	2.43

Proportional estimates of body width to total length for the target species were also used to determine the minimum length of each species excluded or impinged on the trashracks (Table E-19). Based on this assessment, the juvenile stages of the target species would not be excluded or impinged on the trashracks because their maximum reported sizes are smaller than the minimum

estimated exclusion size; however, it is expected that the trashracks still provide some level of deterrence due to the presence of the structures (Fay et al. 2006; Alden 2012; Brown et al. 2009).

Table E-19: Estimated Minimum Lengths of Each Species Excluded By Project Trashracks

Target Species	Scaling Factor for Body Width ¹	Size Range (in) ²		Minimum Size (in) Excluded at Respective Trashrack Clear-Spacing		
		Adult	Juvenile	1.00	2.37	2.44
American Eel	0.037	24-30	NA	27	64	66
Alewife	0.086	10-12	1-6	12	28	28
Blueback Herring	0.087	9-10	1-3	11	27	28
Atlantic Salmon	0.104	25-32	5-8	10	23	23

¹Scaling factor expresses body width as a proportion of total length based on proportional measurements for the target/surrogate species in Smith (1985)

Entrainment risk was evaluated based on species presence in the basin, outmigration periodicity, and downstream fish passage operations at the Project. Juvenile river herring have the highest entrainment risk due to their small size and long outmigration periodicity. The presence of the surface-weirs attracts surface-oriented herring during outmigration, although the high abundance and ability to physically pass through all trashracks at the Project, particularly for blueback herring, make entrainment a possibility. Adult river herring have a moderate risk due to their relatively small size and potential to pass through the trashracks. There are currently very few salmon (smolts and kelts) expected to occur at the Project that would be at risk for entrainment. However, if the salmon run size increases, then smolts are predicted to have a moderate risk of entrainment due to their smaller size and ability to pass through the trashracks.⁸ American eels have a higher risk of entrainment at the Project due to their benthic oriented outmigration and ability to pass through the trashracks at the lower levels of the units. They also have extensive outmigration periodicities (especially in the fall of the year), although abundances are not well known.

Whole station survival was estimated for each target species/lifestage and for direct survival at Ellsworth Dam as well as cumulative survival (Ellsworth Dam and Graham Lake Dam survival) (Table E-20). Estimated survival past both dams was 74.8 – 75.6 percent for adult eel, 91.5 – 92.6 percent for adult river herring, 94.7 – 95.2 percent for smolts, and 97.0 – 98.1 percent for

⁸ A Project specific Atlantic Salmon Smolt Downstream Passage Study Plan has been approved and the study will be conducted in May and June of 2016.

juvenile river herring. Black Bear will be conducting an Atlantic salmon downstream passage survival study at the Project in the spring of 2016 to collect empirical data.

Adult American eels have the lowest whole station survival rates due to their longer lengths at the silver phase, lower blade strike survival, and tendency to migrate along the bottom where larger trashrack spacing allows for physical passage. However, eel tracking studies have shown that even with spacing large enough for eel to pass through, individuals may search for other routes of passage, potentially passing through the surface-weirs (Brown et al. 2009). The 2015 study of downstream passage of eel at the Project resulted in all 47 eels (100 percent) migrating successfully through Graham Lake Dam. All 47 tagged eels continued downstream of the Ellsworth Project, with 43 detected passing through the turbines. As discussed above, approximately 53 percent of the tagged eels survived passage at the Ellsworth development (turbine passage survival was 25 percent for turbine Unit 2, 47 percent for Unit 3, and 86 percent for Unit 4).

Juvenile blueback herring are predicted to have relatively high whole station survival at the Project due to their relatively small size and surface-orientation. Juvenile alewives also orient to the surface during outmigration and show slightly lower survival rates due to their large sizes. Adults of both species have whole station survival rates slightly lower than juvenile Atlantic salmon (Table E-20). Estimated Atlantic salmon kelt whole station survival is the highest of the target species, due to exclusion from entrainment by the trashracks. All kelt passage would occur through the surface-weirs at the river flows investigated, of which none resulted in spill at the Project. However, very few adult salmon currently access areas above the Ellsworth Dam due to extremely low returns.

Indirect survival, or delayed mortality, has been evaluated at some west coast projects. Alden (2012) used results from these studies that averaged 93% for indirect survival, and based on professional judgment, suggested that indirect survival would be 95% for Atlantic salmon passing the Penobscot River hydroelectric projects in Maine, due to the low head relative to the west coast projects where the studies were performed. There is considerable uncertainty regarding how to assess indirect survival, given the difficulty in measuring it. NMFS noted this in its Biological Opinion for evaluating project effects to Atlantic salmon for a number of Black Bear Penobscot River hydroelectric projects, and NMFS did not attempt to quantify delayed mortality (NMFS 2012). Therefore, indirect mortality was not evaluated as part of this Union River analysis, rather only direct survival was determined past Ellsworth Dam, in addition to passage through Graham Lake Dam (Black Bear 2014).

Table E-20: Whole Station Survival Estimates at the Project

Life Stage	Target Species	Size Range (in)	Outmigration Months	Ellsworth Development Total Survival			Cumulative Total Project Survival ¹		
				Exceedance Flow (%) ²			Exceedance Flow (%) ²		
				75%	50%	25%	75%	50%	25%
Adult	American Eel	24-30	July-November	0.753	0.753	0.761	0.748	0.748	0.756
	Alewife	10-12	July-October	0.919	0.919	0.919	0.915	0.915	0.915
	Blueback Herring	9-10	July-October	0.930	0.930	0.930	0.926	0.926	0.926
	Atlantic Salmon	25-32	April-May and October-November	0.990	0.990	0.990	0.985	0.985	0.985
Juvenile	American Eel	NA	NA	NA	NA	NA	NA	NA	NA
	Alewife	1-6	July-November	0.974	0.974	0.979	0.970	0.970	0.975
	Blueback Herring	1-3	July-November	0.986	0.986	0.986	0.981	0.981	0.981
	Atlantic Salmon	5-8	April-June	0.951	0.951	0.956	0.947	0.947	0.952

¹ Cumulative survival includes survival through the Graham Lake Dam Taintor gates and Ellsworth development.

² Varying inflows representing a dry, wet, and normal year were applied to this evaluation, which translated into using the 75%, 50%, and 25% monthly exceedance flows

Essential Fish Habitat

EFH for Atlantic salmon is described 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). The EFH designated habitat for all life stages of Atlantic salmon (eggs, larvae, juveniles, and adults) in Maine includes the Union River and Union River Bay, including the Project area. The Project protects EFH for Atlantic salmon by providing upstream and downstream fish passage and migratory pathways to habitat, and by ensuring suitable habitat downstream of each dam through minimum flows.

Endangered Species

Atlantic Salmon

The Licensee provides a detailed assessment of the effects of the Ellsworth Project on Atlantic salmon and Atlantic salmon critical habitat in its draft Biological Assessment being developed with the NMFS and USFWS under the ESA consultation requirements. Appendix E-12.

Atlantic Sturgeon and Shortnose Sturgeon

Due to the rarity of these species at the Project, normal operations would not affect shortnose or Atlantic sturgeon. There is a possibility that sturgeon could be captured in the fish trap and handled during the sorting process. Black Bear has included in the draft Biological Assessment a sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fishway operations and Project maintenance operations (e.g., if the draft tubes need to be dewatered for maintenance activities).

Freshwater Mussels

The Brook Floater is listed as threatened under Maine's Endangered Species Act. No Brook Floater Mussels were found during the survey of the Union River.

4.4.3.3 Proposed Environmental Measures

Black Bear is proposing to continue to operate and maintain the Project under the existing licensed conditions including minimum flow, water level, and fish passage requirements. Black Bear proposes to enhance upstream eel passage by developing and implementing, in consultation with fisheries management agencies, plans for upstream eel passage at both Project dams. Black Bear proposes to consult with the fisheries management agencies on the need for and, if necessary, the design of 1) downstream eel passage measures, pending the results of ongoing downstream eel passage studies, and 2) upstream and downstream anadromous fish passage

improvements pending the results of ongoing studies and development of the agencies' resource management plans. Black Bear also proposes to implement a sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fishway operations and Project maintenance operations.

4.4.3.4 Cumulative Effects

Impacts to fish from non-federal activities are largely unknown in the Union River. It is possible that occasional recreational fishing may result in incidental takes of Atlantic salmon. However, there is no information to suggest that the effects of future activities in the action area will be any different from effects of activities that have occurred in the past.

Collectively, Lake Leonard and Graham Lake provide spawning habitat for alewives and are the primary stocking locations in the Union River drainage. Neither water body existed prior to the construction of dams, and probably contributed little to the historical alewife population (URFCC 2010). However, dams can create a physical impediment to upstream and downstream fish passage. Cumulative effects from passage of multiple dams may also result in increased mortality and reduced fitness of fish. Black Bear operates fish passage facilities at the Project to promote access to upstream reaches of the Union River as well as minimize impacts associated with passage. Previous studies conducted by Black Bear have shown that the existing fish passage facilities are effective, which is reflected in the continued high returns of alewives, and the diverse and abundant fish community in the Project area. Black Bear does not propose to change the operation of the Project and no geographic or temporal cumulative impacts to fish and aquatic resources are expected.

4.4.3.5 Unavoidable Impacts

Graham Lake was constructed and is operated as a storage reservoir, with no generation. Black Bear maintains water levels in Graham Lake on an annual basis between elevations 104.2' and 93.4'. The reservoir levels are typically lower in late fall and late winter to accommodate high flows associated with spring runoff. The Ellsworth development is operated in a run-of-river mode where all inflows into the Ellsworth headpond are passed either through the generating units or over the dam. Therefore, water level fluctuations in Lake Leonard are minimal and normally within 1-foot of full headpond elevation. There are no significant unavoidable adverse impacts occurring at the Ellsworth development. Water level fluctuations can be greater in Graham Lake and results in shifts in littoral habitat, but field observations have showed connectivity is maintained with tributaries even during lower reservoir levels (Black Bear 2014).

At the Ellsworth Dam, Black Bear provides upstream fish passage by trapping anadromous fish and transporting them to suitable habitat located upstream of the development. Operation of upstream trap and transport passage activities have been shown to be effective and current

facilities are more than sufficient to meet management goals for river herring. It is anticipated that the annual river herring run will approach two million fish within 4 to 5 years through current trap and transport activities (URFCC 2015). Some potentially negative effects from the trapping and transporting of fish could include minor migration delay, handling and holding stress or injury. However, these activities do not appear to result in observed or measured immediate or delayed mortality, injury or stress.

Black Bear operates downstream passage facilities at both Ellsworth Dam and Graham Lake Dam, from April 1 to December 31 annually, as river conditions allow. Downstream migrating fish must use the Project's downstream facilities or pass through the Project turbines, or during rare cases of spill, pass over the spillway to migrate downstream to the Union River estuary and Atlantic Ocean. As described in the analysis above, fish passing through the turbines or over the spillway can incur injury or mortality; estimated total survival past both developments is estimated to be 74.8 – 75.6 percent for adult eels, 91.5 – 92.6 percent for adult river herring, 97.0 – 98.1 percent for juvenile river herring, and 94.7 – 95.2 percent for Atlantic salmon smolts. Black Bear's 2015 recent empirical downstream American eel survival study yielded a total passage survival of 53 percent through the Ellsworth Dam

Black Bear does not propose to change current operational conditions and new unavoidable adverse impacts are not expected to occur on the existing fisheries.

4.4.4 Wildlife Resources

4.4.4.1 Affected Environment

Wildlife Habitats

The Ellsworth Project is located in the Downeast region of Maine, on the lower reach of the Union River in the city of Ellsworth, the towns of Waltham and Mariaville, and Fletchers Landing Township in Hancock County. Other than the project dams, the Ellsworth powerhouse, and associated structures and facilities, development in the immediate vicinity of the project includes year round and seasonal residences, commercial businesses, and a large portion of undeveloped forested areas. The Project area and immediate vicinity provides some diversity of surroundings such as forests, open areas, wetlands, islands, and riverside habitats.

The defined Project area encompasses Graham Lake and nearby lands, the Union River between Graham Lake and Lake Leonard, Lake Leonard, and a small portion of the Union River downstream of the Ellsworth Dam. The Project boundary is at, or along the shoreline of the Union River between Graham Lake and Lake Leonard, and along Lake Leonard. The Project boundary is located at elevation 107' around Graham Lake which is 2.8 feet above normal full pond elevation of 104.2'. In total, the Project boundary encompasses approximately 3,350 acres

of land and 10,099 acres of open water cover types (See Table E-22 in Section 4.4.5: Botanical Resources and Figure 2-8 of the Initial Study Report [ISR], 2014). Most of the upland habitats and associated wildlife resources surrounding the Project water bodies occur on private lands adjacent to, but outside the Project boundary.

A detailed description of cover types within the Project boundary is provided in Section 4.4.5 – Botanical Resources. Cover types within and immediately surrounding the Project boundary are primarily comprised of forested communities. The predominant community type within the Project boundary is Northern Hardwood Forest.

There are distinct forested areas within the Project boundary that may more closely fit the characteristics of the Oak-Northern Hardwood Forest and Oak-Northern Hardwood-White Pine Forest Communities (Gawler and Cutko, 2010). Other areas more closely resemble Spruce-Northern Hardwood Forest. The Northern Hardwood, Oak-Northern Hardwood, Oak-Northern Hardwood-White Pine, and Spruce-Northern Hardwood community types within the Project area intergrade gradually, and Northern Hardwood Forest can be considered the matrix forest cover. Forest downstream of Graham Lake and around Lake Leonard can be described as Oak-Northern Hardwood and Oak-Northern Hardwood-White Pine communities, with some areas of early successional forest cover. The eastern shore of Graham Lake is where most of the Spruce-Northern Hardwood Forest is found, whereas the western shore and islands are primarily where forest cover can be described as Northern Hardwood, Oak-Northern Hardwood, and Oak-Northern Hardwood-White Pine Forest.

There are lacustrine, riverine and estuarine wetland systems associated with Graham Lake, Lake Leonard, the Union River and tributaries, and a number of palustrine wetlands - Palustrine Unconsolidated Bottom (PUB), Palustrine Aquatic Bed (PAB), Palustrine Emergent (PEM), Palustrine Scrub-Shrub (PSS), and Palustrine Forested (PFO) - within the Project boundary (Cowardin et al, 1979). The vast majority of palustrine wetlands within the Project boundary are associated with Graham Lake. Many of the wetlands associated with Graham Lake are narrow fringes along the lake itself or along tributary streams; some areas comprised of numerous wetland classes are more extensive. PEM wetland is associated with the islands within Graham Lake and the tributary streams to Graham Lake. While discrete areas of PEM and/or PSS are located on three large islands and on the peninsula in the southern portion of the lake, most of these areas are interspersed with PEM and PSS vegetation. Bog habitats persist under current project conditions on the three large wetland islands and the large wetland peninsula on the southern side of Graham Lake. Forested swamps are also associated with Graham Lake and wetland complexes within the Project boundary. Narrow fringes of wetland are located along Lake Leonard and the Union River in some areas. Wetland habitats within the Project boundary are described in detail in Section 4.4.5 – Botanical Resources.

Other habitat types found within the Project boundary include open field, electric transmission maintained shrub, and mowed lawn. Those areas that are associated directly with the Project are very small in extent and are described in detail in Section 4.4.5 – Botanical Resources.

In addition to desktop level review, in order to accurately describe wildlife habitats within the Project boundary, Black Bear conducted wildlife habitat related studies in 2014 including a Common Loon Survey and a Marsh-Nesting Bird Habitat Survey (ISR, 2014).

Significant Habitat

Significant Wildlife Habitats are defined under Maine's Natural Resources Protection Act (NRPA), which is administered by the Maine Department of Environmental Protection (Maine DEP) (Maine DIFW, 2014a). Significant habitats which occur within the Project boundary include Deer Wintering Areas (DWA) and Inland Waterfowl/Wading-bird Habitat (IWWH). No known Significant Vernal Pools (SVP) are located within the Project boundary, although specific surveys for SVPs were not conducted.

Deer Wintering Areas (DWA)

Deer congregate in DWAs for shelter, forage and thermal refuge during deep snow and cold conditions. Typically, deer will seek DWAs when snow gets more than 12 inches deep in open areas and in hardwood stands, when the depth that deer sink into the snow exceeds 8 inches in open areas and in hardwood stands, and when mean daily temperatures are below 32 degrees (Maine DIFW 2014b). DWAs are typically located within conifer stands (particularly hemlock) with tree height greater than 30 feet and crown closure of greater than 60% (Maine DIFW, 2014b).

According to Maine Department of Inland Fisheries and Wildlife (Maine DIFW) records, one DWA occurs within the Ellsworth Project area. This DWA is located on the eastern shore of Graham Lake in the town of Waltham to the west of Route 179. Because on-site investigation and verification by Maine DIFW staff has not occurred, this DWA has an indeterminate status.

Inland Waterfowl / Wading -bird Habitat (IWWH)

The Maine DIFW identifies moderate and high value IWWH as significant wildlife habitat. Significant Waterfowl and Wading Bird Habitat and its associated protective buffer (250 feet) is identified based on a variety of factors including wetland type, the diversity of wetland types, the size of the wetland(s), the interspersions of the different wetland types, and the amount of open water (Maine DIFW, 2014a). IWWHs in organized townships were most recently mapped and rated by Maine DIFW in 2008, using the most current, high resolution imagery (Maine DIFW, 2014a).

Maine DIFW identifies nine IWWH areas within the Ellsworth Project boundary, all are associated with Graham Lake or tributaries to Graham Lake. Two of the IWWHs are associated with wetland islands within Graham Lake, one of the IWWHs is associated with the wetland peninsula on the southern side of Graham Lake (Great Meadow), and the other five are associated with emergent or emergent/shrub wetland complexes which are contiguous to tributaries to Graham Lake. One IWWH is located both along a tributary to Graham Lake and adjacent to the lake itself. Four of the IWWHs are ranked by Maine DIFW as moderate value and five are ranked as high value.

Bald Eagle Nest Sites

The bald eagle (*Haliaeetus leucocephalus*) was removed from the Federal endangered species list in 2007 and from the Maine endangered species list in 2009. For this reason, Essential Habitat designations and state regulations that were applied to bald eagle nest sites from 1990 - 2009 are no longer in effect. However, protection for bald eagles and their nests continues under the federal Bald Eagle and Golden Eagle Protection Act (BGEPA).

The U.S. Fish and Wildlife Service (USFWS) has been monitoring the occurrence of nesting bald eagles for many years, and maintains a comprehensive database of known bald eagle nest sites in the state of Maine. The USFWS database identifies three areas of historic bald eagle nesting within the Ellsworth Project boundary on Graham Lake as of 2013 (USFWS, 2015).

Correspondence with Maine DIFW on March 31, 2015 (E. Call, Maine DIFW, March 31, 2015), indicates that two of these nest sites were intact in 2013. One of the intact eagle nests is located on a small island in Graham Lake, south of Harwood Hill Island and approximately 6.8 miles northeast of the Graham Lake Dam. The other intact eagle nest is located on a small island on the southern end of Graham Lake, approximately one mile northeast of the Graham Lake Dam. The northern nest hosted a breeding pair and one fledgling in 2013, while the southern nest hosted a breeding pair, but no fledglings in 2013.

Wildlife

Based on identified habitats within the Ellsworth Project boundary and in its immediate vicinity, several mammalian and avian wildlife species have the potential to occur within the Project boundary. In order to obtain information on wildlife species occurrence and use, and to support an assessment of the potential effects of Project operation on these species, Black Bear conducted wildlife-related studies in 2014 and 2015. These studies consisted of a Common Loon Nesting Survey and a Marsh-Nesting Bird Habitat and Call Back Survey along with field observations of wildlife noted during other studies.

Several of the expected avian and mammalian wildlife species were observed (either directly or via sign) during the common loon nesting and marsh-nesting bird habitat surveys. The mammalian and avian wildlife species assemblage known or considered likely to occur in the area surrounding the Project is typical of those found in Hancock County, Maine. A representative listing of mammalian and avian wildlife species known or considered likely to occur in the vicinity of the Project is included in Table E-21 (DeGraaf and Yamasaki, 2001). Those species that were observed during field studies performed at the Ellsworth Project and State Species of Special Concern, state threatened species and state endangered species which may be located within the Project boundary are indicated in Table E-21; Rare, Threatened and Endangered (RTE) species are discussed in greater detail in Section 4.4.6 below.

Temporal and Spatial Distribution of Wildlife Resources

Some of the wildlife species that occur within the Project vicinity are likely to be present year-round. Other species may migrate seasonally, utilizing separate and distinct breeding and wintering areas. The range of these movements varies significantly among species. Many migratory avian species that utilize the Project vicinity during temperate seasons are absent from the region in winter. Other species tend to display more moderate seasonal shifts of habitat usage, utilizing seasonally distinct areas within the Project vicinity and surrounding region in summer versus winter. Deer and moose exemplify this type of movement, gravitating between preferred breeding and wintering habitats. Some species make only very limited movements between closely associated habitats within a small geographical area, using proximate yet distinctly different habitats or microhabitats by season. Examples of this may include some small mammal species. The specific habits of major species are further described, below.

Table E-21: Wildlife Species Which May Occur or Have Been Documented in the Vicinity of the Ellsworth Project

Common Name	Scientific Name
Mammals	
Beaver*	<i>Castor canadensis</i>
Big Brown Bat	<i>Eptesicus fuscus</i>
Black Bear*	<i>Ursus americanus</i>
Bobcat	<i>Lynx rufus</i>
Deer Mouse	<i>Peromyscus maniculatus</i>
Eastern Chipmunk	<i>Tamias striatus</i>
Eastern Coyote	<i>Canis latrans</i>
Ermine	<i>Mustela erminea</i>
Fisher	<i>Martes pennanti</i>
Little Brown Bat (E)	<i>Myotis lucifugus</i>
Mink*	<i>Mustela vison</i>
Moose*	<i>Alces alces</i>

Common Name	Scientific Name
Muskrat	<i>Ondatra zibethicus</i>
Northern Flying Squirrel	<i>Glaucomys sabrinus</i>
Northern Long-eared Bat (E)	<i>Myotis septentrionalis</i>
Porcupine	<i>Erethizon dorsatum</i>
Raccoon*	<i>Procyon lotor</i>
Red Fox*	<i>Vulpes vulpes</i>
Red Squirrel	<i>Tamiasciurus hudsonicus</i>
River Otter*	<i>Lontra canadensis</i>
Silver-haired Bat (SC)	<i>Lasiurus noctivagans</i>
Snowshoe Hare	<i>Lepus americanus</i>
Striped Skunk	<i>Mephitis mephitis</i>
White-tailed Deer*	<i>Odocoileus virginianus</i>
Birds	
American Black Duck*	<i>Anas rubripes</i>
American Crow	<i>Corvus brachyrhynchos</i>
American Goldfinch*	<i>Spinus tristis</i>
American Kestrel*	<i>Falco sparverius</i>
American Robin	<i>Turdus migratorius</i>
Bald Eagle (SC)*	<i>Haliaeetus leucocephalus</i>
Barred Owl	<i>Strix varia</i>
Bay-breasted Warbler	<i>Dendroica castanea</i>
Belted Kingfisher	<i>Ceryle alcyon</i>
Black Tern (E)	<i>Chlidonias niger</i>
Blackburnian Warbler	<i>Dendroica fusca</i>
Black-capped Chickadee	<i>Poecile atricapillus</i>
Black-throated Green Warbler	<i>Dendroica virens</i>
Blue Jay	<i>Cyanocitta cristata</i>
Blue-winged Teal*	<i>Anas discors</i>
Broad-winged Hawk*	<i>Buteo platypterus</i>
Canada Goose*	<i>Branta canadensis</i>
Cedar Waxwing*	<i>Bombycilla cedrorum</i>
Common Gallinule (T)	<i>Gallinula galeata</i>
Common Grackle	<i>Quiscalus quiscula</i>
Common Loon*	<i>Gavia immer</i>
Common Merganser	<i>Mergus merganser</i>
Common Raven	<i>Corvus corax</i>
Common Redpoll	<i>Carduelis flammea</i>
Common Yellowthroat *	<i>Geothlypis trichas</i>
Downy Woodpecker*	<i>Picoides pubescens</i>
Gray Jay	<i>Perisoreus canadensis</i>
Great Blue Heron (SC)*	<i>Ardea herodias</i>
Green-winged Teal*	<i>Anas crecca</i>

Common Name	Scientific Name
Hairy Woodpecker	<i>Picoides villosus</i>
Hermit Thrush*	<i>Catharus guttatus</i>
Hooded Merganser	<i>Lophodytes cucullatus</i>
Least Bittern (E)	<i>Ixobrychus exilis</i>
Lesser Yellowlegs (SC)*	<i>Tringa flavipes</i>
Mallard*	<i>Anas platyrhynchos</i>
Merlin*	<i>Falco columbarius</i>
Northern Flicker*	<i>Colaptes auratus</i>
Northern Goshawk	<i>Accipiter gentilis</i>
Northern Parula	<i>Parula americana</i>
Osprey*	<i>Pandion haliaetus</i>
Pileated Woodpecker*	<i>Dryocopus pileatus</i>
Pine Siskin	<i>Carduelis pinus</i>
Purple Finch	<i>Carpodacus purpureus</i>
Red-breasted Nuthatch	<i>Sitta canadensis</i>
Red-wing Blackbird	<i>Agelaius phoeniceus</i>
Ruffed Grouse	<i>Bonasa umbellus</i>
Sedge Wren (E)	<i>Cistothorus platensis</i>
Sharp-shinned Hawk	<i>Accipiter striatus</i>
Spotted Sandpiper	<i>Actitis macularia</i>
Swamp Sparrow*	<i>Melospiza georgiana</i>
White-breasted Nuthatch	<i>Sitta carolinensis</i>
Wood Duck*	<i>Aix sponsa</i>
Yellow Rail (SC)	<i>Coturnicops noveboracensis</i>

Source: DeGraaf and Yamasaki, 2001

* Observed during field surveys and noted in Northrop, Devine & Tarbell, Inc., 1990

(SC) State Species of Special Concern (Maine DIFW, 2015a)

(T) State Threatened, (E) State Endangered (Maine DIFW, 2015b and Maine State Legislature, 2015)

Large mammal species that are most likely to occur in the Project area and immediate vicinity are white-tailed deer and moose. Black bear may also be occasionally present.

White-tailed deer are resident species in the area surrounding the Project and signs of white-tailed deer use were observed during field studies performed in 2014. Deer are highly selective herbivores, concentrating on whatever plants or plant parts are currently most nutritious. During the course of the year, deer may browse several hundred species of plants. A few are highly preferred while many others are consumed only when the best have been depleted. Deer consume grasses, sedges, ferns, lichens, mushrooms, weeds, aquatics, leaves (green and fallen), fruits, hard mast (acorns, beech nuts, etc.), grains, and twigs and buds of woody plants. Deer consume twigs and buds of dormant trees and shrubs only when more nutritious foods are unavailable. (Maine DIFW, 2014b).

Major habitats that provide food and cover for white-tailed deer in Maine are forest lands, wetlands, reverting farmlands, and active farmlands. Forest stands containing little or no canopy closure, wetlands, and reverting and active farmland tend to yield ideal forage for deer (Maine DIFW, 2014b), particularly during temperate months. Several of these preferred habitats are available within and near the Project area. For this reason, deer are expected to be present in and near the Project area in temperate months.

During the winter months, when snow depth exceeds 12 inches, deer will converge in DWAs (Maine DIFW, 2014b). These areas provide browse and crucial protection from the elements. One DWA is mapped within the Ellsworth Project boundary.

Moose are year-round residents of forested habitats in the Project region. Moose primarily subsist by browsing on the leaves and twigs of woody plants. Willow, aspen, birch, maple, pin cherry, and mountain ash are important, high quality browse utilized by moose throughout the year. Balsam fir provides additional forage for moose over the winter. Sodium is also important to moose: aquatic plants, such as pondweed and water lily, have higher sodium content than woody vegetation and are an important part of a moose's diet. (Maine DIFW, 2014c).

Habitat use by moose varies by season, and by gender. In general, in the summer, moose tend to spend considerable time near wetlands, where they forage on emergent plant materials. Bulls and cows, however, do use somewhat different habitats during the summer. Cows are typically found at low elevations in regenerating stands and adjacent softwoods, where food sources are concentrated. This concentrated food source limits the amount of time cows spend feeding, which, in turn, limits calves vulnerability to predators. Meanwhile, bulls are typically found at higher elevations in mixed and hardwood stands, where food supply is less available, but shading provides thermal refuge from summer's hot temperatures. (Maine DIFW, 2014c).

During the winter, moose tend to move to drier, mixed hardwood-coniferous habitats where they browse exclusively on trees. Regenerating clear-cuts and forest clearings are particularly important fall and winter foraging habitats for this species (DeGraaf and Yamasaki, 2001). Mature softwood is used as cover when snow depth exceeds 3 feet (Maine DIFW, 2014c).

Black bear are found nearly statewide in Maine, but are most common in northern, northwestern, and eastern Maine; black bear are rarely found in the heavily settled southern and central-coastal regions (Maine DIFW, 2014d). While not common, black bear may occasionally occur in the Project vicinity, particularly in temperate months.

Black bear require forests for protection and food. Bears are omnivores that feed opportunistically on a wide range of plant and animal sources, which vary seasonally. While bears do eat meat, their diet is primarily vegetarian. Early greening grasses, clover, and hardwood tree buds provide a forage base in the spring; fruits and berries are utilized in summer;

and beechnuts, acorns, and hazelnuts are foraged in the fall. This diet is supplemented with insects, including ants and bees (their larvae, adults, and honey), and occasional mammals and birds. Bears may occasionally prey on young deer and moose in late spring, and they will also consume carrion. (Maine DIFW, 2014d).

Black bear may exhibit seasonal habitat use, depending on food supplies. In general, bears will inhabit low elevations more frequently in spring and summer, and higher elevations in the fall. These trends are driven by the seasonal abundance of herbaceous vegetation, insects, various berries and nuts (DeGraaf and Yamasaki, 2001).

Small Mammals

The forested and agricultural habitats in the immediate vicinity of the Project provide year-round homes to a number of small mammal species. Most widespread throughout the region are red fox, raccoon, and striped skunk, which are associated with edge habitats. These species inhabit a variety of habitats consisting of forest, cropland, and pastureland. In addition, they make extensive use of riparian habitats along streams, such as the Union River and its tributaries, during dispersal and foraging. Fisher may inhabit the denser and more extensive areas of coniferous or mixed forest while seeking out forested wetlands during winter. Porcupine may be found in coniferous forests, or mixed or deciduous stands in the Project vicinity. (DeGraaf and Yamasaki, 2001).

Coyote may inhabit the Project area. Coyote often inhabit fragmented habitats, particularly along the edges of second-growth forests, open brushy fields, old pastures, and etcetera; however, Maine DIFW (2014e) states that coyotes now occupy almost every conceivable habitat type, from open agricultural country to dense forest to downtown urban areas. Coyote are opportunistic hunters and scavengers. They primarily eat small animals, such as snowshoe hares, mice, rats, woodchucks, beavers, squirrels, snakes, frogs, fish, and birds. During summer and fall, grasses, fruits and berries may be incorporated into their diet. In the spring and summer coyotes may target deer and fawns as well as other forage items. Coyote may hunt deer more successfully in winter than other seasons, when snow depth restricts deer's movements, making them easier to capture. Where available, coyote will also eat carrion, pet food, garbage, garden crops, livestock and poultry. (Maine DIFW, 2014e). Coyote may occur within the Project vicinity year round.

Beaver are common inhabitants of rivers, streams, ponds, lakes, and occasionally watered roadside ditches in Maine. Beaver are known to be present in the Project vicinity, and are likely year-round inhabitants within the Project area. Bank dens are dug into the banks of streams, rivers and large ponds; they are used for shelter, birthing and rearing. One family of beavers may have several lodges or bank dens, but will typically use only one area during winter.

Preferred forage includes leaves, inner bark, and the twigs of deciduous trees and shrubs. Aspen is the favorite food item, followed by birch, cottonwood, willow, oak, and maple. Beaver will also eat herbaceous plants, grasses, and some aquatic plants. Beaver store food for the winter months by stashing stems underwater and anchoring them to the bottom of the lake or stream. When ice makes it impossible to forage on land, they feed on the bark and stems in their cache, and on the roots and stems of aquatic plants, such as pond lilies and cattails. Beaver do not hibernate, but are less active during winter, spending most of their time in the lodge or den. (Maine DIFW, 2014f).

Muskrat are also likely present in the Project area and are likely year round inhabitants. Muskrat are found throughout still or slow-moving waterways, including marshes, beaver ponds, reservoirs, and the marshy borders of lakes and rivers. Muskrat eat a wide variety of plants, including cattails, sedges, bulrush, arrowhead, water lilies, pondweed and ferns. They will also eat alfalfa, clover, corn and other crops that happen to be in their territory. Muskrat will occasionally eat shellfish, snails, fish, frogs and salamanders, but these are a small part of the diet and are generally consumed when plant foods are scarce. Depending on site conditions, muskrat dens are located in banks or lodges. Bank dens range from a short tunnel leading to an enlarged nest chamber, to a long and complex system of chambers, air ducts and entrances. In marshes and other areas lacking steep banks, muskrats build dome-shaped lodges from leaves, stems, roots and mud. Lodges are constructed in open water that is two to four feet deep, and are built high enough to keep the den above high-water levels. (Maine DIFW, 2014g).

River otter were not observed during field investigations during 2014 relicensing studies, however, they may occasionally occur within the Project area, and their presence is possible year round. This highly aquatic species is known to inhabit riparian streams bordered by forested areas such as those that occur along the Union River and its tributaries (DeGraaf and Yamasaki, 2001). Although seldom seen, river otter are relatively common throughout Maine. In winter, river otter frequent areas that remain ice-free, such as rapids, the outflows of lakes, and waterfalls (Maine DIFW, 2014h). River otter subsist on a variety of aquatic wildlife, such as fish, crayfish, crabs, frogs, birds' eggs, birds, and some reptiles such as turtles. They are also known to incorporate some aquatic plants into their diet. River otter may occasionally prey on other small mammals, such as muskrat or rabbit. River otter dens can be found along the water in abandoned burrows or empty hollows. Den entrances are generally located underwater, so they can be easily accessed from the water. (Maine DIFW, 2014h).

Smaller mammal species that are likely to occur at the Project include numerous squirrel and mouse species. Example species include red squirrel, northern flying squirrel, deer mouse, and eastern chipmunk. Bat species may also potentially occur within the Project area; these include big brown bat, little brown bat and silver-haired bat. None of these species of bats were observed during field investigations. The little brown bat is a state-listed endangered species and

the silver-haired bat is a Species of Special Concern in Maine; these two bats are discussed in Section 4.4.6 below, Rare, Threatened and Endangered Species.

Big brown bats are likely to occur within the Project vicinity. Big brown bats are versatile in their habitat choice and will hunt for insects over water, open forests and cliff sides. Day roosts are generally within deciduous forests, with maternity colonies forming beneath loose bark or in tree crevices. Colonies may also use tree-lined meadows or waterbodies. These bats also commonly roost in man-made structures including house attics, eaves, barns, silos, church steeples, and underneath bridges, in both urban and rural areas. Female big brown bats form large maternity colonies from spring through summer, sometimes numbering hundreds of bats. Male bats are generally solitary and are more flexible about where they roost. These bats hibernate underground in caves and mines, or in buildings where temperatures seldom go below freezing. (Conserve Wildlife Foundation of New Jersey, 2015).

Birds

Bird species that occur within the Project boundary and immediate vicinity are those typical of Hancock County and of Downeast Maine. Waterfowl observed or likely to occur on the Project impoundment include Canada geese, mallard ducks, black ducks, blue-winged teal ducks, wood ducks, common mergansers, and hooded mergansers. Other avian species that are associated with aquatic environments, such as belted kingfisher, great blue heron, spotted sandpiper, lesser yellowlegs, osprey, common loon, and bald eagle, were also observed or are likely to occur within the Project boundary.

A diverse array of other species, such as corvids, woodpeckers, raptors, passerines, and game birds are also expected to occur in shoreline and wetland habitats of the Project area. Many of these are migratory species, but some, such as black-capped chickadee, woodpecker species and corvid species, are expected to remain in the Project vicinity year-round.

Avian species that rely on open water habitats typically do not overwinter on lakes and ponds such as the Graham Lake and Lake Leonard impoundments, due to winter ice cover. Species such as osprey, common loon, great blue heron and other wading birds and waterfowl would typically leave the Project area by late fall or early winter. Some avian species that utilize open water habitats, such as bald eagle and common merganser, are highly individual in seasonal use. Individuals of these species may remain in the immediate area of the Project during part or all of the winter, utilizing isolated pockets of open water and/or other foraging areas; meanwhile other individuals of the same species may leave the region completely.

According to the listing of Species of Special Concern provided on Maine DIFW's website (last updated March 1, 2011) (Maine DIFW, 2015a), three of the avian species that are known or are likely to occur within the Project area are Species of Special Concern. These are great blue

heron, bald eagle, and lesser yellowlegs. All three of these species were observed within in the Project area during the 2014 field investigation (see Table E-21). These bird species are discussed in Section 4.4.6 below, Rare, Threatened and Endangered Species.

Common loons occur and breed on Graham Lake. While not a rare species or a Species of Special Concern in Maine, common loons are frequently a subject of interest on bodies of water that are subject to water level fluctuations. The common loon is a piscivorous bird that is highly adapted for diving and submergent swimming. These adaptations include heavy bones and posteriorly attached webbed feet, which make the loon awkward and poorly mobile on land. Loons nest at the water's edge where their nests are very susceptible to water level fluctuations. Due to its susceptibility to the effects of water level fluctuations during the nesting season, the common loon is frequently identified by wildlife agencies as a species to be evaluated in connection with FERC relicensing of certain reservoir-inclusive projects, such as Graham Lake in the Ellsworth Project.

Common loons may be found in a wide variety of freshwater aquatic habitats, however, they generally prefer lakes larger than 60 acres with clear water, an abundance of small fish, numerous small islands, and an irregular shoreline that creates coves (Evers, 2007). As noted, loons nest in close proximity to the water's edge. Preferred nesting sites include small islands, floating bog mats, and marshy hummocks. Marsh and mainland sites are less preferable and are typically only used when more preferable (particularly island) sites are unavailable (Evers, 2007).

In order to assess the potential impacts of Project operation on common loons nesting on Graham Lake, nesting surveys were performed on seven dates in 2014: June 9, 16 and 28; July 7, 16, and 29; and August 17. The results of the 2014 survey were reported in the ISR (2014) for the Project and are summarized below.

Of the four common loon pairs that attempted to nest on Graham Lake in 2014, three were judged to have been successful in hatching at least one chick. Each of the nesting pairs made a single nesting attempt on floating, or partially floating bog mats. The successful nests were located in the areas of Hardwood Hill East, Great Meadow, and Southeast Meadow. Evidence of hatch was observed at all three nests, however, offspring were observed only at Hardwood Hill East and at Great Meadow. At Southeast Meadow, no chicks were observed; successful nesting was deduced based on incubation time and eggshell fragments (that were consistent with hatching) located on the nest site.

Of the four total nesting attempts made among five territorial loon pairs on Graham Lake in 2014, one failed. The failed nest was located in the area of Hardwood Hill West. The two eggs at the Harwood Hill West nest site were abandoned, for unknown reasons, after partial

incubation. While the actual cause of abandonment is unknown, common causes of nest abandonment while eggs are present include (but are not limited to) human disturbance, territorial interactions, and insect infestations. At the time of abandonment, and for some time after, this nest was judged by surveying biologists to be accessible to incubating loons. That is, water levels did not inundate or strand the nest during or after active incubation. For this reason, water levels have been discounted as a possible cause of nest failure.

4.4.4.2 Environmental Analysis

Effects of continued project operation on riparian, littoral and wetland habitat

Any potential effects of continued Project operation on wildlife habitats within the Project boundary would primarily be related to water level and flow regulation regimes. The Ellsworth Project is operated for water storage and power generation. Operationally, the Project is typically run as a peaking plant, with water being released from the Graham Lake reservoir, which provides storage and has no power facilities, and then is used to generate electricity at the downstream Ellsworth powerhouse. Ellsworth Dam operates in a run-of-river mode with water level variations limited to approximately one foot during normal operations. The Licensee releases a continuous minimum flow of 105 cfs from the Ellsworth Dam and the Graham Lake Dam from July 1 through April 30 and 250 cfs from May 1 through June 30 for the protection of fishery resources.

Water levels in Graham Lake are managed in accordance with the current FERC license between elevations of 93.4' and 104.2' and Lake Leonard between 65.7' and 66.7' (FERC, 1987). Water levels in Graham Lake on an annual basis can vary up to 10.8 feet per year, while water levels in Leonard Lake vary very little (approximately 1 foot) over the course of the year. Generally, this operation regime creates four distinct areas of hydraulic influence within the Project boundary: Graham Lake reservoir; a riverine portion of the Union River between Graham Lake and Lake Leonard; Lake Leonard impoundment; and the portion of the Union River in the Ellsworth Dam tailwater.

Habitats between 104.2' and 107' surrounding Graham Lake that are not associated with developed facilities are not affected by Project operation. Approximately 35 acres of uplands within the Project boundary are occupied by managed vegetation or development; these include open field (approximately 11 acres), electrical transmission corridor/shrubland meadow (approximately 4 acres, non-Project managed) and maintained lawn (approximately 20 acres associated with local residences, non-Project managed). No changes to the management of these areas are expected and no new impacts to habitats in these areas will occur.

No changes are proposed to current Project operation. Therefore, no adverse effects to wildlife habitats within the Project area are expected.

Graham Lake Reservoir

Graham Lake Dam impounds the Union River and creates Graham Lake, a water storage reservoir, which has a surface area of approximately 10,000 acres at a normal full pond surface elevation of 104.2'. The impoundment is fluctuated between full pond and elevation 93.4', which can result in up to a 10.8-foot yearly drawdown. The Project generally follows an operating curve where the impoundment is drawn down during the summer and winter and refilled in the fall (partial) and spring (full). Habitats that currently exist within the Project area in the vicinity of the Graham Lake impoundment drawdown zone are, in part, a product of the current operational regime and are expected to persist as they have under present operation. No changes are proposed to current Project operations, therefore, no new effects to habitats within the drawdown zone are expected. No adverse impacts to existing wildlife habitats within the impoundment are expected to result from the continued operation of the Project, as proposed.

Riverine Portion of the Union River between Graham Lake and Lake Leonard

The portion of the Union River that is between Graham Lake and Lake Leonard is riverine. The Project boundary is basically the bank of the river. Habitats that currently exist within this reach of the Union River are, in part, a product of the current operational regime and are expected to persist as they have under present operation. No changes are proposed to current Project operations, therefore, no new effects to habitats within the Union River in this area are expected.

Lake Leonard Impoundment

The Ellsworth powerhouse operates based primarily on flow management out of Graham Lake. Lake Leonard is managed with very little fluctuation, generally within one foot of normal full pond. Lake Leonard has a surface area of approximately 90 acres at normal maximum pool elevation at 66.7'. Habitats that currently exist within the Lake Leonard impoundment are, in part, a product of the current operational regime and are expected to persist as they have under present operation. No changes are proposed to current Project operations, therefore, no new effects to habitats are expected. No adverse impacts to existing wildlife habitats within the impoundment are expected to result from the continued operation of the Project, as proposed.

Downstream of the Ellsworth Project Dam

Ellsworth Dam operates in a run-of-river mode automatically via pond level control, and passes seasonal continuous minimum flows of either 105 cfs or 250 cfs. As a result of this continuous minimum flow, aquatic based wildlife habitat downstream of the dam is maintained by normal operations throughout important bio-periods. Black Bear is not proposing any changes to current Project operations, therefore, no new effects to habitats downstream of the dam are expected.

For these reasons, it is anticipated that continued operations will not result in adverse effects on wildlife resources downstream of the dam.

Significant Habitat

Deer Wintering Areas (DWA)

Maine DIFW records indicate that a small portion of one indeterminate-status DWA is located within the Ellsworth Project boundary. The deer wintering area is on private property to the west of Route 179 in Waltham and overlaps a small portion of the Project boundary directly adjacent to the eastern side Graham Lake. This DWA is not subject to any effects related to current or proposed Project operation.

Inland Waterfowl and Wading-bird Habitat (IWWH)

Nine mapped IWWHs have been identified within the Ellsworth Project boundary; all of the mapped IWWHs are associated with Graham Lake or tributaries to Graham Lake. All of the IWWHs, as they currently exist, have developed in situ and have become established and stabilized under the existing operating regime. Because Black Bear is proposing no changes to the operation of the Ellsworth Project, it is anticipated that continued operations will not adversely impact these existing wetland communities.

Bald Eagle Nest Sites

The two intact and actively used bald eagle nests documented within the Project boundary in 2013 are both located on islands in Graham Lake (see Section 4.4.6 below for more information on bald eagles within the Project area). Black Bear is proposing to continue to operate the Project with existing water level management and seasonal minimum flows; there will be no change to the existing water level management which would affect these islands and the eagle nests which are located on them.

Effect of continued project operation on wildlife

Continued operation of the Ellsworth Project, as proposed, will have no adverse impacts to Project associated wildlife or wildlife habitats. Potential Project effects on wildlife species are limited to those species using areas that are directly subject to Project operation.

Long-term fluctuations of the Graham Lake reservoir resulting from Project operation will continue to result in an annual cycle of exposure and inundation of areas within the drawdown zone. Impacts to some species of wildlife may occur, but many species have adapted to the fluctuating water level regime, and will not be adversely affected. In addition, areas within the drawdown zone may present unique foraging opportunities, and may benefit some opportunistic

foragers, such as some waterfowl, eagles, herons, shorebirds (e.g. sandpipers) and some small mammals. The Lake Leonard impoundment is very stable normally fluctuating only within a one foot range.

Approximately 35 acres of uplands within the Project boundary are occupied by managed vegetation (i.e. potential wildlife habitat); these include open field (approximately 11 acres), electrical transmission corridor/shrubland meadow (approximately 4 acres, non-Project managed), and maintained lawn (approximately 20 acre associated with local residences, non-Project managed). These areas provide habitat opportunities for several generalist, grassland and edge-habitat species. No changes to the management of these areas are expected or proposed and no new impacts to species that utilize these habitats will occur.

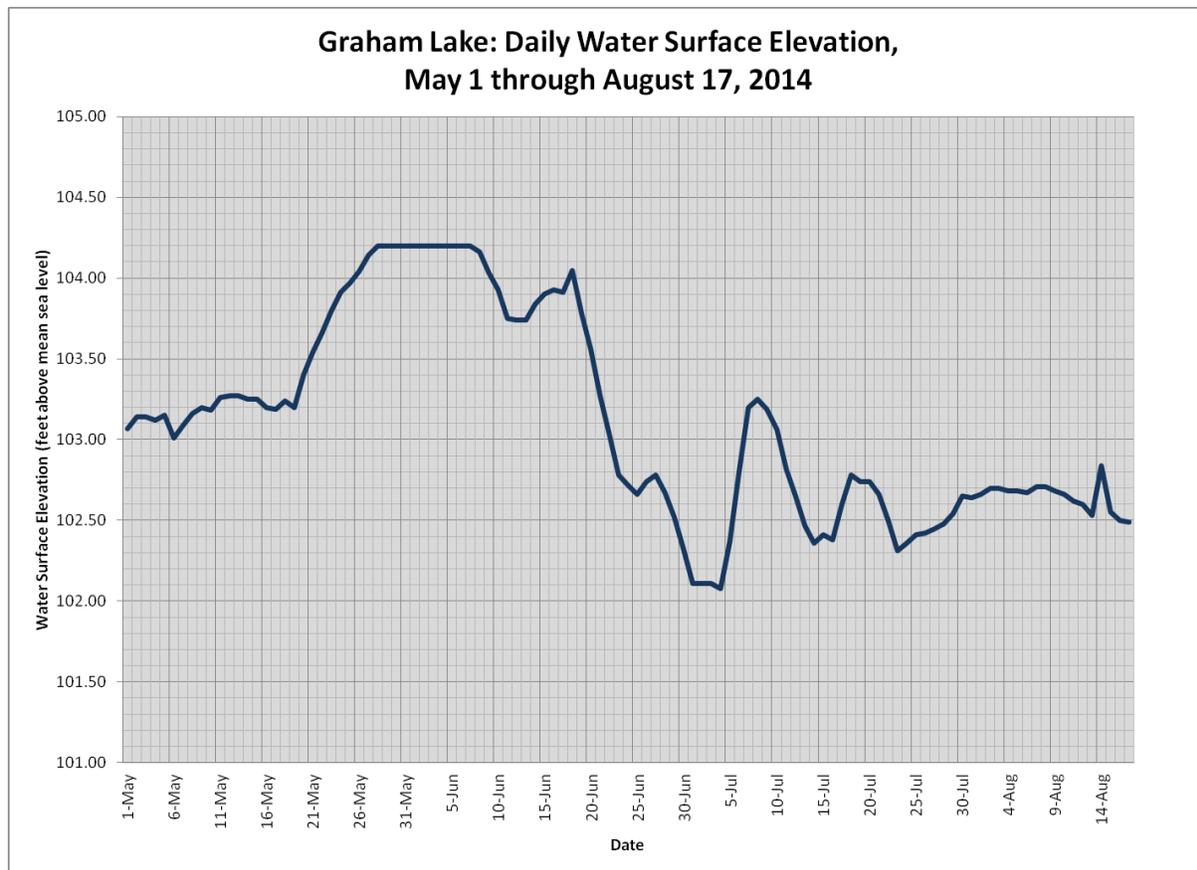
Effects of continued project operations on common loons

A study of common loon population and nesting success on the Ellsworth Project indicates that the continued operation of the Project, as proposed, will not result in adverse impacts to common loons. Generally, common loon nests are highly susceptible to water level fluctuations during the nesting season. It is known that, on average, a change in water level greater than 0.5 vertical feet up, or 1 vertical foot down occurring within a 28-day period can significantly impact the nesting success of common loons (Fair, 1979). Increases in water level can result in flooding of the nest, while decreases potentially hinder accessibility. Reduced accessibility may cause greater time elapse between attendant nest switches, leaving eggs exposed to cooling or predation, or it may render a nest entirely unreachable to the incubating birds.

In order to assess the potential impacts of water level fluctuations on common loons nesting on Graham Lake, Black Bear analyzed Graham Lake water level data for the common loon nesting season of 2014. Daily water levels for Graham Lake for the 2014 common loon nesting season were evaluated by graphing the daily recorded elevations at Graham Lake Dam for the period of May 1 to August 17, which encompasses the duration of common loon nesting activities on Graham Lake. These data are presented in Figure E-14.

Water level data were analyzed with attention to vertical magnitude, frequency, and rate of water level fluctuations during the breeding and nesting season. Daily and weekly changes expounding the bounds of known common loon tolerance during the nesting period were noted and, as appropriate, compared to the concurrent condition of observed nesting attempts on Graham Lake.

Figure E-14: Graham Lake Daily Water Surface Elevation, May 1 through August 17, 2014



This assessment shows that water level changes during the common loon nesting season in 2014 did exceed the range of fluctuation that is known to potentially impact common loon nesting success. Despite this fact, no loon nests failed due to water level fluctuations on Graham Lake in 2014. This is largely attributable to the fact that all four loon nests that were identified were located on floating, or partially floating bog mats, which buffered the effects of changing water levels by moving with them.

Floating bog mat islands are abundant and widely distributed on Graham Lake, making this substrate widely available for use by nesting loons throughout the lake. As previously noted, small islands and floating bog mats are among preferred nesting sites for common loons, with marsh and mainland sites typically only used when preferable sites are unavailable (Evers, 2007). This would suggest that loons are likely to select the abundant and widely available floating island sites on Graham Lake before selecting non-floating sites.

In summary, the continued operation of the Ellsworth Project, as proposed, will result in continued fluctuations of Graham Lake water levels that exceed the normal range of common loon tolerance. However, as shown in 2014, common loons can and do successfully nest on Graham Lake, despite water level fluctuations that exceeded the range that can cause adverse impacts to common loon nesting success. The abundance of floating bog mats on Graham Lake, and the preference of such habitat by loons for nesting (Evers, 2007) naturally mitigate the potential effects of water level fluctuation on nesting success.

Effects of continued project operation on aquatic furbearers

Beaver are known to be present in the Project vicinity, and are likely year-round inhabitants within the Project area. Black Bear is proposing to continue to operate the Project with existing water level management and seasonally variant minimum flows; there will be no change to the existing water level management which would affect beavers living within the Project area.

4.4.4.3 Proposed Environmental Measures

Black Bear is proposing to maintain the existing water level management regime on both Graham Lake (93.4' to 104.2') and Lake Leonard (65.7' to 66.7') and maintain seasonally variant minimum flows at the Project. There are no existing PME measures in-place relative to wildlife resources, and because there are no impacts to wildlife resources anticipated under proposed Project operations, none are proposed.

4.4.4.4 Unavoidable Adverse Impacts

No adverse impacts to Project wildlife or their habitats have been identified or are expected to occur as a result of continued operation of the Ellsworth Project, as proposed.

4.4.5 Botanical Resources

4.4.5.1 Affected Environment

General Setting

The Ellsworth Project lies within the Acadian Plains and Hills Level III Ecoregion. This mostly forested region, with dense concentrations of continental glacial lakes is less rugged than the Northeastern Highlands Ecoregion to the west, is considerably less populated than the Northeastern Coastal Zone Ecoregion to the south, and is bordered to the south and east by the Atlantic Ocean. Vegetation in this ecoregion is mostly spruce-fir on lowlands with maple, beech, and birch on the hills (Griffith et al, 2009). More locally, the project is predominantly within the Central Interior biophysical region of Maine; portions of the project also lie within the Eastern Lowlands and Penobscot Bay biophysical regions (USDA, 2005). In general, these

biophysical regions are a transition zone from a northern Appalachian forest of oak, pine, and mixed hardwoods in southern Maine, to a spruce-fir-northern hardwood forest in northern and eastern Maine (Maine DIFW, 2005).

The Ellsworth Project is located on the lower reach of the Union River in the city of Ellsworth, and the towns of Waltham and Mariaville in Hancock County, Maine. The defined Project area encompasses Graham Lake and nearby lands, the Union River between Graham Lake and Lake Leonard, Lake Leonard, and a very short stretch of the Union River downstream of the Ellsworth Dam. The Project boundary is very close to the shoreline along the Union River between Graham Lake and Lake Leonard, and along Lake Leonard. The Project boundary is located at elevation 107’ around Graham Lake which is 2.8 feet above the normal full pond elevation of 104.2’ and includes associated tributary streams, wetlands and upland areas. In total, the Project boundary encompasses approximately 3,350 acres of land and 10,099 acres of open water cover types (Black Bear, 2014).

Vegetation cover type identification and mapping for the Ellsworth Project area was performed in 2014 as part of the Botanical Reconnaissance Survey (Black Bear, 2014). This effort included desktop photo interpretation, followed by field verification of general cover types. Based on these investigations, vegetation types and land use classifications were assigned. Presence of rare or unique species and habitat was investigated, with particular focus on bog bedstraw (*Galium labradoricum*), estuary bur-marigold (*Bidens hyperborea*), mudwort (*Limosella australis*), Nantucket shadbush (*Amelanchier nantucketensis*), and pale green orchis (*Platanthera flava var herbiola*). Significant communities of noxious and invasive species were also documented.

Open water and terrestrial cover types are summarized in Table E-22.

Table E-22: Cover Types Identified within the Ellsworth Project Boundary

Cover Type	Acres	% Total Project Acreage
<i>Water</i>		
Open Water	10,099	75
<i>Land</i>		
Forested Upland	2,144	16
Wetland	1,171	9
Palustrine Aquatic Bed (PAB)	0.1	
Palustrine Emergent (PEM)	222.2	
Palustrine Emergent/Scrub Shrub (PEM/PSS)	455.9	
Palustrine Forested (PFO)	354.0	

Cover Type	Acres	% Total Project Acreage
Palustrine Scrub-Shrub (PSS)	131.0	
Palustrine Unconsolidated Bottom (PUB)	7.4	
Non-Project Maintained Lawn	20	<1
Open Field	11	<1
Non-Project Electrical Transmission Corridor/Shrubland-Meadow	4	<1
<i>Land subtotal</i>	<i>3,350</i>	<i>25</i>
<i>TOTAL:</i>	<i>13,449</i>	

The predominant plant community on lands within the Project boundary is forest, followed by wetlands. Significantly smaller areas of maintained open field occur. Areas that are associated with Project facilities and Project-related recreation facilities are very small in extent (as compared to other cover types), and are comprised of gravel surfaces, mowed grass, and non-Project maintained electric transmission corridor, and unvegetated surfaces. A small area of maintained electric transmission corridor (non-Project managed) is associated with the Project facilities (Table E-22). Major community types are further described in the following paragraphs.

Upland Habitat Communities and Species

The majority of upland plant communities within the Project area are forest, with approximately 2,144 acres identified as this cover type (Table E-22). Upland plant communities within the Project area are predominantly variations of the Northern Hardwood Forest Community.

There are distinct forested areas within the Project boundary that may more closely fit the characteristics of the Oak-Northern Hardwood Forest and Oak-Northern Hardwood-White Pine Forest Communities (Gawler and Cutko, 2010). Other areas more closely resemble Spruce-Northern Hardwood Forest. The Northern Hardwood, Oak-Northern Hardwood, Oak-Northern Hardwood-White Pine, and Spruce-Northern Hardwood community types within the Project area intergrade gradually, and Northern Hardwood Forest can be considered the matrix forest cover. Forest downstream of Graham Lake and around Lake Leonard can be described as Oak-Northern Hardwood and Oak-Northern Hardwood-White Pine communities, with some areas of early successional forest cover. The eastern shore of Graham Lake is where most of the Spruce-Northern Hardwood Forest is found, whereas the western shore and islands are primarily where forest cover can be described as Northern Hardwood, Oak-Northern Hardwood, and Oak-Northern Hardwood-White Pine Forest.

Other upland plant communities occur far less frequently than forested areas within the Project boundary, collectively comprising <1% of the total area within the Project boundary. These small inclusions consist of isolated occurrences of open fields, electric transmission corridor (non-Project managed), shrubland-meadow, and maintained lawn associated with local residences (non-Project managed).

Wetland Habitat Communities and Species

Wetland cover types occupy approximately 1,171 acres (approximately 9% of all cover types, including water) within the Project boundary (Table E-22). Wetland types within the Project boundary are described herein based on the Cowardin (1979) classification system. Wetland types found within the Project boundary include Lacustrine, Riverine, Estuarine, Palustrine Unconsolidated Bottom (PUB), Palustrine Aquatic Bed (PAB), Palustrine Emergent (PEM), Palustrine Scrub-Shrub (PSS), and Palustrine Forested (PFO). The vast majority of palustrine wetlands within the Project boundary are associated with Graham Lake and the various types are generally found together as wetland complexes. Many of the wetlands associated with Graham Lake are narrow fringes along the lake itself or along tributary streams; some areas comprised of numerous wetland classes are more extensive. Narrow fringes of wetland are located along Lake Leonard and the Union River in some areas; these areas are classified as PAB, PEM, and PSS (Black Bear, 2014).

Lacustrine areas within the Project boundary include Graham Lake and Lake Leonard, which are impoundments of the Union River. Much of the lacustrine areas within the Project area are not vegetated, however some of the shallower areas of Graham Lake are dominated by emergent vegetation. The Project boundary in the vicinity of the Union River between the two impoundments is generally the banks of the river; this area is classified as riverine. There is very little associated riparian wetland associated with the Union River between Graham Lake Dam and Lake Leonard. Below the Ellsworth Dam the Union River is classified as estuarine.

PEM/PSS is the most common vegetated wetland type associated with Graham Lake. PEM wetland is associated with the islands within Graham Lake and the tributary streams to Graham Lake. While discrete areas of PEM and/or PSS are located on three large islands and on the peninsula in the southern portion of the lake, most of these areas are interspersed with PEM and PSS vegetation, and are considered PEM/PSS wetlands. Some of the islands also contain PFO wetland areas. Many contiguous narrow fringes of PEM, PSS, and PFO wetland border Graham Lake or tributary streams within the Project boundary, making up wetlands with varying classifications; some of the wetland areas are more extensive. A few PUB wetlands are also located within the Project boundary.

Bog habitats, dominated by low-growing herbs and stunted shrubs, apparently present prior to Project inception many years ago, persist under current project conditions on the three large wetland islands and the large wetland peninsula on the southern side of Graham Lake. There are also many areas of sphagnum-dominated bog located on the islands and peninsula. These areas are generally classified as PEM/PSS, although they are sometimes classified as PSS where shrub species are the dominant strata. Dominant shrub species in these habitats are ericaceous shrubs. Subdominant but common species include herbaceous species which occur in nutrient-poor, generally soft waters.

Small scrub-shrub swamp habitats (PSS) are also located around the perimeter of Graham Lake and along tributary streams in conjunction with other wetland types. These wetland areas are generally dominated by deciduous shrubs. Forested swamps are also associated with Graham Lake and wetland complexes within the Project boundary.

Shallow fringing marshes dominated by emergent plants (PEM) are few and restricted to coves and other protected locations within the Project boundary. There are only small patches of deep marsh, apparently due to wave action (i.e., high-energy dynamics) that limits their presence. Some small shrubs are also found within PEM wetlands within the Project area. Limited areas of mudflats or vegetated-but-inundated communities were observed. Floating-leaved aquatic beds are uncommon in Graham Lake, with only a few sparse patches observed. Shallow open water PAB area is inundated by the impoundment, and is found in areas of low water velocities along the fringes of the deeper water of the impoundment.

Unique Plant Communities and RTE Botanical Resources

Maine Natural Areas Program (MNAP) online data (MNAP, 2011) and correspondence with MNAP identified five RTE/species of special concern (bog bedstraw, estuary bur-marigold, mudwort, Nantucket shadbush, and pale green orchis) as potentially occurring in the vicinity of the Project.

Of the five RTE plant species, including plants of special concern, reported as potentially occurring in the vicinity of the project by the MNAP, only Nantucket shadbush was observed during field surveys for botanical resources conducted on July 28 and 29, 2014. The shadbush was found on dry ledge, elevated several feet above the Project influence in the Project boundary, in the known location just downstream of the Ellsworth Dam. This plant is listed as threatened in the State of Maine and does not have a federal status. No other plant species federally- or state-listed as threatened or endangered, or tracked as a species of special concern by MNAP was encountered.

Suitable habitat for three of the other reported species – bog bedstraw, estuary bur-marigold, and pale green orchis – was not observed in the immediate Project environs. Suitable habitat for

mudwort was observed in the Union River below Leonard Lake, as well as in some areas of shallow water in Graham Lake, but the species was not encountered. Each of these four species are listed as special concern in the State of Maine and are not listed federally listed.

Beginning with Habitat (BwH) mapping and MNAP correspondence indicates the presence of a raised level bog ecosystem (Great Meadow) within Graham Lake. Great Meadow is located on the wetland peninsula that juts into the southern portion of Graham Lake. This natural community is considered to be an outstanding example of a more common community type (S4). Raised level bog ecosystems are flat peatlands in basins with mostly closed drainage, receiving water from precipitation and runoff from the immediate surroundings. In general, Sphagnum moss dominates the ground surface, the surface of the bog is flat and featureless, and often areas are partially treed with black spruce and larch (Gawler and Cutko, 2010). Field reconnaissance revealed that this bog ecosystem also contains eastern white pine.

Invasive Plants and Noxious Weeds

Noxious and invasive plant species that have been identified within the Project boundary are limited to common reed (*Phragmites australis*), Japanese knotweed (*Fallopia japonica*), and purple loosestrife (*Lythrum salicaria*). Of these occurrences, only the common reed and Japanese knotweed form significant communities within the Project boundary; a few purple loosestrife plants were observed sporadically throughout the Project area. Three large stands of common reed are located on the western side of the northernmost island within Graham Lake; the emergent marsh in this location is dominated by the common reed. Small stands of common reed were observed sporadically along the northwestern and northeastern shores of Graham Lake and are generally near residences; these areas are too small to be depicted on the invasive species mapping. An approximately 150-foot long stand of Japanese knotweed and two other smaller stands of the plant were observed on the south side of Graham Lake adjacent to Route 179 in Ellsworth (Black Bear, 2014). No invasive, purely aquatic species such as variable-leaved milfoil were observed.

4.4.5.2 Environmental Analysis

Effects of continued project operation on riparian, littoral, and wetland habitat

The Ellsworth Project is operated for water storage and power generation. Operationally, the Project is run as a peaking plant, with water being released from the Graham Lake reservoir, which provides storage and has no power facilities and is then used to generate electricity at the downstream Ellsworth powerhouse. Ellsworth Dam operates in a run-of-river mode automatically via pond level control. As required by its FERC license, Black Bear releases a continuous minimum flow of 105 cfs from the Ellsworth Dam and the Graham Lake Dam from July 1 through April 30 and 250 cfs from May 1 through June 30.

Water levels in Graham Lake are managed in accordance with the current FERC license between elevations of 93.4' and 104.2' and Lake Leonard between 65.7' and 66.7' (FERC, 1987). Water levels in Graham Lake on an annual basis can vary up to 10.8 feet per year, while water levels in Leonard Lake vary very little (approximately 1 foot). Generally, this operation regime creates four distinct areas of hydraulic influence within the Project boundary: Graham Lake reservoir; a riverine portion of the Union River between Graham Lake and Lake Leonard; Lake Leonard impoundment; and the portion of the Union River in the Ellsworth Dam tailwater area.

Botanical resources within the Project boundary may be exposed to, or isolated from, different potential influences depending on their location relative to Project waters. Potential Project effects to botanical resources that are associated with the Project's impoundments and riverine and estuarine components are discussed, respectively, below.

Very small amounts of upland are located within the Project boundary adjacent to the Ellsworth Dam tailrace, Lake Leonard, and the Union River between Graham Lake and Lake Leonard; the Project boundary is very close to the river and impoundment banks in these areas. Uplands between 104.2' and 107' surrounding Graham Lake that are not associated with Project facilities are not affected by Project operations. Approximately 35 acres of upland within the Project boundary are occupied by managed vegetation or development; these include open field (approximately 11 acres), electrical transmission corridor/shrubland meadow (approximately 4 acres, non-Project managed) and maintained lawn (approximately 20 acres associated with local residences, non-Project managed). No changes to the management of vegetation in these areas are expected, and because no changes are proposed to current Project operations, no new impacts to vegetation within these upland areas would occur.

Graham Lake Reservoir

Graham Lake Dam creates Graham Lake, a water storage reservoir, which has a surface area of approximately 10,000 acres at normal full pond elevation of 104.2'. The reservoir is fluctuated between full pond and elevation 93.4', which can result in up to a 10.8-foot yearly drawdown. The Project generally follows an operating curve where the impoundment is drawn down during the summer and winter and refilled in the fall (partial) and spring (full). Plant communities within this drawdown zone are subject to water level fluctuations as a result of Project operations on an annual basis.

Approximately 1,171 acres of vegetated wetlands are found within the Project boundary, and the vast majority of these wetlands are associated with Graham Lake. The wetland plant communities that currently exist within the Ellsworth Project boundary and which are associated with the Graham Lake impoundment have become established and stabilized under the existing operating regime that has been in practice since 1979.

Because Black Bear is proposing no changes to the operation of the Ellsworth Project, it is anticipated that continued operations will have no impact on existing wetland communities and other botanical resources associated with Graham Lake.

Riverine Portion of the Union River between Graham Lake and Lake Leonard

The portion of the Union River that is between Graham Lake and Lake Leonard is riverine. This area of river has very little associated riparian wetland and the Project boundary is basically the bank of the river. Botanical and vegetation resources in this area are not subject to any effects as a result of the Ellsworth operations.

Lake Leonard Impoundment

Lake Leonard has a surface area of approximately 90 acres at normal full pond elevation of 66.7'. The Lake Leonard impoundment is managed within 1 foot on a daily basis. Plant communities within this zone are subject to very limited fluctuations as a result of Project operations. A very small amount of PAB, PEM, and PSS wetland is associated with Lake Leonard.

Because Black Bear is proposing no changes to the operation of the Ellsworth Project, it is anticipated that continued operations will have no impact on existing wetland communities and other botanical resources associated with Lake Leonard.

Downstream of the Ellsworth Dam

Ellsworth Dam operates in a run-of-river mode automatically via pond level control. This results in a relatively uniform downstream flow. The Ellsworth Dam is located at the head-of-tide and as such is subject to varying water levels on a daily basis. Wetlands and wetland habitat downstream of the dam are maintained by normal operations and tidal flows throughout important bio-periods. Black Bear is not proposing any changes to current operations. For these reasons, it is anticipated that continued operations will not result in adverse effects on wetland or other botanical resources downstream of the dam.

Effects of continued project operation and maintenance on wildlife habitat

Emera (the local utility) manages vegetation on approximately 4 acres of electrical transmission corridor. Approximately 20 acres of maintained lawn associated with local residences is located within the Project boundary. These areas may provide habitats for several generalist, grassland, and upland edge habitat species. With respect to the transmission line corridor, Emera uses an integrated vegetation management strategy using a combination of hand-cutting and selective herbicide applications on an as-needed basis to maintain the integrity and functionality of the line, facilitate safety inspections, and maintain access for emergency repairs. Mechanical

mowing may be used under unusual circumstances. There are also approximately 11 acres of open field that may provide wildlife habitat. No changes of the management of these areas are expected or proposed, and no effects from continued operation of the Project on species that use these habitats will occur.

Effects of continued project operation and maintenance on the Maine state threatened Nantucket shadbush

During consultations with the MNAP, Black Bear (via letter on October 3, 2012) was informed that Nantucket shadbush, a state threatened species, occurs downstream of the Ellsworth dam. A Nantucket shadbush was observed inside the Project boundary in the documented location in 2014 during botanical surveys, but the plant was located several feet above the Project influence. Given that no changes in Project operation are proposed, no impacts to this species or its habitat are expected. No other RTE plant species were documented within the Project boundary.

Effects of continued project operation and maintenance on invasive plants

Noxious and invasive plant species that have been identified within the Project boundary are limited to common reed, Japanese knotweed and purple loosestrife. Of these occurrences, only the common reed and Japanese knotweed form significant communities within the Project boundary; a few purple loosestrife plants were observed sporadically throughout the Project area. No purely aquatic invasive species such as variable-leaved milfoil were observed during botanical surveys. The larger invasive communities are generally located near residences on the shore of Graham Lake or adjacent to roads and their presence seems to be attributed to residential land use and road use or construction. Given that no changes in Project operation are proposed, no impacts to or spread of invasive species are expected as a result of continued Project operations.

4.4.5.3 Proposed Environmental Measures

Black Bear is proposing to continue to operate the Project with existing water level management and seasonally variant minimum flows. There are no existing PME measures in-place relative to wetland and botanical resources, and because there are no impacts to botanical resources anticipated under proposed Project operations, no PME measures are proposed.

4.4.5.4 Unavoidable Adverse Impacts

Continued operation of the Ellsworth Project, as proposed, will have no new impacts to existing Project area wetlands or botanical resources.

4.4.6 Rare, Threatened and Endangered Species

4.4.6.1 *Affected Environment*

The Ellsworth Project area includes aquatic and terrestrial habitats that are known to or have potential to be utilized by Federally-listed and state-listed rare, threatened, or endangered (RTE) species.

Federally-Listed RTE Species

The USFWS has identified two federally-listed endangered and two federally-listed threatened species as having the potential to occur within the Project boundary: Atlantic salmon (endangered), shortnosed sturgeon (endangered), Atlantic sturgeon (Gulf of Maine DPS threatened), and the northern long-eared bat (threatened). The affected environment for the three fish species is addressed in Section 4.4.3 of this Exhibit E.

Northern long-eared bats, a federally-listed threatened species, may occur within the Project area. DePue and the National Park Service documented northern long-eared bats in Acadia National Park in the summers of 2012 and 2014 (USFWS, Department of Interior, 2015). Northern long-eared bats primarily feed in the understory of forested areas on moths, flies, leafhoppers, caddisflies, and beetles, which they catch in flight with echolocation. They also glean insects from vegetation. In the summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities or crevices in both live trees and in snags. Non-reproductive females and males sometimes also roost in cooler places, like caves or mines. Northern long-eared bats appear to be flexible in selecting roosts, choosing trees of varying species which are generally deciduous. Northern long-eared bats have rarely been observed roosting in human structures, such as barns and sheds. Northern long-eared bats spend the winter hibernating in hibernacula, which generally include caves or mines of varying sizes, with constant temperatures, high humidity, and no air current. Pregnant females roost in small colonies (generally 30 to 60 females and young) and give birth in the summer. (USFWS, 2015).

State-Listed Threatened and Endangered Species

Maine DIFW identified four state-listed threatened or endangered marsh-nesting bird species as having the potential to inhabit or occupy the Project area: least bittern (endangered), sedge wren (endangered), black tern (endangered), and common gallinule (threatened). In addition, the northern long-eared bat, a state-listed endangered species, is discussed in the section above on federally-listed RTE species, and the little brown bat, a state-listed endangered species, is discussed below. The affected environment for the brook floater, a state-listed threatened mussel species, is addressed in Section 4.4.3 of this Exhibit E.

Least bitterns breed in freshwater marshes and usually nest in dense stands of cattails, bulrushes or similar growth about a foot above the water and near open water. Occasionally they nest in a low bush or tree or on the old nest of another bird. Least bitterns generally nest singly but several adjacent pairs may occur in suitable areas. (Baicich and Harrison 2005).

Sedge wrens breed in wet meadows or drier areas of marshes and bogs dominated by grasses and sedges. The birds nest low in grasses, sedges or similar herbaceous species, very near the ground or over shallow water. Nests are well hidden in the bases of growing vegetation but rarely can be 1-2 feet up in the vegetation. (Baicich and Harrison 2005).

Black terns breed on shallow, still water, in freshwater or brackish areas, that are often characterized by reedy vegetation and swampy marshes. The birds can create a variety of nests including: as a heap of floating vegetation in the water, anchored by growing plants, or on mats of floating aquatic vegetation or heaps of fallen herbaceous vegetation; on old muskrat houses, old grebe or coot nests, or floating driftwood; or on firm ground among marshy herbaceous vegetation. Black terns generally nest in small colonies. (Baicich and Harrison 2005).

Common gallinules breed at the edge of fresh water including lakes, rivers, small marshes, and ditches. The birds generally nest on the ground by water, or among plants in water, but sometimes they nest above ground in thick shrubs or in large old nests of other birds in trees. The birds may build additional nests (brood platforms) in territory, especially in marshy sites and use the platforms for brooding young. (Baicich and Harrison 2005).

Little brown bats, which were added to Maine's List of endangered species in May, 2015, are most likely to occur within the Project vicinity in summer. Little brown bats feed primarily over wetlands and other still water where insects are abundant. They also use rivers, streams, and trails as travel corridors to navigate across the landscape. Little brown bats may potentially use areas within the Project vicinity for summer roosting as well, as they prefer summer roosts that are close to water. During the summer, male and female little brown bats roost separately. Summer roosting areas may include barns, attics, outbuildings, bat houses and tree cavities. Female little brown bats will gather into maternity colonies, selecting very warm roosts in which to bear and nurse their young. Males roost in smaller colonies, and may use tree cavities as well as buildings. (NHF&G, 2014).

In the winter, male and female little brown bats hibernate together in clusters in moderately sheltered hibernacula, including caves, mine tunnels, and occasionally in hollow trees. (NHF&G, 2014). Many little brown bats leave the state of Maine in search of adequate hibernacula in winter. No winter hibernacula for little brown bats is known to occur in the Project vicinity.

State-Listed Species of Special Concern

Maine DIFW identified one state-listed special concern marsh-nesting bird species as having the potential to inhabit or occupy the Project area: yellow rail. In addition to the yellow rail, seven vertebrate wildlife species that are Species of Special Concern in Maine have the potential to or are known to occur in the Project vicinity: Arctic char, silver-haired bat, bald eagle, northern leopard frog, wood turtle, great blue heron and lesser yellowlegs.

Yellow rails build nests concealed in a natural hollow with overhanging tufts of vegetation or with grasses bent over to form a concealing canopy, thus they are often hard to locate. The bird nests in sedge marshes or wet meadows, on the ground in drier portions of grasses vegetation, and sometimes among grasses or plant tufts in several inches of water. (Baicich and Harrison 2005).

Silver haired bats, which are a Species of Special Concern in Maine, are less common in Maine than little brown bats. Silver haired bats are migratory, leaving Maine for southern states in winter. For this reason, silver haired bats only have potential to occur in the Project vicinity in summer. In summer, these bats are usually found in heavily forested areas where preferred daytime refuges and roost habitat include tree cavities and areas under loose bark (Fidel and Denham, 2014). They are sometimes known to use buildings for shelter as well. These bats prefer breeding grounds close to lakes and ponds (Fidel and Denham, 2014). The eating habits of the silver haired bat are similar to other Maine bats, and primarily consists of small to medium sized insects. If silver haired bats do occur in the Project vicinity, they would be expected to forage over and near Project waters and possibly roost in upland forested areas in the vicinity during temperate seasons.

An isolated population of silver char (formerly known as Sunapee or blueback trout) occurs within the Union River basin, in Floods Pond and Green Lake (URFCC 2010). Because of their preference for cold water, it is not expected that silver char would occur in Project waters.

As previously discussed, bald eagles are no longer recognized as a Threatened Species under federal or Maine state law. For this reason, Essential Habitat designations and state regulations that applied to bald eagle nest sites from 1990 - 2009 are no longer in effect. Protection for bald eagles and their nests continues under the BGEPA.

Bald eagle is the only bird Species of Special Concern with potential to occur in the Project area year-round. Bald eagles are highly nomadic and some individuals may roam great distances when not breeding. Alternatively, some individuals may stay in interior Maine over winter in areas where food is available. Bald eagles were observed frequently on the impoundments and in the vicinity during relicensing studies. Two intact and actively used eagle nests were documented within the Project boundary in 2013, according to correspondence with Maine

DIFW. One of the nests was located on a small island in Graham Lake, south of Harwood Hill Island and approximately 6.8 miles northeast of the Graham Lake dam. The other intact eagle nest was located on a small island on the southern end of Graham Lake, approximately 1.0 mile northeast of the Graham Lake dam. The northern nest hosted a breeding pair and one fledgling in 2013, while the southern nest hosted a breeding pair but no fledglings.

Northern leopard frogs live in wetlands, ponds, lakes, meadows, or fields in close proximity to water. Northern leopard frogs feed on insects, slugs, snails, and other frogs. The Northern leopard frog overwinters in the mud of lakes and large ponds (Tekiela, 2004). Northern leopard frogs are expected to utilize the Project area in the temperate seasons and overwinter in the Project impoundments.

Wood turtles can be found in slow rivers and streams with woodland floodplains. Wood turtles are a terrestrial species that feed on land consuming plants, berries, mushrooms, worms, and slugs. During the winter months, wood turtle reside underwater beneath the ice. Wood turtle females lay eggs in riverbanks and sandbars (Tekiela, 2004). Wood turtles are expected to utilize the Project area in temperate seasons and overwinter in the Project impoundments.

Great blue heron occur in various saltwater and freshwater habitats, including open coasts, marshes, sloughs, riverbanks, lakes and small ponds. Great blue herons typically stalk fish, frogs and other prey in shallow waters, but they also occasionally forage in grasslands and agricultural fields (Cornell, 2014). Breeding herons gather in colonies (“rookeries”) and build stick nests high off the ground, in tall trees or snags. No heron rookeries are known to occur in the Project vicinity, and none were observed during the study. Great blue herons are a partial migrant; many migrate south to warmer climates in winter, but some may attempt to overwinter in southern Maine (Maine Encyclopedia: Great Blue Heron 2014). Great blue herons are not expected to overwinter in the Project area, but do utilize the Project area for foraging in wetland and shallow water areas during temperate seasons.

Lesser yellowlegs occur in various shallow saltwater and freshwater habitats. Lesser yellowlegs eat aquatic and terrestrial invertebrates, particularly flies and beetles, and occasionally small fish and seeds. Lesser yellowlegs are active feeders, often running through shallow water to chase prey. They breed in open boreal forest with scattered shallow wetlands; they do not breed within the Project vicinity (Cornell, 2015). Lesser yellowlegs are not expected to overwinter in the Project area, but do utilize the Project area for foraging in wetland and shallow water areas during temperate seasons.

4.4.6.2 *Environmental Analysis*

Effects of continued project operation on federally-listed endangered or threatened fish and critical habitat

The environmental analysis for Atlantic salmon, and Atlantic and shortnose sturgeon is addressed in Section 4.4.3.2 of this Exhibit E. Also, a detailed assessment of the effects of the Project on Atlantic salmon and critical habitat in the draft Biological Assessment is attached as Appendix E-12.

Due to the rarity of either sturgeon species being located at the Project, normal operations would likely not affect shortnose or Atlantic sturgeon. A sturgeon handling plan is included as an appendix to the draft Biological Assessment to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fishway lift operations or Project maintenance operations.

Effects of continued project operation on federal- and state-listed wildlife species and species of special concern

One federally-threatened mammal species, which is also a state-endangered species, may occur within the Ellsworth Project area; the northern long-eared bat. This aerial insectivore may forage adjacent to Project waters in forested habitats in the summer, but is not expected to be adversely affected by water level fluctuations as a result of Project operation. This bat species roosts in upland areas outside of the range of potential Project operational affects. This bat species spends winters months in hibernacula, and is not expected to be adversely by water level fluctuations.

One state-endangered mammal species and one state Species of Special Concern may occur within the Ellsworth Project area; these are the little brown bat and silver haired bat, respectively. These aerial insectivores may forage over Project waters and along riparian edges in summer, but are not expected to be adversely affected by water level fluctuations as a result of Project operation. Both bat species roost in upland areas (trees, dwellings, and etc.), outside of the range of potential Project operational affects. Both bat species are expected to migrate out of the Project vicinity in winter.

Three avian state Species of Special Concern are known to occur within the Project area. These are bald eagle, great blue heron, and lesser yellowlegs. None of these species have foraging, breeding or nesting behaviors or needs that are expected to be adversely affected by fluctuating water levels as a result of Project operation.

Two other state Species of Special Concern, the northern leopard frog and the wood turtle may use the Project area. Neither of these species has foraging or breeding behaviors or needs that are expected to be adversely affected by fluctuating water levels as a result of Project operation.

Effects of continued project operation on marsh-nesting birds

In February 2013, Maine DIFW and USFWS expressed an interest in determining if any rare marsh-nesting birds occur in the Project area and if operation of the Graham Lake dam is potentially affecting their productivity. In accordance with the FERC approved RSP for the Ellsworth Project, Black Bear conducted a marsh-nesting bird habitat survey on Graham Lake in 2014 (Black Bear, 2014; Marsh-nesting Bird Habitat Survey). Based on agency consultation, the survey focused on identification of suitable habitat for RTE species, including least bittern (state endangered), sedge wren (state endangered), black tern (state endangered), common gallinule (state threatened), and yellow rail (state species of special concern). In accordance with the FERC approved RSP, the objectives of the survey were to: map the nature and extent of emergent marsh habitat associated with Graham Lake; and document the habitat quality and vegetative composition of this habitat.

Black Bear conducted a desktop study of emergent herbaceous/shrub wetlands associated with Graham Lake, based on review of aerial photographs and Maine DIFW-mapped inland waterfowl and wading bird habitats. A field verification survey was conducted on July 28 and 29, 2014. The survey identified 26 seasonally flooded emergent herbaceous or emergent herbaceous/shrub wetlands that are five acres in size or larger. These wetlands include the three large islands within Graham Lake, the wetland peninsula that juts out into the southern basin of Graham Lake, smaller islands, and numerous wetland complexes associated with tributary streams to Graham Lake. The wetland complexes identified range in size from approximately 5 acres to 417 acres.

After review of the marsh-nesting bird habitat survey data, the Maine DIFW requested broadcast call-back surveys be conducted in three areas mapped by Black Bear as emergent/shrub wetlands, based on coincidence with Maine DIFW-mapped IWWH. These three areas are large in size; one is the large wetland peninsula on the southern end of Graham Lake (Great Meadow) and the other two areas are large islands in the middle portion of Graham Lake. During consultation with the Maine IFW, the yellow rail was removed from the study request. In May/June 2015 the broadcast call-back survey was conducted on three separate occasions at each sampling location. Black Bear surveyed the two northern locations (9 sites) and the Maine DIFW surveyed the southern location (8 sites). No call-back responses were heard at any of the sampling sites during the six sampling periods (three north, three south).

Effects of continued project operation on mussels

The brook floater mussel is listed as threatened under Maine's Endangered Species Act. Maine DIFW requested that Black Bear conduct a study to document the presence of the brook floater (*Alasmidonta varicose*), which is a state-listed threatened mussel species. Black Bear conducted a survey for the brook floater in the riverine and shoreline areas of the Union River between

Graham Lake and Lake Leonard. Black Bear performed the survey on July 24, August 22, and September 22, 2014, using a combination of widely used methodologies (walking the entire shoreline, 19 survey transects using viewing tubes, face masks, and SCUBA, for determining presence/absence of freshwater mussels). No brook floaters were observed; nor were any brook floater shells found along the shore or in shell middens (Black Bear, 2015).

4.4.6.3 Proposed Environmental Measures

Black Bear is proposing to continue to operate the Project under the current operating regime. Proposed environmental measures for Atlantic salmon, and Atlantic and shortnose sturgeon is addressed in Section 4.4.3.3 of this Exhibit E. Black Bear is not proposing any PME for other RTE species having the potential to inhabit the Project area.

4.4.6.4 Unavoidable Adverse Impacts

Black Bear anticipates that no unavoidable adverse effects on RTE species would result from the proposed relicensing of the Ellsworth Project.

4.4.7 Recreation and Land Use

4.4.7.1 Affected Environment

Recreation Access and Facilities

The Project is located within the Downeast & Acadia Tourism Region (MOT, 2012). The region includes many tourist attractions including Acadia National Park and Lamoine State Park and offers boating (motorized and non-motorized), fishing, hunting, hiking, biking, and climbing opportunities and, whale watching and puffin watching.

The Ellsworth Project also provides a variety of public recreation opportunities. The area surrounding the Project is a mixture of year-round and seasonal residential development and undeveloped forest land. The Project is easily accessible from US Route 1 to the south and State Route 9 to the north via Route 179 along the easterly side of the Project and Route 180/181 on the westerly side of the Project. Public access to the Project is available over a combination of public highways, city streets, and private roads, as well as by boat from several launching areas on the impoundments. Black Bear provides public recreation access at several locations for motorized and non-motorized boating and shoreline fishing. Project recreation facilities owned and managed by the Black Bear include: a carry-in boat launch off Shore Road on the Lake Leonard impoundment; the Graham Lake Dam boat launch on Graham Lake; and a canoe portage trail around Graham Lake Dam.

Shore Road Carry-in Launch - The carry-in boat launch off Shore Street provides a small (2 vehicle) parking area and a six-foot wide concrete plank ramp for carry-in boat launch and take out on the east shore of Lake Leonard. Additional vehicles can park along the Pump Station Access Road. The site is also used by bank and shoreline anglers. A Part 8 sign is maintained on site.

Graham Lake Boat Launch - The Graham Lake Dam boat launch is a motorized boat launch with a 12-foot wide concrete plank ramp and gravel parking area just westerly of Graham Lake Dam. The parking area will accommodate approximately eight vehicles and trailers. Access to the site is off Mariaville Road (former Route 180) on the west side of the impoundment. Motorized boat launching is the primary activity at this site. A Part 8 sign is maintained on-site.

Canoe Portage Trail - The canoe portage trail is located on the east side of Graham Lake Dam off Patriot Road (former Route 180). The northerly portion of the trail (Graham Lake to Patriot Road) is approximately 200 feet long with minimal improvements. There is a “portage” sign facing inland near the take-out point on Graham Lake. The trail crosses Patriot Road and parking areas on either side of the road and extends through the woods on the south side of Patriot Road to multiple points on the Union River downstream of Graham Lake Dam. The trail from the parking area to the shoreline is well worn and steep from the parking area for approximately 60 feet. The total length of this section of the trail (south of Patriot Road) is approximately 100 to 160 (varies with downstream access points) feet. A “danger, water may rise” sign is located at approximately the mid-point of the trail. The two parking areas associated with this site along Patriot Road will accommodate approximately 19 vehicles. The primary use of this site is for shoreline angling downstream of Graham Lake Dam.

Municipal, state and private lands provide additional recreation access to the Project. These include: a picnic area/day use site (municipal) on Shore Road on the east shore of Lake Leonard opposite the Middle School; Infant Street access (municipal) on both sides of the Union River; Fletcher’s Landing (State) an unimproved boat launch on Graham Lake; Mariaville carry-in boat launch (municipal) on the west side of Graham Lake; and a carry-in (private) on the West Branch of the Union River. There are no commercial recreation facilities that provide direct access to the Project.

Shore Road Picnic Site - The picnic area/day use site off Shore Street is located on City of Ellsworth property. The site provides two picnic shelters and informal trails and access to the east shore of Lake Leonard. Parking for the site is provided at the Ellsworth Elementary School across from the site.

Infant Street Access – Infant Street is a discontinued city street that once crossed the Union River approximately 1.5 miles upstream of Ellsworth Dam; the bridge has been removed and the city still owns the public right-of-way on either side of the Union River. The site consists of small parking areas (two vehicles on east shore; six vehicles on west shore) and informal footpaths to the respective shorelines. The east side is used primarily for shoreline angling and west shore for angling and picnicking.

Fletchers Landing - Fletchers Landing is located on the east side of Graham Lake in Fletchers Landing Township (T8 SD) and access is directly off Route 179. The site consists of a compacted gravel and grass parking area that will accommodate approximately ten trailer rigs. The boat launch area is approximately 15 feet wide and has an asphalt surface. The ramp facilitates the launching of small trailered watercraft. Site use appears to be primarily by local residents as evidenced by the number of boats stored on site, both in the parking area and tied up along the shoreline.

Mariaville Carry-in Launch - The Mariaville carry-in is located on the west shore of Graham Lake off the Morrison Farm Road in Mariaville. The site consists of a graveled circular entrance road and gravel launch area. Though signed as a carry-in launch, there is evidence that trailered boat launching occurs as well. The site has limited roadside parking for approximately six vehicles.

West Branch Access - The West Branch access site is located on the River Road at its junction with Route 181 in Mariaville. The site consists of a level gravel and grass parking area that accommodates approximately seven vehicles, and a short steep gravel/sand ramp for launching hand-carry watercraft into the West Branch. The launch area exhibits moderate erosion, which may be due to trailered boat launching that appears to occur at the site. This site is privately-owned.

Informal recreation likely occurs along undeveloped portions of the shoreline and on some of the islands on Graham Lake. Such areas can be accessed by boat and by vehicle over private roads. Camping and fishing are the likely predominant activities occurring at informal recreation sites.

Some boating occurs on the Union River between Graham Lake Dam and Lake Leonard, although sections of this stretch of the river may be limited to non-motorized boats due to shallow areas and scattered rips and rapids (Class I-II). Some whitewater boating occurs on this portion of the river based on the availability of flows below Graham Lake Dam, or coordinated releases for events such as the annual Maine Canoe & Kayak Race Organization's race from Graham Lake Dam to the tidal section of the Union River. Based on available data and information, whitewater boating use on this section of the river is low.

Winter activities within the Project area include snowmobiling, ice fishing, snowshoeing, Nordic skiing, and ice skating. A local snowmobile club trail crosses the Project on U.S. Route 1A over the Union River. There are no State Interconnected Trails System snowmobile trails in the Project area.

Recreation Use

Black Bear conducted recreational use counts at Project recreation facilities from April to October 2014. Based on a statistical analysis of the field data collected, annual Project recreational use is estimated to be approximately 2,620 recreation days with peak weekend use estimated at approximately 50 recreational users. FERC defines a recreation day as “each visit to a development for recreational purposes during any portion of a 24-hour period.”

One hundred percent of the 2014 Project recreational use is attributable to daytime activities. Recreational use is fairly evenly spread among the Project recreation facilities: the Graham Lake Dam boat launch had an estimated 920 users, or 35 % of total use; the Lake Leonard carry-in site had an estimated 890 users, or 34 % of total use; and the Graham Lake portage trail/downstream access site had an estimated 820 users, or 31% of total Project use. Most of this latter use is downstream shoreline fishing, with very little portage use.

None of the recreation facilities were reported to be at peak capacity on non-holiday weekends. The Graham Lake Dam boat launch and Lake Leonard carry-in were both reported to be at approximately 20% capacity for non-holiday weekends, while the portage trail/downstream access was reported to be at approximately 10% of capacity on non-holiday weekends. Existing recreation facilities are adequate to meet current recreational use and demand.

Land Use

The project is located on the lower reach of the Union River in the City of Ellsworth, and the towns of Waltham, Mariaville and Fletchers Landing Township in Hancock County, Maine. The watershed is located in an area with mixed land uses. The City of Ellsworth, with a population of 7,741 (U.S. Census Bureau 2010) is located on the southerly portion of the Project and straddles the lower end of Lake Leonard. There are several smaller towns (Otis, Waltham, Eastbrook, Mariaville, Osborn, and Aurora) all with populations less than 600 are scattered throughout the watershed. Developed land including residential, commercial, industrial, transportation, and utility uses, accounts for only a small percentage of the land use in the watershed.

Much of the surrounding lands are privately owned, some by timber management companies. There are private docks scattered along both impoundments’ shorelines where there is residential development. Other than the urban portion of Ellsworth, there are no large-scale industrial or

commercial developments in the area. Approximately 160 acres on the southern end of Hardwood Hill Island in Graham Lake has been placed under conservation by a local land trust. Black Bear's land use in the Project boundary is limited to project operations and maintenance. This includes the operation and maintenance of the Project facilities and powerhouse, and may include road and parking lot maintenance, as well as vegetation management.

Non-Project transmission lines cross through the Project boundary in the northern reach of Graham Lake, over the Union River between Lake Leonard and the Graham Lake Dam, near Branch Lake Brook, and south of Ellsworth Dam.

4.4.7.2 Environmental Analysis

Effects of continued project operation on existing recreational facilities and public access

The Ellsworth Project is located on the lower reach of the Union River, in central coastal Maine. The Project includes Graham Lake, a stretch of the Union River which flows from Graham Lake to Lake Leonard, and Leonard Lake which in turn discharges to the tidal portion of the Union River. The primary recreation interest at the Project is whether existing recreation facilities are adequate for current and future demand and whether the continued operation of the Project would impact the recreational facilities and use.

Black Bear's recreational use studies confirm that public use of Project recreation facilities and the impoundments is currently very low. The Project impoundments are used primarily for fishing and boating. The Graham Lake Dam tailwater area is popular with anglers. Recreation use data collected in 2014 as part of the relicensing studies and for the FERC Form 80 Report indicate that the existing Project area recreation facilities are adequate to meet demand and none of the facilities are at or near their capacity.

Nevertheless, Black Bear is proposing several improvements to enhance access and use of the Project lands and waters for recreational activities. Black Bear will improve the Graham Lake Dam boat launch parking area to improve vehicular access, relocate the existing canoe portage trail to address public safety, make improvements to the existing fishermen access trail below Graham Lake, and implement a Recreation Facilities Management Plan for the maintenance and improvement of recreation amenities at the Project for the term of the license. These measures will continue to maintain public access and recreation opportunities at the Project.

The proposed operation of the Project will continue to provide recreational access and support existing recreation uses and facilities, and will not alter or impact land use. Black Bear is not proposing any changes to current Project operations, and therefore, there will be no adverse impacts on recreation facilities, their use, or Project and adjacent lands.

Effects of continued project operation on flow releases and whitewater boating

At the January 15, 2013 Scoping Meeting, one individual from the public stated the Union River below Graham Lake Dam should be assessed for whitewater boating opportunities. Black Bear conducted a desk-top whitewater boating analysis. In addition, consultants with whitewater boating experience boated the Union River on two occasions and evaluated whitewater boating opportunities. Based on the desk-top analysis and the field reconnaissance, the Union River provides Class I-II boating opportunities. However, due to the limited number of whitewater features, the river is an occasional, local resource at most.

4.4.7.3 Proposed Environmental Measures

Black Bear proposes to make enhancements to several of the Project recreation facilities.

Black Bear will improve drainage at the Graham Lake Dam boat launch to remedy an erosion problem area near the top of the boat ramp. This will entail redirecting drainage from the parking lot away from the boat ramp and toward vegetative buffers on either side of the ramp and hardening the sloped gravel ramp approach with material that will not migrate toward the ramp and lake due to vehicle traffic and run-off events.

Black Bear proposes to relocate the existing portage trail to the west side of Graham Lake Dam (Figure E-15) and develop a take-out area on the existing Graham Lake Dam boat launch property separate from the hard surface ramp to avoid conflicts with launching and retrieving motorized watercraft. The portage trail would cross Mariaville Road and traverse a level field parallel the south side of the flood control structure to a new put-in on the Union River. Portage trail directional signage and “Danger Water May Rise” signage will be installed, and side and overhead vegetation along the trail cleared and maintained, where needed, to accommodate portaging a 16-foot canoe. Shoreline improvements at the downstream put-in will be required. Total length of the relocated trail will be approximately 1,000 feet, compared to approximately 360 feet for the existing trail. The portage trail is being relocated for safety considerations including the current trails very close proximity to the upstream boat barrier.

The downstream portion of the existing east shore access trail would still be maintained for downstream angler access.

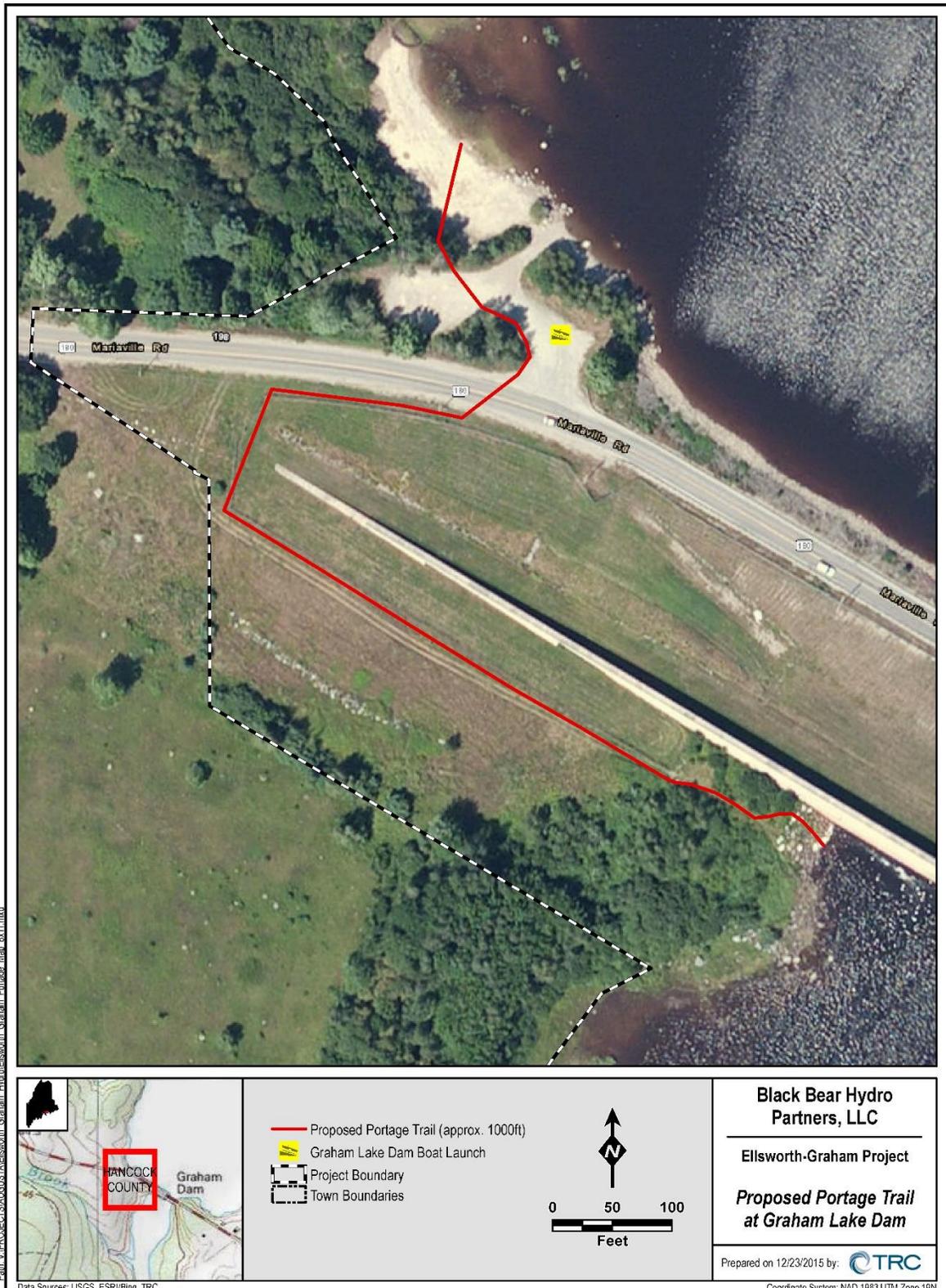
Black Bear proposes to implement a Recreation Facilities Management Plan (Appendix E-9) for the project, which will address management of Project recreation sites over the term of the new license.

Black Bear is not proposing any environmental measures associated with land use.

4.4.7.4 Unavoidable Adverse Impacts

The continued operation of the Ellsworth Project will support the existing recreational uses and will not alter land use associated with the Project. The proposed recreation enhancements will improve public access, public safety and provide additional opportunities at the Project.

Figure E-15: Portage Trail Map



4.4.8 Aesthetics

4.4.8.1 *Affected Environment*

The Project is located in south-central Hancock County, Maine. Both Project dams are located in the City of Ellsworth and the Graham Lake impoundment extends into the Towns of Mariaville, Waltham, and Fletchers Landing Township. Ellsworth Dam and the southerly portion of its associated impoundment, Leonard Lake, are within the urban area of the city and are adjacent to commercial and residential in-town development. The remainder of the Project is rural in nature with undeveloped forest lands and scattered residential development. Terrain around the immediate Project is relatively flat, though some low elevation mountains (< 1,600') are within view of the Project (Black Bear, 2012).

Though close to the downtown area and a major transportation corridor, the Lake Leonard shoreline is well buffered with vegetation and views of development along the shoreline are very limited. Riverbanks downstream of the Ellsworth Dam are of moderate slope; the west riverbank has a few residential structures along the top of the bank and a few commercial and municipal buildings are set back along the east riverbank (Black Bear, 2012).

Lake Leonard is approximately 0.3 mile wide at its widest point and extends approximately 1 mile upstream from the dam to where the impoundment becomes narrow and more riverine. Slopes along both shorelines are gentle with some scattered residential development. Public access points providing views of the impoundment exist from a public trail opposite the Ellsworth Middle School on the east shore and from the dam on the west shore. Limited views of the impoundment also occur along portions of the public roads on the east and west shorelines (Black Bear, 2012).

The Union River extends from the head of the Lake Leonard approximately 3 miles upstream (north) to Graham Lake Dam. This section of the river is approximately 200 feet wide and contains a few short Class I/II areas. Slopes along the river are gentle to moderate. Shore Road parallels the lower east shoreline providing some views of the river, and US Route 1A crosses the river approximately 0.7 mile upstream of the head of the Lake Leonard impoundment. Infant Street on the west shoreline provides access to and a limited view of the river. The shoreline along this section of river is wooded, except where Shore Road extends along the riverbank, with very minimal development (Black Bear, 2012).

The shorelines between Rt. 1A and Graham Lake Dam are mostly undeveloped with the exception of a small residential development on the east shore below Graham Lake Dam, a railroad crossing immediately upstream of the Rt. 1A Bridge, and a non-Project transmission line corridor crossing approximately 0.8 mile downstream of the dam. The shorelines are gentle wooded slopes interspersed with wetlands and minor water courses (Black Bear, 2012).

Graham Lake Dam is located in the northeasterly portion of Ellsworth. Graham Lake extends approximately 10 miles upstream from the dam to the East Branch and West Branch of the Union River. Several other tributaries also feed into the lake. Islands of various size ranging from less than one acre to Hardwood Hill Island (approximately 625 acres) are located throughout the lake. Slopes along the shoreline consist of gentle to moderate slopes (Black Bear, 2012).

The lake shoreline is a mixture of land use classifications. The majority of the shoreline consists of forest growth. Year-round and seasonal residences are scattered along the shoreline and are generally accessed by paved public or private gravel roads (Black Bear, 2012).

Routes 179 and 180/181 roughly parallel the east and west shores, respectively, and offer various views depending on proximity and elevation of the road to the shoreline. Views of much of the Project from these roads are screened by vegetation, topography, and/or distance. There are limited Project views from two high points along State roads: off Route 179 near the intersection of Cemetery Road (elevation 330', view to the southwest); and off Route 181 south of Tannery Brook (elevation 220', view to the southeast). Several public access points provide views of portions of the Project. These include the boat ramp and downstream fishing access trail near Graham Lake Dam, the Morrison Farm Road carry-in and the Route 181 boat launch both on the northern end of the Project in Mariaville, and Fletchers Landing off Route 179 on the southeast shoreline (Black Bear, 2012).

Although the limited views are scenic, the Project's aesthetic quality is not unique, particularly for this area of coastal Maine. Acadia National Park is approximately 15 miles southwest of the Project (Black Bear, 2012).

4.4.8.2 Environmental Analysis

Operation of the Project facilities has little effect or impact on the aesthetic quality of the impoundments and the section of the Union River downstream of the Graham Lake and Ellsworth Dams.

4.4.8.3 Proposed Environmental Measures

Black Bear is proposing to operate the Project as it has in the past. This will maintain the existing scenic quality, therefore Black Bear is not proposing to specifically enhance Project aesthetics.

4.4.8.4 Unavoidable Adverse Impacts

The continued operation of the Ellsworth Project will have little impact on aesthetic resources of the Project.

4.4.9 Cultural Resources

Black Bear conducted several studies to identify cultural resources eligible for listing on the National Register of Historic Places (NRHP) in accordance with Section 106 of the National Historic Preservation Act (NHPA). Studies were conducted for Precontact resources (i.e., Native American archaeological resources), Postcontact resources (i.e., Euroamerican archaeological resources) and historic structures (i.e. architectural resources).

4.4.9.1 Affected Environment

Area of Potential Effect

The Area of Potential Effect (APE) for Precontact and Postcontact archaeological resources for the Ellsworth Project was defined in consultation with the MHPC as lands enclosed within the Project boundaries and/or lands located within 50 feet (15 meters) of the edge of the impoundments or river bank, whichever is the greater of the two areas.

The APE for architectural resources was defined in consultation with the MHPC as “the lands enclosed by the Project’s boundary and lands or properties outside of the Project’s boundary where Project construction and operation or Project-related recreational development or other enhancements may cause changes in the character or use of historic properties, if any historic properties exist.”

Archaeological Resources

The Union River valley has a long history of human occupation with the arrival of people into the area approximately 11,000 years ago. Professional survey by archaeologists from the Abbe Museum in Bar Harbor and the Maine State Museum in Augusta (Bourque 1971; Bourque and Kopec 1984) showed that human use of the Project area around Leonard Lake has occurred almost continuously from the Late Archaic period up until the time of Native American contact with Europeans (ca, 5,000 - 400) years ago.

The Phase I archaeological investigation conducted for the Ellsworth Project included shoreline survey of Graham Lake and Lake Leonard, as well as all tasks specified in a letter dated September 10, 2012 from the MHPC. The investigation included Phase I archaeological survey testing to determine whether any evidence of the historic Learoyd Hill Farmstead (ME 145-013) (Mosher 2010) was present within the Project boundary. As part of the initial survey, Black Bear conducted background research and identified a number of previously known Precontact sites located at the Project vicinity. In addition, at the request of the Maine State Historic Preservation Officer (SHPO), Black Bear reviewed select existing archaeological reports and amateur artifact collections from the Project area. A desktop sensitivity analysis followed by field inspection and

survey work led to the identification of three new Precontact sites. The sites range in age from the Late Archaic to Contact periods. All three sites were recommended for further evaluation (Phase II) to determine their potential eligibility for listing to the National Register of Historic Places (NRHP). Phase II investigation of the three new sites occurred in the summer of 2015 and recommended that two of the sites are eligible for listing in the NRHP. By letter dated December 22, 2015 the MHPC concurred with the finding. The Phase II study report, Phase II Archaeological Investigations of Precontact Sites: 58.29, 58.30 and 58.31 Leonard Lake – Ellsworth, Hancock County, Maine is included in Appendix E-10 filed as a separate Privileged volume of the FLA.

Historic and Architectural Resources

An architectural survey of the Project APE was conducted in November 2013, with follow up work in 2014. The purpose of the survey was to identify historic resources within the Project APE currently listed, or eligible for listing, in the NRHP. The historic architecture survey found, and the Maine State Historic Preservation Officer concurred (letter dated June 3, 2014), that there are three architectural resources in the project's area of potential effect that are either listed in or are eligible for listing in the NRHP. These include: the Ellsworth Powerhouse and Dam (NRHP listed), Graham Lake Dam and Bridge (previously determined NRHP eligible), and the Maine Central Railroad Bridge over the Union River (NRHP eligible). No other NRHP-eligible historic structures were found within the Project APE.

4.4.9.2 Environmental Analysis

Effects of continued project operation on historic properties and archaeological resources

Section 106 of the National Historic Preservation Act (NHPA) requires FERC to take into account the effect of its undertakings on historic properties and to allow the Advisory Council on Historic Preservation (ACHP) the opportunity to comment. For hydropower licensing actions, FERC typically completes Section 106 consultation by entering into a Programmatic Agreement (PA) or Memorandum of Agreement (MOA) with the licensee, the ACHP, and the state and tribal preservation offices. FERC typically requires the licensee to develop and implement a Historic Properties Management Plan (HPMP) as a license condition. Through an approved HPMP, FERC can require consideration and management of effects on historic properties for the license term, thus meeting the requirements of Section 106 for its undertakings.

An HPMP implemented under a license is a plan for considering and managing the effects of hydropower facility activities (such as construction, operation, and maintenance) on historic properties. Historic properties include those properties listed in, or eligible for listing in, the NRHP. The HPMP establishes a decision-making process for considering the potential effects on historic properties and manages the effects of implementing the license over its entire term.

Potential future effects to historic structures and archaeological resources over the term of the new license may occur due to facility maintenance, replacement, and repair; construction of new Project facilities, including recreation facilities; erosion, whether contributed to by natural processes, Project operation, or both; and permitted shoreline uses and activities such as recreational activities; and public use associated with recreation facilities at the Project.

Black Bear will minimize adverse effects to historic properties as a result of recreational facilities development by avoiding development in these areas where practicable. All archaeological site information and site locations will remain confidential relative to the general public so as to minimize the effects of site looting activities. Prior to construction of any recreational development that will require ground disturbing activities near known or potential historic properties, Black Bear will initiate consultation with the SHPO.

Black Bear will also consult with the SHPO prior to conducting any other planned, non-emergency, maintenance or construction activities that have the potential to adversely affect historic properties in the Project APE of the proposed undertaking in accordance with the management measures set forth in the final approved HPMP.

The limited amount of Precontact period cultural material found on Graham Lake may be the result of the lack of access to locations within close proximity to the submerged shoreline of the historic Union River channel. Even at its lowest drawdown elevation of 93.4' the historic Union River channel within Graham Lake is fully submerged. Continued operation of the Project will likely not adversely impact any potential Graham Lake archaeological sites. Black Bear will however, coordinate with the SHPO to complete archaeological surveys of Graham Lake should it be determined that field conditions and planned impoundment levels (i.e., during times when planned maintenance activities requiring sufficiently prolonged low water levels occur) prevail to permit the safe and reasonable review of sites that may be located in the drawdown zone.

Two Precontact archaeological sites within the Project boundary were determined to be NRHP-eligible. These sites will be monitored on an annual basis for erosion in accordance with the final approved HPMP.

There are three (3) historic architectural resources within the Project APE that are listed or eligible for the NRHP – the Ellsworth Dam and powerhouse (NRHP-listed), the Graham Lake Dam/Bridge (NRHP-eligible), and the Central Maine Railroad Bridge (NRHP-eligible). Black Bear will consult with the SHPO prior to undertaking any planned non-emergency maintenance or construction activities (e.g., upstream American eel passage) that could adversely affect the historic integrity of the contributing resources of the Ellsworth Hydroelectric Facility or any other historic resources within the undertaking's APE.

4.4.9.3 Proposed Environmental Measures

In order to manage and protect the cultural resources at the Project during the term of the new license, Black Bear is proposing to implement an HPMP for the Ellsworth Project. The draft of the HPMP (Appendix E-10) is being filed with the Maine HPC and FERC under separate cover as “*Privileged*” because it contains confidential archaeological site location information. The HPMP considers the effects of the Project and its continued operation on historic properties. Moreover, the HPMP establishes specific steps to be taken by Black Bear to protect and manage these historic properties over the term of the new license. With the implementation of an approved HPMP, the continued operation of the Project as proposed by Black Bear will have no adverse impacts on historic properties at the Project.

4.4.9.4 Unavoidable Adverse Impacts

No unavoidable adverse impacts to cultural resources are expected to occur as the result of the continued operation of the Ellsworth Project as proposed.

4.4.10 Socioeconomics

4.4.10.1 Affected Environment

The Ellsworth Project is located in Downeast Maine within Hancock County. Hancock County is the second most eastern county in the state and is the eighth most populous of the state’s 16 counties. The Project boundary is contained within the City of Ellsworth, the Towns of Mariaville and Waltham, and Fletchers Landing Township. The following sections provide a summary of selected socioeconomic variables for Maine, Hancock County, the City of Ellsworth, and the Towns of Mariaville, and Waltham, as they are available.

General Land Use Patterns

Approximately 90.2 percent of Hancock County is comprised of forested land (USDA, 2005). The City of Ellsworth, Towns of Mariaville and Waltham, and Fletchers Landing Township are in the Northeast Maine nonmetropolitan area (BLS, 2013). While lands within the Project vicinity are predominately undeveloped forest lands and wetlands, the city of Ellsworth is an area of dense population (relatively) within the County. Forestry is a common land use in the area, while agricultural uses include apple orchards and blueberry barrens (Ellsworth Comprehensive Planning Committee, 2004, Mariaville Comprehensive Planning Committee, 2006).

Population Patterns

According to the US Census Bureau (2015), the population of Hancock County in 2010 was 54,418 (Table E-23). From April 1, 2010 to July 1, 2013, the population of the County increased by approximately 0.8 percent. The population density of the County in 2010 was 34.3 people per square mile within a land area of 1,586.89 square miles, which is approximately 20.4 percent lower than the state’s average of 43.1 people per square mile (US Census Bureau, 2015h).

The City of Ellsworth had a population of 7,741 in 2010, while Mariaville had a population of 513, and Waltham had a population of 353 (US Census Bureau, 2015a, 2015d, 2015e, 2015f, and 2015g).

Table E-23: Population Statistics for Hancock County and the State of Maine

	Hancock County	Maine
Population		
Population (2013 Estimate)	54,845	1,328,702
Population (2010)	54,418	1,328,361
Population Growth (April 1, 2010 to July 1, 2013)	0.8%	Z*
Geography (2010)		
Land Area in Square Miles	1,586.89	30,842.92
Population Density (per square mile)	34.3	43.1
Gender (2013)		
Male	48.9%	49.0%
Female	51.1%	51.0%
Age (2013)		
Persons Under 5 Years Old	4.4%	4.9%
Persons Under 18 Years Old	17.6%	19.7%
Persons 18 to 64 Years Old	57.3%	57.5%
Persons 65 Years Old and Over	20.7%	17.7%
Race (2013)		
Caucasian	95.5%	94.0%
Black	0.6%	1.4%
American Indian and Alaska Native	0.5%	0.7%
Asian	1.0%	1.1%
Hispanic or Latino	1.3%	1.4%
Two or More Races	1.2%	1.6%

* Value greater than zero but less than half of a percentage unit of measure shown.

Source: US Census Bureau, 2015h

Households/Family Distribution and Income

There were an estimated 24,355 households in Hancock County, which was approximately 4.4 percent of the state’s households based upon the Census 2009-2013 American Community Survey Estimate values. The County had 2.17 persons per household, which is slightly less than the state’s average household size of 2.33 people (US Census Bureau, 2015h).

The median household income in Hancock County was \$47,460, which is approximately one percent below the state median household income of \$48,453 between 2009 and 2013. In addition, Hancock County had a higher per capita income (\$27,797) than the state of Maine (\$26,824), based upon the Census 2009-2013 American Community Survey Estimate values. Approximately 14.0 percent of the population of Hancock County was below the poverty level, while the percent of the state’s population living below poverty level was lower at 13.6 percent (US Census Bureau, 2015h). Hancock County had a higher unemployment rate (7.8 percent) as compared to the overall state (5.5 percent) in December 2014 based upon the data derived from the Local Area Unemployment Statistics (LAUS) program (Maine CRWI, 2015).

Project Vicinity Employment Sources

In Hancock County, as well as the entire state of Maine, the top two sources of employment are in education and health services (7,336 people employed) (Table E-24) and in the retail trade industry (3,286 people employed) (US Census, 2015b and 2015c). The largest employer in Hancock County is Jackson Laboratory, which employed over 1,000 people in 2014 (MDOL, 2014).

Table E-24: Employment Statistics for Hancock County and the State of Maine

	Hancock County	Maine
Civilian Labor Force Employment Status (2009 - 2013)		
Number Employed	27,336	647,099
Employment by Industry (2009 - 2013)		
Agriculture, Forestry, Fishing, Hunting, and Mining	1,522	15,732
Construction	2,547	45,585
Manufacturing	1,604	60,165
Wholesale Trade	436	15,318
Retail Trade	3,286	88,065
Transportation and Utilities	935	25,138
Information	548	11,762
Financial Activities	1,163	39,587

	Hancock County	Maine
Professional and Business Services	2,926	56,228
Education and Health Services	7,336	177,466
Leisure and Hospitality	2,767	55,256
Other Services	1,453	28,612
Public Administration	813	28,185

Source: US Census Bureau, 2015b and 2015c)

Flood Control

Graham Lake reservoir provides significant mitigation of downstream flooding in the downtown area of the City of Ellsworth by attenuating peak flows. Spring flooding is generally the period of most concern, when rain and snow melt combine to provide high levels of inflow. Graham Lake is generally operated in a manner such that the time of maximum drawdown, usually around late-March is just before the high spring flows that fill the lake by mid-May.

4.4.10.2 Environmental Analysis

The Project lands and waters are utilized by the City of Ellsworth, fishermen, and recreationists. Existing shoreline development is currently limited almost exclusively to private residences and seasonal cottages. Other than recreation and the seasonal harvesting of alewives for lobster bait, and American eel elvers for export, there are no significant non-Project socioeconomic resources or uses of the Ellsworth Project.

The Project provides a positive economic benefit to the City of Ellsworth each spring as alewife are harvested below the Ellsworth Dam on the Union River. Alewives have been harvested in Maine for economic purposes for many years. There is high demand for alewives for use as lobster bait. The City of Ellsworth holds a license for harvesting alewives in the Union River and in turn issues permits to fish alewives for commercial purposes, earning 40% of the license holder's revenue as a permit fee (College of the Atlantic 2004). The following table shows annual revenue to the city from the alewife harvest for the past 10 years.

Migrating American juvenile eel, also known as elvers, are also harvested by licensed fishermen on the Union River (Bangor Daily News, 2012). Elvers are second only to lobster in value in Maine's seafood industry (Boston Globe, 2013).

The recreational opportunities in the Project vicinity attract visitors for camping, birding, wildlife viewing, boating, and fishing. There will be no significant changes to the basic operations of the Project impoundments, and therefore, there would be no changes to any socioeconomic resources in the Project area.

Table E-25: City of Ellsworth Revenue from Alewife Harvest 2005 – 2014

Year	Revenue
2005	\$9,500
2006	\$2,778
2007	\$21,053
2008	\$20,287
2009	\$12,355
2010	\$13,306
2011	\$11,700
2012	\$58,799
2013	\$31,816
2014	\$35,872
Total	\$217,466

*Data supplied by City of Ellsworth

4.4.10.3 Proposed Environmental Measures

Black Bear is proposing to continue to operate and maintain the Project under the existing operating regime. Black Bear will generally maintain the current Project schedule of seasonally variable minimum flows and pond level management.

Black Bear is making no proposal for the Project directly aimed at enhancing area socioeconomic resources. However, several of the resource proposals being made will indirectly support the continued use of the Project area for recreation, and will allow the Project to continue to contribute to the recreation and tourism based economy of the region.

4.4.10.4 Unavoidable Adverse Impacts

No unavoidable adverse impacts to socioeconomic resources are expected to occur as a result of the continued operation of the Ellsworth Project as proposed.

4.5 Economic Analysis

4.5.1 Costs and Value of Developmental Resources Associated with the Project

Black Bear is not proposing to add capacity or make major modifications to the project in this license application. The nameplate rated capacity of the Ellsworth Project is 8.9 MW. The Project has generated an average annual energy output of 30,511 MWh over the past 21 years. The values of developmental resources of the Project are discussed in Exhibit D.

4.5.2 Cost of Proposed PME's

Recreational Facilities

Black Bear has developed a Recreation Management Plan to provide for management of Project recreational facilities throughout the term of the license.

- Black Bear proposes to improve the boat launch by grading/compacting the gravel section of the boat launch to improve drainage and stabilize existing erosion areas.
- Black Bear proposes to develop a new portage trail around Graham Lake Dam. The new trail would be located at the west end of the dam. The portage trail will originate in the vicinity of the existing hard-surfaced boat launch, but be designed to not conflict with the boat launch area. The trail will enter the Union River just below the existing flood control structure on the west side of the river.
- For safety reasons, Black Bear proposes to discontinue the existing portage trail at the east end of Graham Lake Dam while at the same time improving and maintaining a portion of the trail for fisherman access to the Union River below the dam.
- Black Bear will maintain appropriate Part 8 and directional and safety signage.

Fish Passage

- Black Bear proposes to develop and implement, in consultation with fisheries management agencies, plans for upstream eel passage at Ellsworth and Graham Lake Dams.
- Black Bear will consult with the fisheries management agencies on the need for and, if necessary, the design of downstream eel passage measures pending the results of downstream eel passage studies.
- Black Bear will consult with the fisheries management agencies on the need for and, if necessary, the design of upstream and downstream anadromous fish passage improvements pending the results of ongoing studies.

Cultural Resources

- Black Bear has developed a draft Historic Properties Management Plan to provide for appropriate management of effects on historic resources throughout the term of the license. Black Bear will implement and maintain the final approved HPMP for the term of the new license.

Table E- 26 below details the estimated cost of the proposed PME's.

Table E-26: Estimated Costs for Proposed PME for the Ellsworth Project (2015 dollars)

Proposed PME Measure	Construction Cost***	Annual Operation and Maintenance Cost
Finalize and implement Recreation Facilities Management Plan	\$5,000	\$5,000
Graham Lake Boat Launch Improvements	\$35,000	N/A
Graham Lake New Portage Trail	\$45,000	N/A
Graham Lake fisherman’s downstream access trail improvements	\$25,000	N/A
Part 8 and Directional and Safety Signage	\$20,000	N/A
Recreation facilities and sites operation and maintenance**	NA	\$26,000
Finalize and implement Historic Properties Management Plan*	\$5,000	\$5,000
Finalize and implement Operations Monitoring Plan	\$5,000	\$5,000
Upstream eel passage measures	\$150,000	\$20,000
Downstream eel passage measures	Unknown	Unknown
Upstream anadromous fish passage measures	Improvements unknown	\$90,000
Downstream anadromous fish passage measures	Improvements unknown	\$20,000

* Exclusive of costs of historic properties investigations that result from implementation of the HPMP.

** Exclusive of costs of major maintenance and repair projects.

*** Does not include costs to permit the measure, or costs of unknown environmental mitigation measures that may be required based upon the permitting process.

4.6 Consistency with Comprehensive Plans

Section 10(a)(2) of the Federal Power Act requires FERC to consider the extent to which a project is consistent with federal and state comprehensive plans for improving, developing, and conserving waterways affected by the project. The comprehensive plans are discussed in Exhibit H of this Final License Application.

5.0 REFERENCES

<http://www.bestplaces.net/climate/city/maine/ellsworth> Accessed April 2015

Alden Research Laboratory (Alden). 2012. Atlantic salmon survival estimates at mainstem hydroelectric projects on the Penobscot River. Holden, Massachusetts.

Atlantic States Marine Fisheries Commission (ASMFC). 2012. River herring benchmark stock assessment: volume 1. Stock Assessment Report No. 12-02. May 2012.
http://www.asmfc.org/speciesDocuments/shad/stockassmtreports/riverHerringBenchmarkStockAssessmentVolumeIR_May2012.pdf. Accessed August 28, 2013. cited in FERC's September 4, 2013 Study Plan Determination

Atlantic Sturgeon Status Review Team. 2007. Status review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). National Marine Fisheries Service. February 23, 2007. 188 pp.

ASMFC. 2012. American Eel Benchmark Stock Assessment. Stock Assessment Report 12-01 of the Atlantic States Marine Fisheries Commission. 342 pp.

ASMFC. 2014. Addendum IV to the Interstate Fishery Management Plan for American Eel. Approved October 2014. 26 pp.

Bakhtansky, E.L., I.A. Barybina, and V.D. Nesterov. 1976. Changes in the intensity of downstream migration of Atlantic salmon smolts according to abiotic conditions. ICES Anadromous and Catadromous Fish Committee C.M.1976/M:4.

Bangor Daily News. 2013. Restoration efforts put spotlight on once plentiful alewives. [Online] URL: <http://bangordailynews.com/2013/05/04/outdoors/restoration-efforts-put-spotlight-on-once-plaintiful-alewives/>.

Bangor Daily News. 2012. Elvers fetching more than \$2,000 per pound. [Online] URL: <http://bangordailynews.com/2012/03/23/news/hancock/elvers-fetching-more-than-2000-per-pound/>.

Bangor Hydro-Electric Company. 1984. Application for License for Major Project – Existing Dam. December 19, 1984

Bangor Pacific Hydro Associates (BPHA). 1994. 1994 Evaluation of Downstream Fish Passage Facilities at the West Enfield Hydroelectric Project. FERC #2600-029. Bangor-Pacific Hydro Associates. Bangor, ME. 18 pp. and appendices.

- Baum, E.T. 1997. Maine Atlantic Salmon: A National Treasure. Atlantic Salmon Unlimited. Hermon, ME. 224 pp.
- _____. 1982. The Union River: An Atlantic salmon management plan. Atlantic Sea Run Salmon Commission. Bangor, Maine. 27 p.
- Bell, M.C. 1991. Fisheries handbook of engineering requirements and biological criteria. Report Prepared for US Army Corps of Engineers, North Pacific District, Portland, Oregon.
- Bishop, M. Maine Department of Environmental Protection. 2014. (personal communication October 8, 2014).
- Black Bear Hydro Partners, LLC. (Black Bear). 2015. Updated Study Report for the Ellsworth Hydroelectric Project, FERC No. 2727. August 2015.
- Black Bear Hydro Partners, LLC. (Black Bear). 2014. Initial Study Report (ISR), Ellsworth Hydroelectric Project, FERC No. 2727. September 2014.
- Black Bear Hydro Partners, LLC. (Black Bear). 2012 Pre-Application Document (PAD), Ellsworth Hydroelectric Project, FERC No. 2727. October 2012.
- Blackwell, B.F. and W.B. Krohn. 1997. Spring foraging distribution and habitat selection by double-crested cormorants on the Penobscot River, Maine, USA. *Colonial Waterbirds* 20(1): 66-76.
- Blackwell, B.F., W.B. Krohn, N.R. Dube, and A.J. Godin. 1997. Spring prey use by double-crested cormorants on the Penobscot River, Maine, USA. *Colonial Waterbirds* 20(1): 77-86.
- Blackwell, B.F. 1996. Ecology of double-crested cormorants using the Penobscot River and Bay Maine. Doctoral dissertation, University of Maine.
- Booth, R.K., E.B. Bombardier, R.S. McKinley, D.A. Scruton, and R.F. Goosney. 1997. Swimming Performance of Post Spawning Adult (Kelts) and Juvenile (Smolts) Atlantic Salmon, *Salma salar*. Can. Manusc. Rep. Fish. Aquat. Sci. No. 2406: V + 18 p.
- Boschung, H.T. Jr., and R.L. Mayden. 2004. Fishes of Alabama. Smithsonian Institution, Washington, DC. 736 pages.
- Boston Globe. 2013. Maine Limiting Lucrative Catch for Glass Eels. [Online] URL: www.bostonglobe.com/...elvers-maine-maine...eels/.../2013/12/14/Maine

- Boston Globe. 2013. [Online] URL>[www.bostonglobe.com/...elvers-maine-maine...eels/.../2013/12/14/Maine limiting lucrative catch for glass eels](http://www.bostonglobe.com/...elvers-maine-maine...eels/.../2013/12/14/Maine-limiting-lucrative-catch-for-glass-eels)
- Bourgeois, C.E. and M.F. O'Connell. 1986. Observations on the seaward migration of Atlantic salmon (*Salmo salar L.*) smolts through a large lake as determined by radio telemetry and Carlin tagging. *Canadian Journal of Zoology* 66: 685-691.
- Bozeman, E.L., Jr., and M.J. VanDen Avyle. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic) -- alewife and blueback herring. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.111). U.S. Army Corps of Engineers, TR EL-82-4. 17 pp.
- Brown L.S., Haro A. and Castro-Santos T., 2009. Three-dimensional movements of silver-phase American eels in the forebay of a small hydroelectric facility. *In: Casselman J.M. and Cairns D.K. (eds.), Eels at the edge: science, status and conservation concerns, American Fisheries Society Symposium, 58, Bethesda, 277–291.*
- Bureau of Labor Statistics (BLS). 2013. May 2013 Metropolitan and Nonmetropolitan Area Definitions. [Online] URL: http://www.bls.gov/oes/current/msa_def.htm#76750.
- Burr, G. Maine DIFW, personal communication, July 23, 2014
- _____. Maine DIFW, personal communication, July 3, 2014
- _____. Maine DIFW, personal communication, July 18, 2013
- _____. Maine DIFW, personal communication, March 7, 2013
- Clough, S.C., Lee-Elliott, I.E., Turnpenney, A.W.H., Holden, S.D.J., and Hinks, C. 2004. Swimming Speeds in Fish: phase 2 Literature Review. Environment Agency R&D Technical Report W2-049/TR2.
- College of the Atlantic. 2004. Alewife Restoration in the Union River Watershed, A Report by the River Ecology and conservation Class. June, 2004.
- Conserve Wildlife Foundation of New Jersey. 2015. New Jersey Endangered and Threatened Species Field Guide: Big Brown Bat. Website accessed April 1, 2015 at: <http://www.conservewildlifenj.org/species/fieldguide/view/Eptesicus%20fuscus/>
- Cornell Lab of Ornithology. 2014. All About Birds. Website accessed November 21, 2014 at: <http://www.allaboutbirds.org>

- _____. 2015. All About Birds. Website accessed April 1, 2015 at:
<http://www.allaboutbirds.org>
- Cowardin, L.M., V.C. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 131 pp.
- Davies, S.P. and L. Tsomides. 2002. Methods for biological sampling and analysis of Maine's rivers and streams. ME Dept. of Env. Prot. Augusta, ME. 31p.
- DeGraaf, Richard M. and Yamasaki, Mariko. 2001. New England Wildlife: Habitat, Natural History, and Distribution. University Press of New England. Lebanon, NH.
- E. Call, Maine DIFW, personal communication March 31, 2015
- Ellsworth Comprehensive Planning Committee. 2004. Ellsworth Comprehensive Plan Update. [Online] URL: <http://www.hpcme.org/ellsworth>.
- Evers, D.C. 2007. Status assessment and conservation plan for the Common Loon (*Gavia immer*) in North America. BRI Report 2007-20. U.S. Fish and Wildlife Service, Hadley, MA.
- Fair, Jeffrey S. 1979. Water level fluctuations and common loon nest failure. In: S. Sutcliffe (ed.) Proceed. N. Amer. Conf. Common Loon Res. Manage. 2: 57-63.
- Fay C., M. Bartron, S. Craig, A. Hecht, J. Pruden, R. Saunders, T. Sheehan and J. Trial. 2006. Status review for anadromous Atlantic salmon (*Salmo salar*) in the United States. Report to the National Marine Fisheries Service and U.S. Fish and Wildlife Service. 294 pages.
- Federal Energy Regulatory Commission (FERC). 1987. Environmental Assessment, Ellsworth Project, FERC No. 2727-003. Issued November 9, 1987.
- Federal Energy Regulatory Commission. (FERC). 1987. Order Issuing New License (Major Project – Existing Dam) (FERC No. 2727). Issued December 28, 1987.
- Federal Energy Regulatory Commission. (FERC). 1991. Order Approving Revised Report on Recreation Resources with Modification. May 22, 1991.
- Federal Energy Regulatory Commission. (FERC). 1994. Order Amending Revised Recreation Report by Approving Hand-Carried Boat Access Facility. September 14, 1994.

- Federal Energy Regulatory Commission. (FERC). 1995. Order Approving Fish Passage Drawings and Construction Schedule and Denying Extension of Time. Issued January 26, 1995.
- Federal Energy Regulatory Commission (FERC). 1997. Final Environmental Impact Statement - Lower Penobscot River Basin, Maine (Basin Mills, Stillwater, and Milford Hydroelectric Projects - FERC Nos. 10981, 2712, and 2534, respectively). FERC, Washington, D.C.
- Federal Energy Regulatory Commission. (FERC). 2006. Order Modifying Minimum Flow Study Plan under Article 404. Issued October 13, 2006.
- Federal Energy Regulatory Commission, Division of Environmental Analysis, Office of Hydropower Licensing. 1987. Environmental Assessment Ellsworth Project FERC No. 2727.
- Fennelly, D. Black Bear Hydro Partners, LLC. personal communication, July 23, 2014
- Fernandes, S.J., G.B. Zydlewski, J.D. Zydlewski, G.S. Wippelhauser, and M.T. Kinnison. 2010. Seasonal distribution and movements of shortnose sturgeon and Atlantic sturgeon in the Penobscot River Estuary, Maine. *Transactions of the American Fisheries Society* 139: 1436-1449.
- Ferwerda, J.A., K.J. LaFlamme, N.R. Kalloch, and R.V. Rourke. 1997. *The Soils of Maine*. Miscellaneous Report 402, Maine Agricultural and Forest Experiment Station, University of Maine.
- Fidel, Jonah and J. Denham. 2014. *New England Bats: A guide to bats including those affected by White Nose Syndrome*. Report of the Essex Land Trust. Accessed online, November 17, 2014 at: <http://nrca.uconn.edu/documents/NEWENGLANDBATSGUIDE.pdf>
- Gawler, S. and Cutko, A. 2010. *Natural Landscapes of Maine: A Guide to Natural Communities and Ecosystems*. Maine Natural Areas Program, Maine Department of Conservation, Augusta, Maine. 347 pp.
- Great Northern Paper Company (GNP). 1989. 1989 report on downstream passage of Atlantic salmon smolts and kelts at Weldon Dam. Great Northern Paper, Millinocket, Maine. 94 pages plus appendices.

- Griffith, G., J. Omernik, S. Bryce, J. Royte, W. Hoar, J. Homer, D. Keirstead, K. Metzler, and G. Hellyer. 2009. Ecoregions of New England (color poster with map, descriptive text, summary tables, and photographs). U.S. Geological Survey (map scale 1:1,325,000). Reston, Virginia. Website accessed July 16, 2012 at: <http://www.epa.gov/region1/neaeb2010/pdfs/PosterHellyerGreg.pdf>
- Griffiths, J.S. 1979. Effects of size and temperature on sustained swimming speeds of Great Lakes fishes., pp. 37: Ontario Hydro Research Division Report.
- Hall, S.D. and S.L. Shepard. 1990. 1989 Progress report of Atlantic salmon kelt radio telemetry investigations on the lower Penobscot River. Bangor Hydro-Electric Company. Bangor, Maine. 30 pages.
- Hanson, E.W., C.C. Rimmer, and J. Gobeille. 2002. The 2001 breeding status of Common Loons in Vermont. Unpublished Report, Vermont Institute of Natural Science, Woodstock, VT.
- Hatch, J.J. and D.V. Weseloh. 1999. Double-crested Cormorant (*Phalacrocorax auritus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/441>. Accessed April 2011.
- Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. The Great Lake Entomologist. pgs. 31-39.
- Hoar, W.S. 1988. The physiology of smolting salmonids. In Fish physiology Vol. XIB (Hoar, W. S. & D. J., Randall eds.). London: Academic Press. Cited in Svendsen 2008.
- Howatt, K. Maine Department of Environmental Protection. 2015. (personal communication June 16, 2015).
- Hynes, H.B.N. 1970. The Ecology of Running Waters. Univ. of Toronto. Toronto, CA 555p. Leeper, P. 2014.
- Jacobson, G.L. 2014. Maine's moist Climate: Available on line URL: http://www.Cocorahs.org/Media/docs/ClimateSum_ME.pdf
- Jenkins, R.E. and N.M. Burkhead. 1993. Freshwater fishes of Virginia. American Fisheries Society, Bethesda, Maryland.
- Jonsson, B. and J. Ruud-Hansen. 1985. Water temperature as the primary influence on timing of seaward migrations of Atlantic salmon (*Salmo salar*) smolts. Canadian Journal of Fisheries and Aquatic Sciences 42:593-595.

- Keeley, E.R. and J.W. A. Grant. 1997. Allometry of diet selectivity in juvenile Atlantic salmon (*Salmo salar*). *Can. J. Fish. Aquat. Sci.* 54: 1894–1902.
- Kircheis, D., and T. Liebich. 2007. Draft habitat requirements and management considerations for Atlantic salmon (*Salmo salar*) in the Gulf of Maine Distinct Population Segment (GOM DPS). November 2007.
- Maine Audubon. 2010. The Common Loon. Online publication accessed February 2015 at: <http://maineaudubon.org/wp-content/uploads/2011/10/The-Common-Loon.pdf>
- Maine Center for Workforce Research and Information (Maine CWRI). 2015. Unemployment and Labor Force. [Online] URL: <http://www.maine.gov/labor/cwri/laus.html>.
- Maine Department of Environmental Protection (Maine DEP), Maine Department of Inland Fisheries and Wildlife (MDIF&W), and Maine Office of GIS (MEGIS). 2009. Maine Lakes: Geographic & Morphometric Information. [Online] URL: <http://www.gulfofmaine.org/kb/2.0/record.html?recordid=9680>.
- Maine Department of Environmental Protection (Maine DEP). 2012. 2012 Integrated Water Quality Monitoring and Assessment Report.
- Maine Department of Inland Fish and Wildlife (Maine DIFW). 2015. Regional Fishing Information - Region C (The Downeast Region). [Online] URL: http://www.maine.gov/ifw/fishing/regional_information/region_c.htm. Accessed April 2015.
- _____. 2013a. Maine Lake Survey Maps – Graham Lake. [Online] URL: http://www.maine.gov/ifw/fishing/lakesurvey_maps/hancock/graham_lake.pdf. Accessed March 2013.
- _____. 2013b. Maine Lake Survey Maps – Lake Leonard. [Online] URL: http://www.maine.gov/ifw/fishing/lakesurvey_maps/hancock/leonard_lake.pdf. Accessed March 2013.
- Maine Department of Inland Fisheries and Wildlife (Maine DIFW). 2008. Waterfowl and Wading Bird Habitat – General. 9-1-2005 (Updated 11-30-2008).
- _____. 2014a. Significant Wildlife Habitats. Website accessed November 17, 2014 at: <http://www.maine.gov/ifw/wildlife/environmental/mdifw/significant.html>
- _____. 2014b. Deer: White-tails in the Maine Woods. Website accessed November 17, 2014 at: <http://www.maine.gov/ifw/wildlife/species/mammals/deer.html>

- _____. 2014c. Moose. Website accessed November 17, 2014 at:
<http://www.maine.gov/ifw/wildlife/species/mammals/moose.html>
- _____. 2014d. Black Bears. Website accessed November 17, 2014 at:
<http://www.maine.gov/ifw/wildlife/species/mammals/bear.html>
- _____. 2014e. Coyotes. Website accessed November 17, 2014 at:
http://www.maine.gov/ifw/wildlife/human/lww_information/coyotes.html
- _____. 2014f. Beavers. Website accessed November 17, 2014 at:
http://www.maine.gov/ifw/wildlife/human/lww_information/beavers.html
- _____. 2014g. Muskrats. Website accessed November 17, 2014 at:
http://www.maine.gov/ifw/wildlife/human/lww_information/muskrats.html
- _____. 2014h. River Otters. Website accessed November 21, 2014 at:
http://www.maine.gov/ifw/wildlife/human/lww_information/otters.html
- _____. 2015a. Species of Special Concern. Website accessed March 31, 2015 at:
<http://www.maine.gov/ifw/wildlife/endangered/specialconcern.htm>
- _____. 2015b. State List of Endangered & Threatened Species. Website accessed on April 3, 2015 at: http://www.maine.gov/ifw/wildlife/endangered/listed_species_me.htm
- Maine Department of Inland Fisheries and Wildlife (Maine DIFW). 2005. Maine's Comprehensive Wildlife Conservation Strategy: Appendix 7 Biophysical Regions of Maine. Website accessed July 10, 2012 at:
http://www.maine.gov/ifw/wildlife/groups_programs/comprehensive_strategy/table_contents.htm.
- Maine Department of Inland Fisheries and Wildlife (MDIF&W). September 2005. Maine's Comprehensive Wildlife Conservation Strategy. Chapter 4. [Online]
http://www.maine.gov/ifw/wildlife/groups_programs/comprehensive_strategy/pdfs/chapter4.pdf
- Maine Department of Labor (MDOL). Second Quarter 2014. Top 50 Private Employers in Maine. [Online] URL:
<http://www.maine.gov/labor/cwri/publications/pdf/MaineTop50Employers.pdf>.
- Maine Department of Marine Resources (Maine DMR). 2014. American Shad Habitat Plan submitted to the Atlantic States Marine Fisheries Commission. Approved February 2014. 24 pp.

- Maine DMR. 2015. Trap Count Statistics. [Online] URL:
<http://www.maine.gov/dmr/searunfish/trapcounts.shtml>.
- Maine Encyclopedia. 2014. Great Blue Heron. Website accessed November 21, 2014 at:
<http://maineencyclopedia.com/great-blue-heron/>
- Maine Geological Survey (MGS). 2008. Bedrock Geology of the Ellsworth Quadrangle, Maine. [Online] <http://www.maine.gov/doc/nrimc/mgs/pubs/online/bedrock/bd-ellsworth.pdf>.
- Maine Natural Areas Program (MNAP). September 8, 2011. Important Plants, Animals, and Habitats by Town (Ellsworth). Website accessed at:
<http://www.maine.gov/doc/nrimc/mnap/assistance/sgcn.htm>.
- Maine State Legislature. Approved May 29, 2015. An Act To Amend Maine's Threatened and Endangered Species List. [Online] URL:
<http://www.mainelegislature.org/legis/bills/getPDF.asp?paper=SP0281&item=3&snm=127>. Mariaville Comprehensive Planning Committee. 2006. Mariaville Maine Comprehensive Plan 2005. [Online] URL:
<http://www.hpcme.org/mariaville/mariavillecompplan112305.pdf>.
- McCormick, S.D., R.A. Cunjack, B. Dempson, M.F. O'Dea and J.B. Carey. 1999. Temperature-related loss of smolt characteristics in Atlantic salmon (*Salmo salar*) in the wild. Canadian Journal of Fisheries and Aquatic Sciences 56:1649-1658.
- McCormick, S.D., L.P. Hansen, T.P. Quinn, and R.L. Saunders. 1998. Movement, migration, and smolting of Atlantic salmon (*Salmo salar*). Canadian Journal of Fisheries and Aquatic Sciences 55:77-92. Cited in Svendsen 2008 and Kircheis and Liebich 2007.
- Meister, A.L. and F. J. Gramlich. 1967. Cormorant predation on tagged Atlantic salmon smolts. Final report of the 1966-67 Cormorant - Salmon Smolt Study. Atlantic Sea Run Salmon Commission, Orono, Maine.
- Mesa, M.G. 1994. Effects of multiple acute stressors on the predator avoidance ability and physiology of juvenile chinook salmon. Transactions of the American Fisheries Society 123(5): 786-793. Cited in USFWS and NMFS 2009.
- Michigan Department of Natural Resources (MDNR). 2014. Little Brown Bat (*Myotis lucifugus*). Website accessed November 17, 2014 at:
http://www.michigan.gov/dnr/0,4570,7-153-10370_12145_12205-70016--,00.html
- Mohler, R. Maine Department of Environmental Protection. 2015. (personal communication February 12, 2015).

- Mote, T. City of Ellsworth. 2015. (personal communication April 21, 2015).
- Mudre, J.M. and W.P. Saunders. 1987. Radio telemetric investigation of downstream passage of Atlantic salmon smolts at Bellows Falls station. Prepared for New England Power and Northeast Utilities; 21 pages w/appn.
- National Marine Fisheries Service (NMFS). 2012. Dam Impact Assessment Model. Lab Reference Document. Northeast Fisheries Science Center, Woods Hole, MA.
- _____. 2009. Endangered and Threatened Species. Designation of critical habitat for Atlantic salmon (*Salmo salar*) Gulf of Maine Distinct Population Segment. Final rule. Federal Register, Vol. 74, No. 117. June 19, 2009.
- _____. 1998. Recovery plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland 104 pp.
- National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2005. Final Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (*Salmo salar*). NMFS, Silver Spring, MD; USFWS, Hadley, MA. 325 pp.
- Natural Resources Conservation Service (NRCS). 2015. NRCS Soil Series Data. [Online] <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>
- New England Fishery Management Council (NEFMC). 1998. Essential Fish Habitat Description Atlantic Salmon (*Salmo salar*). EFH Amendment. October 7, 1998.
- New Hampshire Fish and Game (NHFG). 2014. Little Brown Bat (*Myotis lucifigus*). Website accessed November 17, 2014 at: http://www.wildlife.state.nh.us/Wildlife/Wildlife_profiles/profile_LB_bat.htm
- Nielsen, C., G. Holdensgaard, H.C. Petersen, B.T. Björnsson and S.S. Madsen. 2001. Genetic differences in physiology, growth hormone levels and migratory behaviour of Atlantic salmon smolts. *Journal of Fish Biology* 59, 28-44. *Cited in Svendsen 2008.*
- Northeast Salmon Team. 2011. Managing the Impacts of Cormorant Predation on Smolts. NMFS. [Online] URL: <http://www.nefsc.noaa.gov/salmon/Finalcormorantfactsheet.html>. Accessed July 2011.
- Northrop, Devine & Tarbell, Inc. (NDT). 1990. Study of the Effectiveness of Water Elevation Management Plan. Prepared for Bangor Hydro-Electric Company.

- NRCS. 1998. Soil Survey of Hancock County Area, Maine. [Online]
<http://soildatamart.nrcs.usda.gov/manuscripts/ME611/0/hancock.pdf>.
- Orlov, A.V., Y.V. Gerasimov, and O.M. Lapshin. 2006. The feeding behavior of cultured and wild Atlantic salmon, *Salmo salar* L., in the Louvenga River, Kola Peninsula, Russia. *ICES J. Mar. Sci.* 63 (7):1297-1303.
- Osgood, M.W. 1979. Abundance patterns of filter-feeding caddisflies (Trichoptera: Hydropsychidae) and seston in a Montana (U.S.A.) lake outlet. *Hydrobiologia* Vol. 63 (2):177-183.
- Parker, C.R. and J.R. Voshell Jr. 1983. Production of filter-feeding Trichoptera in an impounded and a free-flowing river. *Can. J. Zool.* 61:70-87.
- Peake, S.J., McKinley, R.S. and Scruton, D.A. 1997. Swimming performance of various freshwater Newfoundland salmonids relative to habitat selection and fishway design. *Journal of Fish Biology* 51: 710-723.
- Power, J.H. and J.D. McCleave. 1980. Riverine movements of hatchery reared Atlantic salmon (*Salmo salar*) upon return as adults. *Environmental Biology of Fishes* 5(1):3-13.
- Raymond, H.L. 1979. Effects of dams and impoundments on migrations of juvenile chinook salmon and steelhead from the Snake River, 1966 to 1975. *Transactions of the American Fisheries Society* 108(6):505-529. *Cited in USFWS and NMFS 2009.*
- Riley, K. L. P. 2012. Recruitment of Estuarine-Dependent Alosines to Roanoke River and Albemarle sound, North Carolina. Ph.D. Dissertation, Department of Biology, East Carolina University, Greenville, North Carolina.
- Ruggles, C.P. 1980. A review of downstream migration of Atlantic salmon. Canadian Technical Report of Fisheries and Aquatic Sciences No. 952. Freshwater and Anadromous Division.
- Shepard, S.L. 1989. 1988 Progress Report of Atlantic Salmon Kelt Radio Telemetry Investigations in the Lower Penobscot River. Bangor Hydro-Electric Company. 30 pp.
- _____. 1991. A radio telemetry investigation of Atlantic salmon smolt migration in the Penobscot River of Maine. Proceedings of the Atlantic salmon workshop, Rockport, Maine March 6-7, 1991. U.S. Fish and Wildlife Service. Pages 101-118.
- _____. 1993. Survival and Timing of Atlantic Salmon Smolts Passing the West Enfield Hydroelectric Project. Bangor-Pacific Hydro Associates. 27 pp.

- _____. 1995. Atlantic salmon spawning migrations in the Penobscot River, Maine: fishways, flows and high temperatures. MS Thesis. Univ. Maine. Orono, ME. 111 pp.
- _____. 2015. American eel biological species report. U.S. Fish and Wildlife Service, Hadley, Massachusetts. xii +120 pages.
- Shrimpton, J.M., B.T. Björnsson, and S.D. McCormick. 2000. Can Atlantic salmon smolt twice? Endocrine and biochemical changes during smolting. *Canadian Journal of Fisheries and Aquatic Sciences* 57:1969 - 1976. *Cited in Svendsen 2008.*
- Sigourney, D.B., and J.D. Zydlewski, E. Hughes, and O. Cox. 2015. Transport, dam passage, and size selection of adult Atlantic salmon in the Penobscot River, Maine. *N. Am. J. Fish. Mgmt.* 35:1164-1176.
- Smith, C. L. 1985. The inland fishes of New York State. The New York State Department of Environmental Conservation, Albany, New York.
- Spence, J.A., and H.B.N. Hynes. 1971. Differences in benthos upstream and downstream of an impoundment. *J. Fish. Res. Bd. Canada* 28: 35-43.
- Spencer, R., K. Gallant, and D. Buckley. 2011. 2010 Progress Report. Migratory behavior and spawning activity of adult sea-run Atlantic salmon translocated to novel upriver habitat within the Penobscot Basin, Maine. A Report for the West Enfield Fisheries Fund Committee. April 25, 2011.
- _____. 2010. Migratory behavior and spawning activity of adult sea-run Atlantic salmon translocated to novel upriver habitat within the Penobscot Basin, Maine. A Progress Report to the West Enfield Fisheries Fund Committee. March 1, 2010.
- Strayer, D.L., and D.R. Smith. 2003. A guide to sampling freshwater mussel populations. American Fisheries Society, Monograph 8, Bethesda, Maryland.
- Taylor, K.M. and H. Vogel. 2003. Summary of New Hampshire Loon Preservation Committee Loon Activities in 2002. Unpublished report, Loon Preservation Committee, Moultonborough, NH.
- Tekiela, Stan. Reptiles & Amphibians of Michigan Field Guide. Adventure Publications, Inc. Cambridge, MN. 2004.
- _____. 2012. Pre-Application Document (PAD), Ellsworth Hydroelectric Project, FERC No. 2727. Submitted by Black Bear Hydro Partners, LLC. October.

Union River Fisheries Coordinating Committee. 2015. Comprehensive Fisheries Management Plan for the Union River Drainage 2015-2017. February 27, 2015.

Union River Fisheries Coordinating Committee (URFCC). 2015. 2014 Annual Report. Prepared by Black Bear Hydro Partners, LLC on behalf of Union River Fisheries Coordinating Committee. 33pp.

_____. 2010. Comprehensive Fishery Management Plan for the Union River Drainage 2011-2014. 29 pp.

USA Bassin. 2014. National Tournament Trail, Official Division Tournament Results, ME-04 Bangor Region Division. [Online] URL: <http://www.usabassin.com>. Accessed July 2014.

U.S. Atlantic Salmon Assessment Committee (USASAC). 1992. Annual Report of the U.S. Atlantic Salmon Assessment Committee. Report No. 4 – 1991 Activities.

US Census Bureau. 2015a. American FactFinder for Ellsworth City, Hancock County, Maine. [Online] URL: http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

US Census Bureau. 2015b. American FactFinder for Hancock County, Maine. [Online] URL: http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

US Census Bureau. 2015c. American FactFinder for Maine. [Online] URL: http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

US Census Bureau. 2015d. American FactFinder for Mariaville Town, Hancock County, Maine. [Online] URL: http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

US Census Bureau. 2015e. American FactFinder for Otis Town, Hancock County, Maine [Online] URL: http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

US Census Bureau. 2015f. American FactFinder for Waltham Town, Hancock County, Maine [Online] URL: http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

US Census Bureau. 2015g. QuickFacts for Ellsworth (City), Maine. [Online] URL: <http://quickfacts.census.gov/qfd/states/23/2323200.html>.

US Census Bureau. 2015h. QuickFacts for Hancock County, Maine. [Online] URL: <http://quickfacts.census.gov/qfd/states/23/23009.html>.

US Department of Agriculture (USDA). 2005. The Forests of Maine: 2003. Resource Bulletin NE-164. USDA Forest Service. 144 pp.

USFWS. 2015. Maine Field Office Bald Eagle Map Tool. Accessed March 31, 2015 at: <http://fws.maps.arcgis.com/explorer/?open=5aa77d8ff7bc419f82a1a26d5712262b>

U.S. Fish and Wildlife Service (USFWS). 2015. Northern Long-Eared Bat. Website accessed April 9, 2015 at: <http://www.fws.gov/midwest/endangered/mammals/nlba/nlbaFactSheet.html>

U.S. Fish and Wildlife Service (USFWS), Department of the Interior. 2015. Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-eared Bat with 4(d) Rule

U.S. Fish and Wildlife Service (USFWS). 2011. USFWS Gulf of Maine Coastal Program (GOMP), GIS data: (USFWS MEASHS) Maine Atlantic Salmon Habitat Surveys. Publication_Date: 20110621. Title: ashab3. Geospatial Data Presentation Form: vector digital data. Online [URL]: <http://www.maine.gov/megis/catalog/>.

_____. 2005. Review of Water Quality Data and Phosphorus Loading Allocation for Graham Lake in Ellsworth, Maine: Final Report. February 2005.

_____. 2001. River herring habitat model. Online URL: http://www.fws.gov/r5gomp/gom/habitatstudy/metadata/river_herring_model.htm. Accessed December 1, 2015

U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 2009. Endangered and Threatened Species. Determination of endangered status for the Gulf of Maine Distinct Population Segment of Atlantic salmon. Final rule. Federal Register, Vol. 74, No. 117. June 19, 2009.

_____. 2000. Endangered and Threatened Species. Gulf of Maine Distinct Population Segment of Atlantic salmon. Listing as endangered. Final rule. Federal Register, Vol. 65, No. 223. November 17, 2000.

Vanderpool, A.M. 1992. Migratory Patterns and Behavior of Atlantic Salmon Smolts in the Penobscot River, Maine. Thesis. University of Maine, Orono. 61pp.

Wolter and Arlinghaus. 2003. Navigation impacts on freshwater fish assemblages: the ecological relevance of swimming performance. *Reviews in Fish Biology & Fisheries* 13: 63-89.

Zydlewski, G. B., M. T. Kinnison, P. E. Dionne¹, J. Zydlewski and G. S. Wipfelhauser. 2011. Shortnose sturgeon use small coastal rivers: the importance of habitat connectivity. *J. Appl. Ichthyol.* 27 (Suppl. 2) (2011), 41–44 © 2011 Blackwell Verlag, Berlin. ISSN 0175–8659.

APPENDIX E-1
CONSULTATION SUMMARY

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Summary of Consultation Record

From	Date	To	Description
FERC	December 9, 2011	Kirk Francis, Chief Penobscot Indian Nation Bonnie Newsom, THPO Penobscot Indian Nation FERC Mailing List	Invitation to participate in relicensing process
Black Bear Hydro Partners, LLC	October 24, 2012	FERC Distribution List	Notice of Intent (NOI) and Pre-Application Document (PAD) for the Ellsworth Hydroelectric Project
Maine Historic Preservation Commission	November 20, 2012	Black Bear Hydro Partners, LLC K. Bose; USFERC	Correspondence on PAD the Ellsworth Hydroelectric Project
FERC	December 20, 2012		Notice of intent to File license application, filing of pre-application document (PAD), commencement of pre-filing process and scoping, request for comments on the PAD and scoping document, and identification of issues and associated study requests, and Scoping meeting dates and locations
FERC	January 15/16, 2013		Scoping Meetings
Mark Whiting	February 15, 2013	FERC	Comments on PAD, Scoping Document 1 and Request for Studies
Maine Department of Marine Resources	February 19, 2013	FERC O. Cox, G. Wippelhauser, and R. Spencer; Maine DMR M. Brown; Maine DIFW K. Howatt; Maine DEP S. Shepard; USFWS S. McDermott and J. Murphy; NOAA	Comments on PAD, Scoping Document 1 and Request for Studies
Maine Department of Inland Fisheries	February 20, 2013	FERC	Comments on PAD, Scoping Document 1 and Request for Studies
FERC	February 21, 2013	Black Bear Hydro Partners, LLC	Comments on PAD,

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From	Date	To	Description
U.S. Fish and Wildlife Service	February 21, 2013	FERC A. Tittler; DOI/SOL K. Mendik; NPS C. Stringer; BIA R. Abele; EPA B. Towler; RO/EN K. Howatt; Maine DEP G. Wippelhauser and P. Christman; Maine DMR S. Walker and G. Burr; Maine DIFW Reading File	Comments on PAD, Scoping Document 1 and Request for Studies
NOAA	February 21, 2013	FERC S. Hall; Black Bear S. Shepard; USFWS O. Cox, G. Wippelhauser, and R. Spencer; Maine DMR S. Walker and G. Burr; Maine DIFW K. Howatt; Maine DEP	Comments on PAD, Scoping Document 1 and Request for Studies
Douglas H. Watts	February 21, 2013	FERC	Comments on PAD, Scoping Document 1 and Request for Studies
Atlantic Salmon Federation	February 21, 2013	FERC	Comments on PAD, Scoping Document 1 and Request for Studies
Maine Department of Environmental Protection	February 21, 2013	FERC	Comments on PAD, Scoping Document 1 and Request for Studies
Downeast Salmon Federation	February 21, 2013	FERC	Comments on PAD, Scoping Document 1 and Request for Studies
Atlantic Salmon Federation	February 21, 2013	FERC	Comments on PAD, Scoping Document 1 and Request for Studies
Kenneth S. Cline	February 21, 2013	FERC	Comments on PAD, Scoping Document 1 and Request for Studies
FERC	February 21, 2013	Black Bear Hydro Partners, LLC	Comments on PAD,

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From	Date	To	Description
Penobscot East Resource Center	February 21, 2013	FERC	Comments on PAD, Scoping Document 1 and Request for Studies
Downeast Salmon Federation	February 21, 2013	FERC	Comments on PAD, Scoping Document 1 and Request for Studies
Black Bear Hydro Partners, LLC	February 22, 2013	FERC	Submits the 2012 Annual Report - Union River Fisheries Coordinating Committee for the Ellsworth Hydroelectric Project
Proof of Publication – The Ellsworth American	February 25, 2013	FERC	NOI to file license application document commencement of pre-filing process & scoping; request for comment on the PAD & Scoping document & identification of issues & associated study requests
Black Bear Hydro Partners, LLC	April 08, 2013	FERC Distribution List	Submits its Proposed Study Plan for the Ellsworth Hydroelectric Project
FERC	April 4, 2013	Black Bear Hydro Partners, LLC	FERC issued SD 2
Black Bear Hydro Partners, LLC	April 22, 2013	FERC Distribution List	Submits notice of rescheduling of the Study Plan Meeting for the Ellsworth Hydroelectric Project
FERC	May 8, 2013	N. Palso, M Watts, B. Connelly, and Carolyn X, FERC S. Hall, D. Dominie, P. Browne, K. Maloney, Black Bear K. Hewett and R. Mohlar, Maine DEP J. Murphy and D. Dow, NOAA S. Shepard, USFWS O. Cox, Maine DMR	Study Plan Meeting and site visit
Black Bear Hydro Partners, LLC	May 9, 2013	Kathy Howatt, Rob Mohlar, and Barry Mower, Maine DEP	Discussion of Water Quality Standards and Protocols
Black Bear Hydro Partners, LLC	May 28, 2013	N. Palso, B. Connelly, FERC S. Hall, D. Dominie, P. Browne, K. Maloney, Black Bear J. Murphy, D. Dow, S. McDermott, NOAA S. Shepard, USFWS	Meeting with fisheries agencies to discuss Atlantic salmon issues

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From	Date	To	Description
		O. Cox, R. Spencer. Maine DMR	
Maine Department of Environmental Protection	June 06, 2013	FERC	Comments on Proposed Study Plan
Black Bear Hydro Partners, LLC	June 19, 2013	B. Connelly, FERC S. Hall, D. Dominie, P. Browne, K. Maloney, Black Bear J. Murphy, NOAA S. Shepard, USFWS O. Cox, R. Spencer. Maine DMR M Beal, A. Atherton, City of Ellsworth G. Wippelhauser, Maine DMR Greg Burr, Maine DIFW Richard Welch Richard Dill	Meeting with fisheries agencies to discuss river herring issues
NOAA	June 28, 2013	FERC	Comments on Proposed Study Plan
Maine Department of Marine Resources	July 01, 2013	FERC O. Cox, G. Wippelhauser, and R. Spencer; Maine DMR K. Howatt; Maine DEP S. McDermott and J. Murphy; NOAA	Comments on Proposed Study Plan
FERC	July 08, 2013	Black Bear Hydro Partners, LLC	Comments on Proposed Study Plan
U.S. Fish and Wildlife Service	July 08, 2013	FERC A. Tittler; DOI/SOL K. Mendik; NPS C. Stringer; BIA R. Abele; EPA B. Towler; RO/EN K. Howatt; Maine DEP G. Wippelhauser and P. Christman; Maine DMR	Comments on Proposed Study Plan

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From	Date	To	Description
		S. Walker and G. Burr; Maine DIFW Reading File	
Black Bear Hydro Partners, LLC	August 05, 2013	FERC Distribution List	Submits its Revised Study Plan for the Ellsworth Hydroelectric Project
Maine Department of Marine Resources	August 19, 2013	FERC O. Cox, G. Wippelhauser, and R. Spencer; Maine DMR J. Perry; Maine DIFW K. Howatt; Maine DEP S. Shepard; USFWS S. McDermott and J. Murphy; NOAA	Comments on Revised Study Plan
National Marine Fisheries Service	August 19, 2013	FERC S. Hall; BLACK BEAR S. Shepard; USFWS O. Cox, G. Wippelhauser, and R. Spencer; Maine DMR J. Perry and G. Burr; Maine DIFW K. Howatt; Maine DEP Service List	Comments on Revised Study Plan
U.S. Fish and Wildlife Service	August 19, 2013	FERC A. Tittler; DOI/SOL K. Mendik; NPS R. Abele; EPA B. Towler; RO/EN K. Howatt; Maine DEP G. Wippelhauser and O. Cox; Maine DMR J. Perry and G. Burr; Maine DIFW Reading File	Comments on Revised Study Plan
Maine Department of Environmental Protection	August 20, 2013	FERC	Comments on Revised Study Plan

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From	Date	To	Description
National Marine Fisheries Service	August 16, 2013	FERC S. Hall; Black Bear S. Shepard; USFWS O. Cox, G. Wippelhauser, and R. Spencer; Maine DMR J. Perry and G. Burr; Maine DIFW K. Howatt; Maine DEP Service List	Comments on Revised Study Plan
Black Bear Hydro Partners, LLC	August 23, 2013	FERC Distribution List	Response to comments on Revised Study Plan
FERC	September 4, 2013	Scott Hall, Black Bear FERC Mailing List	FERC issued Study Plan Determination
Black Bear Hydro Partners, LLC	September 27, 2013	FERC D. Dominie; TRC	Response to Additional Information Request Study Plan Determination
National Marine Fisheries Service	September 30, 2013	FERC S. Shepard; USFWS O. Cox, G. Wippelhauser; Maine DMR J. Perry; Maine DIFW L. Chiarella and S. McDermott; HCD J. Murphy and K. Damon-Randall; PRD K. Howatt; Maine DEP Service List	Comments on Study Plan Determination
FERC	November, 8, 2013	Peter Browne and Mary McCann, Black Bear	Discussion re revision of Upstream Fish Passage Study Plan
FERC	January 29, 2014	Peter Browne, Black Bear	Discussion re revision of Upstream Fish Passage Study Plan
Black Bear Hydro Partners, LLC	February 03, 2014	FERC Distribution List	Submits the modified Upstream Fish Passage Study Plan
Black Bear Hydro Partners, LLC	February 10, 2014	FERC Distribution List	Submits its first study progress report

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From	Date	To	Description
Black Bear Hydro Partners, LLC	April 03, 2014	FERC	2013 Annual Report - Union River Fisheries Coordination Committee, March 2014 Pursuant to Comprehensive Fishery Management Plan
Black Bear Hydro Partners, LLC	May 1, 2014	Barry Mower, Maine DEP	Flow data provided per Maine DEP request
Black Bear Hydro Partners, LLC	May 8, 2014	Kirk Mohny, Maine Historic Preservation Commission	Submitted Historic Architecture Survey
National Marine Fisheries Service	September 03, 2014	Black Bear Hydro Partners, LLC N. Palso; FERC R. Spencer; Maine DMR L. Zicari; USFWS J. Murphy and K. Damon-Randall; PRD	Follow up letter on unlawful take of endangered Atlantic salmon
Black Bear Hydro Partners, LLC	September 04, 2014	FERC Distribution List	Submits the Initial Study Report
National Marine Fisheries Service	September 18, 2014	Black Bear Hydro Partners, LLC K. Bose; FERC O. Cox and R. Spencer; Maine DMR S. Shepard; USFWS J. Perry; Maine DIFW K. Howatt; Maine DEP	Comments regarding the proposed 2014 Comprehensive Fisheries Management Plan
Black Bear Hydro Partners, LLC	October 02, 2014	FERC Distribution List	Initial Study Report Meeting Summary
Douglas H. Watts	October 02, 2014	FERC	Comments on Initial Study Report
Douglas H. Watts	October 03, 2014	FERC	Comments on Initial Study Report
Union Salmon Association	October 08, 2014	FERC	Comments on Initial Study meeting
Douglas H. Watts	October 10, 2014	FERC	Comments on Report
FERC	October 31, 2014	Black Bear Hydro Partners, LLC	Comments on ISR Meeting Summary
NOAA Fisheries Service	November 03, 2014	FERC and Black Bear Hydro Partners Service List	Comments on Request for Study Clarification and Modification

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From	Date	To	Description
Maine Department of Environmental Protection	November 03, 2014	FERC S. Hall; Black Bear P. Browne; HDR Inc. D. Dominie; TRC Solutions O. Cox; Maine DMR J. Perry; Maine DIFW A. Bentivoglio; NOAA T. Burrowes; MDACF	Comments on Initial Study Report
Maine Department of Marine Resources	November 03, 2014	FERC O. Cox and G. Wippelhauser; Maine DMR J. Perry; Maine DIFW K. Howatt; Maine DEP L. Zicari, A. Bentivoglio; USFWS S. McDermott, J. Murphy; NOAA	Comments on Initial Study Report
Black Bear Hydro Partners, LLC	December 02, 2014	FERC	Submits the Response to Comments on Initial Study Report and Requests for Modified Study Plan
Black Bear Hydro Partners, LLC	December 15, 2014	B. Connelly, FERC	Provided requested information re Upstream and Downstream Fish Passage Studies
FERC	December 30, 2014	Scott Hall, Black Bear FERC Mailing List	Determination on Requests for Study Modifications and New Studies
Black Bear Hydro Partners, LLC	February 24, 2015	B. Connelly and N. Palo, FERC D. Dominie, F. Dunlap, and M. McCann, Black Bear	Telephone discussion of recommended downstream salmon passage study and possible extension of study schedule
Black Bear Hydro Partners, LLC	February 27, 2014	J. Murphy and S. McDermott NMFS S. Shepard, A. Bentivoglio, A. Firmenich, USFWS R. Spencer, C Enterline, and G. Wippelhauser, Maine DMR J. Perry, G. Burr, Maine DIFW B. Witham and G. Leinbaugh Union River Salmon Association A. Kane, Atlantic Salmon Federation	Article 406 Compliance – provided 2014 Annual Report – Union River Fisheries Coordinating Committee; Comprehensive Fishery Management Plan for the Union River Drainage

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From	Date	To	Description
		M. Beal and A. Atherton, City of Ellsworth Ken Cline, College of the Atlantic	
Douglas H Watts	March 04, 2015	FERC	Comments and appendices on 2015-2017 URFCC Fisheries Plan
Black Bear Hydro Partners, LLC	March 30, 2015	FERC Distribution List R. Dewechter and J. Clere; Black Bear	Supplemental Information regarding changes in filing schedule for draft license application
Black Bear Hydro Partners, LLC	March 31, 2015	FERC J. Murphy; NMFS S. Shepard; USFWS R. Spencer; Maine DMR Ellsworth Project Relicensing Distribution List R. Dewechter and J. Clere; Black Bear	Submittal of Downstream Smolt Study Plan
Black Bear Hydro Partners, LLC	March 31, 2015	FERC J. Murphy, S. McDermott; NMFS S. Shepard, A. Bentivoglio; USFWS O. Cox, R. Spender; Maine DMR K. Howatt; Maine DEP J. Clere, R. Richter, A. Zarella, T. Wynn, R. Dewechter, J. Cole, J. Stayn, R. Brochu, N. Stevens, F. Dunlap; Black Bear	Supplemental Information regarding fish passage
Black Bear Hydro Partners, LLC	April 01, 2015	FERC	Form 80 Report for Ellsworth Dam & Lake Leonard
Black Bear Hydro Partners, LLC	April 01, 2015	FERC	2014 Form 80 Report for the Graham Dam & Lake
Black Bear Hydro Partners, LLC	April 03, 2015	FERC	Filing of Methodology 2015 FERC Form 80 Recreation Report Monitoring

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From	Date	To	Description
FERC	April 21, 2015	K. Bernier, Black Bear	Approval of Atlantic Salmon Downstream Passage Study Plan
Maine DIFW	May 4, 2015	F. Dunlap, Black Bear	Approval of 2015 Marsh-nesting Bird Survey Scope
Maine DEP	June 16, 2015	K. Howatt, B. Mower, L. Tsomides, R. Mohler, M. Bergeron, A. McLaufin, D. Witherill Maine DEP F. Dunlap, D. Dominie, P. Leeper Black Bear	Discussion of Class B and GPA water quality classification, and macroinvertebrate sampling
Black Bear Hydro Partners, LLC	July 10, 2015	FERC Distribution List	Filed Draft License Application
Black Bear Hydro Partners, LLC	July 10, 2015	G. Cross, FERC	Letter requesting review of attached draft Supporting Design Report
Black Bear Hydro Partners, LLC	August 21, 2015	FERC Distribution List	Filed Updated Study Report
F. Moore Passamaquoddy	August 25, 2015	FERC	General comments
Black Bear Hydro Partners, LLC	August 25, 2015	USFWS, NMFS, MDMR	Meeting with fisheries agencies to discuss BA
Black Bear Hydro Partners, LLC	September 3, 2015	N. Palso, B. Connelly, Amy Chang (phone), Mike Watts (phone) – FERC O. Cox, R. Spencer – Maine DMR S. Shepard – USFWS J. Murphy, D. Dow, J. Higgins, S. McDermott (phone) – NOAA A. Kane – ASF M. Lambdin, G. Leinbaugh, D. Shaw, K. Winslow, D. Watts – DSF J. Newman – City of Ellsworth K. Cline – Sierra Club C. Petersen – COA A. Ajmani – Passamaquoddy F. Dorsey – Frenchman Bay Conservancy	Updated Study Report Meeting in Ellsworth

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From	Date	To	Description
		S. Perrin – Friends of Taunton Bay C Kelly – URSA Perry, T. Stephenson, P. Laplant, T. Carlisle, T. Folsem, P. Ober, A. Clark, T. Little-Siebold, J. Minutolo, A. Atherton, J. Fortier residents F. Dunlap, K. Maloney, K. Bernier – Black Bear D. Dominie, M. Blair – TRC P. Browne, J. Gagnon, S. Arnold - HDR	
Black Bear Hydro Partners, LLC	September 9, 2015	FERC Distribution List	Updated Study Report Meeting Summary
FERC	October 8, 2015	FERC	Comments on Updated Study Report and DLA
K. Howatt, Maine DEP	October 7, 2015	FERC F. Dunlap – Black Bear	Comments on DLA
P. Keliher, Maine DMR	October 5, 2015	FERC O. Cox, G. Wippelhauser, Maine DMR J. Perry; Maine DIFW K. Howatt; Maine DEP S. McDermott, J. Murphy, D. Dow - NOAA	Comments on Updated Study Report and DLA
L. Chiarella NOAA	October 7, 2015	FERC service list	Comments on Updated Study Report and DLA
D. Cole, City of Ellsworth	October 5, 2015	FERC	General comments
Black Bear Hydro Partners, LLC	November 9, 2014	FERC	Response to Comments on Updated Study Report and Requests for Modified Study Plan
FERC	December 8, 2015	Frank Dunlap, Black Bear FERC Mailing List	Determination on Requested Study Modifications

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From	Date	To	Description
Black Bear Hydro Partners, LLC	December 11, 2015	A. Spiess, MHPC	Phase II archaeology report for review
Maine SHPO	December 22, 2015	Frank Dunlap, Black Bear	Comments on Phase II archaeology report concurring with eligibility recommendations

APPENDIX E-2
CONSULTATION DOCUMENTATION

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ELLSWORTH HYDROELECTRIC PROJECT (FERC NO. 2727)

AGENCY COMMENTS ON DRAFT LICENSE APPLICATION

Black Bear Hydro Partners LLC (Black Bear) responds herein and in the Final License Application to the comments on the Draft License Application provided by the Stakeholders and the Federal Energy Regulatory Commission (FERC).

Commenter	Reference/comment #	Comment	Response
1. Maine DEP	Impoundment Trophic Status	Black Bear has provided sufficient data; additional data analysis may be needed to assess overall WQ.	Comment noted.
2. Maine DEP	Impoundment Aquatic Habitat Study	Based on information provided, aquatic life and habitat criteria of Maine’s WQ standards are not met in Graham Lake under current operation conditions. It is unclear whether the methods used accurately calculate this criteria; more discussion and information is needed. At this time the information provided fails to clearly demonstrate that Class GPA WQ standards for aquatic life and habitat are met under current and proposed water level conditions for Graham Lake.	Black Bear will consult with Maine DEP to clarify the methods of the Impoundment Aquatic Habitat Study. Black Bear notes the comments regarding Class GPA water quality standards.
3. Maine DEP	Benthic Macroinvertebrates	Macroinvertebrate community structure and function show evidence of impairment; professional judgment raised the classification to Class C; the project did not meet the Class B WQ standard. The information provided fails to demonstrate the benthic macroinvertebrates in the outlet stream meets Class B aquatic life standards	Black Bear notes Maine DEP’s comments regarding Class B water quality standards. Results of the 2015 benthic macroinvertebrate study are included in Exhibit E, Section 4.4.2.1.

Commenter	Reference/comment #	Comment	Response
		<p>under current proposed minimum flow conditions.</p> <p>Additional macroinvertebrate data was collected in 2015 and is expected to be submitted for analysis. It is expected that these data will be presented in the FLA. The Department is unable to evaluate the project’s attainment of WQ standards for this parameter at this time.</p>	
4. Maine DEP	Dissolved Oxygen Monitoring	...measurements were collected every hour from Mid-July to mid-September using a Hobo water quality sonde.	Maine DEP misstated that DO measurements were obtained using a sonde.
5. Maine DEP	Outlet Stream Aquatic Habitat Study	<p>The wetted width was measured at a flow of 150 cfs, however minimum flow at Graham Lake dam is 105 cfs, nearly 1/3 less than the flow that was measured.</p> <p>Based on the information provided the Department concludes that the information provided by Black Bear is unclear and therefore, at this time we are unable to determine the project meets Class A aquatic life and habitat standards.</p>	<p>As noted in the USR, the additional transect data collected further downstream as part of the Instream Flow and Tributary Access Study also indicated wetted width, and, coupled with the depth at the flow release at Graham Lake Dam of 150 cfs, provided adequate wetted zone of passage and habitat for aquatic organisms in the Union River, as discussed in detail for river herring and Atlantic salmon in the Habitat Suitability section of the Instream Flow and Tributary Access Study. For these seven transects, the wetted width was extrapolated for the target flow of 105 cfs and is presented in Table 3-4 (of the USR). This data demonstrates the wetted width under the target minimum flow was near or exceeded ¾ of the bankfull width.</p> <p>Maine DEP states that it is the Class A aquatic life and habitat standard that is to be met. Black Bear understands that the standard to be met is Class B as per the Maine Statute 38 M.R.S.A. §467.</p>

Commenter	Reference/comment #	Comment	Response
6. Maine DEP	Other comments	<p>The FLA should include final reports and data summaries for all studies. The department will be looking for the benthic macroinvertebrate studies conducted in 2015 as well as a more fully developed discussion of the impoundment aquatic habitat study and the outlet stream aquatic habitat study. The study discussions should present the findings in enough detail to allow Department staff to analyze the project’s compliance with ME WQ standards.</p> <p>Black Bear must demonstrate compliance with all designated uses for the Department to issue a WQC; the WQ studies provide methods to address numeric and some narrative standards, but not all.</p>	<p>Studies completed as part of the licensing process are presented the Initial Study Report (September 4, 2014) and the Updated Study Report (August 21, 2015). Results of the 2015 benthic macroinvertebrate study are included in the FLA. Black Bear notes Maine DEP’s comments regarding water quality certification.</p>
7. Maine DMR	1. DLA, Proposed environmental measures	<p>FLA should address USR and pending downstream studies and potential needs for improving downstream passage effectiveness.</p>	<p>Exhibit E Section 4.4.3.2 has been revised to discuss.</p>
8. Maine DMR	2. DLA, Atlantic salmon	<p>The project does not provide upstream passage for salmon because there are no upstream fish passage facilities. Instream flow study results would help determine if present instream flows ensure suitable habitat.</p>	<p>The trap and transport facility is a method of upstream passage, whose original construction specifically targeted Atlantic salmon. Trap and transport systems have been used successfully to pass other species such as shad restoration on the Susquehanna River and Penobscot River. (<u>Sigourney, 2015</u>)</p> <p>An instream flow habitat study was completed and the results were provided in the USR and discussed in the FLA.</p>

Commenter	Reference/comment #	Comment	Response
9. Maine DMR	3. DLA, Eels	Description of Maine’s fisheries for eel is outdated. Refer to benchmark stock assessment conducted by ASMFC (2013) and 2 addenda.	Exhibit E Section 4.4.3.1 of the FLA has been updated to address this comment.
10. Maine DMR	4. DLA, Shad	Focus of shad fish management is on measures that are implemented for other diadromous species including fish passage.	Agreed and stated as such in the FLA.
11. Maine DMR	5. DLA, Shad	Given 30 year new license term, potential for shad passage should be considered.	The upstream fish passage alternatives study report has been revised to more fully evaluate the potential for shad passage. The final report is appended to the FLA.
12. Maine DMR	6. DLA, Shad	DLA should mention that text in DLA should be changed to note that the fish passage facility is designed to also trap shad. DMR notes that they expect that shad broodstock from the Penobscot River to the Union River will occur during the term of the new license.	The fish passage facility was not originally designed for shad passage. Additional information on shad management goals and available habitat has been added to Exhibit E Section 4.4.3.1.
13. Maine DMR	7. DLA, fish passage	All fish must be handled at the project, even when water temperatures exceed 77°F.	Given the relatively close location of the Ellsworth Project to the estuary/marine environment (compared to the Penobscot, Kennebec or Androscoggin River Projects), Black Bear would not expect salmon to be present in the lower Union River during periods when water temperatures exceed 73 degrees. While we expect a very low probability of salmon captures when water temperature exceeds 73 degrees, we will include a discussion of this concern in the final study report to be appended to the FLA.
14. Maine DMR	8. DLA, trashrack spacing and intake velocity	Trashrack spacing is too wide and intake velocities are too high.	Black Bear measured water velocity in front of the trash racks in October 2015 and has reported the data in the FLA.

Commenter	Reference/comment #	Comment	Response
15. Maine DMR	9. DLA, smolt and eel passage studies	FLA will not be ready for environmental analysis until the smolt and eel passage studies are complete.	Black Bear acknowledges this statement. The FLA will describe the best available information. Subsequent study reports will be filed with FERC as they are completed.
16. NMFS	1. General Comments	The license orders issued by the Federal Energy Regulatory Commission (FERC) of 1975 and 1987 require installation of stream gages to monitor project related flows. The gages were to be installed in collaboration with state and federal resource agencies, and maintenance and operations fees advanced to the U.S. Geological Survey (USGS). As noted in the DLA (Page 5-11), no USGS stream gage data are available for the Union River. Licensee should clarify in the Final License Application (FLA) why stream flow gages were not installed as required by the license articles.	<p>FERC approved the Stream Gaging Plan for the Project, required by Article 405 of the 1987 license order, on July 13, 1989.</p> <p>USGS maintains a gage on the West Branch of the Union River, approximately 5.5 miles upstream from the outlet to Graham Lake. Black Bear maintains sufficient stage and flow monitoring devices at the project and is in conformance with the required Minimum Flow Monitoring Plan (required by Condition 2B of the Project water quality certification).</p>
17. NMFS	2. General Comments	It is unclear from the DLA who owns the fish trap facility and who is responsible for operating and maintaining the structure. Ownership and control of the trap facility is of critical importance to the site because fish are present at the site and fish passage is necessary to mitigate negative project related impacts. Currently, the existing trap is the only available dedicated means to capture fish for stocking above the Project. In the DLA, the Licensee claims the existing trap satisfies their fish passage responsibilities. However, previous licensing documents indicate the existing fish trap is owned by the Maine Department of Marine Resources. The resource agencies need certainty of	It is our understanding that the existing fish trap is owned by the Maine Department of Inland Fisheries and Wildlife and/or Atlantic Salmon Commission. However, the trap and truck facility is contained within the project boundary and is integral to the FERC approved Union River Comprehensive Fishery Management Plan. The Licensee’s roles and responsibilities for the trap and truck facility are clearly laid out in the Plan and codified in the September 27, 2002 FERC Order Amending License Article 406 requiring compliance with the FERC approved Plan.

Commenter	Reference/comment #	Comment	Response
		requirements to maintain and support restoration efforts. We rely on the FERC issued license to ensure such requirements are enforceable license articles. If the Licensee does not own the fish trap facility, or if the fish trap is not considered part of the Project, then it must be clarified how operation of the trap will be required under the FERC license. The DLA needs to clarify whether the trap is part of the Project and the licensee's role, responsibility and ability to control operations of the trap.	
18. NMFS	3. General Comments	Units for average annual generation should be corrected. The DLA indicates 30,333,000 megawatt hours (MWh). This should be corrected to kilowatt hours (kWh).	This has been corrected in the FLA.
19. NMFS	4. General Comments	The DLA refers to the fishway as a fish lift. The structure is a trap. The fish are attracted to an entrance, led to the hopper and trapped for transport or harvest. The final license application should reflect this distinction.	The fishway has been referred to as a trap in the FLA.
20. NMFS	1. Exhibit B Section 1 1.1, Existing Operation Mode, Normal Operations	(Page B-1): The DLA identifies the Project as two developments, the Ellsworth Dam, which is described as run of river, and the Graham Dam which provides timed releases for generation at the Ellsworth Dam resulting in a "peaking" operation. The two dams operate under a single license. As such, the Ellsworth Project operates as a peaking facility with the associated environmental impacts below each dam and should be evaluated as such in the environmental analysis required under the National Environmental Policy Act.	As per FERC terminology the Ellsworth Project consists of two developments: Graham Lake Dam and Ellsworth Dam. The Project collectively is a peaking project utilizing stored water from Graham Lake for power production at Ellsworth Dam. Run-of-river operation refers to water levels at Lake Leonard (Ellsworth Dam) which are kept within a one foot fluctuation and are not fluctuated for power production (i.e. inflows to Lake Leonard are passed through equally at Ellsworth Dam). Nevertheless, operation terminology will be clarified in the FLA.

Commenter	Reference/comment #	Comment	Response
21. NMFS	2. Exhibit B Section 1.1.2, Existing Operation Mode, Adverse and High Water Condition Operation, low Flow	(Page B-2): This section states that drawdown of Graham Lake provides important flow augmentation during dry inflow periods benefiting water quality and habitat. The capacity to provide a consistent minimum flow may have value; however, there may be potential passage impediments in select sections at the current minimum standard. As described in the August 21, 2015, Updated Study Report (USR), portions of the upper and middle reach of the Union River below Graham Dam may be shallow with low flow velocities. The assessment was conducted at 150 cfs, significantly (-40%) greater than the existing minimum of 105 cfs. This hampers our ability to properly evaluate the existing conditions. Table 3-11 (USR, Page 3-63) provides extrapolated habitat conditions at 105 cfs, but the Licensee does not present the methods used to extrapolate the flow in the DLA. Those data only include a potential maximum depth. The potential minimum depth and flow velocity conditions could result in stranding or migration impediments. Extrapolation of the flow data to describe habitat conditions in the FLA should include minimum depths as well as information on how the extrapolation was conducted.	The maximum depths presented in the USR Table 3-11 providing the extrapolated values were appropriate to evaluate whether there was sufficient water depth to allow a zone of passage. Minimum depths would be near zero for every flow and transect when considering shoreline edge and thus would not be useful in evaluating habitat. However, the extrapolated 105 cfs water surface line will be added to the transect figures that show the four observed flows water surface lines. Average velocities were also provided. The extrapolated low flow data are presented similarly as has been done for other relicensing studies in Maine. Formulas for extrapolation have been added as an appendix to the FLA.
22. NMFS	3. Exhibit B Section 2.2, Flow Data	(Page B-5): The method of calculating flows needs to be better described in the FLA. For instance, we are unable to determine if the calculation was based upon average daily generation or based upon unit output at certain time intervals. There is no indication	Further explanation of how the flow duration curves were developed is provided in Exhibit B Section 2.2.

Commenter	Reference/comment #	Comment	Response
		<p>of how spill may have been incorporated. It is unclear whether the flow calculation included the period of time when available flow was less than the minimum turndown flow for the units. In addition, it is not clear from the DLA whether the average head was assumed or determined by detailed PLC (programmable logic controller) data; how unit efficiencies were determined; or why a regression curve was used when data was directly calculated from the plant. Without knowing how the flow was calculated, we are unable to evaluate the merits of the method.</p>	
23. NMFS	4. Exhibit B Section 2.2, Flow Data, Table B-4	<p>(Page B-6): The table for "Monthly Average River Flow 1994-2014 for Ellsworth Dam" includes periods of no flow (0 cfs). This suggests a problem with the flow calculation. See the previous comment. The flow calculation method needs greater detail in its description.</p>	<p>See response to Comment #22. Missing data that was mis-interpreted as "zero" and has been removed from the table.</p>
24. NMFS	5. Exhibit B	<p>The FLA should include a table indicating the monthly minimum, average, and maximum elevation of the Graham Lake impoundment.</p>	<p>The historic operating curves included in the DLA and FLA show the minimum, maximum and average daily Graham Lake elevations for the 1999 through 2014 period of record.</p>
25. NMFS	Draft Exhibit C Section 3.0, Construction Schedule for New	<p>Development (Page C-3): The FLA should propose to install a USGS-type steam flow gage downstream of both the Graham Lake and Ellsworth Project to demonstrate compliance with project license articles.</p>	<p>See response to Comment #16. Further, Ellsworth Dam is tidally influenced to the base of the dam and a USGS gage would be inconclusive and inappropriate in this location. The Operations Monitoring Plan includes the methodology that will be used to demonstrate compliance with both minimum flow and pond level requirements.</p>

Commenter	Reference/comment #	Comment	Response
26. NMFS	1. Exhibit E Section 3.1.3, Existing Project operations Draft Exhibit E	(Page E-3-4): Figure E-2: Graham Lake Reservoir Operating Curves only contains data from 1999-present. Please present all headpond elevation data for Graham Lake Reservoir.	Black Bear believes the last 15 years of data is sufficient and representative period of record.
27. NMFS	2. Exhibit E Section 3.3.3, Proposed Action, Proposed Environmental Measures	(Page E-3-6): Several Protection, Mitigation and Enhancement (PME) measures are proposed, including upstream passage for American eel. No consideration is given to the need for upstream passage for Atlantic salmon or improving downstream passage for all diadromous fish. The FLA should address the findings of the updated study report filed on August 22nd and acknowledge the pending downstream studies and note the potential need for improving downstream passage protection.	The FLA addresses the findings of the USR and acknowledges that other fish passage studies are ongoing.
28. NMFS	3. Exhibit E Section 4.4.2, Water Resources, Affected Environment, Existing Water Quality	(Pages E-4-24 and 25): The FLA should present the results of all water quality sampling for 2013 in Graham Lake and Leonard Lake.	The 2013 water quality sampling results are presented in the ISR.
29. NMFS	4. Exhibit E Section 4.4.2, Water Resources, Affected Environment, Existing Water Quality	(Page E-4- 26): The Licensee states "The community structure and function found in the tailwater section of the Graham Lake Dam on the Union River shows evidence of organic enrichment and filter-feeder dominance which is a common phenomenon below lake outlets and impoundments (Hynes 1970, Spence and Hynes 1970, Parker and Voshell 1983)." Project operations, including ramping, likely affects the macroinvertebrate community structure and function below Ellsworth Dam.	The effect of project operations on the macroinvertebrate community is addressed in the FLA.

Commenter	Reference/comment #	Comment	Response
		<p>Macroinvertebrates are a food source for juvenile fish such as Atlantic salmon parr and juvenile alosines. This impact should be considered in the FLA.</p>	
<p>30. NMFS</p>	<p>5. Exhibit E Section 4.4.2, Water Resources, Affected Environment, Impoundment Tributary Connectivity</p>	<p>(Page E-4-27): The Licensee did not conduct the impoundment tributary connectivity study at the lowest impoundment levels. The Graham Lake tributary study was conducted at El. 97.9’, more than four feet above the lowest allowable elevation (El. 93.4’ msl). Similarly, the Lake Leonard tributary study was conducted between El. 65.7’ and 66.7’ msl although the impoundment can be drawn down to El. 65.7. No explanation is given for the deviation from the FERC approved study plan. The Project operating curves (Figure E-2; Page E-3-4) indicates 98’ msl as the lowest level Graham Lake is currently managed. The tributary connectivity study does not represent the full history of operation at the Project. The study results do not document the full scope of potential effects to tributary connectivity at the Project if the Project continues to be operated at the current lowest allowable elevations of Lake Leonard and Graham Lake. The study should be completed per the study plan determination.</p>	<p>The target normal fall drawdown for Graham Lake is elevation 97.8 and occurs in mid-October (Attachment 1). The Graham Lake elevation during the study was 98.0’ only 0.2 feet above the normal target elevation and 1.1 foot below the 1999-2014 long term average of 98.9’. The lowest licensed elevation of 93.4’ is targeted for the end of March, when Graham Lake is under full ice cover and Atlantic salmon and river herring are not migrating. As such, conducting the study at this time of year to capture the maximum licensed drawdown is impractical and without purpose and is not consistent with the “maximum normal fall drawdown” elevation. Furthermore, as noted in the USR many of the Graham Lake tributaries flow across very flat land as they enter the lake and barriers to connectivity were not found to exist. None-the-less, to address stakeholder comments on the USR, and in accord with FERC’s December 8, 2015 Determination on Requested Study Modifications, Black Bear will provide gradient profiles for the Graham Lake and Lake Leonard tributaries as indicated in the Study Plan Determination and will collect zone of passage information from tributaries selected in consultation with the fisheries agencies. Black Bear will collect this information and file it with FERC by December 31, 2016 as additional information to the FLA.</p>

Commenter	Reference/comment #	Comment	Response
31. NMFS	6. Exhibit E Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Atlantic Salmon	(Page E-4-40): The DLA indicates "The Project protects EFH for Atlantic salmon by providing upstream and downstream fish passage and migratory pathways to habitat, and ensuring suitable habitat downstream of each development through minimum flows." The Project does not provide upstream passage for Atlantic salmon as there are no upstream fish passage facilities at either dam. Fish are trapped and moved around the Project via a truck which requires fish be removed from the Union River. The Union River between Ellsworth Dam and Graham Dam is completely blocked to migratory fish species including Atlantic salmon. The FLA should reflect this. Further, it remains uncertain whether the present instream flow requirements ensure suitable habitat below Graham Dam. Results of the required instream flow study would help determine the extent of that benefit, if a benefit is observed at all.	See response to Comment # 8. Further, alewife and blueback herring, to the extent they occur within the alosid spring migration, are transported into Lake Leonard where Union River habitat between Ellsworth Dam and Graham Dam is available. If determined appropriate by the URFCC, additional species including salmon could be transported to the Lake Leonard reach as well. An instream flow habitat study was completed and the results were provided in the USR and discussed in the FLA.
32. NMFS	7. Exhibit E Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Atlantic Sturgeon and Shortnose Sturgeon	(Page E-4-41): The FLA should present the "limited bathymetry data for the original river channel" mentioned in this section.	The available bathymetry information was provided in the DLA (pages E-4-20 and 21) and is provided in Exhibit E of the FLA.
33. NMFS	8. Exhibit E Section 4.4.3.1, Fish and Aquatic Resources, Affected	(Page E-4-43): The FLA should include a citation to support its claim that a lack of American shad broodstock prevents restoration of shad to the Union River. The claim is contrary to the fact that a significant	The DLA statement "Due to the lack of an available source of brood stock, there currently are no plans for active restoration of shad to the Union River." was taken from the <i>Comprehensive Fisheries Management Plan for the Union River Drainage</i> –

Commenter	Reference/comment #	Comment	Response
	Environment, Other Diadromous Fish	run of American shad that has been restored to the Penobscot River in Maine without the use of broodstock. The run of American shad in the Penobscot River is a direct response to improved passage conditions in the lower river. Unless the Licensee's claim can be substantiated, it is simple supposition and cannot be used to support a license order.	2015-2017 as referenced in the next DLA sentence “The Maine DMR plans to focus its shad restoration efforts on rivers other than the Union River from 2015 to 2017 as identified in the CFMP (URFCC 2015).”
34. NMFS	9. Exhibit E Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Diadromous Fish, American eel	(Page E-4-43): The conclusion of this section is that some American eel enter the project under current operating conditions. Although some eel might enter the project through cracks and leaks in the structure, we do not believe that such conditions constitute safe, timely or effective upstream passage for eel. Therefore, we are supportive of BBHP's proposal to install a dedicated upstream eelway as a PME (see Section 3.3.3, Proposed Action, Proposed Environmental Measures on page E-3-6). Based on data in the DLA, the juvenile eel harvest in the Union River is an important fishery. The upstream eelway will support that harvest. Results of the downstream passage study will inform the need for downstream passage protective measures.	Comment noted. Black Bear maintains the proposal to install upstream eel passage. The potential need and alternatives for downstream protective measures will be considered pending analysis of 2015 downstream eel studies.
35. NMFS	10. Exhibit E Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Diadromous Fish, Other Diadromous Fish	(Page E-4-44): The DLA indicates there are no current plans for American shad restoration in the Union River. This is correct. However, the new license will likely cover a 30 year period. Restoration priorities may change in the future. The potential for American shad passage should be considered.	The upstream fish passage alternatives study report has been revised to more fully evaluate the potential for shad passage. The final report is appended to the FLA.

Commenter	Reference/comment #	Comment	Response
36. NMFS	11. Exhibit E Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Fish passage	(Page E- 4-44): The Licensee should clarify the origins of the fish trap at the Ellsworth Project. Specifically, the FLA should state who originally constructed the fish trap, and who is responsible for operation and maintenance of the facility.	See response to Comment #17. This discussion has been added to the FLA.
37. NMFS	12. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis	(Page E-4-50): The Project operates in a peaking mode. The DLA does not address the potential for ramping impacts on aquatic species or habitat. The FLA should include an analysis describing the extent of existing flow fluctuations in terms of rate of stage change (ramp rate) and frequency in the riverine reach below the Ellsworth Project. This analysis should describe the physical extent of streambed habitat affected by peaking operations at Ellsworth. The analysis should also describe the potential for down-ramping to strand fish. The FLA should present hourly generation data at the project over the last 10 years to support this analysis.	<p>As noted in the Upstream Fish Passage Study report, contained in the 9/4/14 ISR: “The one consistent observation made throughout this year’s study and supplemented with historical observations, was that fish (river herring) occurrence and densities were higher in the afternoon hours, regardless of other conditions. A review of project operations/ river flow data did not suggest the fish migration or fishway numbers responded to changes in flow.” These observations were supported by the observations during the 2015 Upstream Atlantic Salmon Passage Study where alewife movement was more directly related to afternoon and evening hours and incoming tides, and not to project discharge.</p> <p>Generation flows are recorded during the river herring trap and truck operations, and no effects to river herring presence and abundance occur as a function of turbine discharge. Because river herring can access the river below Ellsworth Dam, it is expected that turbine discharge would not affect other diadromous fish from accessing Ellsworth Dam.</p> <p>Based on visual observations of aquatic habitat downstream of the Project, which is affected by tidal flows, the riverbed remains watered under</p>

Commenter	Reference/comment #	Comment	Response
			<p>minimum flow conditions. There were no areas of potential stranding evident.</p>
38. NMFS	13. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Water level Fluctuations	(Page E-4-52): The Licensee states "Observations in Graham Lake indicated tributaries maintain connectivity through at least early fall seasonal drawdown (Black Bear 2014)." The FLA should include a description of tributary connectivity during mid to late fall for Atlantic salmon.	Exhibit E Section 4.4.3.2 of the FLA has been revised to address this comment.
39. NMFS	14. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Water level Fluctuations	(Page E-4-52): The Licensee states "There is very little, if any, adverse impact to the resident fish or diadromous fish from the current operating regime for the Ellsworth Project." Information within the DLA does not support this conclusion as the result of several studies (Atlantic salmon smolt study, tributary connectivity study, instream flow study) that would inform such an analysis are not presented in the document.	<p>Information from the tributary connectivity study was included in the DLA (pages E-4-27 and 28) as was the instream flow study (pages E-4-48 to 50). Exhibit E Section 4.4.3.2 of the FLA has been revised to further address tributary connectivity. See response to Comment #30. The final results of the ongoing or planned studies, American eel downstream passage study and the Atlantic salmon smolt study will be reported separately by December 31, 2016.</p>
40. NMFS	15. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species	(Page E-4-52): The Licensee conducted a visual upstream fish passage study. This study provides qualitative observations of behavior and movement of river herring. Visual observations for evaluating migration delay are inadequate. Results would be based on many assumptions and cannot provide specific data regarding fish migration behavior at the fishway and Project tailrace and spillway. These data will not provide information about timing of passage (duration and energetics) from approach to trap. Therefore, results from this study cannot be used to support a license order.	<p>The upstream passage study was conducted consistent with the FERC approved study plan. The 2015 fish passage season demonstrated the capability of the fishway and trap system to transport the requested escapement numbers and returns supporting one of the state’s largest alewife fisheries (harvest).</p> <p>In addition, the results of the 2015 Upstream Atlantic Salmon Passage Study are reported in the FLA and include observations of river herring throughout the 2015 season.</p>

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41. NMFS	16. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species	(Page E-4-53): BBHP's conducted a visual upstream fish passage study. The FLA should include observation of fish present within 24 hours of opening the fishway entrance. This information would indicate whether the timing for initiating operations is adequate or needs modification to an earlier date.	The results of the 2015 Upstream Atlantic Salmon Passage Study are reported in the FLA and include observations of river herring throughout the 2015 season.
42. NMFS	17. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species	(Page E-4-54): The Licensee states the fish trap at the Project has a positive effect on Atlantic salmon. This claim in unsubstantiated since neither the effectiveness of the fish trap nor survival of Atlantic salmon at the trap has been documented at the Project. Absent substantial scientific information such conclusions should not be included in the FLA.	The low numbers of Atlantic salmon returning to the Union River over the past decade has precluded conducting specific effectiveness testing of the existing trap and truck system. However, it is important to note that Atlantic salmon were the target species for the trap's construction. Salmon captures at Ellsworth prior to 2006 (up to 263 salmon per year) demonstrated the effectiveness of the fishway. Further, information that is available and presented in the upstream fish passage study section of the ISR indicated that Atlantic salmon that used the fishway but were returned downstream of the fishway (as opposed to transport upstream of Graham Lake) often returned to use the fishway again (recaptures), indicating fishway survival was good.
43. NMFS	18. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species	(Page E-4-54): This section notes the Upstream Atlantic Salmon Passage Study. The FLA should consider the effects of the two electrical pumps located right beside the entrance on the behavior of Atlantic salmon.	The studies have been conducted in accordance with the study plans. It is unclear why NMFS suggests the two pumps may be impacting the fishway operation or effectiveness. The pumps have been in place since the fishway was constructed and as discussed above, salmon captures prior to 2006 demonstrate the trap's effectiveness.

Commenter	Reference/comment #	Comment	Response
44. NMFS	19. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species	(Page E-4-54): This section incompletely states potential impacts as follows: "Hydroelectric facilities may result in delays of both upstream and downstream migration of Atlantic salmon." The FLA should also include a statement on the potential for hydroelectric facilities to prevent Atlantic salmon from reaching spawning habitat.	Black Bear disagrees with the statement that hydroelectric facilities prevent salmon from reaching spawning habitat when fish passage is provided at Ellsworth and has been historically utilized by Atlantic salmon. However, a discussion of the potential for delay is included in the FLA. Effects of the Project on downstream passage are pending ongoing studies.
45. NMFS	20. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species	(Page E-4-55): This section states that the trap is not operated at water temperatures above 77°F. State of Maine handling protocol requires handling of adult Atlantic salmon to cease during periods of warm water conditions to prevent mortality from the stress of handling the fish. Because of the existing trap, all fish must be handled at the Ellsworth Project. Therefore, during periods of warmer water, the Ellsworth Project trap is not operated for Atlantic salmon; salmon cannot volitionally pass the Project. By contrast, Milford, West Enfield, and Mattaceunk on the Penobscot have fishways that allow passage regardless of temperature because handling of fish is not required.	See response to Comment # 13.
46. NMFS	21. Exhibit E Table E-1, Ellsworth Trashrack Spacing and Calculated Intake Velocities	(Page E-4-56): The trashrack spacing will not physically exclude downstream migrating smolts or alosine. Trashracks spacing of greater than 2 inch will allow downstream migrating smolts to be entrained. These velocities are well above the US Fish and Wildlife Service's recommended 2 feet per second. Juvenile river herring will certainly be entrained at these velocities.	Comment noted – potential entrainment of downstream migrating smolts and alosines was discussed in the DLA and is maintained in the FLA. Water velocities at the trashracks and fish passage weirs were measured in October 2015 and are reported in the FLA.

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47. NMFS	22. Exhibit E	<p>On October 5, 2015, the Downeast Salmon Federation filed documentation of a juvenile river herring kill below the Ellsworth Project. Injuries observed are consistent with turbine entrainment. In 2014, a similar fish kill was observed. The Licensee responded by evaluating potential areas of impact, consulting with the resource agencies, and making improvements to an auxiliary cooling water system. That action had the intended benefit of preventing future entrainment in that system; however, it did not address the larger concern identified for entrainment at the turbine intakes. The current field observations submitted by the Downeast Salmon Federation indicate the Project continues to impact out migrating fish. What remains unknown is the scale of this impact. We look forward to the results of the downstream passage studies for smolts and eel to further inform the process.</p>	<p>See Brookfield’s letters to FERC dated October 21 and November 10, 2015 in response to the Downeast Salmon Federation filing.</p>
48. NMFS	23. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Downstream Passage	<p>(Page E-4-57): The Licensee qualitatively evaluates risk of entrainment but does not explain how operation of the Project will protect outmigrating fish from project related injury and mortality such that stocks can grow in the Union River to meet management goals. Based on the limited information provided in the DLA, we are unable to concur that out migrating fish will be protected. The anticipated downstream passage survival studies for Atlantic salmon smolts and American eel will be informative on this issue.</p>	<p>The Project operates downstream fishways at both dams to facilitate safe passage downstream. The fact that the Union River supports one of the best alewife fisheries in the country indicates downstream passage for this species is safe and effective. The results of additional studies on downstream eel and Atlantic salmon will be filed by December 31, 2016 and will provide additional empirical data.</p>

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49. NMFS	24. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Downstream Passage,	(Page E-4-57): The desktop analysis completed by BBHP was approved in the study plan determination. These data suggest a (1) potentially high survival for alewife and Atlantic salmon and (2) the potential immediate and delayed survival for American eel is low. The desk top analysis is a modeled sample representing potential site conditions. Site specific studies are needed to verify the desk top analysis and account for Project specific attributes. A site specific study will provide information regarding fish behavior at the intakes under existing conditions, as well as a more precise evaluation of entrainment and impingement impacts. As noted above, we await the results of the required Atlantic salmon smolt and American eel adult downstream studies, including balloon tags, for survival estimates. These studies will provide important Project specific data which will inform the licensing decision. Therefore the FLA will not be ready for environmental analysis before the two studies are complete and analyzed.	Comment noted.
50. NMFS	25. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Downstream Passage,	(Page E-4-57): This section states: "Since there are currently very few salmon expected at the Project, salmon (smolts and kelts) have a very low risk of entrainment..." "We disagree with this statement. Risk of entrainment is not related to the number of fish present; rather, it is the risk to those fish present. Based on rack spacing and velocities, we contend that the risk of entrainment is high.	Black Bear will remove this sentence from the FLA. Velocities were measured at the intake racks and downstream fish passage weirs in October 2015 and are reported in the FLA. The results of the downstream smolt passage study to be conducted in the spring of 2016 will be reported by December 31, 2016.

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51. NMFS	26. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Downstream Passage,	(Page E-4-58): The Licensee states all kelts will pass downstream of the project via surface weirs. This assumes that 100% of all kelts will successfully locate and enter the surface weirs in a timely manner. This statement is unsubstantiated and should not be included in the FLA. No fishway has ever been documented to be 100% successful in passing migratory fish species. Post-spawned Atlantic salmon kelts return to the ocean and can return to spawn again as multi-sea winter adults. Repeat spawners produce more eggs per adult and thus, are highly important to the population in terms of reproductive capacity. Kelts that do not enter the surface weirs will likely die upstream of the project if they cannot return to the ocean.	The statement referenced in the DLA is accurate as stated “All kelt passage would occur through the surface-weirs <i>at the river flows investigated, of which none resulted in spill at the Project.</i> “ [emphasis added] given that trash rack spacing would exclude kelt entrainment (see table on DLA page E-4-57) and no spill conditions leave the surface weirs as the only option for passage.
52. NMFS	27. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Downstream Passage,	(Page E-4-58): The Licensee states that very few salmon are in the Union River due to "extremely low returns." This statement ignores that fact that the fish trap at Ellsworth is functional for Atlantic salmon for about 6 hours per day for 19-39 days a year. By comparison, the migration season at fishways in Maine is typically 200 days between April 15 and November 1, five times the number of functioning days of the fish trap. Increasing the days of activity at the Ellsworth trap may increase the potential for observing Atlantic salmon.	In response to similar comments and additional study request from FERC, Black Bear conducted an upstream fish passage effectiveness study in 2015 where the fish trap was operated from May 1 through October 31, from sunrise to sunset daily. The fish trap was checked 4 times per day. No Atlantic salmon were collected or observed near the fishway entrance.

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53. NMFS	28. Exhibit E Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Endangered Species, Atlantic Sturgeon and Shortnose Sturgeon	(Page E-4-62): The Licensee states "Due to the rarity of these species at the Project, normal operations would not affect shortnose or Atlantic sturgeon." "Rarity" does not preclude impact. Presently, we have no data to support a conclusion on impacts to Atlantic and shortnose sturgeon. We agree that little information is currently available regarding use of the Union River by shortnose and Atlantic sturgeon. The FLA should consider the effects of Project operations, specifically peaking flows, on sturgeon habitat and their use of the river.	In the Status Review of Atlantic sturgeon, it was noted that “The geomorphology of most small coastal rivers in Maine is not sufficient to support Atlantic sturgeon spawning populations, except for the Penobscot and the estuarial complex of the Kennebec, Androscoggin, and Sheepscot Rivers” though subadults may use the estuaries of smaller coastal drainages during the summer months (Atlantic Sturgeon Status Review Team 2007). Zydlewski et al. (2011) found that shortnose sturgeon use small coastal rivers as they migrate between the Kennebec and Penobscot Rivers. However, as noted above, only one shortnose sturgeon and no Atlantic sturgeon tagged at other locations have been detected by the acoustic receivers deployed in the lower Union River (G. Zydlewski, University of Maine, personal communication July 9, 2014 and August 20, 2015). From review of the limited bathymetry data of the original river channel that has been inundated by Lake Leonard there may be steep gradient reaches that would have historically kept Atlantic and shortnose sturgeon from accessing the Union River in the Project vicinity.
54. NMFS	29. Exhibit E Section 4.4.3.4 Fish and Aquatic Resources, Environmental Analysis, Cumulative Effects	(Page E-4-62): The Licensee suggests that the fishway facilities are effective. This cannot be concluded based on the information provided. Required studies for downstream passage survival have not been completed. Further, we have no indication of the effectiveness for Atlantic salmon and American shad upstream passage. Therefore, we cannot concur with this statement at this time.	The fishway has proven effective based on the continued high returns of alewife. Historically, Atlantic salmon successfully used the fishway as well but returns declined as restoration priorities changed to focus on other river systems. The efficacy of the trap and transport facility for Atlantic salmon passage was evaluated and discussed in the ISR and FLA. It should be noted that, according to the Maine DMR American Shad

Commenter	Reference/comment #	Comment	Response
			Habitat Plan, Submitted to the Atlantic States Marine Fisheries Commission as a requirement of Amendment 3 to the Interstate Management Plan for Shad and River Herring, Approved February 6, 2014, there is only 5 miles of historic shad habitat in the Union River, the majority of which is downstream of Ellsworth Dam. Furthermore, there are no current active shad management plans for the River – see response to Comment #33.
55. City of Ellsworth	Graham Lake water levels	Requests impact of water levels in Graham Lake especially during the summer months of July and August be taken into consideration. City recalls that BHE kept levels higher; recent trends have resulted in lower water levels; creates safety hazards for boaters; higher levels would result in additional recreation benefits for all lake users.	By the 1987 FERC order granting a new license for the Project, the normal high water elevation for Graham Lake was lowered from 105.2’ to 104.2’ to address shoreline erosion issues. Since that time water levels in the lake have been managed to the extent practicable in accordance with the historic operating curves presented in Exhibit E.
56. Joe Minutolo, Graham Lake resident	Graham Lake water levels	Timing of summer drawdown damages recreational experiences on the lake; lowers Gram Lake property values; impacts jobs and tax revenue for local communities;	Summer lake elevations are targeted between 104.2 feet and 99 feet between Memorial Day and Labor Day.
57. FERC	1. Initial Statement	Include the address of the Town of Bar Harbor.	The Town of Bar Harbor has been added to the Initial Statement
58. FERC	2. Project Description	Revise Exhibit A to include: (1) Lengths and heights of each section of the dams (i.e., earthen embankments, spillways, abutments at Graham Lake and Lake Leonard (2) Heights of 3 spillway gates, sluiceway, flood wall, wing wall, and steel cell at Graham lake (3) Gross storage volume at Graham Lake	Table A-2 with the requested information has been added to Exhibit A.

Commenter	Reference/comment #	Comment	Response
		(4) Dimensions of the 2 intake facilities and associated facilities at Ellsworth development, including the number and dimensions of each headgate and the clear bar spacing of the trashracks (5) Lengths of all 4 penstocks at the Ellsworth development (6) Dimensions and hydraulic capacities of the upstream and downstream fish [passage facilities at the Graham Lake and Ellsworth developments (7) The minimum hydraulic capacity of each turbine unit at the Ellsworth development The voltage of the 320-foot long transmission line	
59. FERC	3. Project Operations	Sections 1.0 and 2.0 – Describe how the dependable capacity of 8.9 megawatts was calculated, including descriptions of data sources, assumptions, and computations.	Dependable capacity methodology has been added to Exhibit B.
60. FERC	4. Project Operations	Section 2.2 – revise Table B-4 with flow calculated based on project generation, minimum flows, and fish passage facility flows. This would address mean monthly flows in August 2006, and September 2006 and 2007 when 0 flow is shown.	Table B-4 has been corrected to remove a “zero” entry where historic flow data is missing.
61. FERC	5. Project Operations	Appendix B-1 Provide revised flow duration curves that use appropriate minimum flows and downstream fish passage flows to represent the low flow values in Appendix B 1 which currently use 323 cfs.	See response to Comment #22.

Commenter	Reference/comment #	Comment	Response
62. FERC	6. Project Boundary	Lands that do not serve a project purpose should be removed from the Project boundary.	Black Bear has reviewed lands within the project boundary, which generally follow an elevation surrounding the project impoundments as well as project structures. No changes to the existing project boundary are proposed at this time.
63. FERC	7. Project Boundary	Exhibit G drawings should be corrected to show and label all principal project works enclosed within the project boundary including the carry-in boat launch off Shore Road, the Graham lake dam boat launch, the 320-foot long t/l and the vertical slot fishway and trap facility.	Corrections made; see Exhibit G
64. FERC	8. Project Boundary	Exhibit G drawings need to be stamped by a registered land surveyor.	The Exhibit G drawings have been finalized and stamped by a registered land surveyor; see Exhibit G
65. FERC	9. Fish and Aquatic Resources	E-4-45 and 46 Provide all current information about the operation of the project’s upstream and downstream fish passage facilities including: attraction and conveyance flows; a description of the stoplog adjustment protocol for the two surface weirs at the Ellsworth development.	Current operations are described in the USR upstream passage alternatives study report and future operations will be guided by the Fish Passage Operations and Maintenance Plan submitted to FERC on November 10, 2015.
66. FERC	10. Fish and Aquatic Resources	E-4-46 Include a copy of the Operation and Maintenance Plan for the project’s upstream and downstream fish passage facility.	A copy of the Ellsworth Project’s Fish Passage Operations and Maintenance Plan was filed with FERC on November 10, 2015.
67. FERC	11. Wildlife and Botanical Resources	Section 4.4.5.1 Provide acreages of each of the 8 wetland cover types identified.	Table E-22 in Exhibit E Section 4.4.5.1 has been modified to include acreages of the wetland cover types.

Commenter	Reference/comment #	Comment	Response
68. FERC	12. Wildlife and Botanical Resources	Section 4.4.5.2 Include description of standard vegetation maintenance practices (mechanical, chemical, etc.) standard maintenance schedule – annually, seasonally, as needed etc.); procedures form managing vegetation in sensitive habitats (wetlands, riparian habitat, etc.); and procedures when RTE plants or animals are encountered during routine maintenance. 35 acres of upland managed within the project boundary.	See Exhibit E, Sections 4.4.5.2 for a discussion of effects of vegetation maintenance practices.
69. FERC	13. Recreation	Include a map that shows the location and relative length of the proposed new portage trail at Graham Lake.	A new portage trail map has been added.
70. Passamaquoddy	Fish Passage	Recommended fish passage facility improvements: <ul style="list-style-type: none"> • Installation of fish lift 24/7 April through October • Lift engineered to accommodate increased run numbers of all species • Safe and timely passage of multiple species including: river herring, Atlantic salmon, eels, and American shad • A fish ladder at Graham Lake Dam designed for safe and effective passage of large numbers of multiple species • Studies to monitor estuarine anadromous populations below Ellsworth Dam to ensure all species have opportunity to pass both facilities Operational procedure changes: <ul style="list-style-type: none"> • Modernize attraction flow rates to current USFWS standards 	Recommendations noted. Any modifications to fish passage measures will be made based upon the results of the continuing passage studies.

Commenter	Reference/comment #	Comment	Response
		<ul style="list-style-type: none"> • 24/7 hours of operation • Operation season April through October • Check trap more efficiently and regularly for Atlantic salmon • Perform daily walks on both sides of the river for fish kills regularly throughout 24-hour cycle; assess and address issues immediately 	
71. USFWS	5. Fish Passage	The dates for the Ellsworth fish passage facilities should be researched, verified, and included in the FLA.	Comment noted.
72. USFWS	6. Fish Passage	The ownership of the fish trap is unclear. This should be researched and a determination made as to whether Black Bear needs to acquire right, title or interest in order to operate the facility.	See response to Comment #17.
73. USFWS	7. Fish Passage	Section 4.4.3 should mention plans for improving upstream passage of anadromous species, or downstream eel passage. The FLA should address the findings of the Updated Study Report and acknowledge the pending downstream studies and the potential for improving downstream passage effectiveness (e.g., intake rack velocities).	Black Bear will continue consultation with agencies regarding fish passage improvements pending ongoing fish passage studies.
74. USFWS	8. Fish Passage	USFWS notes that operational problems and equipment failures (pump) were not mentioned in the DLA.	See Brookfield’s letters to FERC dated October 21 and November 10, 2015 in response to the Downeast Salmon Federation filing for information regarding the downstream fishway

Commenter	Reference/comment #	Comment	Response
75. USFWS	9. Fish Passage	USFWS feels the configuration of the Ellsworth downstream bypass discharge is likely to cause injury or death of downstream migrants. They would like the orientation of the pipe can be modified at minimal cost and without a specific study.	Downstream passage studies are ongoing for the Project.
76. USFWS	10. Fish Passage	USFWS requires studies using commonly accepted empirical field methods (e.g., telemetry) evaluating the effectiveness of the upstream and downstream passage facilities in order to engage in informal fish passage negotiations.	Downstream passage studies are ongoing for the Project.
77. USFWS	11. Fish Passage	The FLA should acknowledge the management goal of American shad restoration on the Union River.	See response to Comment #33.
78. USFWS	13. Generation	Use correct units for generation: 30,333 MWh	Correction has been made in the FLA
79. USFWS	14. American eel	The description of the American eel fisheries and conservation measures included in the DLA, 4-42 should be expanded and updated. Reference ASMFC Addenda of August 2013 and October 2014.	The discussion of the American eel fishery has been expanded and updated in the FLA.

**STAKEHOLDER COMMENTS ON
THE DRAFT LICENSE APPLICATION**



STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION



PAUL R. LEPAGE
GOVERNOR

AVERY T. DAY
ACTING COMMISSIONER

October 7, 2015

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

RE: Comments on Draft License Application
Ellsworth Hydroelectric Project
FERC No. 2727

Dear Ms. Bose:

The Department of Environmental Protection (Department) reviewed the Draft License Application for the Ellsworth Hydroelectric Project (FERC 2727), located on the Union River in the City of Ellsworth and the towns of Waltham and Mariaville and Fletchers Landing Township in Hancock County, Maine.

The existing Ellsworth Hydroelectric Project consists of a lower dam with a ~90 acres impoundment (Leonard Lake) and an upper dam with a ~10,000 acres storage reservoir (Graham Lake). The lower dam, at Leonard Lake, contains a powerhouse containing four turbine-generator units with a total authorized capacity of 8.9 MW. The project includes a 320-foot transmission lines to transfer the project's electricity to the Project's step-up transformers, as well as appurtenant facilities to operate and maintain the hydropower facility.

The Department understands that Black Bear Hydro Partners, LLC (Black Bear) is proposing no changes to project facilities or operations. Current project operations include:

- Operation of a water storage facility and peaking generation facility; timed releases at Graham Lake are used at Ellsworth dam for power production. The releases can result in minor (~1-foot) surface elevation changes in Lake Leonard. Graham Lake generally follows an operating curve that has historically resulted in fluctuations approaching 11 feet;
- Minimum flows of 105 cfs from the Ellsworth dam (at Leonard Lake) and Graham dam from July 1 through April 30 and a continuous minimum flow of 250 cfs from May 1 through June 30; (flows may be temporarily modified if required by operating emergencies beyond Black Bear's control, and for short periods upon agreement among Black Bear, United States Fish and Wildlife Service (USFWS) and the Department); and

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Letter to K. Bose
(October 7, 2015)
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- Water levels at Leonard Lake are maintained between the elevations of 65.7' msl and 66.7' msl, and water levels in Graham Lake are maintained between elevations of 104.2' msl and 93.4' msl. (Water levels may be temporarily modified if required by operating emergencies beyond Black Bear's control, and for short periods upon agreement among Black Bear, USFWS and the Department).

The Department understands that based on a Generator Enhancement Study Black Bear is not proposing the addition of any turbine-generator units as part of this relicensing, and no new construction is planned. We further understand that, in response to comments from state and federal resource agencies, Black Bear has conducted various studies to assess the impact of project operations on environmental resources. Finally, the Department understands that Black Bear is proposing measures designed to protect and enhance affected resources.

Specifically, Brookfield is proposing to:

- Implement erosion controls at the existing Graham Lake boat launch facility
- Develop a new portage trail at the west end of Graham Lake dam;
- Improve a fisherman's downstream access trail on the east side of Graham Lake dam;
- Develop, in consultation with fisheries agencies, plans for upstream eel passage at Ellsworth and Graham Lake dams.
- Develop a Recreation Facilities Management Plan to provide for appropriate management of recreation facilities throughout the term of the license; and
- Develop a Historic Properties Management Plan to provide for management of historic resources throughout the term of the license.

The Department has the following comments on the draft application.

General Comments

1. The Project history and proposal are reasonably well documented.
2. Baseline water quality studies conducted at the impounded Graham Lake and Lake Leonard and in the Union River between the Graham Lake dam and Lake Leonard pursuant to the Revised Study Plan in support of water quality certification included:

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- a. Collection of Impoundment Trophic State data;
- b. A Dissolved Oxygen Study, including collection of baseline dissolved oxygen and water temperature data;
- c. Impoundment Aquatic Habitat Study;
- d. Benthic Macroinvertebrate Sampling; and
- e. Outlet Stream Aquatic Habitat Study.

The water quality studies provide current water quality conditions in both Lake Leonard and in Graham Lake, document dissolved oxygen concentrations and water temperatures upstream and downstream of both dams, document benthic macroinvertebrate community structure and function downstream of the Graham Lake dam, and determine the effect of project operations on the habitat for fish and other aquatic life.

Impoundment Trophic State Data Collection

On February 21, 2013, the Department filed comments on the Pre-Application Document for the Ellsworth Hydroelectric Project (P-2727) requesting that Black Bear submit a plan for Department approval to determine the trophic state of the Graham Lake and Lake Leonard impoundments. The plan was to be developed in accordance with the Department's "Lake Trophic State Sampling Protocol for Hydropower Studies".

All requested studies were performed as specified and no further data are needed. Data collection was carried out April through October 2013 in Graham Lake and between June and October in Lake Leonard. Samples were collected for Secchi disk transparency, phosphorus, Chlorophyll-a, color, dissolved oxygen, temperature, pH, turbidity, total alkalinity, manganese, magnesium, iron, calcium, silica, and sulfate. Late season samples were collected in August 2013 as specified in the sampling protocol.

Thermal stratification was documented in Lake Leonard in July, August and September. The top of the thermocline was measured between 9 and 12 meters. Thermal stratification was documented in Graham Lake on at all three sampling stations; on June 27 at Station 1 (central area of the lake), on July 18 at Station 3 (north end), and on July 2 and 18, and on August 1 and 28 at Station 2 (south end). The top of the thermocline was measured between 3 and 4 meters in June and on July 18, and between 10 and 11 meters on July 2 and in August.

Sampling results indicates that the Graham Lake impoundment is turbid but does not show signs of nutrient enrichment. The Lake Leonard impoundment is not significantly impacted by water quality conditions in Graham Lake. Lake Leonard does not show signs of nutrient enrichment.

Based on the results of sampling and information contained in the draft application as well as initial and revised study results, the Department concludes that Brookfield has provided

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sufficient data and both Lake Leonard and Graham Lake are likely free of culturally induced algal blooms which impair its use or enjoyment. Analytical data was not analyzed by Black Bear, only compared and found consistent with previous sampling efforts. Additional data analysis may be needed to assess overall water quality. The Department concludes that the trophic state in each of the two project impoundments is stable or declining.

Impoundment Aquatic Habitat Study

On February 21, 2013, the Department filed comments on the Pre-Application Document for the Ellsworth Hydroelectric Project (P-2727) requesting that Black Bear submit a plan for Department approval to evaluate aquatic habitat in the Graham Lake impoundment.

The littoral area for Graham Lake was determined based on bathymetry calculated from ortho-photos at different water elevations. Using a depth of twice the mean Secchi disc transparency measured (1.77 meters or 5.8 feet), the littoral zone was found to be 11.6 feet, or an elevation of 92.6 feet msl. Data collected indicated that water levels need to be at an elevation of 102.5 feet or higher to ensure that at least 75% of the littoral zone remains wet. The Study Report indicates that the operational minimum water level is 93.4 feet msl and that the average daily minimum elevation is ~98 feet msl.

The littoral area of Lake Leonard was not determined. Lake Leonard is operated in a run-of-river mode with water level elevations normally maintained between 65.7 feet msl and 66.7 feet msl. Lake Leonard is found to maintain at least 75% of the littoral zone based on operations.

Based on the information provided by the Applicant, it appears that the aquatic life and habitat criteria of Maine's Water Quality Standards are not met in Graham Lake under the current operating conditions. It is unclear whether the methods used in the Impoundment Aquatic Habitat Study accurately calculate this criteria, more discussion and information is needed. We conclude, therefore, that at this time the information provided fails to clearly demonstrate that Class GPA water quality standards for aquatic life and habitat are met under current and proposed impoundment water levels conditions for Graham Lake.

Benthic Macroinvertebrate Monitoring- Impoundment

On February 21, 2013, the Department filed comments on the Pre-Application Document for the Ellsworth Hydroelectric Project (P-2727) requesting that Black Bear submit a plan for Department approval to sample the benthic macroinvertebrate community. One location was selected approximately 100 meters downstream of the Graham Lake dam and the survey was conducted in accordance with the Department's Methods for Biological Sampling and Analysis of Maine's Inland Waters (Davies and Tsomides 2002).

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Analysis of the results of the sampling, including associated field sheets, using the DEP's linear discriminant model indicates that the sampled macroinvertebrate community did not meet applicable Class B standards for aquatic life. Macroinvertebrate community structure and function show evidence of impairment, specifically mayflies and stoneflies were not well represented. Professional judgment was utilized to account for the lake outlet effect on the sampled community, raising the classification to Class C; the project did not meet the Class B water quality standard.

Additional benthic macroinvertebrate sampling was conducted in July and August 2015 at three locations in the Union River. The 2015 sampling locations were chosen to reflect substrate types described in DEP protocols and according to field conditions and the consultant's professional experience. Results of those samples are not available at the time of the Department's comments on the Draft License Application.

Based on the results of the sampling and the information contained in the draft application, we conclude that information provided by Black Bear fails to demonstrate that the benthic macroinvertebrate in the outlet stream meets Class B aquatic life standards under current and proposed minimum flow conditions. Additional data was collected in the summer of 2015 and is expected to be submitted for analysis. It is expected that these data will be presented in the Final License Application. Therefore, the Department is unable to evaluate the project's attainment of water quality standards for this parameter at this time.

Dissolved Oxygen Monitoring

On February 21, 2013, the Department filed comments on the Pre-Application Document for the Ellsworth Hydroelectric Project (P-2727) requesting that Black Bear submit a plan for Department approval to sample dissolved oxygen in the Union River below Graham Lake dam. Dissolved oxygen was not sampled in the tailwater of the Ellsworth dam because the Union River below the dam is tidal. Therefore, one location was selected and the survey was conducted in accordance with the DEP Sampling Protocol for Hydropower Studies (June 2014).

Dissolved oxygen and temperature data were collected at the Ellsworth Hydroelectric project above and below the Graham Lake dam and in Lake Leonard. DO data collected in the impoundment aids interpretation of attainment of DO criteria downstream. The data collected indicates that both impoundments stratify thermally, therefore oxygen depleted water from Graham Lake could be a source of water with low DO passed downstream. Analysis of the sampling results indicates that water sampled below the thermocline at Graham Lake exhibited low oxygen, and that water sampled below the thermocline in Lake Leonard dropped below 7 ppm on only one date.

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Water quality sampling in the river below the dam DO and temperature measurements were collected every hour from mid-July to mid-September using a Hobo water quality data sonde at one location, in accordance with a study plan reviewed and approved by the DEP.

Analysis of the sampling results indicates that dissolved oxygen concentrations in the Union River met or exceeded applicable Class A standards of 7 parts per million or 75% saturation, whichever is higher, under conditions of low stream flow and high water temperature.

Based on the results of sampling and the information contained in the draft application as well as the initial study results, the Department concludes that Black Bear has provided sufficient information to demonstrate that the project outlet stream meets applicable Class A dissolved oxygen standards under critical water quality conditions.

Outlet Stream Aquatic Habitat Study

On February 21, 2013, the Department filed comments on the Pre-Application Document for the Ellsworth Hydroelectric Project (P-2727) requesting that Black Bear submit a plan for Department approval to evaluate the Outlet Stream Habitat in the Union River below Graham Lake dam.

Bank full and wetted widths were measured in the Union River at a location just below Graham Lake dam. The wetted width was measured at a flow of 150 cfs, however minimum flow at Graham Lake dam is 105 cfs, nearly 1/3 less than the flow that was measured.

Instream flow and tributary access were also studied for four flows on the Union River. Black Bear reports that adequate zone of passage exists for river herring and Atlantic salmon at all flows analyzed, and that adequate connectivity was maintained at low flows to Greys, Shackford, Moore, and Gilpartick brook tributaries of the Union River.

Based on the information provided in the draft application and in the Updated Study Report, the Department concludes that information provided by Black Bear is unclear and, therefore, at this time we are unable to determine that the project meets Class A aquatic life and habitat standards.

Other Comments

The final license application should include final reports and data summaries for all of the studies requested by various stakeholders. In particular, the Department will be looking for the report of benthic macroinvertebrate studies conducted in 2015, as well as a more fully developed discussion of the impoundment aquatic habitat study and the outlet stream aquatic habitat study, in support of water quality certification. The study discussions should present

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the findings in enough detail to allow Department staff to analyze the projects compliance with Maine's water quality standards.

Additionally, Black Bear must demonstrate compliance with all designated uses in order for the Department to issue a water quality certification for the Ellsworth Hydroelectric Project. The water quality study protocols provide methods to address numeric and some narrative standards, but not all.

Thank you for this opportunity to comment. Please contact me by telephone at (207) 446-2642 or by email at Kathy.Howatt@maine.gov if you have any questions.

Sincerely,



Kathy Davis Howatt
Hydropower Coordinator
Division of Land Resource Regulation

Cc: Mr. Frank Dunlap
Brookfield Renewable Energy Group
26 Katherine Drive
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PAUL R. LEPAGE
GOVERNOR

STATE OF MAINE
DEPARTMENT OF MARINE RESOURCES
21 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0021

PATRICK C. KELIHER
COMMISSIONER

October 5, 2015

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

RE: Ellsworth Project (P-2727)
Draft License Application and August 21, 2015, Updated Study Report

Dear Secretary Bose:

On July 10, 2015, Black Bear Hydro Partners, LLC (BBHP) submitted a Draft License Application (DLA) for the Ellsworth Project (P-2727) on the Union River in Maine. On August 21, 2015, BBHP submitted an Updated Study Report. The Maine Department of Marine Resources (MDMR) has reviewed both the DLA and the Updated Study Report, and offers the following comments:

Draft License Application

Draft Exhibit E

1. Section 3.3.3, Proposed Action, Proposed Environmental Measures (page E-3-6): Several Protection, Mitigation and Enhancement (PME) measures are proposed, including upstream passage for American eel. However, the DLA does not mention plans for improving upstream passage for anadromous species and improving downstream passage for all diadromous fish. The FLA should address the findings of the updated study report filed on August 21, and acknowledge the pending downstream studies and the potential need for improving downstream passage effectiveness.
2. Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Atlantic Salmon (Page E-4-40): The DLA indicates "The Project protects EFH for Atlantic salmon by providing upstream and downstream fish passage and migratory pathways to habitat, and ensuring suitable habitat downstream of each development through minimum flows." The Project does not provide upstream passage for Atlantic salmon as there are no upstream fish passage facilities at either dam. Passage is provided via a truck which requires fish be removed from the Union River. The Union River between Ellsworth Dam and Graham Dam is completely blocked to migratory fish species including Atlantic salmon. It remains uncertain whether the

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present instream flow requirements ensure suitable habitat. Instream flow study results would help determine the extent of that benefit, if a benefit is observed at all.

3. Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Other Diadromous Fish (page E-4-42): The description of Maine's fisheries for American eel is outdated. A benchmark stock assessment conducted by the Atlantic States Marine Fisheries Commission (ASMFC 2012) indicated that the American eel stock has declined in recent decades, and the stock is now considered depleted. ASMFC subsequently approved Addendum III (August 2013) and Addendum IV (October 2014) to the American Eel Interstate Fisheries Management Plan with the goal of reducing mortality and increasing conservation of American eel stocks across all life stages. Addendum III eliminated the harvest of silver eels in all states with the exception of New York's weir fishery on the Delaware River. Addendum IV established a 907,671 pound coastwide quota for yellow eel fisheries, and reduced Maine's glass eel quota (for 2014 landings) to 9,688 pounds.
4. Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Other Diadromous Fish (page E-4-43): This section is incomplete. The Comprehensive Fisheries Management Plan For The Union River Drainage 2015 – 2017 states (bold added for emphasis) "The MDMR plans to focus its shad restoration efforts on rivers other than the Union during the period 2015-2017, including the Kennebec, Androscoggin, Saco, Penobscot, and St. Croix. There is also no convenient source of broodstock for the Union that would support an active shad stocking program. **Until such resources become available, management of shad in the Union River will be accomplished using measures that are implemented for other diadromous species, including the provision of interim and permanent fish passage at the lower river dams, and continuation of instream flows at the Ellsworth Hydroelectric Project.**"
5. Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Diadromous Fish, Other Diadromous Fish (page E-4-44): The DLA correctly indicates there are no current plans for American shad restoration. However, the new license will likely cover a 30 year period, and restoration priorities may change. The potential for American shad passage should be considered.
6. Section 4.4.3.2, Environmental Analysis, Upstream Passage, Anadromous species (page E-4-52): The DLA states that the fish passage facility is designed to trap Atlantic salmon and river herring, and to transport fish to suitable upstream habitat located above the Project dams. American shad should be added to this list. Page E-4-3 of the DLA states that the Federal Energy Regulatory Commission identified American shad as a resource that could be cumulatively affected by the proposed operation of the Ellsworth Project. Likewise, the Comprehensive Fisheries Management Plan for the Union River 2015-2017 (section 3.1.3 p14) and the previous version identify the restoration of American shad as a management goal. The plan states that "When resources become available, shad restoration will focus on the historically accessible mainstem and tributary habitat located above and below the Ellsworth Dam." The documented American shad run on the Penobscot River increased from a five-year mean (2009-2013) of 2 shad at the Veazie Dam fishway to 1,806 shad in 2015 at the Milford Dam fish lift following fish passage improvements (removal of the Veazie and

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Great Works Dams; installation of a fish lift at the Milford project). Thus, the probability of transferring American shad broodstock from the Penobscot River to the Union River during the span of the new license is high.

7. Section 4.4.3.2, Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species (P. E-4-55): This section states that the ladder and trap are not operated at water temperatures above 77F. This is a drawback of this facility's operations which is to stop operation and prevent passage of adult Atlantic salmon when temperatures are too high to prevent mortality from the stress of handling the fish. All fish must be handled at the Ellsworth Project. Milford, West Enfield, and Mattaceunk on the Penobscot do not operate in this manner. At those projects, fish are allowed passage regardless of temperature because handling of fish is not required.
8. Table E-14, Ellsworth Trashrack Spacing and Calculated Intake Velocities (page E-4-56): The trashrack spacing will not physically exclude downstream migrating smolts or alosines. Trashracks spacing of greater than 1/2 inch will allow downstream migrating smolts to be entrained. These velocities are well above the US Fish and Wildlife Service's recommended 2 feet per second. Juvenile river herring will certainly be entrained at these velocities.
9. Section 4.4.3.2, Fish and Aquatic Resources, Environmental Analysis, Downstream Passage, (page E-4-57): The results of a desktop analysis completed by BBHP indicate a potentially high survival for alewife and Atlantic salmon and a potentially low survival for American eel. Site specific studies on adult American eels (ongoing) and salmon smolts (planned for spring 2016) will provide information on passage effectiveness. These studies will provide important Project specific data which will inform the licensing decision. Therefore, the FLA will not be ready for environmental analysis until the two studies are complete and analyzed.
10. Section 4.4.3.2, Fish and Aquatic Resources, Environmental Analysis, Downstream Passage, (page E-4-60): MDMR still contends that the low proportion of repeat spawners is an indication of poor downstream survival for post-spawn alewives. The smolt passage studies may provide some insight into this question of downstream passage effectiveness. In addition, MDMR has reduced the exploitation rate of the run and will be able to evaluate changes in the proportion of repeat spawners starting in 2016.

Updated Study Report, Upstream Fish Passage Alternative Study

1. Section 1.2, Project Downstream Passage, Ellsworth Dam (Page 7): Water and fish exit the transport pipe perpendicular to the face of the dam and are then conveyed down the face of the dam to the tailrace area (Photo 1). The existing discharge and conveyance of fish may lead to injury or mortality.
2. Section 1.2, Project Downstream Passage, Ellsworth Dam (Page 7): The downstream passage facilities have never been tested for their overall ability to pass fish safely and effectively. The required downstream passage studies for smolt and American eel will

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provide data critical to the evaluation of Project related impacts on emigrating fish. These data will be informative for the development of license articles and fishway prescriptions.

3. Section 1.3, Upstream Fishway Design Parameters (Page 14): The description of the existing upstream fish passage facility and accompanying figure (Figure 9) are not sufficient. The description of the facility and/or Figure 9 should include 1) fishway channel slope; 2) pool dimensions; 3) drop per pool; and 4) detailed drawing and dimensions of the vertical slot baffle.
4. Section 1.3, Upstream Fishway Design Parameters (Page 14): Ellsworth powerhouse flow capacity is approximately 2,320 cfs and fishway pumped attraction flow is up to 50 cfs at Ellsworth, depending on tailwater elevation. Pumped attraction flow is approximately 2% of station capacity. Current USFWS standard is 3% of station Hydraulic Capacity or 70 cfs. NMFS has been using 3-5% of station hydraulic capacity on the East Coast and 5% per entrance of the flow duration curve for the fish passage season on the west coast. The attraction flow will need to be evaluated by the Licensee specifically for Atlantic salmon.
5. Section 1.3, Upstream Fishway Design Parameters (Page 14): Diffused attraction flow grating has a flow velocity of 1.5 fps. Contrast, the current USFWS criteria is 0.5 fps for horizontal diffusers and 1.0 fps for vertical diffusers. The effects of diffused attraction flow at the Project will need evaluation by the Licensee.
6. Section 2.1 Trap and Transport Alternatives, Existing Facilities (Page 16): The DLA correctly states that the agencies have expressed their concerns with the overall capacity of the fishway to handle full design populations of river herring and American shad and the safe timely and effective passage of Atlantic salmon. However, any upstream passage facility should also be designed to accommodate American shad (see comments in paragraph 3 for Draft Exhibit E).
7. Section 2.1 Trap and Transport Alternatives, Existing Facilities (Page 16): This section indicates a "USFWS design criteria peak hourly rate of 4,725 river herring per hour". This number is incorrect. The design criterion for the cycle time and hopper volume is 12,088 river herring per hour for the peak hour of the peak day.
8. Section 2.1 Trap and Transport Alternatives, Existing Facilities (Page 16): The existing hopper is only 61 cubic feet (cf) and should be 166 cf. The harvesting hopper does not hold water, therefore when it is lifted the fish are in the dry (Photo 2).
9. Section 2.1 Trap and Transport Alternatives, Existing Facilities (Page 16): The stated cycle time is 12 minutes. This does not include the amount of time the trap fishes, not just the time to raise, dump, and lower. Therefore, the true cycle time is much longer, which changes the fishing time and ability to capture an Atlantic salmon, if present.
10. Section 2.1, Trap and Transport Alternatives, Existing Facility (Page 16): This section states: "The 2015 season experience clearly demonstrated the capacity to handle over a half million river herring and the doubled spawning escapement." For clarity, the 555,015 river herring is

Ellsworth Project page 5

a combined total of the harvest and new escapement target. It should be recognized that the current facility managed over a million river herring in 2012. The management goal is twice that volume. With the increased stocking rate, we anticipate returns of river herring to approach the 2.3 million river herring goal in the coming 4-5 years. Decisions made in this proceeding will affect the ability to meet management goals to support a sustainable run and an important harvest, and our ability to support recovery of Atlantic salmon. This should be clarified in the FLA.

11. Section 2.1, Trap and Transport Alternatives, Existing Facility (Page 16): This section states: "The current trap and transport facilities and operating protocols at Ellsworth have proven reliability and functionality by handling river herring runs from 190,000 to 1,200,000 river herring and 0 to 8 Atlantic salmon annually from 2000 to 2015..." We disagree. There are no data to indicate the existing facility and operating protocol have been proven reliable or to function for Atlantic salmon.
12. Section 2.1, Trap and Transport Alternatives, Existing Facility (Page 16): The current trap and truck system does not provide safe fish passage for Atlantic salmon throughout the migratory season. Trap and truck methodology requires cool river temperatures (less than 23°C) to reduce temperature related stress and mortality of salmon during handling; but that water temperature threshold is exceeded during portions of a typical trapping season at Ellsworth. During warm summers, fish passage for Atlantic salmon may be reduced or eliminated for weeks during the migratory window due to the absence of volitional fish passage facilities (fish ladders and fishlifts). These closures are avoidable if Atlantic salmon did not need to be handled and trucked.
13. Section 2.2, Hopper Improvements and Fish Trap Capacity, Ellsworth Fish Trap Capacity (Page 18): The report indicates the fishway pool has a depth of 4.25 feet and total capacity of 255 cubic feet. Without detailed construction drawings these dimensions cannot be verified for the holding pool or the fishway pools. Figure 9 is insufficient. However, based upon Figure 9 the water depth is only 3.25 feet not 4.25 feet as suggested. Construction drawing for the fishway should be provided in the FLA and the depth and calculation verified.
14. Section 2.2, Hopper Improvements and Fish Trap Capacity, Ellsworth Fish Trap Capacity (Page 18): The harvesting hopper does not hold water, thus the capacity is 0 (Photo 2). Retaining water during lifting operation is important for the proper handling of Atlantic salmon.
15. Section 2.2, Hopper Improvements and Fish Trap Capacity, Ellsworth Fish Trap Capacity (Page 18): The "hopper dimensions" provided are the dimensions of the concrete and are incorrectly applied in the report. The hopper capacity does not include the screened wall panels (Photo 3). The capacity is only based upon the watered up portion of the hopper. The inside dimension of the hopper is 5.75 square feet with only 2 feet of water.
16. Section 2.2, Hopper Improvements and Fish Trap Capacity, Ellsworth Fish Trap Capacity (Page 18): This section states: "...the dimensions of the hopper pool walls that establish the

Ellsworth Project page 6

maximum hopper size.” This statement is incorrect. Hopper size is determined by only the inside dimensions of the watered up section of the hopper walls.

17. Section 2.3.2, Separation of River Herring from Atlantic Salmon Passage, Phase 2 – Add Volitional Fish Ladder to Expanded Hopper Pool (Page 22): This section indicates that a steepass or Denil could be accommodated for Atlantic salmon. MDMR would not recommend a steepass or Denil fishway for this amount of head (~65 feet).
18. Section 3.1.1, Fish ladder Alternatives, Steeppass Denil (Page 23): The Steeppass alternative evaluated would be approximately 250 to 300 ft. long, and would include a 170-foot long section on a 30% slope. We have no data to suggest it would be effective for any of the target species.
19. Section 3.1.2, Fish ladder Alternatives, Standard Denil (Page 25): The standard Denil alternative evaluated would be approximately 700 feet long, and would include a 385-foot section on a 12.5% slope with five 180° turning pools. We have no data to suggest it would be effective for any of the target species.
20. Section 3.1.2, Fish ladder Alternatives, Standard Denil (Page 25): The standard Denil alternative evaluated could potentially pass 1,000,000 or more fish. Fishways are designed for the peak hour of the peak day of migration. Therefore we would expect a significant amount of delay to occur in the passage timing at these high numbers.

If you have any questions, please contact Gail Wippelhauser at 207-624-6349 or by email at gail.wippelhauser@maine.gov.

Sincerely,



Patrick C. Keiher, Commissioner

cc: Gail Wippelhauser, Oliver Cox, DMR
John Perry, DIFW
Kathy Howatt, DEP
Steven Shepard, Brett Towler, USFWS
Sean McDermott, Jeff Murphy, Don Dow, NOAA



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

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

OCT 7 2015

RE: Comments on Black Bear Hydro Partners, LLC Draft License Application for the Ellsworth Project (FERC No. 2727) and August 21, 2015, Updated Study Report

Dear Secretary Bose:

On July 10, 2015, Black Bear Hydro Partners, LLC (BBHP) submitted a draft license application for the Ellsworth Project (P-2727) on the Union River in Maine. We have reviewed the draft application and offer the attached comments regarding the accuracy and completeness of information provided. Our principle interests at this Project are: to support implementation of measures aimed at recovering Atlantic salmon; to protect federally listed Atlantic and shortnose sturgeon; to support the management goals for a sustained run and commercial harvest of alewife and American eel; and, to provide conditions suitable for any future effort to manage diadromous species. Actions taken at the Ellsworth Project as a result of this current licensing proceeding, and the broader National Environmental Policy Act analysis, will shape the management, recovery and protection of these fish for the next 30 to 50 years in the Union River. That analysis will be guided by information generated throughout this process including data from the required studies. Our technical comments are largely intended to clarify the information and improve the quality of information in the pending Final License Application.

The Updated Study Report was provided on August 21, 2015. Several studies of interest to us were included in this report, specifically the instream flow and tributary access study, impoundment aquatic habitat study, and upstream fish passage alternative analysis. Data from these studies are important to assess the appropriateness of the proposed Project operations and fish passage mitigation measures relative to design standards of contemporary fishway technology, and whether the habitat needs for critically endangered species and other trust resources are properly addressed. Our technical comments on the Updated Study Report are attached. Our comments generally pertain to the adequacy of the study methodologies and adherence to the study plan determination. In our view, several studies were not adequately conducted. For instance, the tributary access study was not conducted at the lowest allowable headpond level as required by the study plan determination. Failure to previously conduct these studies negatively impacts our ability to determine the full scope of Project related impacts on tributary access. All studies must be completed per the study plan determination and prior to the



final license application being accepted as Ready for Environmental Assessment.

If you have any questions, please contact Sean McDermott of our Habitat Conservation Division at (978) 281-9113 or Sean.McDermott@noaa.gov. For ESA or the section 7 process, contact Jeff Murphy at (207)-866-7379 or Jeff.Murphy@noaa.gov.

Sincerely,



Louis A. Chiarella
Assistant Regional Administrator
for Habitat Conservation

cc: Service List

National Marine Fisheries Service's Comments on Black Bear Hydro Partners, LLC Draft License Application for the Ellsworth Project (FERC No. 2727)

October 7, 2015

On July 10, 2015, Black Bear Hydro Partners, LLC filed a draft license application (DLA) for a new major license at the Ellsworth Project on the Union River in Maine. Below are our comments on the DLA.

General Comments

1. The license orders issued by the Federal Energy Regulatory Commission (FERC) of 1975 and 1987 require installation of stream gages to monitor project related flows¹. The gages were to be installed in collaboration with state and federal resource agencies, and maintenance and operations fees advanced to the U.S. Geological Survey (USGS). As noted in the DLA (Page 5-11), no USGS stream gage data are available for the Union River. Licensee should clarify in the Final License Application (FLA) why stream flow gages were not installed as required by the license articles.
2. It is unclear from the DLA who owns the fish trap facility and who is responsible for operating and maintaining the structure. Ownership and control of the trap facility is of critical importance to the site because fish are present at the site and fish passage is necessary to mitigate negative project related impacts. Currently, the existing trap is the only available dedicated means to capture fish for stocking above the Project. In the DLA, the Licensee claims the existing trap satisfies their fish passage responsibilities. However, previous licensing documents indicate the existing fish trap is owned by the Maine Department of Marine Resources². The resource agencies need certainty of requirements to maintain and support restoration efforts. We rely on the FERC issued license to ensure such requirements are enforceable license articles. If the Licensee does not own the fish trap facility, or if the fish trap is not considered part of the Project, then it must be clarified how operation of the trap will be required under the FERC license. The DLA needs to clarify whether the trap is part of the Project and the licensee's role, responsibility and ability to control operations of the trap.
3. Units for average annual generation should be corrected. The DLA indicates 30,333,000 megawatt hours (MWH). This should be corrected to kilowatt hours (kWH).

¹ Article 405, FERC Order issuing new license, December 28, 1987; Article 8, Terms and Conditions for Constructed Major Project Affecting Navigable Waters of the United States, revised October 1975.

² Water Quality Certificate, Board of Environmental Protection, Maine Department of Environmental Protection, April 22, 1987.

4. The DLA refers to the fishway as a fish lift. The structure is a trap. The fish are attracted to an entrance, led to the hopper and trapped for transport or harvest. The final license application should reflect this distinction.

Draft Exhibit B

1. Section 1.1.1, Existing Operation Mode, Normal Operations (Page B-1): The DLA identifies the Project as two developments, the Ellsworth Dam, which is described as run of river, and the Graham Dam which provides timed releases for generation at the Ellsworth Dam resulting in a “peaking” operation. The two dams operate under a single license. As such, the Ellsworth Project operates as a peaking facility with the associated environmental impacts below each dam and should be evaluated as such in the environmental analysis required under the National Environmental Policy Act.
2. Section 1.1.2, Existing Operation Mode, Adverse and High Water Condition Operation, low Flow (Page B-2): This section states that drawdown of Graham Lake provides important flow augmentation during dry inflow periods benefiting water quality and habitat. The capacity to provide a consistent minimum flow may have value; however, there may be potential passage impediments in select sections at the current minimum standard. As described in the August 21, 2015, Updated Study Report (USR), portions of the upper and middle reach of the Union River below Graham Dam may be shallow with low flow velocities. The assessment was conducted at 150 cfs, significantly (~40%) greater than the existing minimum of 105 cfs. This hampers our ability to properly evaluate the existing conditions. Table 3-11 (USR, Page 3-63) provides extrapolated habitat conditions at 105 cfs, but the Licensee does not present the methods used to extrapolate the flow in the DLA. Those data only include a potential maximum depth. The potential minimum depth and flow velocity conditions could result in stranding or migration impediments. Extrapolation of the flow data to describe habitat conditions in the FLA should include minimum depths as well as information on how the extrapolation was conducted.
3. Section 2.2, Flow Data (Page B-5): The method of calculating flows needs to be better described in the FLA. For instance, we are unable to determine if the calculation was based upon average daily generation or based upon unit output at certain time intervals. There is no indication of how spill may have been incorporated. It is unclear whether the flow calculation included the period of time when available flow was less than the minimum turndown flow for the units. In addition, it is not clear from the DLA whether the average head was assumed or determined by detailed PLC (programmable logic controller) data; how unit efficiencies were determined; or why a regression curve was used when data was directly calculated from the plant. Without knowing how the flow was calculated, we are unable to evaluate the merits of the method.

4. Section 2.2, Flow Data, Table B-4 (Page B-6): The table for “Monthly Average River Flow 1994-2014 for Ellsworth Dam” includes periods of no flow (0 cfs). This suggests a problem with the flow calculation. See the previous comment. The flow calculation method needs greater detail in its description.
5. The FLA should include a table indicating the monthly minimum, average, and maximum elevation of the Graham Lake impoundment.

Draft Exhibit C

Section 3.0, Construction Schedule for New Development (Page C-3): The FLA should propose to install a USGS-type steam flow gage downstream of both the Graham Lake and Ellsworth Project to demonstrate compliance with project license articles.

Draft Exhibit E

1. Section 3.1.3, Existing Project Operations (Page E-3-4): Figure E-2: Graham Lake Reservoir Operating Curves only contains data from 1999-present. Please present all headpond elevation data for Graham Lake Reservoir.
2. Section 3.3.3, Proposed Action, Proposed Environmental Measures (Page E-3-6): Several Protection, Mitigation and Enhancement (PME) measures are proposed, including upstream passage for American eel. No consideration is given to the need for upstream passage for Atlantic salmon or improving downstream passage for all diadromous fish. The FLA should address the findings of the updated study report filed on August 21st and acknowledge the pending downstream studies and note the potential need for improving downstream passage protection.
3. Section 4.4.2, Water Resources, Affected Environment, Existing Water Quality (Pages E-4-24 and 25): The FLA should present the results of all water quality sampling for 2013 in Graham Lake and Leonard Lake.
4. Section 4.4.2, Water Resources, Affected Environment, Existing Water Quality (Page E-4-26): The Licensee states “The community structure and function found in the tailwater section of the Graham Lake Dam on the Union River shows evidence of organic enrichment and filter-feeder dominance which is a common phenomenon below lake outlets and impoundments (Hynes 1970, Spence and Hynes 1970, Parker and Voshell 1983).” Project operations, including ramping, likely affects the macroinvertebrate community structure and function below Ellsworth Dam. Macroinvertebrates are a food source for juvenile fish such as Atlantic salmon parr and juvenile alosines. This impact should be considered in the FLA.

5. Section 4.4.2, Water Resources, Affected Environment, Impoundment Tributary Connectivity (Page E-4-27): The Licensee did not conduct the impoundment tributary connectivity study at the lowest impoundment levels. The Graham Lake tributary study was conducted at El. 97.9, more than four feet above the lowest allowable elevation (El. 93.4' msl). Similarly, the Lake Leonard tributary study was conducted between El. 65.7' and 66.7' msl although the impoundment can be drawn down to El. 65.7. No explanation is given for the deviation from the FERC approved study plan. The Project operating curves (Figure E-2; Page E-3-4) indicates 98' msl as the lowest level Graham Lake is currently managed. The tributary connectivity study does not represent the full history of operation at the Project. The study results do not document the full scope of potential effects to tributary connectivity at the Project if the Project continues to be operated at the current lowest allowable elevations of Lake Leonard and Graham Lake. The study should be completed per the study plan determination.
6. Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Atlantic Salmon (Page E-4-40): The DLA indicates "The Project protects EFH for Atlantic salmon by providing upstream and downstream fish passage and migratory pathways to habitat, and ensuring suitable habitat downstream of each development through minimum flows." The Project does not provide upstream passage for Atlantic salmon as there are no upstream fish passage facilities at either dam. Fish are trapped and moved around the Project via a truck which requires fish be removed from the Union River. The Union River between Ellsworth Dam and Graham Dam is completely blocked to migratory fish species including Atlantic salmon. The FLA should reflect this. Further, it remains uncertain whether the present instream flow requirements ensure suitable habitat below Graham Dam. Results of the required instream flow study would help determine the extent of that benefit, if a benefit is observed at all.
7. Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Atlantic Sturgeon and Shortnose Sturgeon (Page E-4-41): The FLA should present the "limited bathymetry data for the original river channel" mentioned in this section.
8. Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Other Diadromous Fish (Page E-4-43): The FLA should include a citation to support its claim that a lack of American shad broodstock prevents restoration of shad to the Union River. The claim is contrary to the fact that a significant run of American shad that has been restored to the Penobscot River in Maine without the use of broodstock. The run of American shad in the Penobscot River is a direct response to improved passage conditions in the lower river. Unless the Licensee's claim can be substantiated, it is simple supposition and cannot be used to support a license order.
9. Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Diadromous Fish, American eel (Page E-4-43): The conclusion of this section is that some American eel enter the project under current operating conditions. Although some eel might enter the

project through cracks and leaks in the structure, we do not believe that such conditions constitute safe, timely or effective upstream passage for eel. Therefore, we are supportive of BBHP's proposal to install a dedicated upstream eelway as a PME (see Section 3.3.3, Proposed Action, Proposed Environmental Measures on page E-3-6). Based on data in the DLA, the juvenile eel harvest in the Union River is an important fishery. The upstream eelway will support that harvest. Results of the downstream passage study will inform the need for downstream passage protective measures.

10. Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Diadromous Fish, Other Diadromous Fish (Page E-4-44): The DLA indicates there are no current plans for American shad restoration in the Union River. This is correct. However, the new license will likely cover a 30 year period. Restoration priorities may change in the future. The potential for American shad passage should be considered.
11. Section 4.4.3.1, Fish and Aquatic Resources, Affected Environment, Fish passage (Page E-4-44): The Licensee should clarify the origins of the fish trap at the Ellsworth Project. Specifically, the FLA should state who originally constructed the fish trap, and who is responsible for operation and maintenance of the facility.
12. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis (P. E-4-50): The Project operates in a peaking mode. The DLA does not address the potential for ramping impacts on aquatic species or habitat. The FLA should include an analysis describing the extent of existing flow fluctuations in terms of rate of stage change (ramp rate) and frequency in the riverine reach below the Ellsworth Project. This analysis should describe the physical extent of streambed habitat affected by peaking operations at Ellsworth. The analysis should also describe the potential for down-ramping to strand fish. The FLA should present hourly generation data at the project over the last 10 years to support this analysis.
13. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Water level Fluctuations (P. E-4-52): The Licensee states "Observations in Graham Lake indicated tributaries maintain connectivity through at least early fall seasonal drawdown (Black Bear 2014)." The FLA should include a description of tributary connectivity during mid to late fall for Atlantic salmon.
14. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Water level Fluctuations (P. E-4-52): The Licensee states "There is very little, if any, adverse impact to the resident fish or diadromous fish from the current operating regime for the Ellsworth Project." Information within the DLA does not support this conclusion as the result of several studies (Atlantic salmon smolt study, tributary connectivity study, instream flow study) that would inform such an analysis are not presented in the document.
15. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species (P. E-4-52): The Licensee conducted a visual upstream fish passage

study. This study provides qualitative observations of behavior and movement of river herring. Visual observations for evaluating migration delay are inadequate. Results would be based on many assumptions and cannot provide specific data regarding fish migration behavior at the fishway and Project tailrace and spillway. These data will not provide information about timing of passage (duration and energetics) from approach to trap. Therefore, results from this study cannot be used to support a license order.

16. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species (P. E-4-53): BBHP's conducted a visual upstream fish passage study. The FLA should include observation of fish present within 24 hours of opening the fishway entrance. This information would indicate whether the timing for initiating operations is adequate or needs modification to an earlier date.
17. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species (P. E-4-54): The Licensee states the fish trap at the Project has a positive effect on Atlantic salmon. This claim is unsubstantiated since neither the effectiveness of the fish trap nor survival of Atlantic salmon at the trap has been documented at the Project. Absent substantial scientific information such conclusions should not be included in the FLA.
18. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species (P. E-4-54): This section notes the Upstream Atlantic Salmon Passage Study. The FLA should consider the effects of the two electrical pumps located right beside the entrance on the behavior of Atlantic salmon.
19. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species (P. E-4-54): This section incompletely states potential impacts as follows: "Hydroelectric facilities may result in delays of both upstream and downstream migration of Atlantic salmon." The FLA should also include a statement on the potential for hydroelectric facilities to prevent Atlantic salmon from reaching spawning habitat.
20. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Upstream Passage, Anadromous Species (P. E-4-55): This section states that the trap is not operated at water temperatures above 77°F. State of Maine handling protocol requires handling of adult Atlantic salmon to cease during periods of warm water conditions to prevent mortality from the stress of handling the fish. Because of the existing trap, all fish must be handled at the Ellsworth Project. Therefore, during periods of warmer water, the Ellsworth Project trap is not operated for Atlantic salmon; salmon cannot voluntarily pass the Project. By contrast, Milford, West Enfield, and Mattaceunk on the Penobscot have fishways that allow passage regardless of temperature because handling of fish is not required.
21. Table E-14, Ellsworth Trashrack Spacing and Calculated Intake Velocities (Page E-4-56): The trashrack spacing will not physically exclude downstream migrating smolts or alosine. Trashracks spacing of greater than 1/2 inch will allow downstream migrating smolts to be

entrained. These velocities are well above the US Fish and Wildlife Service's recommended 2 feet per second. Juvenile river herring will certainly be entrained at these velocities.

22. On October 5, 2015, the Downeast Salmon Federation filed documentation of a juvenile river herring kill below the Ellsworth Project (accession number 20151005-5376). Injuries observed are consistent with turbine entrainment. In 2014, a similar fish kill was observed. The Licensee responded by evaluating potential areas of impact, consulting with the resource agencies, and making improvements to an auxiliary cooling water system. That action had the intended benefit of preventing future entrainment in that system; however, it did not address the larger concern identified for entrainment at the turbine intakes. The current field observations submitted by the Downeast Salmon Federation indicate the Project continues to impact out migrating fish. What remains unknown is the scale of this impact. We look forward to the results of the downstream passage studies for smolts and eel to further inform the process.
23. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Downstream Passage, (P. E-4-57): The Licensee qualitatively evaluates risk of entrainment but does not explain how operation of the Project will protect outmigrating fish from project related injury and mortality such that stocks can grow in the Union River to meet management goals. Based on the limited information provided in the DLA, we are unable to concur that out migrating fish will be protected. The anticipated downstream passage survival studies for Atlantic salmon smolts and American eel will be informative on this issue.
24. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Downstream Passage, (P. E-4-57): The desktop analysis completed by BBHP was approved in the study plan determination. These data suggest a (1) potentially high survival for alewife and Atlantic salmon and (2) the potential immediate and delayed survival for American eel is low. The desk top analysis is a modeled sample representing potential site conditions. Site specific studies are needed to verify the desk top analysis and account for Project specific attributes. A site specific study will provide information regarding fish behavior at the intakes under existing conditions, as well as a more precise evaluation of entrainment and impingement impacts. As noted above, we await the results of the required Atlantic salmon smolt and American eel adult downstream studies, including balloon tags, for survival estimates. These studies will provide important Project specific data which will inform the licensing decision. Therefore the FLA will not be ready for environmental analysis before the two studies are complete and analyzed.
25. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Downstream Passage, (P. E-4-57): This section states: "Since there are currently very few salmon expected at the Project, salmon (smolts and kelts) have a very low risk of entrainment..." We disagree with this statement. Risk of entrainment is not related to the number of fish

present; rather, it is the risk to those fish present. Based on rack spacing and velocities, we contend that the risk of entrainment is high.

26. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Downstream Passage, (P. E-4-58): The Licensee states all kelts will pass downstream of the project via surface weirs. This assumes that 100% of all kelts will successfully locate and enter the surface weirs in a timely manner. This statement is unsubstantiated and should not be included in the FLA. No fishway has ever been documented to be 100% successful in passing migratory fish species. Post-spawned Atlantic salmon kelts return to the ocean and can return to spawn again as multi-sea winter adults. Repeat spawners produce more eggs per adult and thus, are highly important to the population in terms of reproductive capacity³. Kelts that do not enter the surface weirs will likely die upstream of the project if they cannot return to the ocean.
27. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Downstream Passage, (P. E-4-58): The Licensee states that very few salmon are in the Union River due to “extremely low returns.” This statement ignores that fact that the fish trap at Ellsworth is functional for Atlantic salmon for about 6 hours per day for 19-39 days a year. By comparison, the migration season at fishways in Maine is typically 200 days between April 15 and November 1, five times the number of functioning days of the fish trap. Increasing the days of activity at the Ellsworth trap may increase the potential for observing Atlantic salmon.
28. Section 4.4.3.2 Fish and Aquatic Resources, Environmental Analysis, Endangered Species, Atlantic Sturgeon and Shortnose Sturgeon (P. E-4-62): The Licensee states “Due to the rarity of these species at the Project, normal operations would not affect shortnose or Atlantic sturgeon.” “Rarity” does not preclude impact. Presently, we have no data to support a conclusion on impacts to Atlantic and shortnose sturgeon. We agree that little information is currently available regarding use of the Union River by shortnose and Atlantic sturgeon. The FLA should consider the effects of Project operations, specifically peaking flows, on sturgeon habitat and their use of the river.
29. Section 4.4.3.4 Fish and Aquatic Resources, Environmental Analysis, Cumulative Effects (P. E-4-62): The Licensee suggests that the fishway facilities are effective. This cannot be concluded based on the information provided. Required studies for downstream passage survival have not been completed. Further, we have no indication of the effectiveness for Atlantic salmon and American shad upstream passage. Therefore, we cannot concur with this statement at this time.

³ Baum, E.T. 1997. Maine Atlantic Salmon: A National Treasure, 1st Ed. Hermon, ME: Atlantic Salmon Unlimited

**National Marine Fisheries Service's Comments on Black Bear Hydro Partners, LLC
Updated Study Report for the Ellsworth Project (FERC No. 2727) dated August 21, 2015**

October 7, 2015

On August 21, 2015, Black Bear Hydro Partners, LLC filed an Updated Study report for studies conducted at the Ellsworth Project on the Union River in Maine. We participated in the Updated Study Report meeting held in Ellsworth, ME on September 3, 2015. Below are our comments on the report.

Section 3.2.1, Impoundment Aquatic Habitat Study

1. The Licensee's August 5, 2013 Revised Study Plan stated tributary access in the impoundments will be assessed "during maximum normal fall drawdown." The study was conducted when Graham Lake was at an elevation almost 6 ft higher than the licensed drawdown conditions (El. 93.4). At an elevation 6 feet lower, tributary connectivity in Graham Lake would be different than observed in the study. Based on the study methods used instead of those approved, the purpose of the study was not achieved; it remains unknown whether tributary access would remain suitable at lower water levels or become more challenging to fish species including river herring and Atlantic salmon. As such, we request the Licensee be required to evaluate tributary access in Graham Lake at the lowest licensed elevation of El. 93.4, if the facility is to operate at the existing lowest elevation levels.
2. During the Updated Study report meeting held in Ellsworth on September 3, 2015, the Licensee acknowledged that water levels were not studied at the licensed elevation of El. 93.4. Therefore, the Impoundment Aquatic Habitat and Tributary Access studies did not demonstrate the full scope of potential Project related impacts on aquatic resources. Project related impacts on aquatic resources associated with peaking operations remains unknown. This study should be completed under the full head pond range provided under the current license conditions.
3. By letter dated July 8, 2013, the FERC stated the impoundment tributary access study should include photos of the exposed tributary deltas when the impoundments are drawn down and tributary gradient profiles for the normal range of impoundment operating elevations. The Licensee did not collect the required tributary gradient profiles. As such, we request the Licensee be required to collect the tributary gradient profiles at the licensed drawdown El. 93.4.
4. All photographs of Graham Lake tributaries collected during the assessment should be included.

5. The Licensee did not evaluate zone-of-passage conditions in Graham Lake tributaries using established scientific criteria for fish species. During the Updated Study report meeting held in Ellsworth on September 3rd, the Licensee acknowledged that no zone of passage criteria were used for various life stages of Atlantic salmon, river herring or American eel to evaluate tributary connectivity. Stream hydraulic factors such as channel depth and velocities must be related to the various life stages of fish species to determine whether a suitable zone-of-passage exists at these tributaries. Simply judging them to be passable without reference to understood criteria related to various species, as was done by the Licensee, is far too subjective and does not comport with standard scientific principles. Therefore the Licensee's conclusions cannot be relied upon and cannot support the development of license articles.

Section 3.2.2, Outlet Stream Aquatic Habitat Study

1. The purpose of this study was to evaluate instream aquatic habitat in the outlet stream below Graham Lake as a migration pathway for Atlantic salmon, American shad, alewife, and American eel. The study was also required to evaluate this reach of river for production of brook trout, Atlantic salmon, American shad, alewife, and American eel. The Licensee's August 5, 2013 Revised Study Plan required four flow levels be evaluated including: 105 cfs, 250 cfs, a mid-level generating capacity flow, and a high-level generating capacity flow. The lowest observed flow observed during the study was 150 cfs. A flow of 150 cfs is over 40% higher than the 105 cfs minimum flow. The Licensee did not conduct the approved study as provided in the study plan determination. Further, the Licensee provides no reasonable cause or justification for not studying the 105 cfs flow. As such, we request the Licensee be required to collect data in the outlet stream as provided in the August 5, 2013 Revised Study Plan at a flows of 105 cfs.
2. No methodology was provided describing how the flow data were extrapolated for assessing flow impacts. Past compliance reports indicate that the Licensee is capable maintaining minimum flows at the project. The Final License Application (FLA) should include all formulas and calculations for extrapolating the wetted width to the unobserved 105 cfs study flow.
3. The Licensee states that changes in instream flow for the Ellsworth Project would not be expected to affect diadromous fish downstream of the Ellsworth Dam due to tidal influence. Peaking, however, has been demonstrated to negatively impacts migrating fish (e.g., Hunter 1992⁴). To verify the Licensee's statement, hourly generation flows during

⁴ Hunter, M.A. 1992. Hydropower flow fluctuations and salmonids: a review of the biological effects, mechanical causes, and options for mitigation. Washington Department of Fisheries Technical Report 119. Olympia, Washington. 46 pp.

the upstream migration period in the Union River (April 1 – November 1) should be provided for the last 10 years. These data can be used to evaluate the potential for Atlantic salmon passage in the tailrace. Absent such data, the Licensee's conclusion is mere supposition and cannot be relied upon by FERC and the resource agencies.

4. The Licensee's August 5, 2013 Revised Study Plan required stage, velocity, and depth measurements at all nine transects to verify the measured flow against the recorded flows. On p. 3-60 of the Updated Study Report, the Licensee states that stage, velocity, and depth data were collected at each transect at the lowest flow evaluated. Those data should be presented for review to the resource agencies. These may be made available in the FLA.
5. The Licensee states that the velocity meter used during the study malfunctioned and an alternative method was used to calculate velocities along transects was used. Each estimated velocity should be clearly identified in the FLA.
6. Table 3-8 on p. 3-61. Data from actual stream gaging (depth x velocity x width) at each transect pursuant to p. 3-60 of the report should be added.
7. The Licensee did not evaluate zone-of-passage conditions in at outlet stream tributaries using established scientific criteria for fish species, as required in the study plan determination. Stream hydraulic factors such as channel depth, width, and velocities must be related to the various life stages of fish species to determine whether a suitable zone-of-passage exists at these tributaries. Judging them to be passable without reference to understood criteria related to various species, as described in the report, is subjective and does not comport with standard scientific methodologies. Therefore the results cannot be used to evaluate project related impacts or support the development of license articles.
8. All photographs taken during this study should be provided in the FLA.
9. Table 3-12 on p. 3-74. Data within this table are not clearly defined. To enhance our understanding of this table, use of the 50% optimal cutoff should be explained in the methodology.

Attachment 3-1, Upstream Fish Passage Alternatives Study

1. In the Introduction, the study purpose is defined as "...reviewing previously developed fish passage design concepts considered for the Ellsworth Project in the past and updating them, as well as an assessment of any newer fish passage technologies that may be appropriate for the site." Typically, an ice harbor pool and weir type fishway or a fish lift is recommended for a hydropower facility of this design. The ice harbor alternative was not considered. Including an ice harbor fishway design would provide a more complete

understanding of options at this site. Therefore we recommend the FLA include additional analysis of fish passage options to include consideration of an ice harbor design.

2. Section 1.2, Ellsworth Project Site Description (Page 1). The section states the following "...an average annual generation of 30,333,000 megawatt-hours (MWH)." This is incorrectly labeled. The units should be kilowatt-hours (kWH). See also Section 7, Estimated Generation Costs of Alternatives (Page 157).
3. Section 1.2, Project Downstream Passage, Ellsworth Dam (Page 7): It is important to note that water and fish exit the transport pipe perpendicular to the face of the dam and are then conveyed down the face of the dam to the tailrace area (Photo 1). The existing discharge and conveyance of fish may lead to injury or mortality.
4. Section 1.2, Project Downstream Passage, Ellsworth Dam (Page 7): Downstream passage facilities are present at the project with modifications as described in the study. The downstream passage facilities have never been tested for their overall ability to pass fish safely and effectively. The required downstream passage studies for smolt and American eel will provide data critical to the evaluation of Project related impacts on out migrating fish. These data will be informative for the development of license articles and fishway prescriptions and the FLA will not be ready for environmental analysis until these studies are completed.
5. Section 1.2, Project Downstream Passage, Graham Dam (Page 7): A surface weir is used at the Graham Dam to provide downstream passage of out-migrating fish. Additional information should be provided to clarify whether the weir functions for passage under all headpond conditions and identify the flow rate provided under all headpond conditions.
6. Section 1.2, Project Downstream Passage, Graham Dam (Page 7): Figure 4 shows the downstream passage discharge as viewed from below the dam. The photo station is out of range to clearly show the discharge conditions. We recommend additional photos of this Project feature, including photos clearly showing the pipe-dam interaction point.
7. Section 1.2, Project Upstream Passage (Page 10): This section indicates that no Atlantic salmon returned to the Union River between 2006 and 2011. This statement cannot be substantiated because, among other reasons, the fish trap is only operated 1/5th of the period of the Atlantic salmon migration. At most, the Licensee can state that it did not observe Atlantic salmon during this period.
8. Section 1.2, Project Upstream Passage, Ellsworth Dam (Page 10): This section states "The Ellsworth Dam trap and transport facility is equipped with a four-weir vertical slot upstream fishway leading to a trap..." This is a flawed description of the fishway as a "weir." This is a vertical slot fishway with pools leading to the trap, not a pool and weir fishway. This section should be corrected in the FLA.

9. Section 1.2, Project Upstream Passage, Ellsworth Dam (Page 10): Additional information should be provided in the FLA to clarify the operations: time period of operating the fish trap during this period (date to date); days of the week the fish trap was operated; time of day was the fishtrap was operated; frequency of checking the fish trap; etc. This information defines the availability of the trap for Atlantic salmon and the probability of operators to observe individual fish.
10. Section 1.2, Project Upstream Passage (Page 11): Captions for Figures 6 and 7 indicate the fish passage facility is a fish lift. Technically this is a fish trap. There is no swim through capability at this site. This should be corrected in the FLA.
11. Section 1.2, Project Upstream Passage, Graham Dam (Page 11): Noted in this section is that Graham Dam does not have a fishway. Atlantic salmon that fall back over the Graham Dam have no ability to pass upstream. Their ability to access spawning habitat is restricted. This is a significant impact on the migratory habitat of Atlantic salmon. Passage at both dams associated with the Ellsworth Project will need passage facilities to mitigate impacts on migratory fish.
12. Section 1.2, Project Upstream Passage (Page 13): The Operations and Maintenance plan agency consultation remains ongoing. We are working cooperatively with the Licensee to complete that document.
13. Section 1.3, Upstream Fishway Design Parameters (Page 14): Ellsworth powerhouse flow capacity is approximately 2,320 cfs and fishway pumped attraction flow is up to 50 cfs at Ellsworth, depending on tailwater elevation. Pumped attraction flow is approximately 2% of station capacity. Current USFWS standard is 3% of station Hydraulic Capacity or 70 cfs. We have been using 3-5% of station hydraulic capacity on the East Coast and 5% per entrance of the flow duration curve for the fish passage season on the West Coast. The attraction flow will need to be evaluated by the Licensee specifically for Atlantic salmon.
14. Section 1.3, Upstream Fishway Design Parameters (Page 14): The diffused attraction flow grating at the fish trap has a flow velocity of 1.5 fps. By contrast, the current USFWS criteria is 0.5 fps for horizontal diffusers and 1.0 fps for vertical diffusers. The effects of diffused attraction flow at the Project will need evaluation by the Licensee.
15. Section 2.1 Trap and Transport Alternatives, Existing Facilities (Page 16): This section indicates a "USFWS design criteria peak hourly rate of 4,725 river herring per hour." This number is incorrect. The design criterion for the cycle time and hopper volume is 12,088 river herring per hour for the peak hour of the peak day.
16. Section 2.1 Trap and Transport Alternatives, Existing Facilities (Page 16): The existing hopper is only 61 cf. The harvesting hopper does not hold water, therefore when it is lifted the fish are in the dry (Photo 2). The hopper should be 166 cf to meet design standards.

17. Section 2.1 Trap and Transport Alternatives, Existing Facilities (Page 16): The stated cycle time is 12 minutes. This cycle time only accounts for the time to raise, dump, and lower; it does not include the amount of time the trap fishes. Therefore, the true cycle time is much longer, which changes the fishing time and ability to capture an Atlantic salmon, if present.
18. Section 2.1 Trap and Transport Alternatives, Existing Facilities (Page 16): The current handling of salmon includes dip netting. Dip netting salmon is not an acceptable way to handle the fish due to the potential for injury and stress to the fish. Protocols for handling salmon will need to be improved regardless of the ultimate fish passage method installed. This will be completed in consultation with the resource agencies.
19. Section 2.1 Trap and Transport Alternatives, Existing Facilities (Page 17): The report suggests that capture, handling and release of wild Atlantic salmon can be completed within a couple hours. The timing depends upon how often the trap is checked. A salmon could be in the process for a total of 5 hours since the trap is only checked once every 3 hours. Therefore, the potential time for handling and associated stress is greater than described in the DLA.
20. Section 2.1, Trap and Transport Alternatives, Existing Facility (Page 16): This section states: "The 2015 season experience clearly demonstrated the capacity to handle over a half million river herring and the doubled spawning escapement." For clarity, the 555,015 river herring is a combined total of the harvest and new escapement target. It should be recognized that the current facility managed over a million river herring in 2012. The management goal is twice that volume. With the increased stocking rate, we anticipate returns of river herring to approach the 2.3 million river herring goal in the coming 4-5 years. Decisions made in this proceeding will affect the ability to meet management goals to support a sustainable run and an important harvest, and our ability to support recovery of Atlantic salmon. This should be clarified in the FLA.
21. Section 2.1, Trap and Transport Alternatives, Existing Facility (Page 16): This section states: "The current trap and transport facilities and operating protocols at Ellsworth have proven reliability and functionality by handling river herring runs from 190,000 to 1,200,000 river herring and 0 to 8 Atlantic salmon annually from 2000 to 2015..." We disagree. There are no data to indicate the existing facility and operating protocol have been proven reliable or that they function properly for Atlantic salmon.
22. Section 2.2 Hopper Improvements and Fish Trap Capacity, Ellsworth Fish Trap Capacity (Page 18): The report indicates the fishway pool has a depth of 4.25 feet and total capacity of 255 cubic feet. Without detailed construction drawings, these dimensions cannot be verified for the holding pool or the fishway pools. Figure 9 is insufficient. However, based upon Figure 9 the water depth is only 3.25 feet not 4.25 feet as suggested. Construction drawing for the fishway should be provided in the FLA and the depth and calculation verified.

23. Section 2.2 Hopper Improvements and Fish Trap Capacity, Ellsworth Fish Trap Capacity (Page 18): The harvesting hopper does not hold water, thus the capacity is 0 (Photo 2). Retaining water during lifting operation is important for the proper handling of Atlantic salmon.
24. Section 2.2 Hopper Improvements and Fish Trap Capacity, Ellsworth Fish Trap Capacity (Page 18): The “hopper dimensions” provided are the dimensions of the concrete and are incorrectly applied in the report. The hopper capacity does not include the screened wall panels (Photo 3). The capacity is only based upon the watered up portion of the hopper. The inside dimension of the hopper is 5.75 square feet with only 2 feet of water.
25. Section 2.2 Hopper Improvements and Fish Trap Capacity, Ellsworth Fish Trap Capacity (Page 18): This section states: “...the dimensions of the hopper pool walls that establish the maximum hopper size.” This statement is incorrect. Hopper size is determined by only the inside dimensions of the watered up section of the hopper walls.
26. Section 2.3.2, Separation of River Herring from Atlantic Salmon Passage, Phase 2 – Add Volitional Fish Ladder to Expanded Hopper Pool (Page 22): This section indicates that a steep pass or Denil could be accommodated for Atlantic salmon. We generally would not recommend a steep pass fishway for this high amount of head. A standard 4 foot wide Denil could be used for Atlantic salmon. However, we would not recommend a Denil for American shad or river herring because of the amount of head.
27. Section 3.0, Fish ladder Alternatives (Page 23): We appreciate the effort to complete this required study. The licensee will need to provide their proposed alternative in the FLA. Our conclusion on the appropriateness of any one design will be formulated when all data are available and the application is ready for environmental analysis notice. We do not typically recommend or prescribe trap and truck for hydropower facilities less 250 feet in head because there are alternative fishway designs that better accommodate the migration behavior.
28. Section 3.0, Fish ladder Alternatives (Page 23): Analysis of fish ladder alternatives is based on the assumption that the existing vertical slot trap functions efficiently and effectively. While the vertical slot trap has been effective in meeting the stocking management goals for river herring, the trap has not been evaluated for its efficiency to attract and capture fish. Similarly, we have no data to determine whether the vertical slot trap functions effectively or efficiently for Atlantic salmon. Therefore, we are not able to assess the potential success of this structure for meeting passage and survival goals for Atlantic salmon.
29. Section 3.0, Fish ladder Alternatives (Page 23): The fish ladder alternative introduces pumping river herring out of the holding pool. This represents a new handling action that would require evaluation for post handling injury and mortality. If this design was

implemented and handling mortality and injury were found significant, further alternatives would need to be considered and implemented.

30. Section 3.1.1, Fish ladder Alternatives, Steeppass Denil (Page 23): The Steeppass alternative evaluated would be approximately 250 to 300 ft long. This would be one of the longest Steeppass fishways in the world; we know of no other that would be this long. We, therefore, have no monitoring data from similar fishways to guide the analysis. Although it is appropriate for the alternatives analysis, we have no data to suggest it would be effective for any of the target species.
31. Section 3.1.2, Fish ladder Alternatives, Standard Denil (Page 25): The standard Denil alternative evaluated would be one of the longer Denils in the world. The Woodland Denil fishway on the St. Croix River in Maine has been said to be the longest in the world at almost 700 ft in total length. We have no data to suggest a Denil at the Ellsworth Project would be effective for any of the target species. Although it is appropriate for the alternatives analysis, we have no data to suggest it would be effective for any of the target species.
32. Section 3.1.2, Fish ladder Alternatives, Standard Denil (Page 25): The standard Denil alternative evaluated could potentially pass 1,000,000 or more fish. However, it is intended for a smaller design population. Fishways are designed for the peak hour of the peak day of migration. At this high number, we anticipate the returns to overwhelm the fishway and result in significant delay in the passage timing.

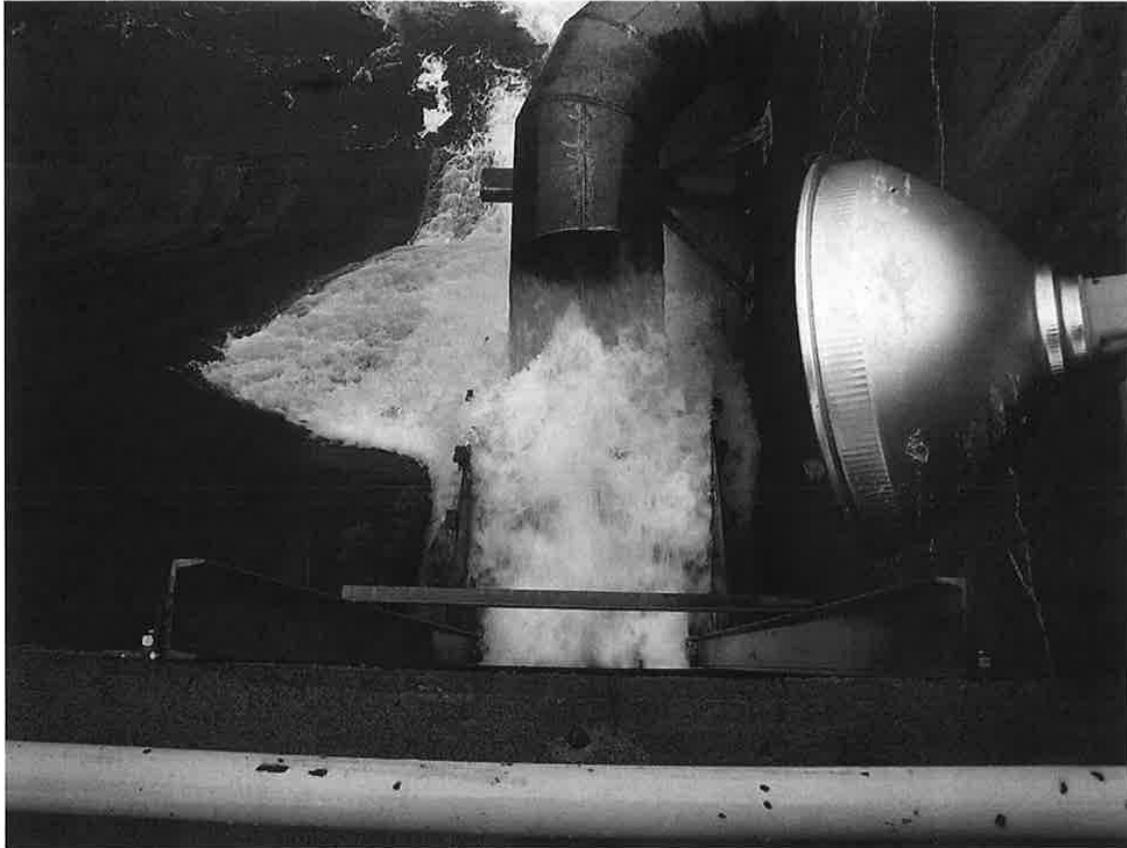


Photo 1. This view is looking down the face of the dam from above the surface weir adjacent to the Unit 1. In view is water discharged from surface weir and the transport pipe directing flow from two stoplog controlled surface weirs above Units 2 through 4. The two structures converge at this point with fish and water passing down the dam to a plunge pool. Photo: Don Dow, NMFS.

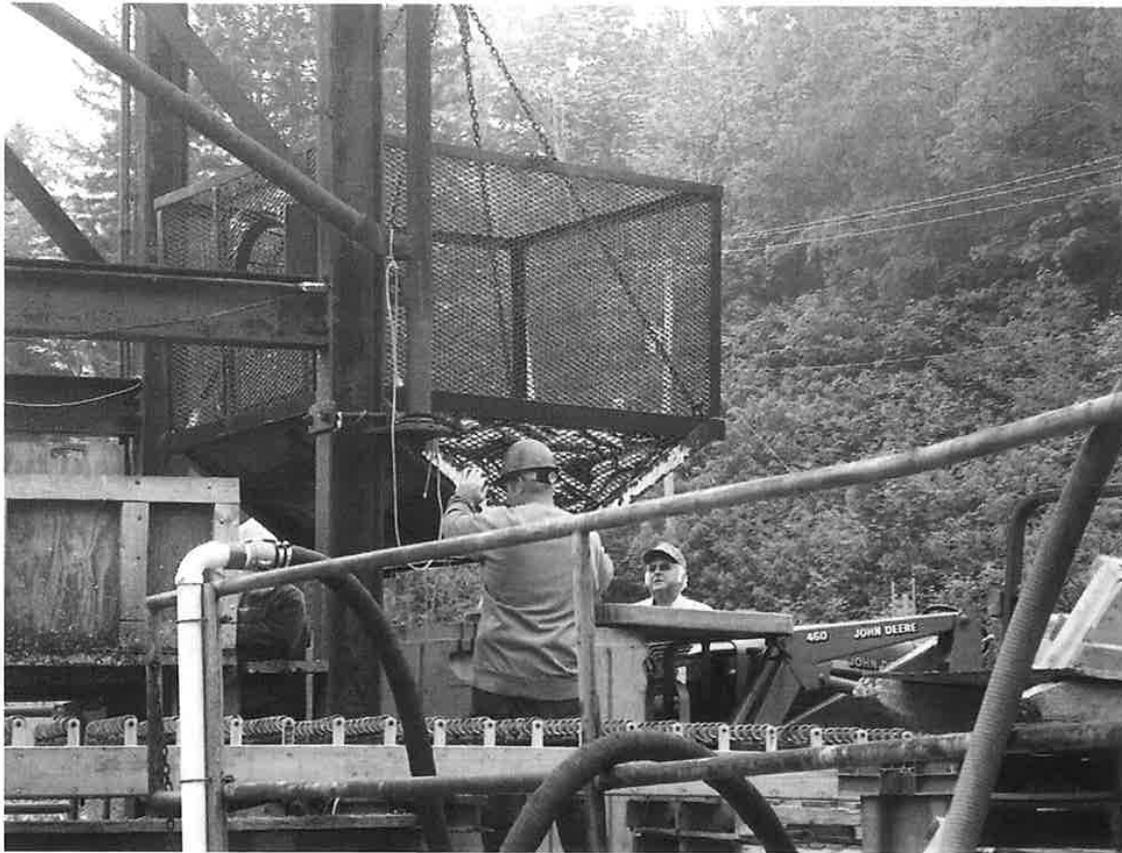


Photo 2. The harvest hopper does not hold water. Fish are in the dry when the hopper is lifted.
Photo: Don Dow, NMFS.

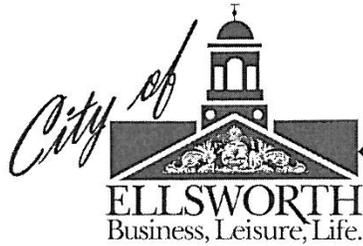


Photo 3. The hopper capacity does not include the screened wall panels. The capacity is only based upon the watered up portion of the hopper as measured from the interior walls. Photo: Don Dow, NMFS.

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Document Content(s)

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*City Manager*

1 City Hall Plaza ♦ Ellsworth, ME 04605-1942

Phone (207) 669-6601 ♦ Fax (207) 667-4908

www.ellsworthmaine.gov

October 5, 2015

Nicholas Palso, Moderator
Federal Energy Regulatory Commission
888 First Street, NE
Room 62-30
Washington, DC 20426

**RE: Impacts of Graham Lake Water Levels on Recreation
Relicensing of Ellsworth Hydroelectric Project (# 2727)**
DELIVERED VIA EMAIL (nicholas.palso@ferc.gov)

Dear Mr. Palso;

The City of Ellsworth is looking forward to having the Ellsworth Hydroelectric Project in productive use for another 30 years. The two dams have provided many benefits to the community, including recreational opportunities on both Graham Lake and the Union River. As part of the relicensing of the Ellsworth Hydroelectric Project, the City respectfully requests that the impact of low water levels in Graham Lake (especially during the summer months of July and August) be taken into consideration during the upcoming review process.

To the best of our recollection it seems that while under Bangor Hydroelectric management, Graham Lake water levels were typically kept higher through the summer months, and through to the Labor Day holiday. More recent water drawdown trends have resulted in lower water levels during the summer, making the lake more unpredictable, and thus creating potential safety hazard conditions for boaters. Keeping higher water levels through the summer would result in additional recreational benefits for all lake users.

It would be very much appreciated if you would take our concern into consideration and have it go on record. I look forward to having a chance to further discuss this matter.

Respectfully submitted,

A handwritten signature in black ink that reads "David Cole" with a stylized flourish at the end.

David A. Cole

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Document Content(s)

Ellsworth Hydro Project 2727 - Letter to FERC.PDF.....1-1

Joe Minutolo
77 Whitmore Road
Mariaville, Maine 04605
jminutolo58@gmail.com

October 7, 2015

Nicholas Palso, Moderator
FERC
888 First Street, NE
Room 62-30
Washington, DC 20426
nicholas.palso@ferc.gov

RE. Relicensing of Ellsworth Hydro Electric Project #2727

VIA EMAIL

Dear Mr. Palso,

I recently attended a public meeting at the Ellsworth City Hall concerning the relicensing for operating the Dam on Graham Lake. It was a well attended meeting that lasted for 3 1/2 hours. The majority of the meeting was concern for the fish, eel and alewives habitat and population. The discussion was in depth and very informative, with exchanges in dialog between many organized groups, such as: U.S. Fish and Wildlife, National Marine Fisheries Service, Atlantic Salmon Federation, Downeast Salmon Federation, College of the Atlantic, Frenchman's Bay Conservancy and more.

To my surprise there was nobody representing the landowners and residents of Graham Lake except for myself. I found out about this meeting by chance, and after asking questions to some of my neighbors, it appears that nobody knew about it, or they would have come. This is a very important part of the picture needed to construct the details of the future licensing. The 30 year agreement is a big deal as it affects all the surrounding communities in so many ways. The interests of this group need to be heard and taken into consideration.

I have lived on Graham Lake for four years. When I talk to people about the lake, one of the biggest concerns that I constantly hear is the drawdown of the water level in the summer. It starts in July, and in August, Graham Lake can be so low that it can be deemed unsafe to use any type of boat or watercraft. This is the best time of the year in Maine. It's time to swim, boat, kayak, go fishing, and use Graham Lake to its fullest potential. The timing of this drawdown damages all

recreational experiences on the lake. In turn, this has a great affect on the recreational users, property owners, and residents. Even on the communities that surround Graham Lake. We all know that to this point, Graham Lakes land value is lower than any of the surrounding lakes per acre. The reason for that is the uncertainty of the water levels in the summer months. The lower water levels create an environment that is not desirable to the recreational users. That is why the other lakes exceed in recreational use, and land values. People invest on lakes to recreate, this creates value. When the value is higher, people invest. It creates jobs, raises more tax revenue for local communities. That's what builds schools, repairs roads and creates more jobs.

Graham Lake has the potential to be one of the most dynamic resources in Hancock County. The population is growing and headed this way. That makes it imperative to protect these water levels. The other lakes are already getting overcrowded, and the fact that the size and scale of GL are such it exceeds Beech Hill Pond, Green Lake, and Branch Lake combined. That alone will help with the demand on these resources, and improve the recreational experiences for all.

As a side note, I request to be added to the Distribution List dealing with this matter.

Sincerely,

A handwritten signature in black ink, appearing to read 'J. Minutolo', written in a cursive style.

Joseph Minutolo

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, DC 20426
October 8, 2015

OFFICE OF ENERGY PROJECTS

Project No. 2727-086-Maine
Ellsworth Hydroelectric Project
Brookfield White Pine Hydro LLC

Mr. Frank H. Dunlap
Brookfield White Pine Hydro LLC
26 Katherine Drive
Hallowell, ME 04347

RE: Comments on Draft License Application and Updated Study Report

Dear Mr. Dunlap:

Pursuant to 18 CFR § 5.16(e), this letter contains Commission staff's comments on your July 10, 2015, draft license application for the Ellsworth Hydroelectric Project. Our specific comments on the application are outlined in Appendix A.

In the draft license application, you indicate that additional information will be provided in the final license application.¹ This information and the information requested in Appendix A should be included in your final license application or the Commission may find that the application is not ready for environmental analysis, pursuant to 18 CFR § 5.22 of the Commission's regulations.

Additionally, pursuant to 18 C.F.R. § 5.15(f), Black Bear Hydro Partners, LLC (Black Bear Hydro) conducted a meeting on September 3, 2015, with relicensing stakeholders and Commission staff, to provide an updated report on the studies required by the Commission-approved study plan.² Our comments on the updated study report are attached in Appendix B. On September 9, 2015, Black Bear Hydro filed its initial study report meeting summary. We have no comments on or disagreements with the meeting summary.³

¹ This information includes the field component of the Upstream Atlantic Salmon Passage Study and the Downstream American Eel Passage Study.

² See the Commission's September 4, 2013, study determination letter and December 30, 2014, study modification letter.

³ See section 5.15(c)(4) of the Commission's regulations.

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If you have any questions regarding this letter or the contents of your final license application, please contact Dr. Nicholas Palso at (202) 502-8854, or via email at nicholas.palso@ferc.gov.

Sincerely,

Bob Easton, Chief
New England Branch
Division of Hydropower Licensing

Attachments: Appendix A – Comments on Draft License Application
Appendix B—Comments on the Updated Study Report

cc: Mailing List, Public Files

Appendix A

Comments on Draft License Application

Commission staff's review of your draft license application (DLA) has identified the following deficiencies, additional information, and clarifications that should be addressed in your final license application (FLA).

Initial Statement

1. The Initial Statement includes the name and mailing address of municipalities of over 5,000 residents within 15 miles of the project, as required by section 5.18(a)(2)(ii)(B); however, the list does not include the Town of Bar Harbor. You should include the address of the Town of Bar Harbor in the FLA.

Project Description

2. Exhibit A does not provide all of the information that is required by section 4.51(b) of the Commission's regulations. To address this deficiency, Exhibit A of the FLA should be revised to describe the following facilities: (1) respective dimensions (i.e., lengths and heights) of each section of the dams at the Ellsworth and Graham Lake Developments (i.e., earthen embankments, spillways, and abutments); (2) heights of the three spillway gates, sluiceway, flood wall, wing wall, and steel cell at the Graham Lake Development; (3) gross storage volume of Graham Lake; (4) dimensions of the two intake facilities and associated facilities at the Ellsworth Development, including the number and dimension of each headgate and the clear bar spacing of the trashracks; (5) lengths of all four penstocks at the Ellsworth Development; (6) dimensions and hydraulic capacities of the upstream and downstream fish passage facilities at the Graham Lake and Ellsworth Developments; (7) the minimum hydraulic capacity of each turbine unit at the Ellsworth Development; and (8) the voltage of the 320-foot-long transmission line.

Project Operation

3. Sections 1.0 and 2.0 of Exhibit B describe the installed capacity and dependable capacity of the project as 8.90 megawatts (MW) and 9.05 MW, respectively. You should describe how the dependable capacity was calculated, including descriptions of data sources, assumptions, and computations in the FLA.

4. Section 2.2 of the DLA states that you calculated mean monthly flow data for the project based on project generation because there are no United States Geological Survey gauges in the Union River watershed. However, table B-4 indicates that the mean monthly flow for August 2006, September 2006, and September 2007 was 0 cubic feet per second (cfs). While the project may not have generated during these months, it seems unlikely that there was no flow through project. Therefore, you should include a revised

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table B-4 with flow calculated based on project generation, minimum flows, and fish passage facility flows in the FLA.

5. You state that the low flow value shown on the flow duration curves in Appendix B-1 (323 cfs) is based on the required minimum flows for the project and the flow through the fish passage facilities. However, you use 323 cfs for nearly all the monthly flow duration curves even though the required minimum flow for the project is 250 cfs from May 1 through June 30 and 105 cfs from July 1 through April 30. Therefore, you should provide revised flow duration curves that use the appropriate minimum flows and downstream fish passage flows to represent the low flow value in the FLA.

Project Boundary

6. Section 1.0 of Exhibit A and the Exhibit G drawings indicate that the proposed project boundary around the Graham Lake impoundment is generally established by contour elevation 107 feet mean sea level (msl), which is 2.8 feet above the impoundment's normal maximum water surface elevation of 104.2 feet msl. Section 4.41(h)(2) of the Commission's regulations requires that the project boundary must include "only those lands necessary for operation and maintenance of the project and for other project purposes, such as recreation, shoreline control, or protection of environmental resources." The FLA should describe any project related uses of the lands above the normal maximum water surface elevation. If the lands above the impoundment's normal maximum water surface elevation do not serve a project purpose, you should propose to remove these lands from the project boundary and revise your descriptions of the proposed project boundary in Exhibits A, E, and G of the FLA, as appropriate.

7. The Exhibit G drawings filed with the DLA do not enclose all lands necessary for operation and maintenance of the project and for other project related purposes, such as recreation, shoreline control, and protection of environmental resources as required by Section 4.41(h)(2) of the Commission's regulations. To correct this deficiency, the Exhibit G drawings filed with the FLA must show and label all principal project works necessary for operation and maintenance of the project enclosed within the project boundary, including the a carry-in boat launch off Shore Road, the Graham Lake Dam boat launch, the 320-foot-long transmission line, and the vertical slot fishway and trap facility.

8. The Exhibit G drawings filed with the DLA have not been stamped by a registered land surveyor as required by Section 4.39(a) of the Commission's regulations. To correct this deficiency, the Exhibit G drawings filed with the FLA must be stamped by a registered land surveyor.

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Fish and Aquatic Resources

9. Pages E-4-45 and E-4-46 of Exhibit E provide descriptions and information about the operation of upstream and downstream fish passage facilities at the Ellsworth and Graham Lake Developments but do not provide any information about attraction or conveyance flows for the passage facilities. You provided some information about attraction and conveyance flows for the fish passage facilities at the Ellsworth Development in Section 6.3.3 of your proposed study plan but did not provide any information about the attraction flow for the downstream fish passage facility at the Graham Lake Development. Additionally, page E-4-45 of Exhibit E states that two of the surface weirs at the Ellsworth Development are controlled with stoplogs, but you do not provide any information about the water level conditions that would require adjustment of the stoplogs. Lastly, your March 31, 2015, letter indicated that you have acquired new information about the operation of the fish passage facilities at the Ellsworth Development. You should provide all current information about the operation of the projects' upstream and downstream passage facilities, including the attraction and conveyance flows, and a description of the stoplog adjustment protocol for the two surface weirs at the Ellsworth Development in the FLA.

10. Pages E-4-46 of Exhibit E states that Black Bear Hydro developed an operation and maintenance plan (O&M plan) for the for the project's upstream and downstream fish passage facility and that Black Bear Hydro would implement the plan in 2015 and future years. However, the O&M plan was not included in the DLA. You should include a copy of the O&M plan in the FLA.

Wildlife and Botanical Resources

11. Section 4.4.5.1 identifies eight wetland cover types (i.e., lacustrine, riverine, estuarine, palustrine emergent, palustrine scrub-shrub, palustrine forested, palustrine aquatic bed, and palustrine unconsolidated bottom) in the project boundary; however, the acreages of each wetland cover type were not provided. To the extent possible, you should provide the acreages of each wetland cover type identified in the FLA.

12. Section 4.4.5.2 states that about 35 acres of uplands are managed within the project boundary. In the FLA, you should include a description of your standard vegetation maintenance practices, including the methods you use to manage vegetation (i.e., mechanical, chemical, etc.); your standard maintenance schedule (i.e., activities performed annually, seasonally, as-needed, etc.); your procedures for managing vegetation in sensitive habitats (i.e., wetlands, riparian habitat, etc.); and your procedures when rare, threatened, or endangered plants or animals are encountered during routine maintenance.

Ellsworth Project
Project No. 2727-086

A-4

Recreation

13. Section 4.4.7.3 of Exhibit E describes a new portage trail around Graham Lake dam to replace the existing trail. The DLA does not include a map of the proposed portage trail. You should include a map that shows the location and relative length of the proposed portage trail in the FLA.

Appendix B

Comments on Updated Study Report

Impoundment Aquatic Habitat Study

1. Section 3.2.1.6 of the updated study report (USR) states that you did not measure the stream gradient profiles for the tributaries entering Graham Lake and Lake Leonard as required by the Commission's study modification determination letter issued on December 30, 2014. This information is needed for staff's analysis of the effects of impoundment elevations on tributary connectivity; therefore, you must measure the stream gradient profiles for the tributaries entering Graham Lake and Lake Leonard and file with the results of your Atlantic salmon smolt downstream passage study.

Upstream Fish Passage and Decommissioning Alternative Study

2. The results of the Upstream Fish Passage and Decommissioning Alternative Study include a brief discussion of the ability of Atlantic salmon and river herring to migrate upstream using each of the upstream passage alternatives. However, the Union River Fisheries Coordinating Committee's 2015 Comprehensive Fisheries Management Plan indicates that other migratory species, including American shad, Atlantic sturgeon, Atlantic tomcod, rainbow smelt, sea lamprey, and striped bass have been observed in the Union River downstream of Ellsworth dam.⁴ The study results did not discuss the effects of each passage alternative on these other migratory species as required by the Commission's study modification determination letter. Therefore, you should include a discussion of the potential effects of each alternative on each of these migratory fish species in the final license application (FLA).

3. The upstream fish passage alternatives presented in the USR considered long steppass and Denil fishways. To the extent possible, you should include a list of other hydropower projects with long steppass or Denil fishways and any available information regarding the effectiveness of those fishways in the FLA.

4. The Atlantic Salmon Commission's guidance recommends not handling salmon at water temperatures greater than 77° F and not transporting salmon at water temperatures greater than 72° F to avoid exacerbating the effects of temperature-related stress on the fish.⁵ However, the results of the Upstream Fish Passage and Decommissioning

⁴ Black Bear Hydro filed the Comprehensive Fisheries Management Plan on February 27, 2015.

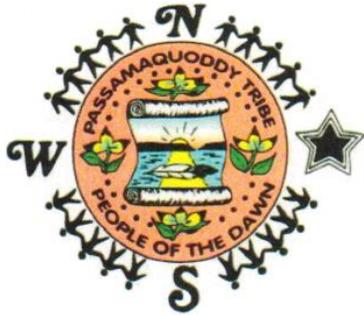
⁵ Black Bear Hydro included the ASC guidance in the 2006 URFCC report filed on March 7, 2007.

Ellsworth Project
Project No. 2727-086

B-2

Alternative Study did not discuss how water temperature would affect the operation of each upstream passage alternative for Atlantic salmon. Therefore, you should include a discussion of the effects of water temperature on the operation of each upstream fish passage alternative in the FLA.

5. The results of the Upstream Fish Passage and Decommissioning Alternative Study refer to the 2015 operation and maintenance costs for the existing trap and haul facility but did not provide the actual costs. So that staff can compare the costs of the existing trap and haul facility to the alternatives discussed in the USR, you should provide the operation and maintenance costs for the existing trap and haul facility in the FLA.



Pleasant Point Reservation

P.O. Box 343 • Perry, Maine 04667
Tel. (207) 853-2600

October 8, 2015

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

RE: Ellsworth Project (P-2727)

Dear Secretary Bose,

As stated in a letter Chief Frederick Moore III signed and submitted on August 25, 2015, the Pleasant Point Passamaquoddy Tribe has a vested interest in protecting watersheds and lands within the Passamaquoddy Aboriginal Homeland. The Union River falls within these traditional boundaries and connects to the larger Gulf of Maine, a culturally significant ecosystem to the Passamaquoddy. The Passamaquoddy are actively involved in conserving this ecosystem and providing uninhibited access to culturally important species. In order to sustainably manage fish, a traditional food source, the Passamaquoddy recognize the necessity in restoring fish species to their home waters.

The Passamaquoddy believe that no action should directly or indirectly result in the endangerment of any species. All living creatures, brothers and sisters in this world, deserve the respect and right to fully use and inhabit their native lands and waters. Guided by this principle, the Passamaquoddy ask for safe, timely and effective fish passage for all aquatic species within the Union River and its tributaries.

Current Passage Critique

Upstream passage at the Ellsworth and Graham Lake project sites needs extensive modifications. Currently, fish passage through the Ellsworth Dam and Graham Lake Dam projects is inadequate. The trap and truck operation is inefficient, creating a backlog when the trap is closed, preventing passage for all species. The harvest-style trap dewateres when lifted, leaving the fish dry and exposed to crushing, coupled with handling and transportation stress, increasing the risk of delayed mortality. The percentage of fish required to pass does not reflect a long-term (30-50 years) increase in river herring or Atlantic salmon returns. Current operations do not address the return of other species (American shad, American eel, Rainbow smelt, Atlantic tomcod) to the watershed.

We find it unacceptable that fish have no safe and effective downstream passage route. Downstream passage at Ellsworth Dam has proven to be lethal for herring and eels. The downstream passage facility has a turn that does not provide safe passage. Part of the spillway falls onto rocks, increasing the risk of injury and mortality to downstream migrants. Passage through the turbines is lethal for many species, resulting in dismemberment or death from pressure changes. Those that may survive should be examined for internal injuries and assessed for mortality further downstream. These should include experimentation with turbine exclusion grates, screens, and other modifications that help all fish species pass downstream in a safe, timely and effective manner.

Fish Passage Recommendations

The Passamaquoddy Tribe requires that safe, timely and effective fish passage be provided for all species utilizing the Union River and its tributaries. We recommend the following fish passage facility improvements: the installation of a fish lift at the Ellsworth Dam facility, operated on a 24 hour basis from April through October. Fish passage facility improvements should include:

- Installation of a fish lift at the Ellsworth Dam facility, operated on a 24 hour basis from April through October.
- The lift needs to have the engineered capacity to accommodate dramatic increases in the number of returns for all species.
- Safe and timely passage to multiple species, including river herring, Atlantic salmon, eels and American Shad.
- At Graham Lake Dam, a fish ladder designed to safely and effectively pass large numbers of multiple species.
- Provide upstream eel passage at both facilities.
- Ongoing studies to monitor the estuarine anadromous fish population below Ellsworth Dam, to ensure all species present have the opportunity to pass above both facilities.

Seasonal operation of the trap does not coincide with the main upstream migration time of Atlantic salmon. The trap ceases operation in mid-June, preventing passage of fall returning Atlantic salmon. Current operating flows are high during the day, and lower at night, which may inhibit the ability of fish to find their way upstream. Operational procedure changes need to include:

- Modernize attraction flow rates to current US Fish and Wildlife standards.
- Provide upstream access 24 hours a day. Current trap operations run only during working hours, and passage is closed at night.
- Increase the operational season, to provide access from April through October.
- Check the trap more efficiently and regularly for Atlantic salmon. Currently, the trap is checked every 3 hours for the presence of Atlantic salmon. It is raised until approximately 3 feet of water remains in the bottom. In these conditions and with an abundance of herring in the trap, it would be easy to miss spotting a salmon.
- Perform daily walks for fish kills on both sides of the river, regularly throughout a 24 hour cycle and the entirety of the downstream passage season. Assess and address issues immediately, to prevent lethal passage.

Current Study Critiques

In regards to the downstream eel passage study, we feel a larger sample size would more adequately represent the population's behavior. The current study assumes all PIT tags detected downstream are survivals, which may be erroneous, as mortalities may travel downstream and pass through the antennae. It is important to conduct the study in such a way that distinguishes between true survivals and mortalities. Injuries in survivals and mortalities should be assessed and documented.

Current tributary connectivity results indicate that a few inches to 5+ feet of water connect all tributaries to the Union River during drawdown periods. However, Atlantic salmon require more than a few inches of water for successful upstream passage and spawning. Also, the study was not conducted at minimum lake elevation, and depths are not indicative of what they would be at the lowest flow levels. No measurements were taken and no criteria established. Based on this study, it is impossible to determine whether the tributaries are passable. The study should be redone at the lowest drawdown level, adhering to established criteria and providing critical measurements to assess whether the tributaries are truly accessible.

Studies determined that winter dewatering of the littoral zone had no impact on fish communities. However, the study failed to assess whether dewatering would negatively impact food growth and availability for juvenile herring. It is imperative that juvenile fish have access to a prey base for growth and survival. The study should be redone at the lowest lake elevation level to determine the effect of dewatering on the prey community.

The Passamaquoddy are connected to the land and waters through culture, tradition, ancestry, and history. The Passamaquoddy empathize with all animals unable to inhabit and use their traditional territory. For decades, fish have been denied access to their native waters. It is time to welcome the fish home.

Sincerely,



Asha Ajmani, MS
Environmental Scientist
Sipayik Environmental Department
Passamaquoddy Tribe – Pleasant Point
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Document Content(s)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
Maine Field Office
17 Godfrey Drive, Suite 2
Orono, Maine 04473
207/866-3344 Fax: 207/866-3351



October 8, 2015

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

FILED ELECTRONICALLY

RE: U.S. FISH & WILDLIFE SERVICE COMMENTS
Draft License Application, Ellsworth Hydroelectric Project, FERC No. 2727

Dear Secretary Bose:

The U.S. Fish and Wildlife Service (Service) has reviewed the Draft License Application (DLA) for the Ellsworth Project (P-2727) dated July 10, 2015. The Service has participated in the Ellsworth Project relicensing by attending the site visit/scoping meeting, filing comments on the PAD, requesting various studies, providing study plan comments, and attended the meeting to review study results. Our office has also brought certain Ellsworth Project fish passage issues to the attention of the Federal Energy Regulatory Commission (FERC) and we appreciate the diligence of FERC staff in addressing these matters.

The License is proposing no changes in the way the Ellsworth Project is currently operated (DLA page E-3-6). The Service provides the following comments on the Licensee's proposal in the DLA, with reference to relevant documents in the Ellsworth Project docket.

FISH PASSAGE COMMENTS

1. It is the Service's opinion that the existing fish trap does not provide safe, timely and effective upstream passage. The current Comprehensive Fishery Management Plan for the Union River Drainage (CFMP) includes a spawning escapement goal of 315,000 river herring. This spawning escapement will increase to 357,151 when a few remaining portions of the watershed become accessible (DLA page E-4-37). The CFMP also calls for a harvestable surplus of two million river herring, which the Licensee contends could be harvested from the trap.

The Service and NOAA-Fisheries have evaluated the capacity of the current trap design. They conclude that the vertical slot portion of the trap has the capacity to pass about 900,000 river herring, well short of the 2,357,151 combined harvest and spawning

escapement goal. The Service and NOAA-Fisheries also calculated that the live transport hopper has a capacity of 219,000 river herring. This hopper capacity is only nine percent of the harvest and spawning escapement goal. However, if one assumes that the live capture hopper is only used to capture the river herring spawning escapement (i.e., the harvest hopper is used at other times), then the hopper capacity meets 61 percent of the spawning escapement goal.

The Licensee proposes that the trap will also be used for Atlantic salmon and American shad. Since the spawning migration of these species overlaps with the timing of the river herring run, they further reduce the capacity of the fish trap. Due to these capacity shortcomings, the trap cannot provide safe, timely and effective upstream passage for migratory fish in the Union River.

2. The maximum Ellsworth Dam powerhouse flow is approximately 2,320 cfs and fishway pumped attraction flow is up to 50 cfs, depending on tailwater elevation. Thus, the pumped attraction flow is approximately two percent of station capacity. Currently, the Service requires three to five percent of station hydraulic capacity (i.e., 70-116 cfs) for fishway attraction flow at the entrance. The attraction flow will need to be increased to meet this requirement. Alternatively, the Licensee must provide studies to demonstrate the effectiveness of the current facility with the lower attraction flow.
3. The DLA does not describe the attraction water configuration of the existing fish trap, nor does it describe any of the standard operating procedures for the trap. It is our understanding that two pumps are used to operate the trap. The original pump may still be in use and if so, it dates to circa 1974. This pump discharges to the hopper pit and provides flow through the trap and vertical slot section. The second pump was added pursuant to requirements of the previous relicensing of the Ellsworth Project. The second pump introduces water from the tailrace through a side diffuser in the lower pool of the vertical slot section. The velocity of this attraction water is 1.5 fps at the diffuser grating (DLA page 14) which exceeds the Service criterion of 0.5 fps. Flow from both pumps is discharged at the entrance.

Detailed information should be included on the pumps and diffusion configuration. Specifically, what are the pump capacities, their manufacture, and age? What is the diffuser grating size? What is the tidal gate configuration and how is the tidal gate operated? Is the tidal gate automated? How is the vertical slot section operated? Does the vertical slot section include any baffles or barrier screens? Any other relevant details of the trap operation should be included.

4. The existing harvest hopper does not hold water and is not suitable to move live fish. The live transport hopper holds only 61 cubic feet and does not meet Service criteria which would require a hopper with 166 cubic feet of capacity. The existing trap requires a large hopper to meet Service criteria.
5. The DLA Table on page C-2 notes that in 1986 the “fish passage facility (was) installed” at Ellsworth and also notes 2004 as the date that “a stop log system used for downstream passage of migratory fish” was installed at Ellsworth. Neither date is correct. The

upstream trapping facility was installed in 1974 with roughly half the funding from the Anadromous Fish Conservation Act (federal monies) and the remaining funds split nearly equally among the Licensee and private sources.¹ The downstream passage system, including the weirs and pump-back system, were installed as part of the remedial safety measures built in 1993. The reference to downstream passage installation in 2004 may be for the downstream passage weir installed at the Graham Lake Dam. (Note: DLA page E-4-45 states that the Graham Lake downstream passage weir became operational in 2003.) The dates for the construction of the Ellsworth Project fish passage facilities should be researched, verified, and included in the Final License Application.

6. The DLA is not clear regarding ownership of the fish trap. Although the Licensee states that the facility meets the requirements for fish passage at the site, the facility may be owned by the State of Maine. If that is the case, then there may be jurisdictional issues. The Licensee should research this issue and determine if they need to acquire right, title or interest in order to operate the facility.
7. The Licensee proposes a new upstream passage facility for American eel in Section 4.4.3. However, this section of the DLA does not mention plans for improving upstream passage for any of the anadromous species, nor does it propose to and improve downstream passage for American eel. With regard to downstream passage, the DLA notes that intake velocities at the trash racks of units 2, 3 and 4 are close to three feet per second (DLA Table E-14). This velocity exceeds the Service criterion of 2.0 fps, as measured normal to, and one foot from, the trash racks. The FLA should address the findings of the updated study report filed on August 21, and acknowledge the pending downstream studies and the potential need for improving downstream passage effectiveness.
8. The DLA does not include any discussion of the operational problems and equipment failures that have plagued the Ellsworth dam downstream passage system. This includes the pump failure that compromised the downstream fishway during the 2014 migration. It is worth noting that the same pump has failed again in the last few days, coincident with high river flows that have triggered the fall migration of juvenile river herring and adult eels. Anecdotal accounts lead us to believe that this pump has not functioned properly since it was installed.
9. It is our opinion that the configuration of the Ellsworth downstream bypass discharge is likely to cause injury or death of downstream migrants. Although this opinion has been provided to the Licensee on several occasions, the DLA does not described the issue, nor provide any solution. The Service does not recommend a study of this issue, but believes the orientation of the pipe can be modified at minimal cost and without a specific study.
10. Until the current relicensing proceeding, none of the upstream and downstream fish passage facilities have ever been evaluated for effectiveness using commonly accepted empirical field methods such as telemetry. As stated in the record for the relicensing that

¹ Baum, E.T. 1982. The Union River: An Atlantic salmon management report. Maine Atlantic Sea Run Salmon Commission, Bangor, Maine. 27 pages.

was completed in 1987, and restated in this proceeding, upstream and downstream passage studies are needed for Atlantic salmon, river herring, and American eel. The Service requires such information in order to engage in informed fish passage negotiations with the Licensee.

11. The DLA does not address upstream or downstream passage requirements of American shad. Page E-4-3 of the DLA notes that the Federal Energy Regulatory Commission identified American shad as a resource that could be cumulatively affected by the proposed operation of the Ellsworth Project. The Union River CFMP (section 3.1.3), as well as the previous Union River CFMP, identified American shad restoration as a management goal. American shad recovery on the Penobscot, Sebasticook and Kennebec Rivers indicate this feasible. The nearby Milford broodstock collection facility on the Penobscot River could provide a donor stock. The FLA should acknowledge this management goal and the possibility of implementing American shad restoration during the term of the license.
12. Required studies of adult American eel and salmon smolt downstream passage are ongoing and will be completed in 2016. These studies will provide important Project specific data on passage effectiveness and turbine mortality. These data will inform the licensing decision. Therefore, the FLA will not be ready for environmental analysis until the two studies are complete and analyzed.

OTHER COMMENTS

13. There is some confusion regarding the annual generation of the Ellsworth Project. The Licensee has previously filed documents with the FERC stating that:
 - a. the average annual Ellsworth Project generation is 29,907 MWh, and
 - b. the gross generation from 10/1/2013 – 9/30/2014 was 31,431 MWh.

The DLA uses the wrong units but apparently intends to convey that annual generation is 30,333 MWh. The Licensee should provide an accurate figure for average annual generation for the project, with the correct units and clear attribution/citation.

14. The Licensee should expand and update the description of American eel fisheries and conservation measures included in the DLA at page 4-42. The recent Atlantic States Marine Fisheries Commission benchmark stock assessment concluded that the American eel stock has declined in recent decades and the stock is now considered depleted.² The ASMFC has subsequently approved two Addenda (in August 2013 and October 2014) to the American Eel Interstate Fisheries Management Plan in order to reduce eel mortality and conserve all life stages of American eel. These Addenda have eliminated the harvest of silver eels in all states, except for a small artisanal fishery on the Delaware River and reduced the harvests of yellow and glass eels. The Maine glass eel fishery has been reduced by more than half in the last three years.

² ASMFC. 2012. American Eel Benchmark Stock Assessment. Stock Assessment Report No. 12-01 of the Atlantic States Marine Fisheries Commission. 342 pages.

The Service thanks the FERC for their consideration of Service comments on the DLA. Should you have any questions regarding our comments, please contact Steve Shepard by email at: *steven_shepard@fws.gov* or by telephone at 207/866-3344 Extension 1116.

Sincerely,

Laury A. Zicari,
Field Supervisor
Maine Field Office

ec: Gail Wippelhauser, Paul Christman, MDMR – Augusta, Maine
Oliver Cox, MDMR – Bangor, Maine
Sean McDermott, NOAA – Gloucester, Massachusetts
Jeff Murphy, NOAA – Orono, Maine
Kathy Howatt, MDEP – Augusta, Maine
Laury Zicari, USFWS – Orono, Maine
Brett Towler -- Hadley, Maine

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APPENDIX E-3
2015 MACROINVERTEBRATE SAMPLING STUDY

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2015
Macroinvertebrate Sampling Study
Downstream
of
Graham Lake Dam
Ellsworth Maine
FERC #2727

Submitted by:

Paul C. Leeper
Moody Mountain Environmental
137 Diamond Street
Searsmont Maine 04973

Submitted to:

TRC
249 Western Avenue
Augusta, ME 04330

Date: December 2015

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Introduction

This macroinvertebrate sampling study was conducted in support of the relicensing of the Ellsworth Hydroelectric Project (Project or Ellsworth Project), Federal Energy Regulatory Commission (FERC) Project No. 2727. This report details the Year 2 (2015 field season) study efforts as part of the Water Quality Sampling Study.

Study Objectives

The goal of the macroinvertebrate sampling study was to generate data on the aquatic macroinvertebrate community in the Union River downstream of the Graham Lake Dam and assess this community in terms of Maine's Aquatic Life Standards.

Study Area

In 2015 we placed samples at three (3) sites in the Union River downstream of the Graham Lake Dam to study aquatic macroinvertebrates (Figure 1).

Site 1 was located at the downstream end of the “pool” below the Graham Lake Dam. This site was approximately 950 ft downstream of the dam. **Site 2** was located was located approximately 1750 ft downstream of the dam. **Site 3** was located approximately 1.92 miles downstream of the dam, approximately 850 ft upstream of the railroad crossing. Site 3 was just downstream of a bedrock hydraulic constriction that changed the character of the river from slow moving meandering flat water to rapids.

Figure 1. Location of aquatic macroinvertebrate sampling sites downstream of the Graham Lake Dam. Union River, July, August 2015.



Water Classification

The Union River downstream of the Graham Lake Dam is classified Class B (38 M.R.S.A § 467(18)(A)(1)). With respect to designated uses, the Maine Water Quality Law requires that “Class B waters must be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as habitat for fish and other aquatic life. The habitat must be characterized as unimpaired” (38 M.R.S.A. § 465(3)(A)). The word “unimpaired” is defined to mean “without a diminished capacity to support aquatic life” (38 M.R.S.A. § 466(11)). In addition, for Class B waters, “Discharges to Class B waters may not cause adverse impact to aquatic life in that the receiving waters must be of sufficient quality to support all aquatic species indigenous to the receiving water without detrimental changes in the resident biological community” (38 M.R.S.A. § 465(3)(C)). The term “resident biological community” is defined as “aquatic life expected to exist in a habitat which is free from the influence of the discharge of any pollutant” (38 M.R.S.A. § 466(10)). The term “without detrimental changes in the resident

biological community” means no significant loss of species or excessive dominance by any species or group of species attributable to human activity” ((38 M.R.S.A. § 466(12)).

Study Methods

The Maine Department of Environmental Protection (DEP) "Methods for Biological Sampling and Analysis of Maine's Inland Waters" (Davies and Tsomides 2002) were used as the basis of the field and laboratory procedures in the macroinvertebrate sampling study. A summary of these methods is given below.

The DEP standard rock bag samplers were used for this study. These samplers hold approximately 16 lbs of clean, washed, bank-run cobble, graded to uniform diameter range of 1.5 to 3 inches. Three (3) samplers were placed at each sample site; samplers are left in the river for approximately 28 days (\pm 4 days) to allow for invertebrate colonization. Retrieval of the samplers was done using an aquatic D-net. The net was placed directly downstream of a sampler; the sampler was then picked up and placed in the net. The contents of each sampler and the net were washed through a sieve bucket and preserved in labeled jars. Habitat measurements including substrate type, depth, and temperature were collected at sampler collection retrieval.

Samples from Sites 2 and 3 were collected, preserved, and transported to the Moody Mountain Environmental laboratory. Samples from Site 1 had been pulled up and then dropped again to the bottom. Because of the obvious disturbance the samplers were not further analyzed.

The three (3) samplers (replicates) from Sites 2 and 3 were sorted, identified, and enumerated.

Results

The samplers were placed in the river on July 15, 2015. Samplers were retrieved on August 11, 2015. Habitat measurements for Site 2 and 3 are shown in Table 1. Photos of the areas around the samples sites are included below.

Table 1. Habitat measurements in the Union River downstream of Graham Lake Dam for aquatic macroinvertebrate sampling. July 2015

Macroinvertebrate Field Data Sheet

Log Number _____	Directions _____	Type of Sampler RB
Station Number 2	_____	Date Deployed 7-15-15
Waterbody Union	_____	Number Deployed 3
River Basin Union	Lat-Long Coordinates _____	Date Retrieved 8-11-15
Town Ellsworth	Latitude 44°35'11.29"N	Number Retrieved 3
Stream Order 6	Longitude 68°26'31.47"W	Collector(s) P Leeper MME

1. Land Use (surrounding watershed)	2. Terrain	3. Canopy Cover
<input type="checkbox"/> Urban	<input type="checkbox"/> Upland conifer	<input type="checkbox"/> Dense (75-100% shaded)
<input type="checkbox"/> Cultivated	<input checked="" type="checkbox"/> Swamp hardwood	<input type="checkbox"/> Partly open (25-75% shaded)
<input type="checkbox"/> Pasture	<input type="checkbox"/> Swamp conifer	<input checked="" type="checkbox"/> Open (0-25% shaded)
<input checked="" type="checkbox"/> Upland hardwood	<input type="checkbox"/> Marsh	(% daily direct sun) <u>100%</u>
	<input type="checkbox"/> Flat	
	<input checked="" type="checkbox"/> Rolling	
	<input type="checkbox"/> Hilly	
	<input type="checkbox"/> Mountains	

4. Physical Characteristics of Bottom estimate % over 12 m stretch					
<input type="checkbox"/> Bedrock	[30]	<input type="checkbox"/> Cobble (2.5" – 10")	[30]	<input type="checkbox"/> Sand (<1/8")	<input type="checkbox"/> Clay
[20]	<input type="checkbox"/> Boulders (>10")	[20]	<input type="checkbox"/> Gravel (1/8" – 2.5")	<input type="checkbox"/> Silt	<input type="checkbox"/> Muck

5. Habitat Characteristics (immediate area)		Temp. Probe # <input type="checkbox"/> deployed	7. Water Samples
Time 1030h	Time _____	6. Observations 7-15-15 – Tapegrass sunken timber	<input type="checkbox"/> Standard
Wetted Width _____	Wetted Width (m) Bank _____		<input type="checkbox"/> Other
Bank Fl Width 193'	Full Width (m) _____		Lab Number _____
Depth 3.8'	Depth _____		8. Photograph <u>Put-In</u> Yes <u>Take-Out</u> Yes
Velocity 0.57f/s	Velocity <u>0.55</u>		
Diss. O ₂ (ppm) 8.6	Diss. O ₂ (ppm) <u>8.3</u>		
Temp (C) 23.3	Temp (C) <u>22.3</u>		
Turbidity 3.72 ntu	Turbidity _____		
DO Meter # _____ Cal? Y / N?	DO Meter # _____ Cal? Y / N		

Table 1 continued.

Macroinvertebrate Field Data Sheet

Log Number _____	Directions _____	Type of Sampler RB
Station Number 3	_____	Date Deployed 7-15-15
Waterbody Union	_____	Number Deployed 3
River Basin Union	Lat-Long Coordinates _____	Date Retrieved 8-11-15
Town Ellsworth	Latitude 44°34'1.79"N	Number Retrieved 3
Stream Order 6	Longitude 68°26'35.79"W	Collector(s) P Leeper MME

1. Land Use (surrounding watershed)		2. Terrain	3. Canopy Cover
<input type="checkbox"/> Urban	<input type="checkbox"/> Upland conifer	<input type="checkbox"/> Flat	<input type="checkbox"/> Dense (75-100% shaded)
<input type="checkbox"/> Cultivated	<input checked="" type="checkbox"/> Swamp hardwood	<input checked="" type="checkbox"/> Rolling	<input type="checkbox"/> Partly open (25-75% shaded)
<input type="checkbox"/> Pasture	<input type="checkbox"/> Swamp conifer	<input type="checkbox"/> Hilly	<input checked="" type="checkbox"/> Open (0-25% shaded)
<input checked="" type="checkbox"/> Upland hardwood	<input type="checkbox"/> Marsh	<input type="checkbox"/> Mountains	(% daily direct sun) <u>100%</u>

4. Physical Characteristics of Bottom estimate % over 12 m stretch			
[40]	Bedrock	[20]	Cobble (2.5" – 10")
[]		[]	Sand (<1/8")
[]	Clay	[]	
[20]	Boulders (>10")	[20]	Gravel (1/8" – 2.5")
[]		[]	Silt
[]		[]	Muck

5. Habitat Characteristics (immediate area)		Temp. Probe #	7. Water Samples
Time 1115h	Time 1140h	<input type="checkbox"/> deployed	<input type="checkbox"/> Standard
Wetted Width	Wetted Width (m) Bank	6. Observations	<input type="checkbox"/> Other
Bank Fl Width 167'	Full Width (m)		Lab Number
Depth 2.7'	Depth	8. Photograph	
Velocity 2.06f/s	Velocity 1.2f/s	Put-In <u>Yes</u>	
Diss. O ₂ (ppm) 8.4	Diss. O ₂ (ppm) 8.3	Take-Out <u>Yes</u>	
Temp (C) 22.9	Temp (C) 22.8		
Turbidity 3.94ntu	Turbidity		
DO Meter # _____ Cal? Y/N?	DO Meter # _____ Cal? Y/N?		

Photo 1. Sample Site 2 view southeast (downstream). Union R. 7-15-15



Photo 2. Sample Site 2 view north (upstream). Union R. 7-15-15



Photo 3. Sample Site 2 view west. Union R. 7-15-15



Photo 4. Sample Site 3 view southeast (downstream). Union R. 7-15-15



Photo 5. Sample Site 3 view northeast (upstream). Union R. 7-15-15



Photo 6. Sample Site 3 view west. Union R. 7-15-15



Photo 7. Sample Site 3 view east. Union R. 7-15-15



Sites 2 and 3 Community Analysis

The macroinvertebrate communities sampled downstream of the Graham Lake Dam were abundant but not very rich in taxa (Appendix 1). The community at Site 2 was populated with 26 different taxa with a Mean Total Abundance of 355. The Site 3 community was much more numerous (Total Abundance of 2430) but was less rich with 15 taxa. Both communities were dominated by filter-feeding caddisflies, representing over 67% of Total Abundance at Site 2 and over 93% at Site 3. The Diversity values were correspondingly low at 1.70 (Site 2) and 1.76 (Site 3). Structural indices for the sampled community are shown in Tables 2 and 3.

Table 2. Indices of community structure for the aquatic invertebrate community downstream of the Graham Lake Dam. Union River, July-August 2015.

Site	Tot. Abund.	Taxa Richness	S-W Div.	Hils. Biotic Index (HBN)	Water Quality indication from HBN	Mayfly, Stonefly, Caddisfly (EPT) Richness	Mayfly, Stonefly (EP)		Midge	
							Rich	% Ab	Rich	% Ab
Site 2	355	26	1.70	4.30	Good	10	3	3.3	9	4.7
Site 3	2430	15	1.76	4.36	Good	9	2	2.0	4	2.0

Indexes measuring the tolerance to poor water quality conditions revealed that caddisflies adapted to a wide range of conditions dominated the communities. The EP index of sensitive mayflies and stoneflies showed 3 and 2 taxa respectively. These insect orders represented less than 4% of the communities. No stoneflies were collected at either sampling site. The Hilsenhoff Biotic Index values, 4.30 (Site 2) and 4.36 (Site 3), indicated good water quality (Hilsenhoff 1987).

Dominant organisms (representing over 5% of the Total Abundance) in the community are shown in Table 3 arranged from the most sensitive organisms to the organisms most tolerant of poor water quality conditions. The Site 2 community had four (4) organisms that made up 84% of the total abundance. This community was dominated by intermediate organisms (middling between sensitive and tolerant). The Site 3 community had five (5) organisms that made up 94% of the community. Intermediate organisms also dominated this community although, it should be noted that sensitive organisms made up 21% of the community.

Table 3. Dominant aquatic invertebrate organisms downstream of the Graham Lake Dam. Union River, July- August 2015.

	Site 2		Site 3	
Sensitivity to Poor Water Quality	Dominant Organism	% of Community	Dominant Organism	% of Community
Sensitive			Macrostemum	15
			Chimarra	6
Intermediate	Cheumatopsyche	54	Hydropsyche	29
	Neureclipsis	11	Cheumatopsyche	31
			Neureclipsis	13
Tolerant	Hydrobiidae	11		
	Planariidae	8		

The community structure and function found downstream of the Graham Lake Dam on the Union River indicates evidence of organic enrichment and filter-feeder dominance which is a

common phenomenon below lake outlets and impoundments (Hynes 1970, Spence and Hynes 1970, Parker and Voshell 1983).

Enrichment and caddisfly dominance downstream of lake outlets and dam outlets is a common phenomenon that has long been reported in the literature. Illies (1956 in Spence and Hynes 1970) reported an increase in the number of filter-feeding Trichoptera below a lake when compared to upstream communities. He attributed this to an increase in food availability. Filter-feeding organisms, including *Cheumatopsyche* and *Neureclipsis*, are often the dominant organism in streams and rivers (Hynes 1970) and frequently are very abundant at lake outlets (Carlsson et al. 1977; Valett and Stanford 1987). The density or biomass of these filter-feeders typically decline the farther one looks downstream (Osgood 1979). This blossoming and decline of the aquatic community may be in response to a gradient in the quantity and/or quality of the food resources. High quality lake seston (the particulate matter in the water), typically made up of algal cells, is processed by the filter-feeders near the outlet and may be transformed to lower quality detritus (Benke and Wallace 1980, Valett and Stanford 1987).

This phenomenon has also been long observed at impoundment outlets. Spence and Hynes (1971) reported increased numbers of Hydropsychidae (*Cheumatopsyche* is a genus in the family Hydropsychidae) and other organisms downstream of an impoundment and stated that the downstream differences were comparable to mild organic enrichment. Parker and Voshell (1983) reported production of filter-feeding Trichoptera to be the highest at a site closest to the dam when compared to sites farther downstream and sites on free-flowing rivers. They concluded that, not only the amount of high quality food, but the specific size of the seston, contributed to the ability of the caddisflies to occupy this niche.

Of note in this study was the increase in filter-feeders at the most downstream site (Site 3) compared with the site 1.6 miles closer to the dam (Site 2). It may be that the slow meandering riverine habitat between the two sites also produces large amounts of algae that is then available to the filter-feeders.

The communities sampled are influenced by the food suspended in the water. This resource allows the aquatic caddisfly filter feeders to flourish. However, the lack of stoneflies in

the community, and the small proportion of mayflies, indicates changes to the resident biological community.

Therefore is my professional opinion that the communities downstream of Graham Lake Dam on the Union River do not attain Class B aquatic life standards.

Summary

1. The objective of the macroinvertebrate sampling study was to generate data on the aquatic macroinvertebrate community in the Union River downstream of the Graham Lake Dam and assess this community in terms of Maine's Aquatic Life Standards. The Union River downstream of the dam is classified Class B.
2. The Maine Department of Environmental Protection (DEP) "Methods for Biological Sampling and Analysis of Maine's Inland Waters" (Davies and Tsomides 2002) were used as the basis of the field and laboratory procedures in this study.
3. Samplers were retrieved from two sample sites, 950 ft and 1750 ft and 1.92 miles downstream of the dam, on August 11, 2015 within an acceptable colonization time frame. Site 1 samplers had been disturbed and were not analyzed further.
4. The invertebrate communities sampled downstream of the Graham Lake Dam were abundant, and dominated by filter-feeders. The dominance of filter-feeders is a natural response to the food resource exiting the lake. This response is also found at natural lake outlets. The most downstream community may be responding to food produced in the slow riverine habitat upstream.
5. The community structure and function found downstream of the Graham Lake Dam: specifically the lack of stoneflies and the small numbers of mayflies indicates that there have been changes to the resident biological community.
6. It is my professional opinion that the macroinvertebrate communities sampled downstream of the Graham Lake Dam on the Union River do not attain Class B aquatic life standards.
7. The data was sent to MDEP for analysis in the State's linear discriminant model, and based on the model results and best professional judgment, the MDEP determined that the sites attained Class C standards.

References

- Benke, A.C. and J.B. Wallace. 1980. Trophic basis of production among net-spinning caddisflies in a southern Appalachian stream. *Ecology* 61: 108-118.
- Carlsson, M., L.M. Nilsson, Bj. Svensson, and S. Ulfstrand, 1977. Lacustrine seston and other factors influencing blackflies (Diptera: Simuliidae) inhabiting lake outlets in Swedish Lapland. *Oikos* 29: 229-238.
- Davies, S.P. and L. Tsomides. 2002. Methods for biological sampling and analysis of Maine's rivers and streams. ME Dept. of Env. Prot. Augusta, ME. 31p.
- Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. *The Great Lake Entomologist*. Pgs. 31-39.
- Hynes, H.B.N. 1970. *The Ecology of Running Waters*. Univ. of Toronto. Toronto, CA 555p.
- Osgood, M.W. 1979. Abundance patterns of filter-feeding caddisflies (Trichoptera: Hydropsychidae) and seston in a Montana (U.S.A.) lake outlet. *Hydrobiologia* Vol. 63 (2):177-183.
- Parker, C.R. and J.R. Voshell Jr. 1983. Production of filter-feeding Trichoptera in an impounded and a free-flowing river. *Can. J. Zool.* 61:70-87.
- Spence, J.A., and H.B.N. Hynes. 1971. Differences in benthos upstream and downstream of an impoundment. *J. Fish. Res. Bd. Canada* 28: 35-43.
- Valett, H.M. and A. Stanford. 1987. Food quality and Hydropsychidae caddisfly density in a lake outlet stream in Glacier National Park, Montana, U.S.A. *Can. J. Fish Aquat. Sci.* 44: 77-82.

Appendix 1

Site 2					
Taxon Name	Rep 1	Rep 2	Rep 3	Total	%
Planariidae	29	29	24	27.3	7.7%
Annelida	1	3	2	2.0	0.6%
Hyaella azteca	1	0	0	0.3	0.1%
Argia	4	2	5	3.7	1.0%
Heptageniidae	21	3	9	11.0	3.1%
Stenonema	1	0	1	0.7	0.2%
Attenella	1	0	0	0.3	0.1%
Neureclipsis	35	40	47	40.7	11.5%
Cheumatopsyche	246	130	202	192.7	54.3%
Macrostemum	4	3	11	6.0	1.7%
Ochrotrichia	4	7	2	4.3	1.2%
Oxyethira	0	1	0	0.3	0.1%
Ceraclea	5	1	1	2.3	0.7%
Oecetis	2	1	4	2.3	0.7%
Sialis	0	1	0	0.3	0.1%
Ablabesmyia	22	6	3	10.3	2.9%
Pentaneura	0	0	1	0.3	0.1%
Cricotopus	0	1	0	0.3	0.1%
Nanocladius	2	2	0	1.3	0.4%
Tanytarsus	1	1	0	0.7	0.2%
Dicrotendipes	1	0	0	0.3	0.1%
Microtendipes	0	0	1	0.3	0.1%
Parachironomus	5	2	2	3.0	0.8%
Polypedilum	0	1	0	0.3	0.1%
Hydrobiidae	32	60	23	38.3	10.8%
Sphaeriidae	0	15	1	5.3	1.5%

Richness **26**

Total Ab. **355**

Site 3					
Taxon Name	Rep 1	Rep 2	Rep 3	Total	%
Planariidae	40	8	32	26.7	1.1%
Baetidae	17	2	24	14.3	0.6%
Heptageniidae	47	0	24	23.7	1.0%
Plauditus	0	1	0	0.3	0.0%
Stenonema	16	5	8	9.7	0.4%
Chimarra	72	223	168	154.3	6.4%
Neureclipsis	80	192	640	304.0	12.5%
Cheumatopsyche	496	1271	477	748.0	30.8%
Hydropsyche	688	930	498	705.3	29.0%
Macrostemum	280	602	181	354.3	14.6%
Ochrotrichia	38	1	9	16.0	0.7%
Oecetis	42	1	3	15.3	0.6%
Ablabesmyia	6	11	2	6.3	0.3%
Cricotopus	0	3	4	2.3	0.1%
Rheotanytarsus	3	2	2	2.3	0.1%
Polypedilum	7	118	16	47.0	1.9%
Simulium	0	1	0	0.3	0.0%

Richness 15
Tot. Ab. 2430.3

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APPENDIX E-4
FLOW STUDY REPORT – ADDITIONAL INFORMATION

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**Additional Information on the Instream Flow and Union River
Tributary Access Study**

The following information is provided in response to requested information by stakeholders in comments on the Updated Study Report, which was filed with FERC on August 21, 2015. The requested information consists of:

1. Calculations for extrapolated data down to the minimum flows of 105 cfs.
2. Updated transect profile data showing the extrapolated 105 cfs.
3. Field data used to calculate extrapolated data
4. Photographs of the tributary stream connectivity at the lowest observed flow of 150 cfs

The field study was conducted under low flow conditions that were estimated by Black Bear to be 150 cfs based on Graham Lake Dam gate settings. Since the licensed minimum flow is 105 cfs, the hydraulic parameters, including wetted width, depth and average velocity were extrapolated down to 105 cfs based on the four measured flows observed during the study. Further information was requested to explain the USR Flow Study extrapolation used to estimate the hydraulic parameters for a flow of 105 cfs. The USR Table 3-11 provided the extrapolated values for the hydraulic parameters estimated for a flow of 105 cfs. Note that the red text indicates the addition to the USR table to provide clarification requested after agency review of the USR.

**(USR) Table 3-11: Extrapolated Transect Hydraulic Parameters
at Graham Lake Dam Release Flow of 105 cfs**

Transect		Estimated Hydraulic Parameters at Graham Lake Dam Release Flow of 105 cfs ³				
Sub-Reach	Type	Wetted Width (ft)	Wetted Width % Bankfull	Wetted Area (sq ft)	Maximum Depth (ft)	Average Velocity ¹ (ft/s)
Upper	Riffle/Run	304.0	83	941	6.5	0.12
	Pool ²	123 (191)	55 (83)	695	9.2	0.16
Middle	Riffle	178.8	74	316	6.7	0.35
	Pool	172.0	73	404	4.5	0.27
	Run	128.1	68	238	2.8	0.47
Lower	Riffle	173.1	73	739	9.1	0.15
	Pool/Run	139.3	74	1,061	11.0	0.10

Notes:

¹The average velocity is the channel average velocity based on the wetted transect area and a Graham Lake Dam release flow of 105 cfs, and does not include potential flow contribution below Graham Lake Dam.

²Both the measured wetted width at the vegetated low terrace, and the estimated wetted width of the pool just upstream of the vegetated low terrace in parenthesis, are provided to best represent the pool transect.

³Hydraulic parameters presented are estimated for the minimum flow of 105 cfs by using extrapolation from the measured parameter from four observed flows to the estimated parameter value at the flow of 105 cfs provided in this table. The extrapolation is calculated using the “Interpolate” function available in the *XIXtrFun* function add-in package for Microsoft Excel, which is a free software download available at www.xlxtrfun.com.

The USR Figures 3-23, 3-24 and 3-25 provide the graphic representation of this extrapolation. The extrapolation is calculated using double parabolic curve interpolation, to allow for an array of values to be used to fit a curve to estimate an additional value not measured. *XIXtrFun* is a collection of functions which extends the capabilities of Microsoft Excel, developed primarily to facilitate interpolation of 2-dimensional and 3-dimensional data, and simplify 2-variable curve fitting. The “Interpolate” function available in the *XIXtrFun* function add-in package for Microsoft Excel was utilized to develop the double parabolic curve for the measured data and estimate additional data along this curve. An example of the extrapolation equation used in the Microsoft Excel function “Interpolate” is provided below:

Extrapolated wetted width for 105 cfs = Interpolate ((Array of X= Measured Discharges 150, 300, 1,350, and 2,100), (Array of Y=Measured Wetted Width 310, 329, 358, 362, 366), (Given X= Extrapolated Discharge 105 cfs), (Extrapolation=True), (Parabolic=True))

The following table provides the example of the extrapolation setup.

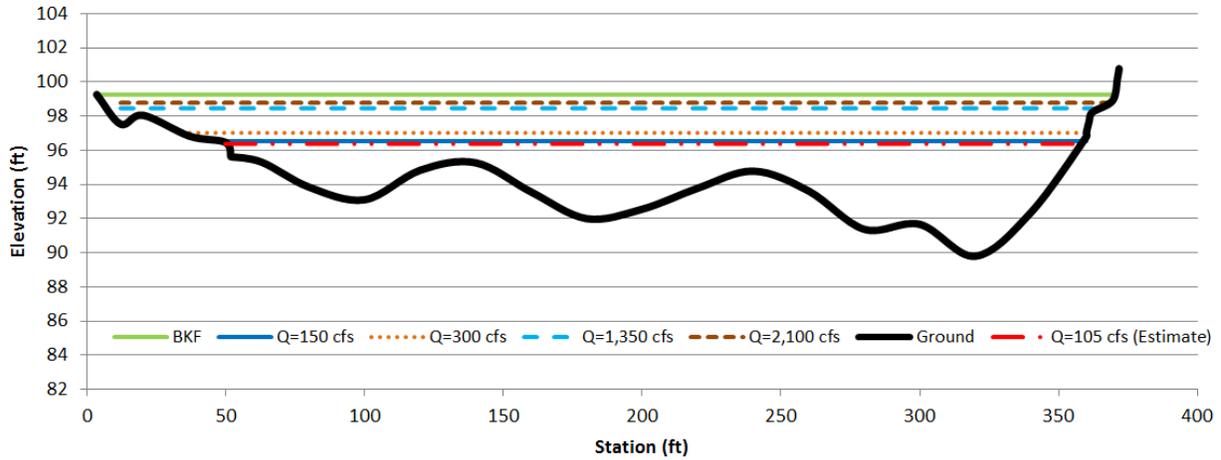
(Extra Table for example of extrapolation): Example of Extrapolation for Wetted Width for Instream Flow and Tributary Access Study Transects

Transect		Example Calculation Equation Components	Graham Dam Release Discharge (cfs)	Wetted Width (ft)
Sub-Reach	Type			
Upper Reach	Riffle/Run	Extrapolated Value	105	304
		Array Values of Measured Data	150	310
			300	329
			1,350	358
			2,100	362
			Bankfull	366

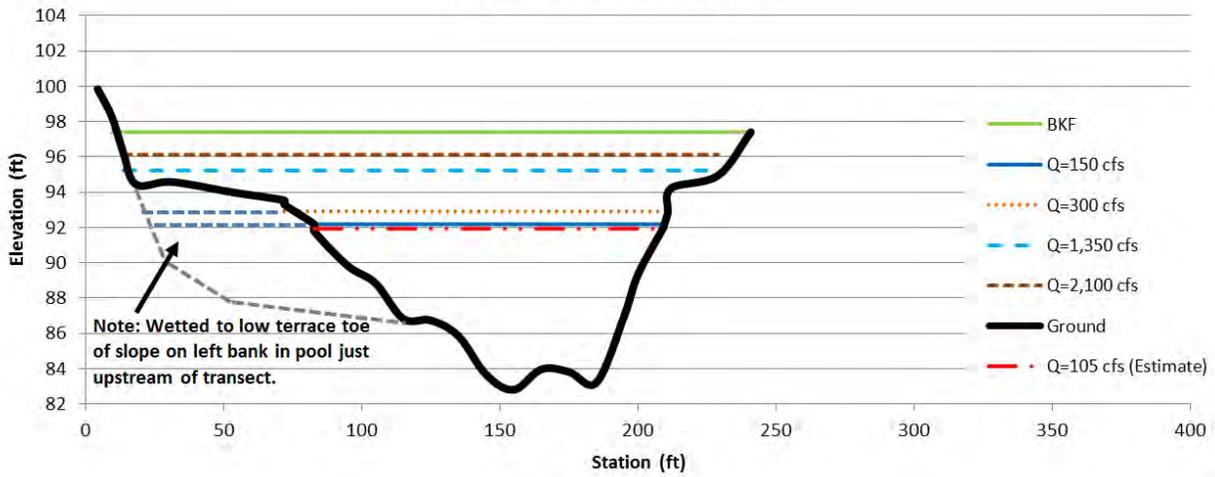
Further information was requested to explain the USR Flow Study minimum depth estimated at each transect for a flow of 105 cfs. The following Figures are the USR Figures 3-23, 3-24 and 3-25, updated to add the estimated water surface level at each transect for a flow of 105 cfs. These Figures show that there is very little difference in the water level at each transect between a flow of 150 cfs and a flow of 105 cfs, and suggest that at a flow of 105 cfs, the Study reach continues

to meet the aquatic habitat criteria providing adequate wetted area to provide connectivity for adequate zone of passage.

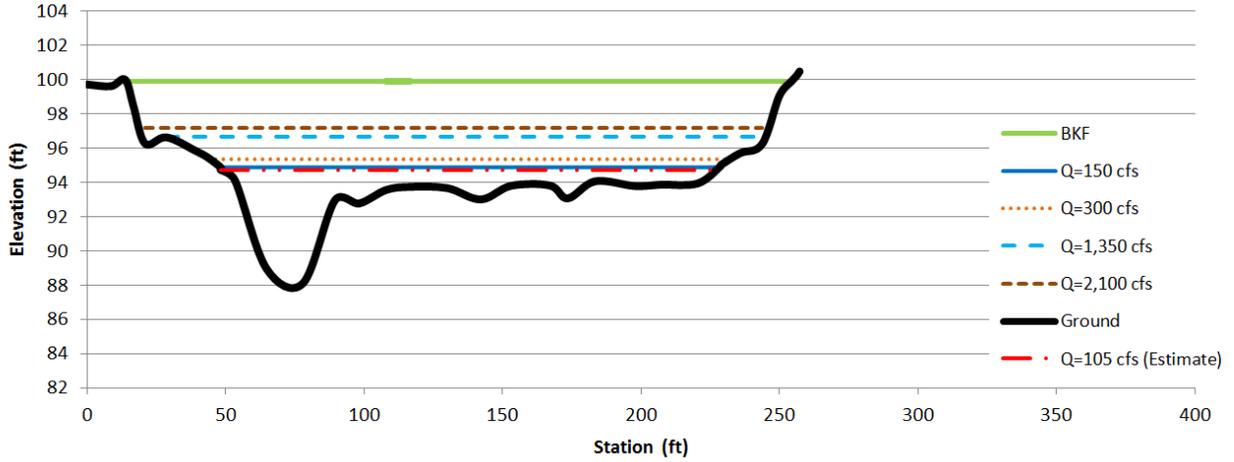
Upper Reach - Riffle



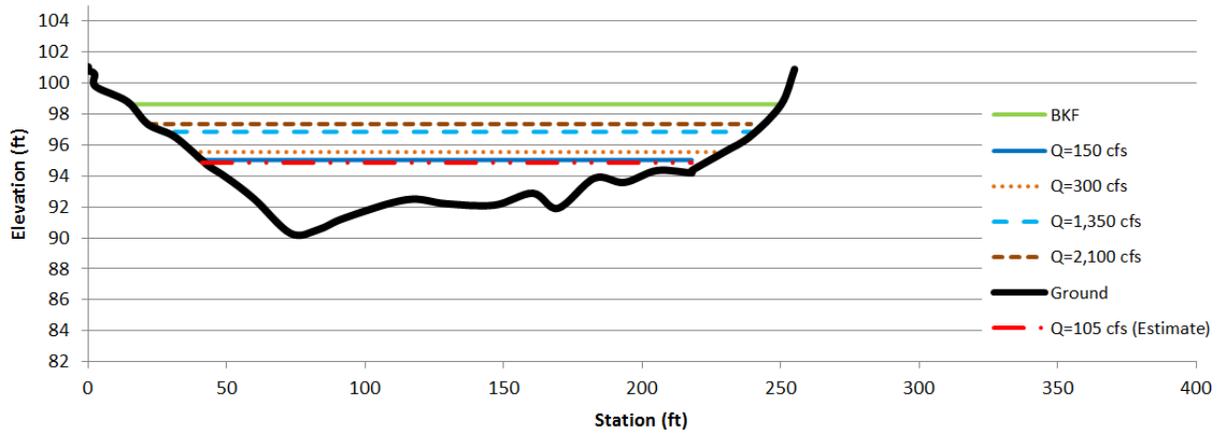
Upper Reach - Pool



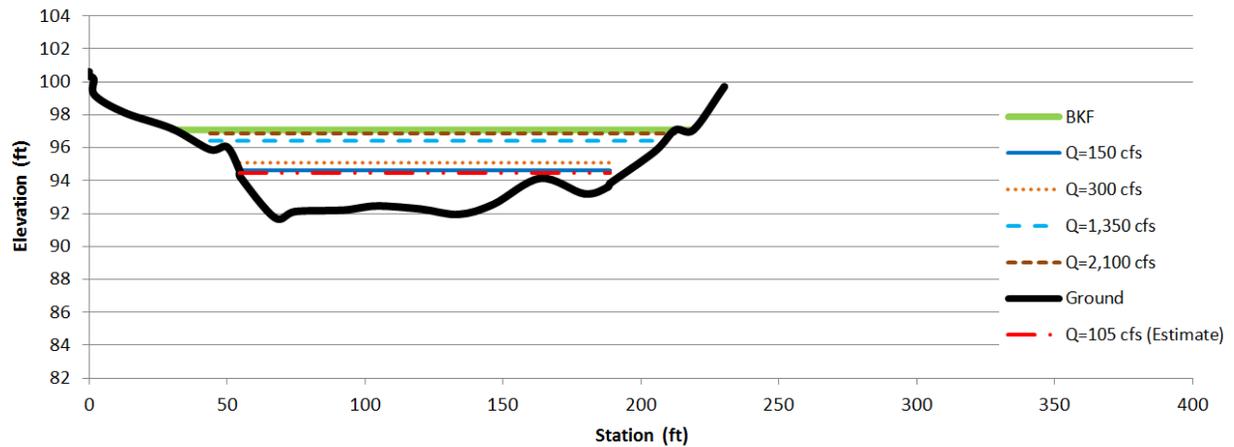
Middle Reach - Riffle



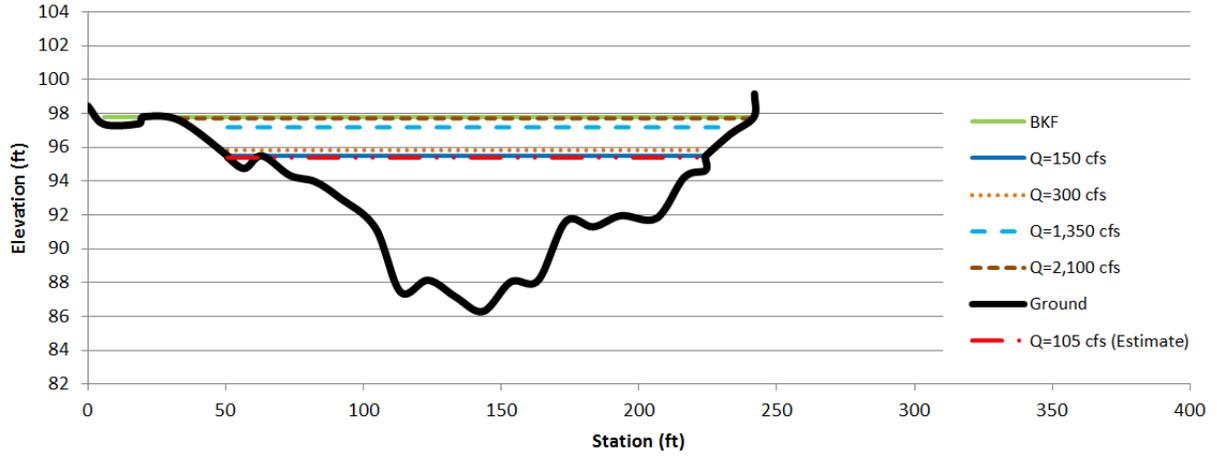
Middle Reach - Pool



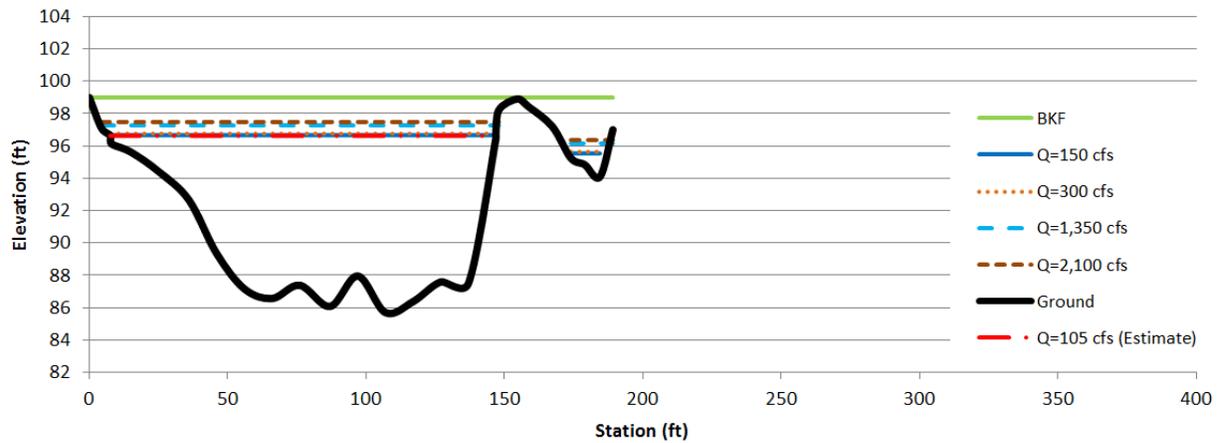
Middle Reach - Run



Lower Reach - Riffle



Lower Reach - Pool



Further information was requested to provide the field collected and calculated data for the USR Flow Study. This data is provided below.

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Upper Reach Flow Data

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Project	Ellsworth Flow Study			
Transect Name	Upper Reach Riffle	Date	9/9/2014	
Purpose / Project	Verification flow measurement reportedly 150 cfs	Time	Begin	17:30
			End	18:15
Conditions / Test	Minimum flow			
Transect Location	Union River - Upstream of Rt 1A Bridge			
Zero Station Location				
Verification Team	Gagnon/Sears/MacVane	Total Flow =	235.7	cfs

Data									Comment
Field Measurements					Calculations				
Personnel / Method	Node	Station Distance (ft) <small>(tag line)</small>	Station Depth (ft)	Mean Station Velocity (ft/sec)	Incremental Nodal Area (ft ²)	Incremental Mean Nodal Velocity (ft/sec)	Incremental Nodal Flow (cfs)	Total Accumulated Flow (cfs)	
Manual	0	51.8	0.00	0.000	0.00	0.00	0.00	0.00	
Manual	1	53.4	0.80	0.650	0.64	0.33	0.21	0.21	LEW
Manual	2	59.0	1.00	0.530	5.04	0.59	2.97	3.18	
Manual	3	64.0	1.20	0.670	5.50	0.60	3.30	6.48	
Manual	4	75.0	2.20	0.010	18.70	0.34	6.36	12.84	Large Boulders US
Manual	5	90.0	3.40	0.535	42.00	0.27	11.45	24.28	
Manual	6	105.0	3.40	0.535	51.00	0.54	27.29	51.57	
Manual	7	120.0	1.80	0.700	39.00	0.62	24.08	75.65	
Manual	8	135.0	1.40	0.020	24.00	0.36	8.64	84.29	Large Boulders US
Manual	9	150.0	2.20	0.660	27.00	0.34	9.18	93.47	
Manual	10	165.0	3.10	0.700	39.75	0.68	27.03	120.50	Large Woody Debris US
Manual	11	180.0	4.40	0.350	56.25	0.53	29.53	150.03	Large Woody Debris US
Manual	12	195.0	3.30	0.315	57.75	0.33	19.20	169.24	Large Woody Debris US
Manual	13	210.0	3.00	0.280	47.25	0.30	14.06	183.29	Large Woody Debris US
Manual	14	225.0	3.00	0.140	45.00	0.21	9.45	192.74	
Manual	15	240.0	1.80	0.310	36.00	0.23	8.10	200.84	
Manual	16	260.0	2.92	0.150	47.15	0.23	10.84	211.69	Too deep for wading measurement;
Manual	17	280.0	5.155	0.1	80.70	0.13	10.09	221.77	no flow due to large woody debris in velocity columns
Manual	18	300.0	4.86	0.05	100.15	0.08	7.51	229.29	Use depth from transect tapper velocity to 0
Manual	19	320.0	6.73	0.025	115.90	0.04	4.35	233.63	
Manual	20	340.0	4.176	0.01	109.06	0.02	1.91	235.54	
Manual	21	360.0	0	0	41.76	0.01	0.21	235.75	REW
Manual	22				0.00	0.00	0.00	235.75	
Manual	23				0.00	0.00	0.00	235.75	
Manual	24				0.00	0.00	0.00	235.75	
Manual	25				0.00	0.00	0.00	235.75	
Manual	26				0.00	0.00	0.00	235.75	
Manual	27				0.00	0.00	0.00	235.75	
Manual	28				0.00	0.00	0.00	235.75	
Manual	29				0.00	0.00	0.00	235.75	
Manual	30				0.00	0.00	0.00	235.75	
Manual	31				0.00	0.00	0.00	235.75	
Manual	32				0.00	0.00	0.00	235.75	
Manual	33				0.00	0.00	0.00	235.75	
Manual	34				0.00	0.00	0.00	235.75	
Manual	35				0.00	0.00	0.00	235.75	
Manual	36				0.00	0.00	0.00	235.75	
Manual	37				0.00	0.00	0.00	235.75	
Manual	38				0.00	0.00	0.00	235.75	
Manual	39				0.00	0.00	0.00	235.75	
Manual	40				0.00	0.00	0.00	235.75	
Manual	41				0.00	0.00	0.00	235.75	
Manual	42				0.00	0.00	0.00	235.75	
Manual	43				0.00	0.00	0.00	235.75	
Manual	44				0.00	0.00	0.00	235.75	
Manual	45				0.00	0.00	0.00	235.75	
Manual	46				0.00	0.00	0.00	235.75	
Manual	47				0.00	0.00	0.00	235.75	
Manual	48				0.00	0.00	0.00	235.75	
Manual	49				0.00	0.00	0.00	235.75	
Manual	50				0.00	0.00	0.00	235.75	
Manual	51				0.00	0.00	0.00	235.75	

Project	Ellsworth Flow Study			
Transect Name	Upper Reach Pool	Date	9/9/2014	
Purpose / Project	Verification flow measurement reportedly 150 cfs	Time	Begin	17:30
			End	18:15
Conditions / Test	Minimum flow			
Transect Location	Union River - Upstream of Rt 1A Bridge			
Zero Station Location				
Verification Team	Gagnon/Sears/MacVane	Total Flow =	283.8	cfs

Data									Comment
Field Measurements					Calculations				
Personnel / Method	Node	Station Distance (ft) <small>(tag line)</small>	Station Depth (ft)	Mean Station Velocity (ft/sec)	Incremental Nodal Area (ft ²)	Incremental Mean Nodal Velocity (ft/sec)	Incremental Nodal Flow (cfs)	Total Accumulated Flow (cfs)	
Manual	0	82.8	0.00	0.000	0.00	0.00	0.00	0.00	
Manual	1	90.4	1.30	0.000	4.94	0.00	0.00	0.00	LEW
Manual	2	95.0	2.50	0.030	8.74	0.02	0.13	0.13	Boulder/Bedrock outcrop
Manual	3	100.0	3.20	0.095	14.25	0.06	0.89	1.02	Boulder/Bedrock outcrop
Manual	4	105.0	4.40	0.275	19.00	0.19	3.52	4.54	Woody debris
Manual	5	110.0	4.60	0.255	22.50	0.27	5.96	10.50	
Manual	6	115.0	4.60	0.420	23.00	0.34	7.76	18.26	
Manual	7	120.0	5.20	0.480	24.50	0.45	11.03	29.29	
Manual	8	125.0	5.70	0.360	27.25	0.42	11.45	40.73	Woody debris
Manual	9	130.0	6.50	0.405	30.50	0.38	11.67	52.40	
Manual	10	135.0	5.90	0.395	31.00	0.40	12.40	64.80	TWG
Manual	11	140.0	6.30	0.505	30.50	0.45	13.73	78.52	Woody debris
Manual	12	145.0	8.67	0.605	37.42	0.56	20.77	99.29	Survey rod measured depth
Manual	13	150.0	8.42	0.645	42.71	0.63	26.69	125.98	Survey rod measured depth
Manual	14	155.0	9.33	0.545	44.38	0.60	26.40	152.39	Survey rod measured depth
Manual	15	160.0	8.67	0.440	45.00	0.49	22.16	174.55	Survey rod measured depth
Manual	16	165.0	8.17	0.490	42.08	0.47	19.57	194.12	Survey rod measured depth
Manual	17	170.0	7.58	0.410	39.38	0.45	17.72	211.84	Survey rod measured depth
Manual	18	175.0	8.333333	0.39	39.79	0.40	15.92	227.75	Survey rod measured depth
Manual	19	180.0	7.25	0.38	38.96	0.39	15.00	242.75	Survey rod measured depth
Manual	20	185.0	9	0.365	40.63	0.37	15.13	257.88	Survey rod measured depth
Manual	21	190.0	7.333333	0.265	40.83	0.32	12.86	270.75	Survey rod measured depth
Manual	22	195.0	4.6	0.24	29.83	0.25	7.53	278.28	
Manual	23	200.0	2.4	0.23	17.50	0.24	4.11	282.39	
Manual	24	206.0	1.5	0.01	11.70	0.12	1.40	283.80	
Manual	25	209.0	0	0	2.25	0.01	0.01	283.81	REW
Manual	26				0.00	0.00	0.00	283.81	
Manual	27				0.00	0.00	0.00	283.81	
Manual	28				0.00	0.00	0.00	283.81	
Manual	29				0.00	0.00	0.00	283.81	
Manual	30				0.00	0.00	0.00	283.81	
Manual	31				0.00	0.00	0.00	283.81	
Manual	32				0.00	0.00	0.00	283.81	
Manual	33				0.00	0.00	0.00	283.81	
Manual	34				0.00	0.00	0.00	283.81	
Manual	35				0.00	0.00	0.00	283.81	
Manual	36				0.00	0.00	0.00	283.81	
Manual	37				0.00	0.00	0.00	283.81	
Manual	38				0.00	0.00	0.00	283.81	
Manual	39				0.00	0.00	0.00	283.81	
Manual	40				0.00	0.00	0.00	283.81	
Manual	41				0.00	0.00	0.00	283.81	
Manual	42				0.00	0.00	0.00	283.81	
Manual	43				0.00	0.00	0.00	283.81	
Manual	44				0.00	0.00	0.00	283.81	
Manual	45				0.00	0.00	0.00	283.81	
Manual	46				0.00	0.00	0.00	283.81	
Manual	47				0.00	0.00	0.00	283.81	
Manual	48				0.00	0.00	0.00	283.81	
Manual	49				0.00	0.00	0.00	283.81	
Manual	50				0.00	0.00	0.00	283.81	
Manual	51				0.00	0.00	0.00	283.81	

Ellsworth
Upper Reach

Survey Date: 9/9/2014

Note: Left half transect full riffle, right half of transect riffle/run.

BM 100

Riffle	HI1 102.7188			9/9/2014	9/10/2014	9/11/2014	9/11/2014
Station	FS	El	Notes	SG Reading (inches)			
				1.5	7.375	24.625	28.5
				Q=150 cfs	Q=300 cfs	Q=1,350 cfs	Q=2,100 cfs BKF
3.5	2.71875	100	LP Top				
3.5	3.458333	99.26042	LP G BKF				
12.1	5.1875	97.53125	LT Boulders				
20.2	4.666667	98.05208	LT Boulders				
37	5.895833	96.82292	LT Boulders				
49.8	6.25	96.46875	LEW CG				
51.8	6.1875	95.625	WS LEW at SG				
51.8	7.09375	95.625	CG at SG				
63	7.416667	95.30208	CG				
80	8.875	93.84375	CG				
100	9.614583	93.10417	CG				
120	7.885417	94.83333	CG				
140	7.447917	95.27083	CG				
160	9.15625	93.5625	CG				
180	10.71875	92	CG				
200	10.16667	92.55208	CG				
220	8.9375	93.78125	CG				
240	7.9375	94.78125	CG - Boulder				
260	9.104167	93.61458	CG				
280	11.34375	91.375	CG				
300	11.05208	91.66667	CG				
320	12.91667	89.80208	CG				
340	10.36458	92.35417	CG				
360	5.927083	96.79167	REW CG; 50% Emergent Veg, barely wetted				
360	5.708333	97.01042	WS REW				
361	5.041667	97.67708	LT Toe Bank				
362.2	4.489583	98.22917	MT Top Bank				
369.5	3.8125	98.90625	MT BKF Toe				
371.2	2.520833	100.1979	HT BKF Top				
371.8	1.947917	100.7708	Tree G				

Ellsworth
Upper Reach

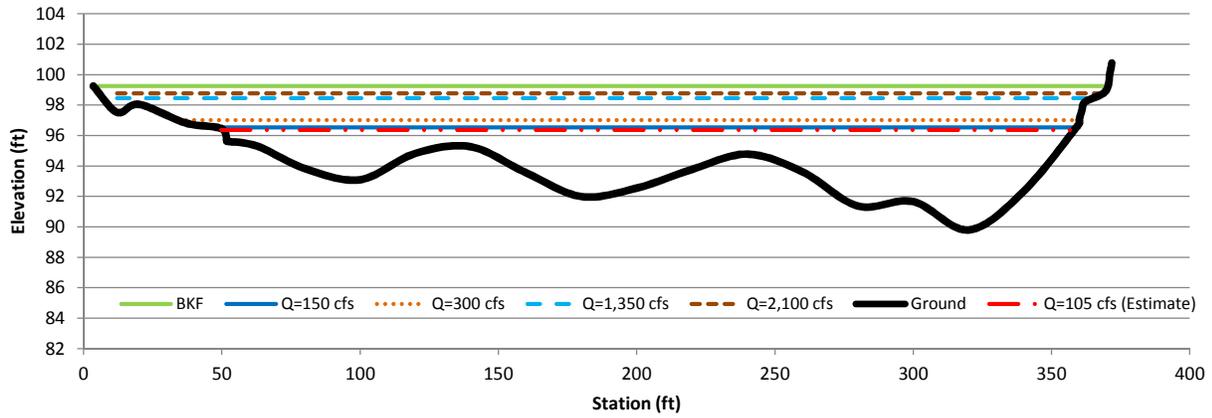
Survey Date: 9/9/2014

Note: Left LT Boulder Shelf. Transect located just upstream of Rt 1A Bridge.

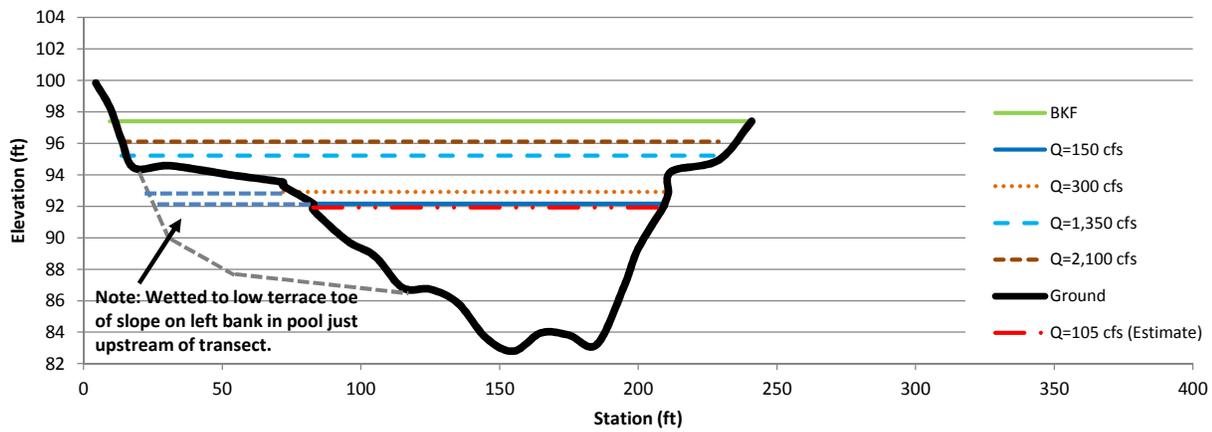
BM 100

Pool	HI1 99.66667			9/9/2014	9/10/2014	9/11/2014	9/11/2014
Station	FS	El	Notes	SG Reading (inches)			
				3.625	12.5	40.2	51
				Q=150 cfs	Q=300 cfs	Q=1,350 cfs	Q=2,100 cfs BKF
4.4	-0.16667	99.83333	LP G				
9.5	1.385417	98.28125	BKF Top HT				
13.7	3.447917	96.21875	G Mid Slope				
18.3	5.239583	94.42708	LT Toe Slope				
31.2	5.09375	94.57292	LT Boulder shelf				
52.7	5.666667	94	LT Veg Boulder shelf				
71.9	6.135417	93.53125	LT Veg Boulder shelf				
71.9	6.364583	93.30208	LT Toe riprap				
82.8	7.5	92.16667	WS LEW				
82.8	7.895833	91.77083	LEW CG				
95	9.854167	89.8125	CG Bedrock slope				
105	10.83333	88.83333	CG				
115	12.84375	86.82292	CG				
125	12.9375	86.72917	CG				
135	13.82292	85.84375	TWG				
145	16.01042	83.65625	CG				
155	16.875	82.79167	CG				
165	15.70833	83.95833	CG				
175	15.85417	83.8125	CG				
185	16.45833	83.20833	CG				
195	12.69792	86.96875	CG				
200	10.34375	89.32292	CG				
209.3	7.65625	92.01042	REW CG				
209.3	7.59375	92.07292	WS REW				
210.8	6.84375	92.82292	LT Toe Mud				
212	5.447917	94.21875	MT Top; Veg				
229	4.729167	94.9375	BKF Toe				
240.9	2.270833	97.39583	RP G BKF Top				
240.9	0.895833	98.77083	RP Top				

Upper Reach - Riffle



Upper Reach - Pool



*****WinXSPRO*****

C:\WinXPro\UpRif2.out
 Input File: C:\WinXPro\UpRif.sec
 Run Date: 10/17/14
 Analysis Procedure: Hydraulics
 Cross Section Number: 1
 Survey Date: 9/08/14

Subsections/Dividing positions

Resistance Method: Manning's n
 SECTION A
 Low Stage n 0.035
 High Stage n 0.035

Unadjusted horizontal distances used

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)
6.7	T	985.82	311.5	310.1	3.16	3.18
6.71	T	988.92	311.91	310.51	3.17	3.18
6.72	T	992.03	312.32	310.91	3.18	3.19
6.73	T	995.14	312.72	311.32	3.18	3.2
6.74	T	998.26	313.13	311.73	3.19	3.2
6.75	T	1001.38	313.54	312.13	3.19	3.21
6.76	T	1004.5	313.95	312.54	3.2	3.21
6.77	T	1007.63	314.35	312.95	3.21	3.22
6.78	T	1010.76	314.76	313.35	3.21	3.23
6.79	T	1013.9	315.17	313.76	3.22	3.23
6.8	T	1017.04	315.58	314.17	3.22	3.24
6.81	T	1020.18	315.99	314.57	3.23	3.24
6.82	T	1023.33	316.39	314.98	3.23	3.25
6.83	T	1026.48	316.8	315.38	3.24	3.25
6.84	T	1029.64	317.21	315.79	3.25	3.26
6.85	T	1032.8	317.62	316.2	3.25	3.27
6.86	T	1035.96	318.02	316.6	3.26	3.27
6.87	T	1039.13	318.43	317.01	3.26	3.28
6.88	T	1042.31	318.84	317.42	3.27	3.28
6.89	T	1045.48	319.25	317.82	3.27	3.29
6.9	T	1048.66	319.66	318.23	3.28	3.3
6.91	T	1051.85	320.06	318.64	3.29	3.3
6.92	T	1055.04	320.47	319.04	3.29	3.31
6.93	T	1058.23	320.88	319.45	3.3	3.31
6.94	T	1061.43	321.29	319.86	3.3	3.32

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
6.95	T	1064.63	321.69	320.26	3.31	3.32
6.96	T	1067.83	322.1	320.67	3.32	3.33
6.97	T	1071.04	322.51	321.08	3.32	3.34
6.98	T	1074.26	322.92	321.48	3.33	3.34
6.99	T	1077.47	323.32	321.89	3.33	3.35
7	T	1080.7	323.7	322.25	3.34	3.35
7.01	T	1083.92	324.07	322.61	3.34	3.36
7.02	T	1087.15	324.44	322.97	3.35	3.37
7.03	T	1090.38	324.6	323.13	3.36	3.37
7.04	T	1093.61	324.75	323.26	3.37	3.38
7.05	T	1096.85	324.9	323.4	3.38	3.39
7.06	T	1100.08	325.04	323.54	3.38	3.4
7.07	T	1103.32	325.19	323.67	3.39	3.41
7.08	T	1106.56	325.34	323.81	3.4	3.42
7.09	T	1109.8	325.49	323.95	3.41	3.43
7.1	T	1113.04	325.63	324.08	3.42	3.43
7.11	T	1116.28	325.78	324.22	3.43	3.44
7.12	T	1119.52	325.93	324.36	3.43	3.45
7.13	T	1122.77	326.07	324.49	3.44	3.46
7.14	T	1126.02	326.22	324.63	3.45	3.47
7.15	T	1129.26	326.37	324.77	3.46	3.48
7.16	T	1132.51	326.52	324.9	3.47	3.49
7.17	T	1135.76	326.66	325.04	3.48	3.49
7.18	T	1139.01	326.81	325.18	3.49	3.5
7.19	T	1142.27	326.96	325.31	3.49	3.51
7.2	T	1145.52	327.1	325.45	3.5	3.52
7.21	T	1148.78	327.25	325.59	3.51	3.53
7.22	T	1152.04	327.41	325.74	3.52	3.54
7.23	T	1155.29	327.56	325.89	3.53	3.55
7.24	T	1158.55	327.72	326.04	3.54	3.55
7.25	T	1161.82	327.87	326.2	3.54	3.56
7.26	T	1165.08	328.03	326.35	3.55	3.57
7.27	T	1168.34	328.18	326.5	3.56	3.58
7.28	T	1171.61	328.34	326.65	3.57	3.59
7.29	T	1174.88	328.49	326.8	3.58	3.6
7.3	T	1178.15	328.65	326.96	3.58	3.6
7.31	T	1181.42	328.8	327.11	3.59	3.61
7.32	T	1184.69	328.96	327.26	3.6	3.62
7.33	T	1187.97	329.11	327.41	3.61	3.63
7.34	T	1191.24	329.27	327.56	3.62	3.64
7.35	T	1194.52	329.42	327.71	3.63	3.65
7.36	T	1197.8	329.58	327.87	3.63	3.65
7.37	T	1201.08	329.73	328.02	3.64	3.66
7.38	T	1204.36	329.89	328.17	3.65	3.67
7.39	T	1207.64	330.04	328.32	3.66	3.68

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
7.4	T	1210.93	330.2	328.47	3.67	3.69
7.41	T	1214.21	330.36	328.62	3.68	3.69
7.42	T	1217.5	330.51	328.78	3.68	3.7
7.43	T	1220.79	330.67	328.93	3.69	3.71
7.44	T	1224.08	330.82	329.08	3.7	3.72
7.45	T	1227.37	330.98	329.23	3.71	3.73
7.46	T	1230.67	331.13	329.38	3.72	3.74
7.47	T	1233.96	331.29	329.53	3.72	3.74
7.48	T	1237.26	331.44	329.69	3.73	3.75
7.49	T	1240.56	331.6	329.84	3.74	3.76
7.5	T	1243.86	331.75	329.99	3.75	3.77
7.51	T	1247.16	331.91	330.14	3.76	3.78
7.52	T	1250.46	332.06	330.29	3.77	3.79
7.53	T	1253.77	332.22	330.44	3.77	3.79
7.54	T	1257.07	332.37	330.6	3.78	3.8
7.55	T	1260.38	332.53	330.75	3.79	3.81
7.56	T	1263.69	332.68	330.9	3.8	3.82
7.57	T	1267	332.84	331.05	3.81	3.83
7.58	T	1270.31	332.99	331.2	3.81	3.84
7.59	T	1273.62	333.15	331.35	3.82	3.84
7.6	T	1276.94	333.3	331.51	3.83	3.85
7.61	T	1280.26	333.46	331.66	3.84	3.86
7.62	T	1283.57	333.61	331.81	3.85	3.87
7.63	T	1286.89	333.77	331.96	3.86	3.88
7.64	T	1290.21	333.92	332.11	3.86	3.88
7.65	T	1293.54	334.08	332.26	3.87	3.89
7.66	T	1296.86	334.23	332.42	3.88	3.9
7.67	T	1300.19	334.39	332.57	3.89	3.91
7.68	T	1303.51	334.54	332.72	3.9	3.92
7.69	T	1306.84	334.7	332.87	3.9	3.93
7.7	T	1310.17	334.85	333.02	3.91	3.93
7.71	T	1313.5	335.01	333.18	3.92	3.94
7.72	T	1316.84	335.16	333.33	3.93	3.95
7.73	T	1320.17	335.34	333.5	3.94	3.96
7.74	T	1323.51	335.7	333.86	3.94	3.96
7.75	T	1326.85	336.06	334.21	3.95	3.97
7.76	T	1330.2	336.43	334.57	3.95	3.98
7.77	T	1333.54	336.79	334.93	3.96	3.98
7.78	T	1336.9	337.15	335.29	3.97	3.99
7.79	T	1340.25	337.51	335.64	3.97	3.99
7.8	T	1343.61	337.87	336	3.98	4
7.81	T	1346.97	338.23	336.36	3.98	4
7.82	T	1350.34	338.6	336.71	3.99	4.01
7.83	T	1353.71	338.96	337.07	3.99	4.02
7.84	T	1357.08	339.32	337.43	4	4.02

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
7.85	T	1360.46	339.68	337.78	4.01	4.03
7.86	T	1363.84	340.04	338.14	4.01	4.03
7.87	T	1367.22	340.4	338.5	4.02	4.04
7.88	T	1370.61	340.77	338.86	4.02	4.04
7.89	T	1374	341.14	339.22	4.03	4.05
7.9	T	1377.4	341.5	339.59	4.03	4.06
7.91	T	1380.79	341.87	339.95	4.04	4.06
7.92	T	1384.2	342.24	340.31	4.04	4.07
7.93	T	1387.6	342.61	340.68	4.05	4.07
7.94	T	1391.01	342.98	341.04	4.06	4.08
7.95	T	1394.42	343.34	341.4	4.06	4.08
7.96	T	1397.84	343.71	341.77	4.07	4.09
7.97	T	1401.26	344.08	342.13	4.07	4.1
7.98	T	1404.69	344.45	342.5	4.08	4.1
7.99	T	1408.11	344.81	342.86	4.08	4.11
8	T	1411.54	345.18	343.22	4.09	4.11
8.01	T	1414.98	345.55	343.59	4.09	4.12
8.02	T	1418.42	345.92	343.95	4.1	4.12
8.03	T	1421.86	346.28	344.31	4.11	4.13
8.04	T	1425.3	346.65	344.68	4.11	4.14
8.05	T	1428.75	347.02	345.04	4.12	4.14
8.06	T	1432.21	347.39	345.41	4.12	4.15
8.07	T	1435.66	347.75	345.77	4.13	4.15
8.08	T	1439.12	348.12	346.13	4.13	4.16
8.09	T	1442.59	348.49	346.5	4.14	4.16
8.1	T	1446.05	348.86	346.86	4.15	4.17
8.11	T	1449.53	349.23	347.22	4.15	4.17
8.12	T	1453	349.59	347.59	4.16	4.18
8.13	T	1456.48	349.96	347.95	4.16	4.19
8.14	T	1459.96	350.33	348.32	4.17	4.19
8.15	T	1463.45	350.7	348.68	4.17	4.2
8.16	T	1466.94	351.06	349.04	4.18	4.2
8.17	T	1470.43	351.43	349.41	4.18	4.21
8.18	T	1473.93	351.8	349.77	4.19	4.21
8.19	T	1477.43	352.17	350.13	4.2	4.22
8.2	T	1480.93	352.53	350.5	4.2	4.23
8.21	T	1484.44	352.9	350.86	4.21	4.23
8.22	T	1487.95	353.27	351.23	4.21	4.24
8.23	T	1491.46	353.64	351.59	4.22	4.24
8.24	T	1494.98	354	351.95	4.22	4.25
8.25	T	1498.5	354.36	352.31	4.23	4.25
8.26	T	1502.03	354.73	352.68	4.24	4.26
8.27	T	1505.55	355.1	353.05	4.25	4.27
8.28	T	1509.08	355.47	353.42	4.26	4.28
8.29	T	1512.61	355.84	353.79	4.26	4.29

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
8.3	T	1516.13	354.74	352.67	4.27	4.3
8.31	T	1519.66	354.81	352.74	4.28	4.31
8.32	T	1523.19	354.89	352.81	4.29	4.32
8.33	T	1526.72	354.96	352.88	4.3	4.33
8.34	T	1530.25	355.03	352.95	4.31	4.34
8.35	T	1533.78	355.11	353.02	4.32	4.34
8.36	T	1537.31	355.18	353.09	4.33	4.35
8.37	T	1540.84	355.26	353.17	4.34	4.36
8.38	T	1544.37	355.33	353.24	4.35	4.37
8.39	T	1547.91	355.41	353.31	4.36	4.38
8.4	T	1551.44	355.48	353.38	4.36	4.39
8.41	T	1554.98	355.56	353.45	4.37	4.4
8.42	T	1558.51	355.63	353.52	4.38	4.41
8.43	T	1562.05	355.73	353.62	4.39	4.42
8.44	T	1565.59	355.89	353.78	4.4	4.43
8.45	T	1569.13	356.05	353.94	4.41	4.43
8.46	T	1572.67	356.21	354.1	4.41	4.44
8.47	T	1576.21	356.37	354.25	4.42	4.45
8.48	T	1579.75	356.53	354.41	4.43	4.46
8.49	T	1583.3	356.69	354.57	4.44	4.47
8.5	T	1586.85	356.85	354.73	4.45	4.47
8.51	T	1590.4	357.01	354.88	4.45	4.48
8.52	T	1593.95	357.17	355.04	4.46	4.49
8.53	T	1597.5	357.32	355.2	4.47	4.5
8.54	T	1601.05	357.48	355.36	4.48	4.51
8.55	T	1604.61	357.64	355.51	4.49	4.51
8.56	T	1608.16	357.8	355.67	4.49	4.52
8.57	T	1611.72	357.96	355.83	4.5	4.53
8.58	T	1615.28	358.12	355.99	4.51	4.54
8.59	T	1618.84	358.28	356.14	4.52	4.55
8.6	T	1622.41	358.44	356.3	4.53	4.55
8.61	T	1625.97	358.6	356.46	4.53	4.56
8.62	T	1629.54	358.76	356.62	4.54	4.57
8.63	T	1633.1	358.92	356.77	4.55	4.58
8.64	T	1636.67	359.07	356.93	4.56	4.59
8.65	T	1640.24	359.23	357.09	4.57	4.59
8.66	T	1643.82	359.39	357.25	4.57	4.6
8.67	T	1647.39	359.55	357.4	4.58	4.61
8.68	T	1650.97	359.71	357.56	4.59	4.62
8.69	T	1654.54	359.87	357.72	4.6	4.63
8.7	T	1658.12	360.03	357.88	4.61	4.63
8.71	T	1661.7	360.19	358.04	4.61	4.64
8.72	T	1665.28	360.35	358.19	4.62	4.65
8.73	T	1668.87	360.51	358.35	4.63	4.66
8.74	T	1672.45	360.66	358.51	4.64	4.67

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
8.75	T	1676.04	360.82	358.67	4.65	4.67
8.76	T	1679.63	360.98	358.82	4.65	4.68
8.77	T	1683.22	361.14	358.98	4.66	4.69
8.78	T	1686.81	361.3	359.14	4.67	4.7
8.79	T	1690.4	361.46	359.3	4.68	4.7
8.8	T	1694	361.62	359.45	4.68	4.71
8.81	T	1697.59	361.78	359.61	4.69	4.72
8.82	T	1701.19	361.94	359.77	4.7	4.73
8.83	T	1704.79	362.1	359.93	4.71	4.74
8.84	T	1708.39	362.26	360.08	4.72	4.74
8.85	T	1711.99	362.41	360.24	4.72	4.75
8.86	T	1715.6	362.57	360.4	4.73	4.76
8.87	T	1719.2	362.73	360.56	4.74	4.77
8.88	T	1722.81	362.89	360.71	4.75	4.78
8.89	T	1726.42	363.05	360.87	4.76	4.78
8.9	T	1730.03	363.21	361.03	4.76	4.79
8.91	T	1733.64	363.37	361.19	4.77	4.8
8.92	T	1737.25	363.53	361.34	4.78	4.81
8.93	T	1740.87	363.69	361.5	4.79	4.82
8.94	T	1744.48	363.85	361.66	4.79	4.82
8.95	T	1748.1	364.01	361.82	4.8	4.83
8.96	T	1751.72	364.16	361.97	4.81	4.84
8.97	T	1755.34	364.32	362.13	4.82	4.85
8.98	T	1758.97	364.48	362.29	4.83	4.86
8.99	T	1762.59	364.64	362.45	4.83	4.86
9	T	1766.22	364.8	362.61	4.84	4.87
9.01	T	1769.85	364.96	362.76	4.85	4.88
9.02	T	1773.47	365.12	362.92	4.86	4.89
9.03	T	1777.11	365.28	363.08	4.87	4.89
9.04	T	1780.74	365.44	363.24	4.87	4.9
9.05	T	1784.37	365.6	363.39	4.88	4.91
9.06	T	1788.01	365.75	363.55	4.89	4.92
9.07	T	1791.64	365.91	363.71	4.9	4.93
9.08	T	1795.28	366.07	363.87	4.9	4.93
9.09	T	1798.92	366.23	364.02	4.91	4.94
9.1	T	1802.56	366.39	364.18	4.92	4.95
9.11	T	1806.21	366.49	364.28	4.93	4.96
9.12	T	1809.85	366.56	364.34	4.94	4.97
9.13	T	1813.5	366.63	364.4	4.95	4.98
9.14	T	1817.14	366.69	364.47	4.96	4.99
9.15	T	1820.79	366.76	364.53	4.96	4.99
9.16	T	1824.43	366.83	364.59	4.97	5
9.17	T	1828.08	366.9	364.66	4.98	5.01
9.18	T	1831.73	366.96	364.72	4.99	5.02
9.19	T	1835.38	367.03	364.78	5	5.03

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
9.2	T	1839.03	367.1	364.84	5.01	5.04
9.21	T	1842.68	367.16	364.91	5.02	5.05
9.22	T	1846.33	367.23	364.97	5.03	5.06
9.23	T	1849.98	367.3	365.03	5.04	5.07
9.24	T	1853.63	367.37	365.1	5.05	5.08
9.25	T	1857.28	367.43	365.16	5.05	5.09
9.26	T	1860.93	367.5	365.22	5.06	5.1
9.27	T	1864.59	367.57	365.28	5.07	5.1
9.28	T	1868.24	367.64	365.35	5.08	5.11
9.29	T	1871.89	367.7	365.41	5.09	5.12
9.3	T	1875.55	367.77	365.47	5.1	5.13
9.31	T	1879.21	367.84	365.54	5.11	5.14
9.32	T	1882.86	367.9	365.6	5.12	5.15
9.33	T	1886.52	367.97	365.66	5.13	5.16
9.34	T	1890.18	368.04	365.73	5.14	5.17
9.35	T	1893.83	368.11	365.79	5.14	5.18
9.36	T	1897.49	368.17	365.85	5.15	5.19
9.37	T	1901.15	368.24	365.91	5.16	5.2
9.38	T	1904.81	368.31	365.98	5.17	5.2
9.39	T	1908.47	368.38	366.04	5.18	5.21
9.4	T	1912.14	368.44	366.1	5.19	5.22
9.41	T	1915.8	368.51	366.17	5.2	5.23
9.42	T	1919.46	368.58	366.23	5.21	5.24
9.43	T	1923.12	368.65	366.29	5.22	5.25
9.44	T	1926.79	368.71	366.35	5.23	5.26
9.45	T	1930.45	368.78	366.42	5.23	5.27
9.46	T	1934.12	368.84	366.47	5.24	5.28
9.47	T	1937.78	368.86	366.48	5.25	5.29
9.48	T	1941.45	368.89	366.49	5.26	5.3
9.49	T	1945.11	368.92	366.51	5.27	5.31

*****WinXSPRO*****

C:\WinXPro\UpPool2.out
 Input File: C:\WinXPro\UpPool.sec
 Run Date: 10/17/14
 Analysis Procedure: Hydraulics
 Cross Section Number: 1
 Survey Date: 9/08/14

Subsections/Dividing positions

Resistance Method: Manning's n
 SECTION A
 Low Stage n 0.035
 High Stage n 0.035

Unadjusted horizontal distances used

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)
9.3	T	717.54	129.32	126.54	5.55	5.67
9.31	T	718.81	129.35	126.56	5.56	5.68
9.32	T	720.07	129.39	126.58	5.57	5.69
9.33	T	721.34	129.42	126.6	5.57	5.7
9.34	T	722.6	129.45	126.62	5.58	5.71
9.35	T	723.87	129.48	126.64	5.59	5.72
9.36	T	725.14	129.51	126.66	5.6	5.73
9.37	T	726.4	129.55	126.68	5.61	5.73
9.38	T	727.67	129.62	126.75	5.61	5.74
9.39	T	728.94	129.74	126.86	5.62	5.75
9.4	T	730.21	129.86	126.98	5.62	5.75
9.41	T	731.48	129.98	127.09	5.63	5.76
9.42	T	732.75	130.1	127.21	5.63	5.76
9.43	T	734.02	130.22	127.33	5.64	5.76
9.44	T	735.3	130.34	127.44	5.64	5.77
9.45	T	736.57	130.46	127.56	5.65	5.77
9.46	T	737.85	130.57	127.67	5.65	5.78
9.47	T	739.13	130.69	127.79	5.66	5.78
9.48	T	740.41	130.81	127.91	5.66	5.79
9.49	T	741.69	130.93	128.02	5.66	5.79
9.5	T	742.97	131.05	128.14	5.67	5.8
9.51	T	744.25	131.17	128.25	5.67	5.8
9.52	T	745.53	131.29	128.37	5.68	5.81
9.53	T	746.82	131.41	128.49	5.68	5.81
9.54	T	748.1	131.53	128.6	5.69	5.82

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
9.55	T	749.39	131.64	128.72	5.69	5.82
9.56	T	750.68	131.76	128.83	5.7	5.83
9.57	T	751.97	131.88	128.95	5.7	5.83
9.58	T	753.26	132	129.07	5.71	5.84
9.59	T	754.55	132.12	129.18	5.71	5.84
9.6	T	755.84	132.24	129.3	5.72	5.85
9.61	T	757.14	132.36	129.41	5.72	5.85
9.62	T	758.43	132.48	129.53	5.73	5.86
9.63	T	759.73	132.6	129.65	5.73	5.86
9.64	T	761.02	132.71	129.76	5.73	5.86
9.65	T	762.32	132.83	129.88	5.74	5.87
9.66	T	763.62	132.95	129.99	5.74	5.87
9.67	T	764.92	133.07	130.11	5.75	5.88
9.68	T	766.23	133.19	130.23	5.75	5.88
9.69	T	767.53	133.31	130.34	5.76	5.89
9.7	T	768.83	133.43	130.46	5.76	5.89
9.71	T	770.14	133.55	130.57	5.77	5.9
9.72	T	771.44	133.67	130.69	5.77	5.9
9.73	T	772.75	133.78	130.81	5.78	5.91
9.74	T	774.06	133.9	130.92	5.78	5.91
9.75	T	775.37	134.02	131.04	5.79	5.92
9.76	T	776.68	134.14	131.15	5.79	5.92
9.77	T	777.99	134.26	131.27	5.79	5.93
9.78	T	779.31	134.38	131.39	5.8	5.93
9.79	T	780.62	134.5	131.5	5.8	5.94
9.8	T	781.94	134.62	131.62	5.81	5.94
9.81	T	783.26	134.74	131.73	5.81	5.95
9.82	T	784.57	134.85	131.85	5.82	5.95
9.83	T	785.89	134.97	131.97	5.82	5.96
9.84	T	787.21	135.09	132.08	5.83	5.96
9.85	T	788.54	135.21	132.2	5.83	5.96
9.86	T	789.86	135.33	132.31	5.84	5.97
9.87	T	791.18	135.45	132.43	5.84	5.97
9.88	T	792.51	135.57	132.55	5.85	5.98
9.89	T	793.83	135.69	132.66	5.85	5.98
9.9	T	795.16	135.81	132.78	5.86	5.99
9.91	T	796.49	135.92	132.9	5.86	5.99
9.92	T	797.82	136.04	133.01	5.86	6
9.93	T	799.15	136.16	133.13	5.87	6
9.94	T	800.48	136.28	133.24	5.87	6.01
9.95	T	801.82	136.4	133.36	5.88	6.01
9.96	T	803.15	136.52	133.48	5.88	6.02
9.97	T	804.49	136.64	133.59	5.89	6.02
9.98	T	805.82	136.76	133.71	5.89	6.03
9.99	T	807.16	136.88	133.82	5.9	6.03

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
10	T	808.5	137	133.94	5.9	6.04
10.01	T	809.84	137.11	134.06	5.91	6.04
10.02	T	811.18	137.23	134.17	5.91	6.05
10.03	T	812.53	137.35	134.29	5.92	6.05
10.04	T	813.87	137.46	134.39	5.92	6.06
10.05	T	815.21	137.57	134.5	5.93	6.06
10.06	T	816.56	137.68	134.6	5.93	6.07
10.07	T	817.91	137.79	134.71	5.94	6.07
10.08	T	819.25	137.9	134.81	5.94	6.08
10.09	T	820.6	138.01	134.92	5.95	6.08
10.1	T	821.95	138.12	135.02	5.95	6.09
10.11	T	823.3	138.23	135.13	5.96	6.09
10.12	T	824.66	138.34	135.23	5.96	6.1
10.13	T	826.01	138.45	135.33	5.97	6.1
10.14	T	827.36	138.56	135.44	5.97	6.11
10.15	T	828.72	138.67	135.54	5.98	6.11
10.16	T	830.08	138.78	135.65	5.98	6.12
10.17	T	831.43	138.89	135.75	5.99	6.12
10.18	T	832.79	139	135.86	5.99	6.13
10.19	T	834.15	139.11	135.96	6	6.14
10.2	T	835.51	139.22	136.07	6	6.14
10.21	T	836.87	139.33	136.17	6.01	6.15
10.22	T	838.23	139.44	136.28	6.01	6.15
10.23	T	839.6	139.55	136.38	6.02	6.16
10.24	T	840.96	139.66	136.49	6.02	6.16
10.25	T	842.33	139.77	136.59	6.03	6.17
10.26	T	843.7	139.88	136.69	6.03	6.17
10.27	T	845.06	139.99	136.8	6.04	6.18
10.28	T	846.43	140.1	136.9	6.04	6.18
10.29	T	847.8	140.21	137.01	6.05	6.19
10.3	T	849.17	140.32	137.11	6.05	6.19
10.31	T	850.54	140.43	137.22	6.06	6.2
10.32	T	851.92	140.53	137.32	6.06	6.2
10.33	T	853.29	140.64	137.43	6.07	6.21
10.34	T	854.67	140.75	137.53	6.07	6.21
10.35	T	856.04	140.86	137.64	6.08	6.22
10.36	T	857.42	140.97	137.74	6.08	6.22
10.37	T	858.8	141.08	137.85	6.09	6.23
10.38	T	860.18	141.19	137.95	6.09	6.24
10.39	T	861.56	141.3	138.05	6.1	6.24
10.4	T	862.94	141.41	138.16	6.1	6.25
10.41	T	864.32	141.52	138.26	6.11	6.25
10.42	T	865.7	141.63	138.37	6.11	6.26
10.43	T	867.09	141.74	138.47	6.12	6.26
10.44	T	868.47	141.85	138.58	6.12	6.27

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
10.45	T	869.86	141.96	138.68	6.13	6.27
10.46	T	871.25	142.07	138.79	6.13	6.28
10.47	T	872.64	142.18	138.89	6.14	6.28
10.48	T	874.03	142.29	139	6.14	6.29
10.49	T	875.42	142.4	139.1	6.15	6.29
10.5	T	876.81	142.51	139.21	6.15	6.3
10.51	T	878.2	142.62	139.31	6.16	6.3
10.52	T	879.6	142.64	139.32	6.17	6.31
10.53	T	880.99	142.67	139.33	6.18	6.32
10.54	T	882.38	142.69	139.34	6.18	6.33
10.55	T	883.78	142.71	139.35	6.19	6.34
10.56	T	885.17	142.74	139.35	6.2	6.35
10.57	T	886.57	142.76	139.36	6.21	6.36
10.58	T	887.96	142.78	139.37	6.22	6.37
10.59	T	889.35	142.81	139.38	6.23	6.38
10.6	T	890.75	142.83	139.39	6.24	6.39
10.61	T	892.14	142.85	139.4	6.25	6.4
10.62	T	893.54	142.88	139.41	6.25	6.41
10.63	T	894.93	142.9	139.41	6.26	6.42
10.64	T	896.32	142.92	139.42	6.27	6.43
10.65	T	897.72	142.95	139.43	6.28	6.44
10.66	T	899.11	142.97	139.44	6.29	6.45
10.67	T	900.51	142.99	139.45	6.3	6.46
10.68	T	901.9	143.02	139.46	6.31	6.47
10.69	T	903.3	143.04	139.47	6.32	6.48
10.7	T	904.69	143.06	139.48	6.32	6.49
10.71	T	906.09	143.08	139.48	6.33	6.5
10.72	T	907.48	143.11	139.49	6.34	6.51
10.73	T	908.88	143.13	139.5	6.35	6.52
10.74	T	910.27	143.18	139.54	6.36	6.52
10.75	T	911.67	143.61	139.96	6.35	6.51
10.76	T	913.07	144.03	140.38	6.34	6.5
10.77	T	914.48	144.45	140.79	6.33	6.5
10.78	T	915.89	144.88	141.21	6.32	6.49
10.79	T	917.31	145.3	141.63	6.31	6.48
10.8	T	918.72	145.72	142.05	6.3	6.47
10.81	T	920.15	146.14	142.47	6.3	6.46
10.82	T	921.57	146.57	142.89	6.29	6.45
10.83	T	923.01	146.99	143.3	6.28	6.44
10.84	T	924.44	147.41	143.72	6.27	6.43
10.85	T	925.88	147.84	144.14	6.26	6.42
10.86	T	927.32	148.26	144.56	6.25	6.41
10.87	T	928.77	148.68	144.98	6.25	6.41
10.88	T	930.22	149.11	145.4	6.24	6.4
10.89	T	931.68	149.53	145.81	6.23	6.39

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
10.9	T	933.14	149.95	146.23	6.22	6.38
10.91	T	934.61	150.37	146.65	6.22	6.37
10.92	T	936.07	150.8	147.07	6.21	6.36
10.93	T	937.55	151.22	147.49	6.2	6.36
10.94	T	939.03	151.64	147.91	6.19	6.35
10.95	T	940.51	152.07	148.32	6.18	6.34
10.96	T	941.99	152.49	148.74	6.18	6.33
10.97	T	943.48	152.91	149.16	6.17	6.33
10.98	T	944.98	153.34	149.58	6.16	6.32
10.99	T	946.47	153.76	150	6.16	6.31
11	T	947.98	154.18	150.41	6.15	6.3
11.01	T	949.48	154.6	150.83	6.14	6.29
11.02	T	950.99	155.03	151.25	6.13	6.29
11.03	T	952.51	155.45	151.67	6.13	6.28
11.04	T	954.03	155.87	152.09	6.12	6.27
11.05	T	955.55	156.3	152.51	6.11	6.27
11.06	T	957.08	156.72	152.92	6.11	6.26
11.07	T	958.61	157.14	153.34	6.1	6.25
11.08	T	960.15	157.56	153.76	6.09	6.24
11.09	T	961.69	157.99	154.18	6.09	6.24
11.1	T	963.23	158.41	154.6	6.08	6.23
11.11	T	964.78	158.83	155.02	6.07	6.22
11.12	T	966.33	159.26	155.43	6.07	6.22
11.13	T	967.89	159.68	155.85	6.06	6.21
11.14	T	969.45	160.1	156.27	6.06	6.2
11.15	T	971.01	160.53	156.69	6.05	6.2
11.16	T	972.58	160.95	157.11	6.04	6.19
11.17	T	974.16	161.37	157.53	6.04	6.18
11.18	T	975.73	161.79	157.94	6.03	6.18
11.19	T	977.32	162.22	158.36	6.02	6.17
11.2	T	978.9	162.64	158.78	6.02	6.17
11.21	T	980.49	163.06	159.19	6.01	6.16
11.22	T	982.09	163.45	159.58	6.01	6.15
11.23	T	983.69	163.83	159.96	6	6.15
11.24	T	985.29	164.22	160.34	6	6.14
11.25	T	986.89	164.61	160.73	6	6.14
11.26	T	988.5	165	161.11	5.99	6.14
11.27	T	990.12	165.39	161.5	5.99	6.13
11.28	T	991.73	165.78	161.88	5.98	6.13
11.29	T	993.35	166.17	162.26	5.98	6.12
11.3	T	994.98	166.55	162.65	5.97	6.12
11.31	T	996.61	166.94	163.03	5.97	6.11
11.32	T	998.24	167.33	163.42	5.97	6.11
11.33	T	999.88	167.72	163.8	5.96	6.1
11.34	T	1001.52	168.11	164.18	5.96	6.1

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
11.35	T	1003.16	168.5	164.57	5.95	6.1
11.36	T	1004.81	168.89	164.95	5.95	6.09
11.37	T	1006.46	169.28	165.33	5.95	6.09
11.38	T	1008.12	169.66	165.72	5.94	6.08
11.39	T	1009.78	170.05	166.1	5.94	6.08
11.4	T	1011.44	170.44	166.49	5.93	6.08
11.41	T	1013.11	170.83	166.87	5.93	6.07
11.42	T	1014.78	171.22	167.25	5.93	6.07
11.43	T	1016.45	171.68	167.72	5.92	6.06
11.44	T	1018.13	172.3	168.33	5.91	6.05
11.45	T	1019.82	172.91	168.94	5.9	6.04
11.46	T	1021.51	173.52	169.55	5.89	6.02
11.47	T	1023.21	174.13	170.16	5.88	6.01
11.48	T	1024.92	174.74	170.78	5.87	6
11.49	T	1026.63	175.36	171.39	5.85	5.99
11.5	T	1028.34	175.97	172	5.84	5.98
11.51	T	1030.07	176.58	172.61	5.83	5.97
11.52	T	1031.8	177.19	173.22	5.82	5.96
11.53	T	1033.53	177.81	173.83	5.81	5.95
11.54	T	1035.28	178.42	174.45	5.8	5.93
11.55	T	1037.02	179.03	175.06	5.79	5.92
11.56	T	1038.78	179.64	175.67	5.78	5.91
11.57	T	1040.54	180.25	176.28	5.77	5.9
11.58	T	1042.3	180.87	176.89	5.76	5.89
11.59	T	1044.08	181.48	177.51	5.75	5.88
11.6	T	1045.85	182.09	178.12	5.74	5.87
11.61	T	1047.64	182.7	178.73	5.73	5.86
11.62	T	1049.43	183.32	179.34	5.72	5.85
11.63	T	1051.23	183.93	179.95	5.72	5.84
11.64	T	1053.03	185	181.03	5.69	5.82
11.65	T	1054.85	186.53	182.55	5.66	5.78
11.66	T	1056.68	188.05	184.07	5.62	5.74
11.67	T	1058.53	189.58	185.6	5.58	5.7
11.68	T	1060.4	191.1	187.12	5.55	5.67
11.69	T	1062.27	192.63	188.64	5.51	5.63
11.7	T	1064.17	194.15	190.16	5.48	5.6
11.71	T	1066.08	195.68	191.69	5.45	5.56
11.72	T	1068	197.2	193.21	5.42	5.53
11.73	T	1069.94	198.73	194.73	5.38	5.49
11.74	T	1071.9	200.25	196.25	5.35	5.46
11.75	T	1073.87	201.78	197.77	5.32	5.43
11.76	T	1075.86	203.3	199.3	5.29	5.4
11.77	T	1077.86	204.83	200.82	5.26	5.37
11.78	T	1079.87	206.35	202.34	5.23	5.34
11.79	T	1081.9	206.7	202.69	5.23	5.34

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
11.8	T	1083.93	206.97	202.96	5.24	5.34
11.81	T	1085.96	207.23	203.22	5.24	5.34
11.82	T	1087.99	207.5	203.48	5.24	5.35
11.83	T	1090.03	207.76	203.74	5.25	5.35
11.84	T	1092.07	208.03	204.01	5.25	5.35
11.85	T	1094.11	208.29	204.27	5.25	5.36
11.86	T	1096.15	208.55	204.53	5.26	5.36
11.87	T	1098.2	208.82	204.79	5.26	5.36
11.88	T	1100.25	209.08	205.05	5.26	5.37
11.89	T	1102.3	209.35	205.32	5.27	5.37
11.9	T	1104.36	209.61	205.58	5.27	5.37
11.91	T	1106.42	209.88	205.84	5.27	5.38
11.92	T	1108.48	210.14	206.1	5.27	5.38
11.93	T	1110.54	210.41	206.37	5.28	5.38
11.94	T	1112.6	210.67	206.63	5.28	5.38
11.95	T	1114.67	210.93	206.89	5.28	5.39
11.96	T	1116.74	211.2	207.15	5.29	5.39
11.97	T	1118.82	211.46	207.42	5.29	5.39
11.98	T	1120.89	211.73	207.68	5.29	5.4
11.99	T	1122.97	211.99	207.94	5.3	5.4
12	T	1125.05	212.26	208.2	5.3	5.4
12.01	T	1127.14	212.52	208.46	5.3	5.41
12.02	T	1129.22	212.78	208.73	5.31	5.41
12.03	T	1131.31	213.05	208.99	5.31	5.41
12.04	T	1133.4	213.31	209.25	5.31	5.42
12.05	T	1135.5	213.58	209.51	5.32	5.42
12.06	T	1137.59	213.84	209.78	5.32	5.42
12.07	T	1139.69	214.11	210.04	5.32	5.43
12.08	T	1141.8	214.37	210.3	5.33	5.43
12.09	T	1143.9	214.63	210.56	5.33	5.43
12.1	T	1146.01	214.9	210.82	5.33	5.44
12.11	T	1148.12	215.16	211.09	5.34	5.44
12.12	T	1150.23	215.43	211.35	5.34	5.44
12.13	T	1152.35	215.69	211.61	5.34	5.45
12.14	T	1154.46	215.96	211.87	5.35	5.45
12.15	T	1156.58	216.13	212.05	5.35	5.45
12.16	T	1158.7	216.21	212.12	5.36	5.46
12.17	T	1160.83	216.29	212.19	5.37	5.47
12.18	T	1162.95	216.36	212.27	5.38	5.48
12.19	T	1165.07	216.44	212.34	5.38	5.49
12.2	T	1167.2	216.52	212.42	5.39	5.49
12.21	T	1169.32	216.59	212.49	5.4	5.5
12.22	T	1171.45	216.67	212.56	5.41	5.51
12.23	T	1173.57	216.75	212.64	5.41	5.52
12.24	T	1175.7	216.82	212.71	5.42	5.53

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
12.25	T	1177.83	216.9	212.79	5.43	5.54
12.26	T	1179.96	216.98	212.86	5.44	5.54
12.27	T	1182.09	217.06	212.94	5.45	5.55
12.28	T	1184.22	217.13	213.01	5.45	5.56
12.29	T	1186.35	217.21	213.08	5.46	5.57
12.3	T	1188.48	217.29	213.16	5.47	5.58
12.31	T	1190.61	217.36	213.23	5.48	5.58
12.32	T	1192.75	217.44	213.31	5.49	5.59
12.33	T	1194.88	217.52	213.38	5.49	5.6
12.34	T	1197.01	217.59	213.45	5.5	5.61
12.35	T	1199.15	217.67	213.53	5.51	5.62
12.36	T	1201.29	217.75	213.6	5.52	5.62
12.37	T	1203.42	217.83	213.68	5.52	5.63
12.38	T	1205.56	217.9	213.75	5.53	5.64
12.39	T	1207.7	217.98	213.82	5.54	5.65
12.4	T	1209.84	218.06	213.9	5.55	5.66
12.41	T	1211.98	218.13	213.97	5.56	5.66
12.42	T	1214.12	218.21	214.05	5.56	5.67
12.43	T	1216.26	218.29	214.12	5.57	5.68
12.44	T	1218.4	218.36	214.19	5.58	5.69
12.45	T	1220.54	218.44	214.27	5.59	5.7
12.46	T	1222.69	218.52	214.34	5.6	5.7
12.47	T	1224.83	218.6	214.42	5.6	5.71
12.48	T	1226.98	218.67	214.49	5.61	5.72
12.49	T	1229.12	218.75	214.57	5.62	5.73
12.5	T	1231.27	218.83	214.64	5.63	5.74
12.51	T	1233.42	218.9	214.71	5.63	5.74
12.52	T	1235.56	218.98	214.79	5.64	5.75
12.53	T	1237.71	219.06	214.86	5.65	5.76
12.54	T	1239.86	219.13	214.94	5.66	5.77
12.55	T	1242.01	219.21	215.01	5.67	5.78
12.56	T	1244.16	219.29	215.08	5.67	5.78
12.57	T	1246.32	219.37	215.16	5.68	5.79
12.58	T	1248.47	219.44	215.23	5.69	5.8
12.59	T	1250.62	219.52	215.31	5.7	5.81
12.6	T	1252.77	219.6	215.38	5.7	5.82
12.61	T	1254.93	219.67	215.45	5.71	5.82
12.62	T	1257.08	219.75	215.53	5.72	5.83
12.63	T	1259.24	219.83	215.6	5.73	5.84
12.64	T	1261.4	219.9	215.68	5.74	5.85
12.65	T	1263.56	219.98	215.75	5.74	5.86
12.66	T	1265.71	220.06	215.82	5.75	5.86
12.67	T	1267.87	220.14	215.9	5.76	5.87
12.68	T	1270.03	220.21	215.97	5.77	5.88
12.69	T	1272.19	220.29	216.05	5.78	5.89

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
12.7	T	1274.35	220.37	216.12	5.78	5.9
12.71	T	1276.52	220.44	216.2	5.79	5.9
12.72	T	1278.68	220.52	216.27	5.8	5.91
12.73	T	1280.84	220.6	216.34	5.81	5.92
12.74	T	1283.01	220.67	216.42	5.81	5.93
12.75	T	1285.17	220.75	216.49	5.82	5.94
12.76	T	1287.34	220.83	216.57	5.83	5.94
12.77	T	1289.5	220.91	216.64	5.84	5.95
12.78	T	1291.67	220.98	216.71	5.85	5.96
12.79	T	1293.84	221.06	216.79	5.85	5.97
12.8	T	1296.01	221.14	216.86	5.86	5.98
12.81	T	1298.18	221.21	216.94	5.87	5.98
12.82	T	1300.35	221.29	217.01	5.88	5.99
12.83	T	1302.52	221.37	217.08	5.88	6
12.84	T	1304.69	221.44	217.16	5.89	6.01
12.85	T	1306.86	221.52	217.23	5.9	6.02
12.86	T	1309.04	221.6	217.31	5.91	6.02
12.87	T	1311.21	221.68	217.38	5.92	6.03
12.88	T	1313.38	221.75	217.45	5.92	6.04
12.89	T	1315.56	221.83	217.53	5.93	6.05
12.9	T	1317.74	221.91	217.6	5.94	6.06
12.91	T	1319.91	221.98	217.68	5.95	6.06
12.92	T	1322.09	222.06	217.75	5.95	6.07
12.93	T	1324.27	222.14	217.83	5.96	6.08
12.94	T	1326.45	222.21	217.9	5.97	6.09
12.95	T	1328.63	222.29	217.97	5.98	6.1
12.96	T	1330.81	222.37	218.05	5.98	6.1
12.97	T	1332.99	222.44	218.12	5.99	6.11
12.98	T	1335.17	222.52	218.2	6	6.12
12.99	T	1337.35	222.6	218.27	6.01	6.13
13	T	1339.54	222.68	218.34	6.02	6.13
13.01	T	1341.72	222.75	218.42	6.02	6.14
13.02	T	1343.91	222.83	218.49	6.03	6.15
13.03	T	1346.09	222.91	218.57	6.04	6.16
13.04	T	1348.28	222.98	218.64	6.05	6.17
13.05	T	1350.47	223.06	218.71	6.05	6.17
13.06	T	1352.66	223.14	218.79	6.06	6.18
13.07	T	1354.84	223.21	218.86	6.07	6.19
13.08	T	1357.03	223.29	218.94	6.08	6.2
13.09	T	1359.22	223.37	219.01	6.09	6.21
13.1	T	1361.41	223.45	219.08	6.09	6.21
13.11	T	1363.61	223.52	219.16	6.1	6.22
13.12	T	1365.8	223.6	219.23	6.11	6.23
13.13	T	1367.99	223.68	219.31	6.12	6.24
13.14	T	1370.19	223.75	219.38	6.12	6.25

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
13.15	T	1372.38	223.83	219.46	6.13	6.25
13.16	T	1374.58	223.91	219.53	6.14	6.26
13.17	T	1376.77	223.98	219.6	6.15	6.27
13.18	T	1378.97	224.06	219.68	6.15	6.28
13.19	T	1381.17	224.14	219.75	6.16	6.29
13.2	T	1383.36	224.22	219.83	6.17	6.29
13.21	T	1385.56	224.29	219.9	6.18	6.3
13.22	T	1387.76	224.37	219.97	6.19	6.31
13.23	T	1389.96	224.45	220.05	6.19	6.32
13.24	T	1392.17	224.52	220.12	6.2	6.32
13.25	T	1394.37	224.6	220.2	6.21	6.33
13.26	T	1396.57	224.68	220.27	6.22	6.34
13.27	T	1398.77	224.75	220.34	6.22	6.35
13.28	T	1400.98	224.83	220.42	6.23	6.36
13.29	T	1403.18	224.91	220.49	6.24	6.36
13.3	T	1405.39	224.99	220.57	6.25	6.37
13.31	T	1407.6	225.06	220.64	6.25	6.38
13.32	T	1409.8	225.14	220.72	6.26	6.39
13.33	T	1412.01	225.22	220.79	6.27	6.4
13.34	T	1414.22	225.29	220.86	6.28	6.4
13.35	T	1416.43	225.37	220.94	6.28	6.41
13.36	T	1418.64	225.45	221.01	6.29	6.42
13.37	T	1420.85	225.52	221.09	6.3	6.43
13.38	T	1423.06	225.6	221.16	6.31	6.43
13.39	T	1425.27	225.68	221.23	6.32	6.44
13.4	T	1427.49	225.76	221.31	6.32	6.45
13.41	T	1429.7	225.83	221.38	6.33	6.46
13.42	T	1431.92	225.91	221.46	6.34	6.47
13.43	T	1434.13	225.98	221.53	6.35	6.47
13.44	T	1436.35	226.06	221.6	6.35	6.48
13.45	T	1438.56	226.13	221.67	6.36	6.49
13.46	T	1440.78	226.2	221.73	6.37	6.5
13.47	T	1443	226.27	221.8	6.38	6.51
13.48	T	1445.22	226.35	221.87	6.39	6.51
13.49	T	1447.44	226.42	221.94	6.39	6.52
13.5	T	1449.66	226.49	222.01	6.4	6.53
13.51	T	1451.88	226.56	222.08	6.41	6.54
13.52	T	1454.1	226.63	222.15	6.42	6.55
13.53	T	1456.32	226.71	222.22	6.42	6.55
13.54	T	1458.55	226.78	222.28	6.43	6.56
13.55	T	1460.77	226.85	222.35	6.44	6.57
13.56	T	1462.99	226.92	222.42	6.45	6.58
13.57	T	1465.22	226.99	222.49	6.45	6.59
13.58	T	1467.45	227.07	222.56	6.46	6.59
13.59	T	1469.67	227.14	222.63	6.47	6.6

EXHIBIT 2

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)
13.6	T	1471.9	227.21	222.7	6.48	6.61
13.61	T	1474.13	227.28	222.77	6.49	6.62
13.62	T	1476.35	227.36	222.84	6.49	6.63
13.63	T	1478.58	227.43	222.9	6.5	6.63
13.64	T	1480.81	227.5	222.97	6.51	6.64
13.65	T	1483.04	227.57	223.04	6.52	6.65
13.66	T	1485.28	227.64	223.11	6.52	6.66
13.67	T	1487.51	227.72	223.18	6.53	6.67
13.68	T	1489.74	227.79	223.25	6.54	6.67
13.69	T	1491.97	227.86	223.32	6.55	6.68
13.7	T	1494.21	227.93	223.39	6.56	6.69
13.71	T	1496.44	228	223.45	6.56	6.7
13.72	T	1498.68	228.08	223.52	6.57	6.7
13.73	T	1500.91	228.15	223.59	6.58	6.71
13.74	T	1503.15	228.22	223.66	6.59	6.72
13.75	T	1505.39	228.29	223.73	6.59	6.73
13.76	T	1507.63	228.37	223.8	6.6	6.74
13.77	T	1509.86	228.44	223.87	6.61	6.74
13.78	T	1512.1	228.51	223.94	6.62	6.75
13.79	T	1514.34	228.58	224	6.62	6.76
13.8	T	1516.59	228.65	224.07	6.63	6.77
13.81	T	1518.83	228.73	224.14	6.64	6.78
13.82	T	1521.07	228.8	224.21	6.65	6.78
13.83	T	1523.31	228.87	224.28	6.66	6.79
13.84	T	1525.56	228.94	224.35	6.66	6.8
13.85	T	1527.8	229.01	224.42	6.67	6.81
13.86	T	1530.04	229.09	224.49	6.68	6.82
13.87	T	1532.29	229.16	224.55	6.69	6.82
13.88	T	1534.54	229.23	224.62	6.69	6.83
13.89	T	1536.78	229.3	224.69	6.7	6.84
13.9	T	1539.03	229.37	224.76	6.71	6.85
13.91	T	1541.28	229.45	224.83	6.72	6.86
13.92	T	1543.53	229.52	224.9	6.73	6.86
13.93	T	1545.78	229.59	224.97	6.73	6.87
13.94	T	1548.03	229.66	225.04	6.74	6.88
13.95	T	1550.28	229.74	225.1	6.75	6.89
13.96	T	1552.53	229.81	225.17	6.76	6.89
13.97	T	1554.79	229.88	225.24	6.76	6.9
13.98	T	1557.04	229.95	225.31	6.77	6.91
13.99	T	1559.29	230.02	225.38	6.78	6.92
14	T	1561.55	230.1	225.45	6.79	6.93
14.01	T	1563.8	230.17	225.52	6.79	6.93
14.02	T	1566.06	230.24	225.59	6.8	6.94
14.03	T	1568.32	230.31	225.66	6.81	6.95
14.04	T	1570.57	230.38	225.72	6.82	6.96

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
14.05	T	1572.83	230.46	225.79	6.82	6.97
14.06	T	1575.09	230.53	225.86	6.83	6.97
14.07	T	1577.35	230.6	225.93	6.84	6.98
14.08	T	1579.61	230.67	226	6.85	6.99
14.09	T	1581.87	230.75	226.07	6.86	7
14.1	T	1584.13	230.82	226.14	6.86	7.01
14.11	T	1586.39	230.89	226.21	6.87	7.01
14.12	T	1588.66	230.96	226.27	6.88	7.02
14.13	T	1590.92	231.03	226.34	6.89	7.03
14.14	T	1593.18	231.11	226.41	6.89	7.04
14.15	T	1595.45	231.18	226.48	6.9	7.04
14.16	T	1597.71	231.25	226.55	6.91	7.05
14.17	T	1599.98	231.32	226.62	6.92	7.06
14.18	T	1602.25	231.39	226.69	6.92	7.07
14.19	T	1604.52	231.47	226.76	6.93	7.08
14.2	T	1606.78	231.54	226.82	6.94	7.08
14.21	T	1609.05	231.61	226.89	6.95	7.09
14.22	T	1611.32	231.68	226.96	6.95	7.1
14.23	T	1613.59	231.76	227.03	6.96	7.11
14.24	T	1615.86	231.83	227.1	6.97	7.12
14.25	T	1618.14	231.9	227.17	6.98	7.12
14.26	T	1620.41	231.97	227.24	6.99	7.13
14.27	T	1622.68	232.04	227.31	6.99	7.14
14.28	T	1624.96	232.12	227.37	7	7.15
14.29	T	1627.23	232.19	227.44	7.01	7.15
14.3	T	1629.51	232.26	227.51	7.02	7.16
14.31	T	1631.78	232.33	227.58	7.02	7.17
14.32	T	1634.06	232.4	227.65	7.03	7.18
14.33	T	1636.34	232.48	227.72	7.04	7.19
14.34	T	1638.61	232.55	227.79	7.05	7.19
14.35	T	1640.89	232.62	227.86	7.05	7.2
14.36	T	1643.17	232.69	227.93	7.06	7.21
14.37	T	1645.45	232.77	227.99	7.07	7.22
14.38	T	1647.73	232.84	228.06	7.08	7.22
14.39	T	1650.01	232.91	228.13	7.08	7.23
14.4	T	1652.3	232.98	228.2	7.09	7.24
14.41	T	1654.58	233.05	228.27	7.1	7.25
14.42	T	1656.86	233.13	228.34	7.11	7.26
14.43	T	1659.15	233.2	228.41	7.11	7.26
14.44	T	1661.43	233.27	228.48	7.12	7.27
14.45	T	1663.72	233.34	228.54	7.13	7.28
14.46	T	1666	233.41	228.61	7.14	7.29
14.47	T	1668.29	233.49	228.68	7.15	7.3
14.48	T	1670.58	233.56	228.75	7.15	7.3
14.49	T	1672.87	233.63	228.82	7.16	7.31

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
14.5	T	1675.16	233.7	228.89	7.17	7.32
14.51	T	1677.45	233.77	228.96	7.18	7.33
14.52	T	1679.74	233.85	229.03	7.18	7.33
14.53	T	1682.03	233.92	229.09	7.19	7.34
14.54	T	1684.32	233.99	229.16	7.2	7.35
14.55	T	1686.61	234.06	229.23	7.21	7.36
14.56	T	1688.9	234.14	229.3	7.21	7.37
14.57	T	1691.2	234.21	229.37	7.22	7.37
14.58	T	1693.49	234.28	229.44	7.23	7.38
14.59	T	1695.79	234.35	229.51	7.24	7.39
14.6	T	1698.08	234.42	229.58	7.24	7.4
14.61	T	1700.38	234.47	229.61	7.25	7.41
14.62	T	1702.68	234.5	229.63	7.26	7.41
14.63	T	1704.97	234.53	229.65	7.27	7.42
14.64	T	1707.27	234.57	229.67	7.28	7.43
14.65	T	1709.57	234.6	229.69	7.29	7.44
14.66	T	1711.87	234.63	229.71	7.3	7.45
14.67	T	1714.16	234.66	229.73	7.3	7.46
14.68	T	1716.46	234.7	229.75	7.31	7.47
14.69	T	1718.76	234.73	229.77	7.32	7.48

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Middle Reach Flow Data

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Project	Ellsworth Flow Study			
Transect Name	Middle Reach Riffle	Date	9/8/2014	
Purpose / Project	Verification flow measurement reportedly 150 cfs	Time	Begin	10:30
			End	12:00
Conditions / Test	Minimum flow			
Transect Location	Downstream of Rt 1A Bridge			
Zero Station Location				
Verification Team	Gagnon/Sears/MacVane	Total Flow =	296.4	cfs

Data									Comment
Field Measurements					Calculations				
Personnel / Method	Node	Station Distance (ft) (tag line)	Station Depth (ft)	Mean Station Velocity (ft/sec)	Incremental Nodal Area (ft ²)	Incremental Mean Nodal Velocity (ft/sec)	Incremental Nodal Flow (cfs)	Total Accumulated Flow (cfs)	
Manual	0	50.0	0.00	0.000	0.00	0.00	0.00	0.00	
Manual	1	65.0	3.50	0.740	26.25	0.37	9.71	9.71	LEW
Manual	2	77.9	3.60	0.865	45.80	0.80	36.75	46.46	
Manual	3	88.0	2.00	1.690	28.28	1.28	36.13	82.59	
Manual	4	98.0	1.90	2.860	19.50	2.28	44.36	126.95	TWG
Manual	5	107.0	0.90	2.220	12.60	2.54	32.00	158.96	
Manual	6	116.6	0.70	0.340	7.68	1.28	9.83	168.79	
Manual	7	130.0	1.20	1.420	12.73	0.88	11.20	179.99	
Manual	8	142.1	1.70	2.820	17.55	2.12	37.20	217.19	
Manual	9	153.1	1.30	1.175	16.50	2.00	32.96	250.14	
Manual	10	167.1	1.00	0.780	16.10	0.98	15.74	265.88	
Manual	11	173.5	1.60	0.100	8.32	0.44	3.66	269.54	Boulder US
Manual	12	183.4	0.70	1.840	11.39	0.97	11.04	280.59	
Manual	13	197.8	1.10	0.220	12.96	1.03	13.35	293.93	Boulders
Manual	14	207.1	0.80	0.130	8.83	0.18	1.55	295.48	Boulders
Manual	15	220.4	1.00	0.020	11.97	0.08	0.90	296.38	
Manual	16	228.7	0.00	0.000	4.15	0.01	0.04	296.42	REW
Manual	17				0.00	0.00	0.00	296.42	
Manual	18				0.00	0.00	0.00	296.42	
Manual	19				0.00	0.00	0.00	296.42	
Manual	20				0.00	0.00	0.00	296.42	
Manual	21				0.00	0.00	0.00	296.42	
Manual	22				0.00	0.00	0.00	296.42	
Manual	23				0.00	0.00	0.00	296.42	
Manual	24				0.00	0.00	0.00	296.42	
Manual	25				0.00	0.00	0.00	296.42	
Manual	26				0.00	0.00	0.00	296.42	
Manual	27				0.00	0.00	0.00	296.42	
Manual	28				0.00	0.00	0.00	296.42	
Manual	29				0.00	0.00	0.00	296.42	
Manual	30				0.00	0.00	0.00	296.42	
Manual	31				0.00	0.00	0.00	296.42	
Manual	32				0.00	0.00	0.00	296.42	
Manual	33				0.00	0.00	0.00	296.42	
Manual	34				0.00	0.00	0.00	296.42	
Manual	35				0.00	0.00	0.00	296.42	
Manual	36				0.00	0.00	0.00	296.42	
Manual	37				0.00	0.00	0.00	296.42	
Manual	38				0.00	0.00	0.00	296.42	
Manual	39				0.00	0.00	0.00	296.42	
Manual	40				0.00	0.00	0.00	296.42	
Manual	41				0.00	0.00	0.00	296.42	
Manual	42				0.00	0.00	0.00	296.42	
Manual	43				0.00	0.00	0.00	296.42	
Manual	44				0.00	0.00	0.00	296.42	
Manual	45				0.00	0.00	0.00	296.42	
Manual	46				0.00	0.00	0.00	296.42	
Manual	47				0.00	0.00	0.00	296.42	
Manual	48				0.00	0.00	0.00	296.42	
Manual	49				0.00	0.00	0.00	296.42	
Manual	50				0.00	0.00	0.00	296.42	
Manual	51				0.00	0.00	0.00	296.42	

Project	Ellsworth Flow Study			
Transect Name	Middle Reach Pool	Date	9/8/2014	
Purpose / Project	Verification flow measurement reportedly 150 cfs	Time	Begin	13:30
			End	14:15
Conditions / Test	Minimum flow			
Transect Location	Downstream of Rt 1A Bridge			
Zero Station Location				
Verification Team	Gagnon/Sears/MacVane	Total Flow =	433.3	cfs

Data									Comment
Field Measurements					Calculations				
Personnel / Method	Node	Station Distance (ft) <small>(tag line)</small>	Station Depth (ft)	Mean Station Velocity (ft/sec)	Incremental Nodal Area (ft ²)	Incremental Mean Nodal Velocity (ft/sec)	Incremental Nodal Flow (cfs)	Total Accumulated Flow (cfs)	
Manual	0	43.6	0.00	0.000	0.00	0.00	0.00	0.00	
Manual	1	50.0	1.00	0.000	3.20	0.00	0.00	0.00	LEW
Manual	2	60.0	2.70	0.405	18.50	0.20	3.75	3.75	Bottom Vegetated
Manual	3	73.1	3.70	0.980	41.92	0.69	29.03	32.78	
Manual	4	83.1	4.80	1.265	42.50	1.12	47.71	80.48	
Manual	5	97.4	2.40	1.040	51.48	1.15	59.33	139.81	
Manual	6	114.8	2.40	2.020	41.76	1.53	63.89	203.71	
Manual	7	129.2	2.20	2.060	33.12	2.04	67.56	271.27	
Manual	8	146.6	2.70	0.930	42.63	1.50	63.73	335.00	Boulders 5 ft US
Manual	9	157.0	2.00	1.130	24.44	1.03	25.17	360.18	
Manual	10	169.6	1.90	1.320	24.57	1.23	30.10	390.27	
Manual	11	182.7	1.00	1.590	19.00	1.46	27.64	417.91	Boulders along REW
Manual	12	193.5	1.10	0.600	11.34	1.10	12.42	430.33	Boulders along REW
Manual	13	205.3	0.20	0.160	7.67	0.38	2.91	433.24	Boulders along REW
Manual	14	217.9	0.00	0.000	1.26	0.08	0.10	433.34	REW
Manual	15				0.00	0.00	0.00	433.34	
Manual	16				0.00	0.00	0.00	433.34	
Manual	17				0.00	0.00	0.00	433.34	
Manual	18				0.00	0.00	0.00	433.34	
Manual	19				0.00	0.00	0.00	433.34	
Manual	20				0.00	0.00	0.00	433.34	
Manual	21				0.00	0.00	0.00	433.34	
Manual	22				0.00	0.00	0.00	433.34	
Manual	23				0.00	0.00	0.00	433.34	
Manual	24				0.00	0.00	0.00	433.34	
Manual	25				0.00	0.00	0.00	433.34	
Manual	26				0.00	0.00	0.00	433.34	
Manual	27				0.00	0.00	0.00	433.34	
Manual	28				0.00	0.00	0.00	433.34	
Manual	29				0.00	0.00	0.00	433.34	
Manual	30				0.00	0.00	0.00	433.34	
Manual	31				0.00	0.00	0.00	433.34	
Manual	32				0.00	0.00	0.00	433.34	
Manual	33				0.00	0.00	0.00	433.34	
Manual	34				0.00	0.00	0.00	433.34	
Manual	35				0.00	0.00	0.00	433.34	
Manual	36				0.00	0.00	0.00	433.34	
Manual	37				0.00	0.00	0.00	433.34	
Manual	38				0.00	0.00	0.00	433.34	
Manual	39				0.00	0.00	0.00	433.34	
Manual	40				0.00	0.00	0.00	433.34	
Manual	41				0.00	0.00	0.00	433.34	
Manual	42				0.00	0.00	0.00	433.34	
Manual	43				0.00	0.00	0.00	433.34	
Manual	44				0.00	0.00	0.00	433.34	
Manual	45				0.00	0.00	0.00	433.34	
Manual	46				0.00	0.00	0.00	433.34	
Manual	47				0.00	0.00	0.00	433.34	
Manual	48				0.00	0.00	0.00	433.34	
Manual	49				0.00	0.00	0.00	433.34	
Manual	50				0.00	0.00	0.00	433.34	
Manual	51				0.00	0.00	0.00	433.34	

Project	Ellsworth Flow Study			
Transect Name	Middle Reach Run	Date	9/8/2014	
Purpose / Project	Verification flow measurement reportedly 150 cfs	Time	Begin	15:00
			End	15:50
Conditions / Test	Minimum flow			
Transect Location	Downstream of Rt 1A Bridge			
Zero Station Location				
Verification Team	Gagnon/Sears/MacVane	Total Flow =	324.1	cfs

Data									Comment
Field Measurements					Calculations				
Personnel / Method	Node	Station Distance (ft) (tag line)	Station Depth (ft)	Mean Station Velocity (ft/sec)	Incremental Nodal Area (ft ²)	Incremental Mean Nodal Velocity (ft/sec)	Incremental Nodal Flow (cfs)	Total Accumulated Flow (cfs)	
Manual	0	54.5	0.00	0.000	0.00	0.00	0.00	0.00	
Manual	1	56.8	1.70	0.440	1.96	0.22	0.43	0.43	LEW; Rock face EB
Manual	2	66.2	2.70	1.720	20.68	1.08	22.33	22.76	Rock face EB
Manual	3	74.8	2.50	3.830	22.36	2.78	62.05	84.81	TWG
Manual	4	92.2	2.10	0.900	40.02	2.37	94.65	179.46	
Manual	5	104.3	2.30	0.270	26.62	0.59	15.57	195.03	Behind Boulder
Manual	6	120.3	2.20	1.870	36.00	1.07	38.52	233.55	
Manual	7	133.9	2.50	0.870	31.96	1.37	43.79	277.34	
Manual	8	146.5	2.10	1.130	28.98	1.00	28.98	306.32	Boulders along REW
Manual	9	163.5	0.40	0.330	21.25	0.73	15.51	321.83	Boulders along REW
Manual	10	179.5	0.60	0.180	8.00	0.26	2.04	323.87	Boulders along REW
Manual	11	188.1	0.00	0.000	2.58	0.09	0.23	324.10	REW
Manual	12				0.00	0.00	0.00	324.10	
Manual	13				0.00	0.00	0.00	324.10	
Manual	14				0.00	0.00	0.00	324.10	
Manual	15				0.00	0.00	0.00	324.10	
Manual	16				0.00	0.00	0.00	324.10	
Manual	17				0.00	0.00	0.00	324.10	
Manual	18				0.00	0.00	0.00	324.10	
Manual	19				0.00	0.00	0.00	324.10	
Manual	20				0.00	0.00	0.00	324.10	
Manual	21				0.00	0.00	0.00	324.10	
Manual	22				0.00	0.00	0.00	324.10	
Manual	23				0.00	0.00	0.00	324.10	
Manual	24				0.00	0.00	0.00	324.10	
Manual	25				0.00	0.00	0.00	324.10	
Manual	26				0.00	0.00	0.00	324.10	
Manual	27				0.00	0.00	0.00	324.10	
Manual	28				0.00	0.00	0.00	324.10	
Manual	29				0.00	0.00	0.00	324.10	
Manual	30				0.00	0.00	0.00	324.10	
Manual	31				0.00	0.00	0.00	324.10	
Manual	32				0.00	0.00	0.00	324.10	
Manual	33				0.00	0.00	0.00	324.10	
Manual	34				0.00	0.00	0.00	324.10	
Manual	35				0.00	0.00	0.00	324.10	
Manual	36				0.00	0.00	0.00	324.10	
Manual	37				0.00	0.00	0.00	324.10	
Manual	38				0.00	0.00	0.00	324.10	
Manual	39				0.00	0.00	0.00	324.10	
Manual	40				0.00	0.00	0.00	324.10	
Manual	41				0.00	0.00	0.00	324.10	
Manual	42				0.00	0.00	0.00	324.10	
Manual	43				0.00	0.00	0.00	324.10	
Manual	44				0.00	0.00	0.00	324.10	
Manual	45				0.00	0.00	0.00	324.10	
Manual	46				0.00	0.00	0.00	324.10	
Manual	47				0.00	0.00	0.00	324.10	
Manual	48				0.00	0.00	0.00	324.10	
Manual	49				0.00	0.00	0.00	324.10	
Manual	50				0.00	0.00	0.00	324.10	
Manual	51				0.00	0.00	0.00	324.10	

Ellsworth Flow Study
Middle Reach

Survey Date: 9/8/2014

BM 100

Riffle	HI1	101.165		9/9/2014	9/10/2014	9/11/2014	9/11/2014
Station	FS	El	Notes	SG Reading (cm)			
0	1.45	99.715	LP G	0	14.6	54.7	70.3
8.6	1.55	99.615	FP G	Q=150 cfs	Q=300 cfs	Q=1,350 cfs	Q=2,100 cfs BKF
13.7	1.165	100	FP BKF Tree				
16.7	2.71	98.455	LT Toe at tree				
20.9	4.9	96.265	LT G				
28.6	4.53	96.635	LT G				
39.1	5.32	95.845	LT G				
43.5	5.71	95.455	LT G				
48.2	6.29	94.875	WS LEW				
48.2	6.43	94.735	LEW CG				
53.4	7.06	94.105	CG at SG				
64.7	12.2	88.965	CG				
77.9	13.06	88.105	CG				
89.4	8.22	92.945	CG				
98.1	8.4	92.765	CG - TWG				
107.9	7.61	93.555	CG				
116.6	7.43	93.735	CG				
130	7.5	93.665	CG				
142.1	8.16	93.005	CG				
153.1	7.36	93.805	CG				
167.1	7.35	93.815	CG				
173.5	8.1	93.065	CG				
183.4	7.1	94.065	CG				
197.8	7.38	93.785	CG - Large Boulders				
207.1	7.3	93.865	CG - Large Boulders				
220.4	7.23	93.935	CG - Large Boulders				
228.7	6.21	94.955	REW CG				
228.7	6.16	95.005	WS REW				
235.7	5.46	95.705	LT				
243.7	4.92	96.245	LT Toe				
249.9	2.1	99.065	Mid Slope				
254.3	1.26	99.905	BKF				
256	0.96	100.205	RP G				
257.2	0.69	100.475	G Tree				

Ellsworth Flow Study
Middle Reach

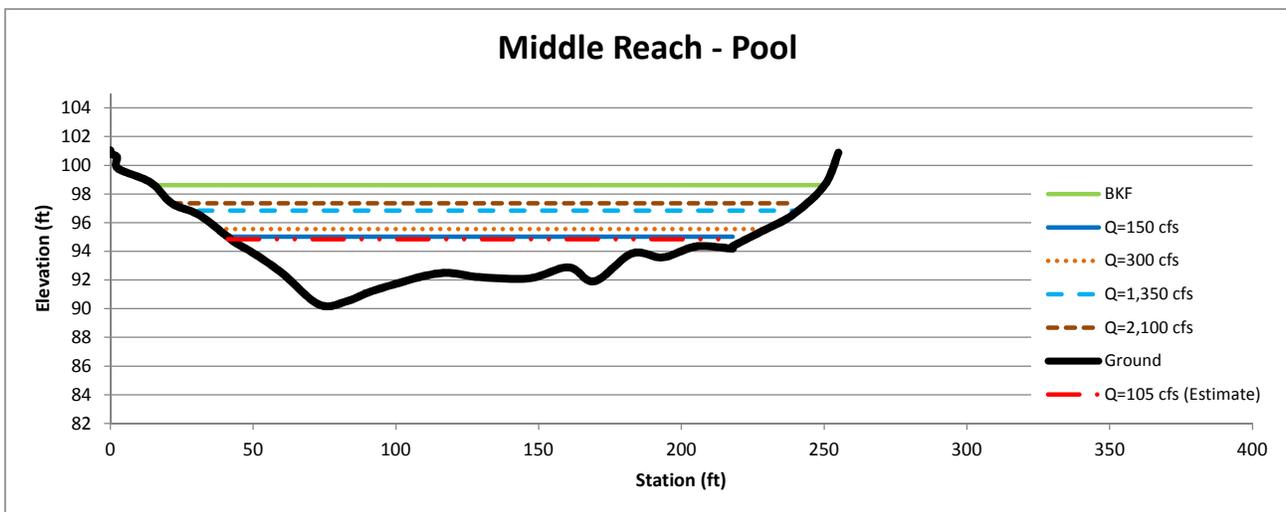
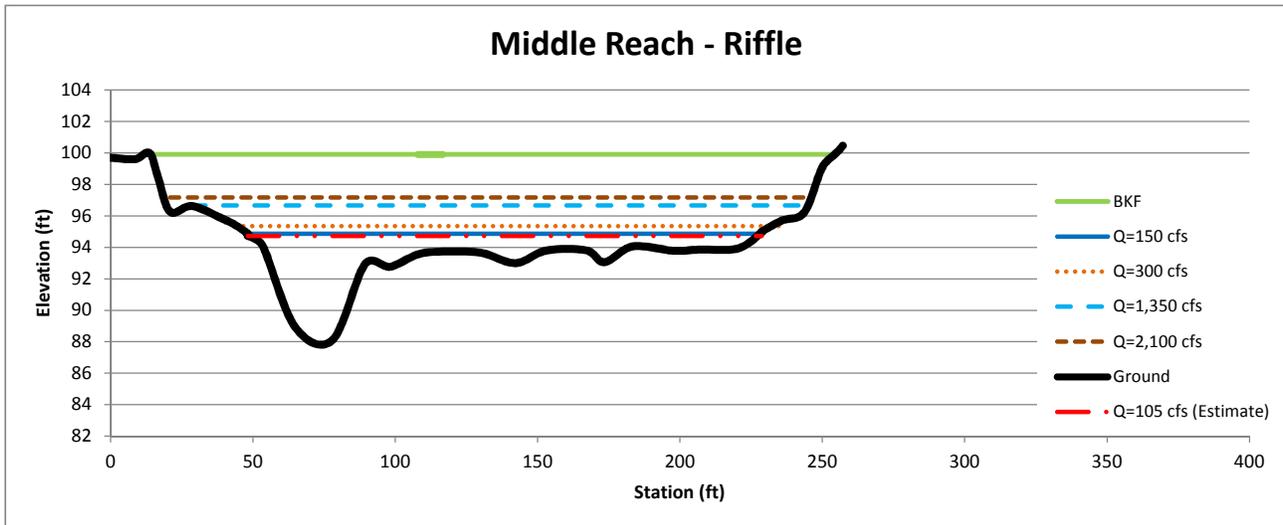
Survey Date: 9/8/2014

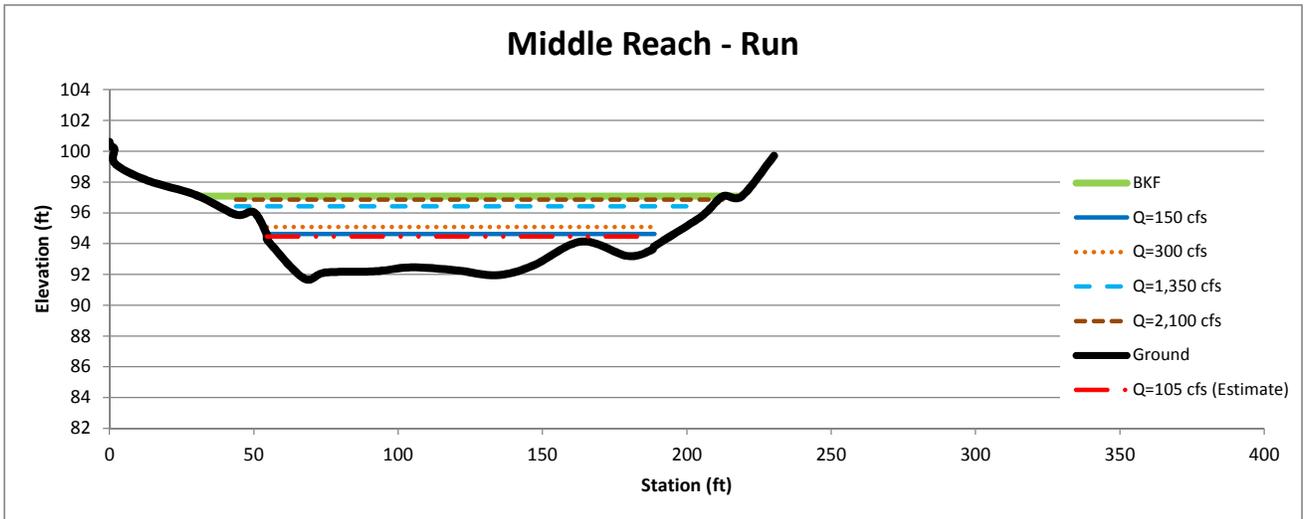
Pool	HI2	100.9		9/9/2014	9/10/2014	9/11/2014	9/11/2014
Station	FS	El	Notes	SG Reading (cm)			
0	0.12	101.045	LP Top	0	15.9	55.6	71
0	0.345	100.82	LP G	Q=150 cfs	Q=300 cfs	Q=1,350 cfs	Q=2,100 cfs BKF
2.3	0.59	100.575	BKF				
2.6	1.38	99.785	MT Toe				
14.1	2.36	98.805	LT Toe				
21.5	3.82	97.345	LT Toe				
31	4.61	96.555	LT Toe				
40.6	6.08	95.085	LEW G				
41.1	6.14	95.025	WS LEW				
43.6	6.54	94.625	CG at SG				
50	7.28	93.885	CG				
60	8.66	92.505	CG				
73.1	10.88	90.285	CG				
83.1	10.63	90.535	CG				
92.7	9.87	91.295	CG - Large Boulders				
114.8	8.7	92.465	CG - Large Boulders				
129.2	8.96	92.205	CG - TWG				
146.6	9.05	92.115	CG				
160.5	8.28	92.885	CG				
169.6	9.25	91.915	CG - Large Boulders				
182.7	7.31	93.855	CG - Large Boulders				
193.5	7.32	93.58	CG - Large Boulders				
205.3	6.55	94.35	CG - Large Boulders				
217.9	6.71	94.19	REW CG				
217.9	6.55	94.35	WS REW				
229.6	5.36	95.54	LT				
239.3	4.31	96.59	LT Toe				
250.2	2.28	98.62	BKF MT				
255	0.02	100.88	RP G				

Ellsworth Flow Study
Middle Reach

Survey Date: 9/8/2014

Run	HI3 101.88			9/9/2014	9/10/2014	9/11/2014	9/11/2014
Station	FS	El	Notes	SG Reading (cm)			
0	1.27	100.61	LP Top	12.5	26.8	67.3	81
0	1.52	100.36	LP G	Q=150 cfs	Q=300 cfs	Q=1,350 cfs	Q=2,100 cfs BKF
1.7	1.72	100.16	BKF				
2	2.69	99.19	LT Toe				
12.8	3.75	98.13	LT				
30.1	4.73	97.15	LT				
43.8	5.99	95.89	LT				
50	5.83	96.05	LT				
54.5	7.26	94.62	WS LEW				
54.5	7.38	94.5	LEW CG				
54.7	7.64	94.24	CG at SG				
67.3	10.13	91.75	CG				
74.8	9.75	92.13	CG				
92.2	9.67	92.21	CG				
104.3	9.42	92.46	CG				
120.3	9.61	92.27	CG				
133.9	9.93	91.95	CG				
146.5	9.32	92.56	CG				
163.5	7.74	94.14	CG				
179.5	8.68	93.2	CG				
188.1	8.26	93.62	REW CG				
188.8	8.04	93.84	WS REW				
205	6.11	95.77	LT				
212.4	4.8	97.08	LT				
219	4.8	97.08	BKF				
230.2	2.17	99.71	RP G				





*****WinXSPRO*****

C:\WinXPro\MidRiffle2.out
 Input File: C:\WinXPro\MidRiffle.sec
 Run Date: 10/17/14
 Analysis Procedure: Hydraulics
 Cross Section Number: 1
 Survey Date: 9/08/14

Subsections/Dividing positions

Resistance Method: Manning's n

SECTION A
 Low Stage n 0.035
 High Stage n 0.035

Unadjusted horizontal distances used

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)
6.7	T	333.95	181.74	179.28	1.84	1.86
6.71	T	335.75	181.83	179.36	1.85	1.87
6.72	T	337.54	181.92	179.44	1.86	1.88
6.73	T	339.34	182.02	179.52	1.86	1.89
6.74	T	341.13	182.11	179.6	1.87	1.9
6.75	T	342.93	182.2	179.69	1.88	1.91
6.76	T	344.73	182.29	179.77	1.89	1.92
6.77	T	346.53	182.38	179.85	1.9	1.93
6.78	T	348.32	182.55	180.01	1.91	1.94
6.79	T	350.13	182.71	180.17	1.92	1.94
6.8	T	351.93	182.87	180.34	1.92	1.95
6.81	T	353.73	183.04	180.5	1.93	1.96
6.82	T	355.54	183.2	180.66	1.94	1.97
6.83	T	357.35	183.37	180.82	1.95	1.98
6.84	T	359.16	183.53	180.99	1.96	1.98
6.85	T	360.97	183.69	181.15	1.97	1.99
6.86	T	362.78	183.78	181.23	1.97	2
6.87	T	364.59	183.88	181.31	1.98	2.01
6.88	T	366.41	183.97	181.39	1.99	2.02
6.89	T	368.22	184.06	181.47	2	2.03
6.9	T	370.04	184.15	181.55	2.01	2.04
6.91	T	371.85	184.33	181.74	2.02	2.05
6.92	T	373.67	184.52	181.92	2.03	2.05
6.93	T	375.49	184.7	182.1	2.03	2.06

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
6.94	T	377.32	184.88	182.28	2.04	2.07
6.95	T	379.14	185.06	182.46	2.05	2.08
6.96	T	380.97	185.24	182.64	2.06	2.09
6.97	T	382.79	185.43	182.82	2.06	2.09
6.98	T	384.62	185.61	183	2.07	2.1
6.99	T	386.45	185.79	183.18	2.08	2.11
7	T	388.29	185.97	183.37	2.09	2.12
7.01	T	390.12	186.16	183.55	2.1	2.13
7.02	T	391.96	186.34	183.73	2.1	2.13
7.03	T	393.8	186.52	183.91	2.11	2.14
7.04	T	395.64	186.7	184.09	2.12	2.15
7.05	T	397.48	186.88	184.27	2.13	2.16
7.06	T	399.32	187.07	184.45	2.13	2.16
7.07	T	401.17	187.25	184.63	2.14	2.17
7.08	T	403.02	187.43	184.81	2.15	2.18
7.09	T	404.87	187.61	184.99	2.16	2.19
7.1	T	406.72	187.8	185.18	2.17	2.2
7.11	T	408.57	187.98	185.36	2.17	2.2
7.12	T	410.43	188.16	185.54	2.18	2.21
7.13	T	412.28	188.34	185.72	2.19	2.22
7.14	T	414.14	188.52	185.9	2.2	2.23
7.15	T	416	188.71	186.08	2.2	2.24
7.16	T	417.86	188.89	186.26	2.21	2.24
7.17	T	419.73	189.07	186.44	2.22	2.25
7.18	T	421.59	189.25	186.62	2.23	2.26
7.19	T	423.46	189.44	186.81	2.24	2.27
7.2	T	425.33	189.62	186.99	2.24	2.27
7.21	T	427.2	189.8	187.17	2.25	2.28
7.22	T	429.07	189.98	187.35	2.26	2.29
7.23	T	430.95	190.16	187.53	2.27	2.3
7.24	T	432.83	190.35	187.71	2.27	2.31
7.25	T	434.7	190.53	187.89	2.28	2.31
7.26	T	436.58	190.71	188.07	2.29	2.32
7.27	T	438.47	190.89	188.25	2.3	2.33
7.28	T	440.35	191.07	188.44	2.3	2.34
7.29	T	442.24	191.26	188.62	2.31	2.34
7.3	T	444.12	191.44	188.8	2.32	2.35
7.31	T	446.01	191.62	188.98	2.33	2.36
7.32	T	447.9	191.8	189.16	2.34	2.37
7.33	T	449.8	191.99	189.34	2.34	2.38
7.34	T	451.69	192.17	189.52	2.35	2.38
7.35	T	453.59	192.35	189.7	2.36	2.39
7.36	T	455.49	192.56	189.92	2.37	2.4
7.37	T	457.39	192.78	190.13	2.37	2.41
7.38	T	459.29	192.99	190.34	2.38	2.41

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
7.39	T	461.2	193.21	190.55	2.39	2.42
7.4	T	463.1	193.42	190.77	2.39	2.43
7.41	T	465.01	193.63	190.98	2.4	2.43
7.42	T	466.92	193.85	191.19	2.41	2.44
7.43	T	468.84	194.06	191.41	2.42	2.45
7.44	T	470.75	194.27	191.62	2.42	2.46
7.45	T	472.67	194.49	191.83	2.43	2.46
7.46	T	474.59	194.7	192.04	2.44	2.47
7.47	T	476.51	194.92	192.26	2.44	2.48
7.48	T	478.43	195.13	192.47	2.45	2.49
7.49	T	480.36	195.34	192.68	2.46	2.49
7.5	T	482.29	195.56	192.9	2.47	2.5
7.51	T	484.22	195.77	193.11	2.47	2.51
7.52	T	486.15	195.98	193.32	2.48	2.51
7.53	T	488.09	196.2	193.53	2.49	2.52
7.54	T	490.02	196.41	193.75	2.49	2.53
7.55	T	491.96	196.63	193.96	2.5	2.54
7.56	T	493.9	196.84	194.17	2.51	2.54
7.57	T	495.85	197.05	194.39	2.52	2.55
7.58	T	497.79	197.27	194.6	2.52	2.56
7.59	T	499.74	197.48	194.81	2.53	2.57
7.6	T	501.69	197.7	195.03	2.54	2.57
7.61	T	503.64	197.96	195.29	2.54	2.58
7.62	T	505.6	198.22	195.55	2.55	2.59
7.63	T	507.55	198.48	195.81	2.56	2.59
7.64	T	509.51	198.74	196.07	2.56	2.6
7.65	T	511.48	199.01	196.33	2.57	2.61
7.66	T	513.44	199.27	196.59	2.58	2.61
7.67	T	515.41	199.53	196.85	2.58	2.62
7.68	T	517.38	199.79	197.11	2.59	2.62
7.69	T	519.35	200.05	197.37	2.6	2.63
7.7	T	521.33	200.31	197.64	2.6	2.64
7.71	T	523.3	200.58	197.9	2.61	2.64
7.72	T	525.29	200.84	198.16	2.62	2.65
7.73	T	527.27	201.1	198.42	2.62	2.66
7.74	T	529.25	201.36	198.68	2.63	2.66
7.75	T	531.24	201.64	198.96	2.63	2.67
7.76	T	533.23	201.93	199.24	2.64	2.68
7.77	T	535.23	202.21	199.52	2.65	2.68
7.78	T	537.23	202.49	199.8	2.65	2.69
7.79	T	539.23	202.77	200.09	2.66	2.69
7.8	T	541.23	203.05	200.37	2.67	2.7
7.81	T	543.23	203.33	200.65	2.67	2.71
7.82	T	545.24	203.62	200.93	2.68	2.71
7.83	T	547.25	203.9	201.21	2.68	2.72

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
7.84	T	549.27	204.18	201.49	2.69	2.73
7.85	T	551.28	204.46	201.77	2.7	2.73
7.86	T	553.3	204.74	202.05	2.7	2.74
7.87	T	555.33	205.03	202.33	2.71	2.74
7.88	T	557.35	205.31	202.62	2.71	2.75
7.89	T	559.38	205.59	202.9	2.72	2.76
7.9	T	561.41	205.87	203.18	2.73	2.76
7.91	T	563.44	206.15	203.46	2.73	2.77
7.92	T	565.48	206.43	203.74	2.74	2.78
7.93	T	567.52	206.72	204.02	2.75	2.78
7.94	T	569.56	207	204.3	2.75	2.79
7.95	T	571.61	207.28	204.58	2.76	2.79
7.96	T	573.65	207.56	204.86	2.76	2.8
7.97	T	575.7	207.84	205.15	2.77	2.81
7.98	T	577.76	208.13	205.43	2.78	2.81
7.99	T	579.81	208.41	205.71	2.78	2.82
8	T	581.87	208.69	205.99	2.79	2.82
8.01	T	583.93	208.97	206.27	2.79	2.83
8.02	T	586	209.25	206.55	2.8	2.84
8.03	T	588.07	209.53	206.83	2.81	2.84
8.04	T	590.14	209.82	207.11	2.81	2.85
8.05	T	592.21	210.1	207.39	2.82	2.86
8.06	T	594.29	210.38	207.68	2.82	2.86
8.07	T	596.36	210.66	207.96	2.83	2.87
8.08	T	598.45	210.94	208.24	2.84	2.87
8.09	T	600.53	211.23	208.52	2.84	2.88
8.1	T	602.62	211.51	208.8	2.85	2.89
8.11	T	604.71	211.79	209.08	2.86	2.89
8.12	T	606.8	212.07	209.36	2.86	2.9
8.13	T	608.9	212.35	209.64	2.87	2.9
8.14	T	610.99	212.63	209.92	2.87	2.91
8.15	T	613.09	212.79	210.08	2.88	2.92
8.16	T	615.2	212.95	210.24	2.89	2.93
8.17	T	617.3	213.34	210.62	2.89	2.93
8.18	T	619.41	213.73	211	2.9	2.94
8.19	T	621.52	214.12	211.38	2.9	2.94
8.2	T	623.64	214.5	211.77	2.91	2.94
8.21	T	625.76	214.89	212.15	2.91	2.95
8.22	T	627.88	215.28	212.53	2.92	2.95
8.23	T	630.01	215.67	212.91	2.92	2.96
8.24	T	632.14	216.05	213.3	2.93	2.96
8.25	T	634.28	216.44	213.68	2.93	2.97
8.26	T	636.42	216.83	214.06	2.94	2.97
8.27	T	638.56	217.22	214.44	2.94	2.98
8.28	T	640.71	217.6	214.83	2.94	2.98

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
8.29	T	642.86	217.99	215.21	2.95	2.99
8.3	T	645.01	218.38	215.59	2.95	2.99
8.31	T	647.17	218.77	215.97	2.96	3
8.32	T	649.33	219.15	216.35	2.96	3
8.33	T	651.5	219.54	216.74	2.97	3.01
8.34	T	653.67	219.93	217.12	2.97	3.01
8.35	T	655.84	220.32	217.5	2.98	3.02
8.36	T	658.02	220.7	217.88	2.98	3.02
8.37	T	660.2	221.09	218.27	2.99	3.02
8.38	T	662.38	221.48	218.65	2.99	3.03
8.39	T	664.57	221.87	219.03	3	3.03
8.4	T	666.76	222.25	219.41	3	3.04
8.41	T	668.96	222.64	219.79	3	3.04
8.42	T	671.16	223.03	220.18	3.01	3.05
8.43	T	673.37	223.42	220.56	3.01	3.05
8.44	T	675.57	223.8	220.94	3.02	3.06
8.45	T	677.79	224.19	221.32	3.02	3.06
8.46	T	680	224.58	221.71	3.03	3.07
8.47	T	682.22	224.97	222.09	3.03	3.07
8.48	T	684.44	225.35	222.47	3.04	3.08
8.49	T	686.67	225.74	222.85	3.04	3.08
8.5	T	688.9	226.13	223.24	3.05	3.09
8.51	T	691.14	226.52	223.62	3.05	3.09
8.52	T	693.38	226.9	224	3.06	3.1
8.53	T	695.62	227.28	224.37	3.06	3.1
8.54	T	697.86	227.32	224.41	3.07	3.11
8.55	T	700.11	227.37	224.45	3.08	3.12
8.56	T	702.35	227.41	224.49	3.09	3.13
8.57	T	704.6	227.46	224.53	3.1	3.14
8.58	T	706.84	227.51	224.57	3.11	3.15
8.59	T	709.09	227.55	224.62	3.12	3.16
8.6	T	711.34	227.6	224.66	3.13	3.17
8.61	T	713.58	227.64	224.7	3.13	3.18
8.62	T	715.83	227.69	224.74	3.14	3.19
8.63	T	718.08	227.74	224.78	3.15	3.19
8.64	T	720.33	227.78	224.82	3.16	3.2
8.65	T	722.58	227.83	224.86	3.17	3.21
8.66	T	724.83	227.87	224.9	3.18	3.22
8.67	T	727.08	227.92	224.94	3.19	3.23
8.68	T	729.33	227.96	224.99	3.2	3.24
8.69	T	731.58	228.01	225.03	3.21	3.25
8.7	T	733.83	228.06	225.07	3.22	3.26
8.71	T	736.08	228.1	225.11	3.23	3.27
8.72	T	738.33	228.15	225.15	3.24	3.28
8.73	T	740.58	228.19	225.19	3.25	3.29

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
8.74	T	742.84	228.24	225.23	3.25	3.3
8.75	T	745.09	228.28	225.27	3.26	3.31
8.76	T	747.34	228.33	225.32	3.27	3.32
8.77	T	749.6	228.38	225.36	3.28	3.33
8.78	T	751.85	228.42	225.4	3.29	3.34
8.79	T	754.11	228.47	225.44	3.3	3.35
8.8	T	756.36	228.51	225.48	3.31	3.35
8.81	T	758.62	228.56	225.52	3.32	3.36
8.82	T	760.87	228.61	225.56	3.33	3.37
8.83	T	763.13	228.65	225.6	3.34	3.38
8.84	T	765.38	228.7	225.64	3.35	3.39
8.85	T	767.64	228.74	225.69	3.36	3.4
8.86	T	769.9	228.79	225.73	3.37	3.41
8.87	T	772.16	228.83	225.77	3.37	3.42
8.88	T	774.42	228.88	225.81	3.38	3.43
8.89	T	776.67	228.93	225.85	3.39	3.44
8.9	T	778.93	228.97	225.89	3.4	3.45
8.91	T	781.19	229.02	225.93	3.41	3.46
8.92	T	783.45	229.06	225.97	3.42	3.47
8.93	T	785.71	229.11	226.02	3.43	3.48
8.94	T	787.97	229.15	226.06	3.44	3.49
8.95	T	790.24	229.2	226.1	3.45	3.5
8.96	T	792.5	229.25	226.14	3.46	3.5
8.97	T	794.76	229.29	226.18	3.47	3.51
8.98	T	797.02	229.34	226.22	3.48	3.52
8.99	T	799.28	229.38	226.26	3.48	3.53
9	T	801.55	229.43	226.3	3.49	3.54
9.01	T	803.81	229.48	226.34	3.5	3.55
9.02	T	806.08	229.52	226.39	3.51	3.56
9.03	T	808.34	229.57	226.43	3.52	3.57
9.04	T	810.61	229.61	226.47	3.53	3.58
9.05	T	812.87	229.66	226.51	3.54	3.59
9.06	T	815.14	229.7	226.55	3.55	3.6
9.07	T	817.4	229.75	226.59	3.56	3.61
9.08	T	819.67	229.8	226.63	3.57	3.62
9.09	T	821.94	229.84	226.67	3.58	3.63
9.1	T	824.2	229.89	226.72	3.59	3.64
9.11	T	826.47	229.93	226.76	3.59	3.64
9.12	T	828.74	229.98	226.8	3.6	3.65
9.13	T	831.01	230.02	226.84	3.61	3.66
9.14	T	833.28	230.07	226.88	3.62	3.67
9.15	T	835.55	230.12	226.92	3.63	3.68
9.16	T	837.82	230.16	226.96	3.64	3.69
9.17	T	840.09	230.21	227	3.65	3.7
9.18	T	842.36	230.25	227.04	3.66	3.71

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
9.19	T	844.63	230.3	227.09	3.67	3.72
9.2	T	846.9	230.35	227.13	3.68	3.73
9.21	T	849.17	230.39	227.17	3.69	3.74
9.22	T	851.45	230.44	227.21	3.69	3.75
9.23	T	853.72	230.48	227.25	3.7	3.76
9.24	T	855.99	230.53	227.29	3.71	3.77
9.25	T	858.26	230.57	227.33	3.72	3.78
9.26	T	860.54	230.62	227.37	3.73	3.78
9.27	T	862.81	230.67	227.42	3.74	3.79
9.28	T	865.09	230.71	227.46	3.75	3.8
9.29	T	867.36	230.76	227.5	3.76	3.81
9.3	T	869.64	230.8	227.54	3.77	3.82
9.31	T	871.92	230.85	227.58	3.78	3.83
9.32	T	874.19	230.9	227.62	3.79	3.84
9.33	T	876.47	230.94	227.66	3.8	3.85
9.34	T	878.75	230.99	227.7	3.8	3.86
9.35	T	881.02	231.03	227.74	3.81	3.87
9.36	T	883.3	231.08	227.79	3.82	3.88
9.37	T	885.58	231.12	227.83	3.83	3.89
9.38	T	887.86	231.17	227.87	3.84	3.9
9.39	T	890.14	231.22	227.91	3.85	3.91
9.4	T	892.42	231.26	227.95	3.86	3.91
9.41	T	894.7	231.31	227.99	3.87	3.92
9.42	T	896.98	231.35	228.03	3.88	3.93
9.43	T	899.26	231.4	228.07	3.89	3.94
9.44	T	901.54	231.44	228.12	3.9	3.95
9.45	T	903.82	231.49	228.16	3.9	3.96
9.46	T	906.11	231.54	228.2	3.91	3.97
9.47	T	908.39	231.58	228.24	3.92	3.98
9.48	T	910.67	231.63	228.28	3.93	3.99
9.49	T	912.95	231.67	228.32	3.94	4
9.5	T	915.24	231.72	228.36	3.95	4.01
9.51	T	917.52	231.77	228.4	3.96	4.02
9.52	T	919.81	231.81	228.44	3.97	4.03
9.53	T	922.09	231.86	228.49	3.98	4.04
9.54	T	924.38	231.9	228.53	3.99	4.04
9.55	T	926.66	231.95	228.57	4	4.05
9.56	T	928.95	231.99	228.61	4	4.06
9.57	T	931.24	232.04	228.65	4.01	4.07
9.58	T	933.52	232.09	228.69	4.02	4.08
9.59	T	935.81	232.13	228.73	4.03	4.09
9.6	T	938.1	232.18	228.77	4.04	4.1
9.61	T	940.39	232.22	228.81	4.05	4.11
9.62	T	942.68	232.27	228.86	4.06	4.12
9.63	T	944.97	232.31	228.9	4.07	4.13

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
9.64	T	947.26	232.36	228.94	4.08	4.14
9.65	T	949.55	232.41	228.98	4.09	4.15
9.66	T	951.84	232.45	229.02	4.09	4.16
9.67	T	954.13	232.5	229.06	4.1	4.17
9.68	T	956.42	232.54	229.1	4.11	4.17
9.69	T	958.71	232.59	229.14	4.12	4.18
9.7	T	961	232.64	229.19	4.13	4.19
9.71	T	963.3	232.68	229.23	4.14	4.2
9.72	T	965.59	232.73	229.27	4.15	4.21
9.73	T	967.88	232.77	229.31	4.16	4.22
9.74	T	970.18	232.82	229.35	4.17	4.23
9.75	T	972.47	232.86	229.39	4.18	4.24
9.76	T	974.76	232.91	229.43	4.19	4.25
9.77	T	977.06	232.96	229.47	4.19	4.26
9.78	T	979.36	233	229.51	4.2	4.27
9.79	T	981.65	233.05	229.56	4.21	4.28
9.8	T	983.95	233.09	229.6	4.22	4.29
9.81	T	986.24	233.14	229.64	4.23	4.29
9.82	T	988.54	233.18	229.68	4.24	4.3
9.83	T	990.84	233.23	229.72	4.25	4.31
9.84	T	993.14	233.28	229.76	4.26	4.32
9.85	T	995.43	233.32	229.8	4.27	4.33
9.86	T	997.73	233.37	229.84	4.28	4.34
9.87	T	1000.03	233.41	229.89	4.28	4.35
9.88	T	1002.33	233.46	229.93	4.29	4.36
9.89	T	1004.63	233.51	229.97	4.3	4.37
9.9	T	1006.93	233.55	230.01	4.31	4.38
9.91	T	1009.23	233.6	230.05	4.32	4.39
9.92	T	1011.53	233.64	230.09	4.33	4.4
9.93	T	1013.84	233.69	230.13	4.34	4.41
9.94	T	1016.14	233.73	230.17	4.35	4.41
9.95	T	1018.44	233.78	230.21	4.36	4.42
9.96	T	1020.74	233.83	230.26	4.37	4.43
9.97	T	1023.05	233.87	230.3	4.37	4.44
9.98	T	1025.35	233.92	230.34	4.38	4.45
9.99	T	1027.65	233.96	230.38	4.39	4.46
10	T	1029.96	234.01	230.42	4.4	4.47
10.01	T	1032.26	234.05	230.46	4.41	4.48
10.02	T	1034.57	234.1	230.5	4.42	4.49
10.03	T	1036.88	234.15	230.54	4.43	4.5
10.04	T	1039.18	234.19	230.59	4.44	4.51
10.05	T	1041.49	234.24	230.63	4.45	4.52
10.06	T	1043.79	234.28	230.67	4.46	4.53
10.07	T	1046.1	234.33	230.71	4.46	4.53
10.08	T	1048.41	234.38	230.75	4.47	4.54

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
10.09	T	1050.72	234.42	230.79	4.48	4.55
10.1	T	1053.03	234.47	230.83	4.49	4.56
10.11	T	1055.34	234.51	230.87	4.5	4.57
10.12	T	1057.65	234.56	230.91	4.51	4.58
10.13	T	1059.95	234.6	230.96	4.52	4.59
10.14	T	1062.27	234.65	231	4.53	4.6
10.15	T	1064.58	234.7	231.04	4.54	4.61
10.16	T	1066.89	234.74	231.08	4.54	4.62
10.17	T	1069.2	234.79	231.12	4.55	4.63
10.18	T	1071.51	234.83	231.16	4.56	4.64
10.19	T	1073.82	234.88	231.2	4.57	4.64
10.2	T	1076.14	234.93	231.24	4.58	4.65
10.21	T	1078.45	234.97	231.29	4.59	4.66
10.22	T	1080.76	235.02	231.33	4.6	4.67
10.23	T	1083.08	235.06	231.37	4.61	4.68
10.24	T	1085.39	235.11	231.41	4.62	4.69
10.25	T	1087.71	235.15	231.45	4.63	4.7
10.26	T	1090.02	235.2	231.49	4.63	4.71
10.27	T	1092.34	235.25	231.53	4.64	4.72
10.28	T	1094.65	235.29	231.57	4.65	4.73
10.29	T	1096.97	235.34	231.61	4.66	4.74
10.3	T	1099.29	235.38	231.66	4.67	4.75
10.31	T	1101.6	235.43	231.7	4.68	4.75
10.32	T	1103.92	235.47	231.74	4.69	4.76
10.33	T	1106.24	235.52	231.78	4.7	4.77
10.34	T	1108.56	235.57	231.82	4.71	4.78
10.35	T	1110.88	235.61	231.86	4.71	4.79
10.36	T	1113.2	235.66	231.9	4.72	4.8
10.37	T	1115.51	235.7	231.94	4.73	4.81
10.38	T	1117.83	235.75	231.99	4.74	4.82
10.39	T	1120.16	235.8	232.03	4.75	4.83
10.4	T	1122.48	235.84	232.07	4.76	4.84
10.41	T	1124.8	235.89	232.11	4.77	4.85
10.42	T	1127.12	235.93	232.15	4.78	4.86
10.43	T	1129.44	235.98	232.19	4.79	4.86
10.44	T	1131.76	236.03	232.23	4.8	4.87
10.45	T	1134.09	236.07	232.28	4.8	4.88
10.46	T	1136.41	236.12	232.32	4.81	4.89
10.47	T	1138.73	236.16	232.36	4.82	4.9
10.48	T	1141.06	236.21	232.4	4.83	4.91
10.49	T	1143.38	236.26	232.44	4.84	4.92
10.5	T	1145.71	236.3	232.48	4.85	4.93
10.51	T	1148.03	236.35	232.52	4.86	4.94
10.52	T	1150.36	236.39	232.57	4.87	4.95
10.53	T	1152.69	236.44	232.61	4.88	4.96

EXHIBIT 2

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)
10.54	T	1155.01	236.49	232.65	4.88	4.96
10.55	T	1157.34	236.53	232.69	4.89	4.97
10.56	T	1159.67	236.58	232.73	4.9	4.98
10.57	T	1162	236.62	232.77	4.91	4.99
10.58	T	1164.32	236.67	232.81	4.92	5
10.59	T	1166.65	236.72	232.86	4.93	5.01
10.6	T	1168.98	236.76	232.9	4.94	5.02
10.61	T	1171.31	236.81	232.94	4.95	5.03
10.62	T	1173.64	236.85	232.98	4.96	5.04
10.63	T	1175.97	236.9	233.02	4.96	5.05
10.64	T	1178.3	236.95	233.06	4.97	5.06
10.65	T	1180.64	236.99	233.1	4.98	5.06
10.66	T	1182.97	237.04	233.15	4.99	5.07
10.67	T	1185.3	237.08	233.19	5	5.08
10.68	T	1187.63	237.13	233.23	5.01	5.09
10.69	T	1189.96	237.18	233.27	5.02	5.1
10.7	T	1192.3	237.22	233.31	5.03	5.11
10.71	T	1194.63	237.27	233.35	5.03	5.12
10.72	T	1196.97	237.31	233.39	5.04	5.13
10.73	T	1199.3	237.36	233.44	5.05	5.14
10.74	T	1201.64	237.41	233.48	5.06	5.15
10.75	T	1203.97	237.45	233.52	5.07	5.16
10.76	T	1206.31	237.5	233.56	5.08	5.16
10.77	T	1208.64	237.55	233.6	5.09	5.17
10.78	T	1210.98	237.59	233.64	5.1	5.18
10.79	T	1213.32	237.64	233.68	5.11	5.19
10.8	T	1215.66	237.68	233.73	5.11	5.2
10.81	T	1217.99	237.73	233.77	5.12	5.21
10.82	T	1220.33	237.78	233.81	5.13	5.22
10.83	T	1222.67	237.82	233.85	5.14	5.23
10.84	T	1225.01	237.87	233.89	5.15	5.24
10.85	T	1227.35	237.91	233.93	5.16	5.25
10.86	T	1229.69	237.96	233.97	5.17	5.26
10.87	T	1232.03	238.01	234.02	5.18	5.26
10.88	T	1234.37	238.05	234.06	5.19	5.27
10.89	T	1236.71	238.1	234.1	5.19	5.28
10.9	T	1239.05	238.14	234.14	5.2	5.29
10.91	T	1241.4	238.19	234.18	5.21	5.3
10.92	T	1243.74	238.24	234.22	5.22	5.31
10.93	T	1246.08	238.28	234.26	5.23	5.32
10.94	T	1248.42	238.33	234.31	5.24	5.33
10.95	T	1250.77	238.37	234.35	5.25	5.34
10.96	T	1253.11	238.42	234.39	5.26	5.35
10.97	T	1255.46	238.5	234.46	5.26	5.35
10.98	T	1257.8	238.57	234.53	5.27	5.36

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
10.99	T	1260.15	238.65	234.61	5.28	5.37
11	T	1262.5	238.72	234.68	5.29	5.38
11.01	T	1264.84	238.8	234.75	5.3	5.39
11.02	T	1267.19	238.87	234.82	5.3	5.4
11.03	T	1269.54	238.95	234.89	5.31	5.4
11.04	T	1271.89	239.02	234.97	5.32	5.41
11.05	T	1274.24	239.1	235.04	5.33	5.42
11.06	T	1276.59	239.17	235.11	5.34	5.43
11.07	T	1278.94	239.25	235.18	5.35	5.44
11.08	T	1281.3	239.32	235.25	5.35	5.45
11.09	T	1283.65	239.4	235.32	5.36	5.45
11.1	T	1286	239.47	235.4	5.37	5.46
11.11	T	1288.36	239.55	235.47	5.38	5.47
11.12	T	1290.71	239.63	235.54	5.39	5.48
11.13	T	1293.07	239.7	235.61	5.39	5.49
11.14	T	1295.43	239.78	235.68	5.4	5.5
11.15	T	1297.79	239.85	235.76	5.41	5.5
11.16	T	1300.14	239.93	235.83	5.42	5.51
11.17	T	1302.5	240	235.9	5.43	5.52
11.18	T	1304.86	240.08	235.97	5.44	5.53
11.19	T	1307.22	240.15	236.04	5.44	5.54
11.2	T	1309.59	240.23	236.11	5.45	5.55
11.21	T	1311.95	240.3	236.19	5.46	5.55
11.22	T	1314.31	240.38	236.26	5.47	5.56
11.23	T	1316.67	240.45	236.33	5.48	5.57
11.24	T	1319.04	240.53	236.4	5.48	5.58
11.25	T	1321.4	240.6	236.47	5.49	5.59
11.26	T	1323.77	240.68	236.55	5.5	5.6
11.27	T	1326.13	240.75	236.62	5.51	5.6
11.28	T	1328.5	240.83	236.69	5.52	5.61
11.29	T	1330.87	240.9	236.76	5.52	5.62
11.3	T	1333.24	240.98	236.83	5.53	5.63
11.31	T	1335.61	241.05	236.9	5.54	5.64
11.32	T	1337.98	241.13	236.98	5.55	5.65
11.33	T	1340.35	241.2	237.05	5.56	5.65
11.34	T	1342.72	241.28	237.12	5.56	5.66
11.35	T	1345.09	241.35	237.19	5.57	5.67
11.36	T	1347.46	241.43	237.26	5.58	5.68
11.37	T	1349.84	241.51	237.34	5.59	5.69
11.38	T	1352.21	241.58	237.41	5.6	5.7
11.39	T	1354.59	241.66	237.48	5.61	5.7
11.4	T	1356.96	241.73	237.55	5.61	5.71
11.41	T	1359.34	241.81	237.62	5.62	5.72
11.42	T	1361.72	241.88	237.69	5.63	5.73
11.43	T	1364.09	241.96	237.77	5.64	5.74

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
11.44	T	1366.47	242.03	237.84	5.65	5.75
11.45	T	1368.85	242.11	237.91	5.65	5.75
11.46	T	1371.23	242.18	237.98	5.66	5.76
11.47	T	1373.61	242.26	238.05	5.67	5.77
11.48	T	1375.99	242.33	238.13	5.68	5.78
11.49	T	1378.37	242.41	238.2	5.69	5.79
11.5	T	1380.76	242.48	238.27	5.69	5.79
11.51	T	1383.14	242.66	238.44	5.7	5.8
11.52	T	1385.53	243.73	239.51	5.68	5.78
11.53	T	1387.93	244.8	240.57	5.67	5.77
11.54	T	1390.34	245.86	241.64	5.65	5.75
11.55	T	1392.77	246.93	242.7	5.64	5.74
11.56	T	1395.2	248	243.77	5.63	5.72
11.57	T	1397.64	249.07	244.83	5.61	5.71
11.58	T	1400.1	250.14	245.89	5.6	5.69
11.59	T	1402.56	251.21	246.96	5.58	5.68
11.6	T	1405.04	252.27	248.02	5.57	5.66
11.61	T	1407.52	253.25	249	5.56	5.65
11.62	T	1410.01	253.47	249.2	5.56	5.66
11.63	T	1412.51	253.69	249.41	5.57	5.66
11.64	T	1415	253.91	249.61	5.57	5.67
11.65	T	1417.5	254.13	249.81	5.58	5.67
11.66	T	1420	254.34	250.02	5.58	5.68
11.67	T	1422.5	254.56	250.22	5.59	5.68
11.68	T	1425.01	254.78	250.43	5.59	5.69
11.69	T	1427.51	255	250.63	5.6	5.7
11.7	T	1430.02	255.22	250.84	5.6	5.7
11.71	T	1432.53	255.43	251.04	5.61	5.71
11.72	T	1435.04	255.65	251.24	5.61	5.71
11.73	T	1437.56	255.87	251.45	5.62	5.72
11.74	T	1440.07	256.09	251.65	5.62	5.72
11.75	T	1442.59	256.31	251.86	5.63	5.73
11.76	T	1445.11	256.52	252.06	5.63	5.73
11.77	T	1447.63	256.74	252.27	5.64	5.74
11.78	T	1450.16	256.96	252.47	5.64	5.74
11.79	T	1452.68	257.18	252.68	5.65	5.75
11.8	T	1455.21	257.4	252.88	5.65	5.75
11.81	T	1457.74	257.62	253.09	5.66	5.76
11.82	T	1460.27	257.84	253.3	5.66	5.77
11.83	T	1462.81	258.06	253.51	5.67	5.77
11.84	T	1465.35	258.29	253.71	5.67	5.78
11.85	T	1467.88	258.51	253.92	5.68	5.78
11.86	T	1470.43	258.73	254.13	5.68	5.79
11.87	T	1472.97	258.95	254.34	5.69	5.79
11.88	T	1475.51	259.18	254.55	5.69	5.8

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
11.89	T	1478.06	259.4	254.76	5.7	5.8

*****WinXSPRO*****

C:\WinXPro\MidPool2.out
 Input File: C:\WinXPro\MidPool.sec
 Run Date: 10/17/14
 Analysis Procedure: Hydraulics
 Cross Section Number: 1
 Survey Date: 9/08/14

Subsections/Dividing positions

Resistance Method: Manning's n
 SECTION A
 Low Stage n 0.035
 High Stage n 0.035

Unadjusted horizontal distances used

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)
4.7	T	431.75	183.79	182.52	2.35	2.37
4.71	T	433.58	184.02	182.73	2.36	2.37
4.72	T	435.41	184.24	182.95	2.36	2.38
4.73	T	437.24	184.47	183.16	2.37	2.39
4.74	T	439.07	184.7	183.38	2.38	2.39
4.75	T	440.9	184.95	183.62	2.38	2.4
4.76	T	442.74	185.13	183.8	2.39	2.41
4.77	T	444.58	185.32	183.98	2.4	2.42
4.78	T	446.42	185.5	184.16	2.41	2.42
4.79	T	448.27	185.68	184.35	2.41	2.43
4.8	T	450.11	185.87	184.53	2.42	2.44
4.81	T	451.96	186.03	184.69	2.43	2.45
4.82	T	453.8	186.2	184.85	2.44	2.45
4.83	T	455.65	186.36	185.02	2.45	2.46
4.84	T	457.51	186.53	185.18	2.45	2.47
4.85	T	459.36	186.69	185.35	2.46	2.48
4.86	T	461.21	186.86	185.51	2.47	2.49
4.87	T	463.07	187.02	185.67	2.48	2.49
4.88	T	464.93	187.18	185.84	2.48	2.5
4.89	T	466.79	187.35	186	2.49	2.51
4.9	T	468.65	187.51	186.16	2.5	2.52
4.91	T	470.51	187.68	186.33	2.51	2.53
4.92	T	472.38	187.84	186.49	2.51	2.53
4.93	T	474.24	188.01	186.65	2.52	2.54
4.94	T	476.11	188.17	186.82	2.53	2.55

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
4.95	T	477.98	188.34	186.98	2.54	2.56
4.96	T	479.85	188.5	187.15	2.55	2.56
4.97	T	481.72	188.67	187.31	2.55	2.57
4.98	T	483.6	188.83	187.47	2.56	2.58
4.99	T	485.47	189	187.64	2.57	2.59
5	T	487.35	189.16	187.8	2.58	2.6
5.01	T	489.23	189.33	187.96	2.58	2.6
5.02	T	491.11	189.49	188.13	2.59	2.61
5.03	T	492.99	189.66	188.29	2.6	2.62
5.04	T	494.88	189.82	188.45	2.61	2.63
5.05	T	496.76	189.99	188.62	2.61	2.63
5.06	T	498.65	190.15	188.78	2.62	2.64
5.07	T	500.54	190.32	188.95	2.63	2.65
5.08	T	502.43	190.48	189.11	2.64	2.66
5.09	T	504.32	190.65	189.27	2.65	2.66
5.1	T	506.22	190.81	189.44	2.65	2.67
5.11	T	508.11	190.98	189.6	2.66	2.68
5.12	T	510.01	191.14	189.76	2.67	2.69
5.13	T	511.91	191.31	189.93	2.68	2.7
5.14	T	513.81	191.47	190.09	2.68	2.7
5.15	T	515.71	191.64	190.25	2.69	2.71
5.16	T	517.61	191.8	190.42	2.7	2.72
5.17	T	519.52	191.97	190.58	2.71	2.73
5.18	T	521.43	192.13	190.75	2.71	2.73
5.19	T	523.34	192.3	190.91	2.72	2.74
5.2	T	525.25	192.46	191.07	2.73	2.75
5.21	T	527.16	192.63	191.24	2.74	2.76
5.22	T	529.07	192.79	191.4	2.74	2.76
5.23	T	530.99	192.96	191.56	2.75	2.77
5.24	T	532.9	193.12	191.73	2.76	2.78
5.25	T	534.82	193.29	191.89	2.77	2.79
5.26	T	536.74	193.45	192.05	2.77	2.79
5.27	T	538.66	193.61	192.21	2.78	2.8
5.28	T	540.59	193.77	192.37	2.79	2.81
5.29	T	542.51	193.93	192.53	2.8	2.82
5.3	T	544.44	194.09	192.68	2.81	2.83
5.31	T	546.37	194.24	192.84	2.81	2.83
5.32	T	548.3	194.4	193	2.82	2.84
5.33	T	550.23	194.56	193.16	2.83	2.85
5.34	T	552.16	194.72	193.31	2.84	2.86
5.35	T	554.09	194.88	193.47	2.84	2.86
5.36	T	556.03	195.04	193.63	2.85	2.87
5.37	T	557.97	195.2	193.79	2.86	2.88
5.38	T	559.91	195.36	193.94	2.87	2.89
5.39	T	561.85	195.52	194.1	2.87	2.89

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
5.4	T	563.79	195.68	194.26	2.88	2.9
5.41	T	565.73	195.83	194.42	2.89	2.91
5.42	T	567.68	195.99	194.58	2.9	2.92
5.43	T	569.63	196.15	194.73	2.9	2.93
5.44	T	571.57	196.31	194.89	2.91	2.93
5.45	T	573.53	196.47	195.05	2.92	2.94
5.46	T	575.48	196.63	195.21	2.93	2.95
5.47	T	577.43	196.79	195.36	2.93	2.96
5.48	T	579.38	196.95	195.52	2.94	2.96
5.49	T	581.34	197.11	195.68	2.95	2.97
5.5	T	583.3	197.27	195.84	2.96	2.98
5.51	T	585.26	197.42	196	2.96	2.99
5.52	T	587.22	197.58	196.15	2.97	2.99
5.53	T	589.18	197.74	196.31	2.98	3
5.54	T	591.15	197.9	196.47	2.99	3.01
5.55	T	593.11	198.06	196.63	2.99	3.02
5.56	T	595.08	198.22	196.78	3	3.02
5.57	T	597.05	198.38	196.94	3.01	3.03
5.58	T	599.02	198.54	197.1	3.02	3.04
5.59	T	600.99	198.7	197.26	3.02	3.05
5.6	T	602.97	198.86	197.41	3.03	3.05
5.61	T	604.94	199.02	197.57	3.04	3.06
5.62	T	606.92	199.17	197.73	3.05	3.07
5.63	T	608.9	199.33	197.89	3.05	3.08
5.64	T	610.88	199.49	198.05	3.06	3.08
5.65	T	612.86	199.65	198.2	3.07	3.09
5.66	T	614.84	199.81	198.36	3.08	3.1
5.67	T	616.83	199.97	198.52	3.08	3.11
5.68	T	618.81	200.13	198.68	3.09	3.11
5.69	T	620.8	200.29	198.83	3.1	3.12
5.7	T	622.79	200.45	198.99	3.11	3.13
5.71	T	624.78	200.61	199.15	3.11	3.14
5.72	T	626.77	200.76	199.31	3.12	3.14
5.73	T	628.77	200.92	199.47	3.13	3.15
5.74	T	630.76	201.08	199.62	3.14	3.16
5.75	T	632.76	201.24	199.78	3.14	3.17
5.76	T	634.76	201.4	199.94	3.15	3.17
5.77	T	636.76	201.56	200.1	3.16	3.18
5.78	T	638.76	201.72	200.25	3.17	3.19
5.79	T	640.77	201.88	200.41	3.17	3.2
5.8	T	642.77	202.04	200.57	3.18	3.2
5.81	T	644.78	202.2	200.73	3.19	3.21
5.82	T	646.79	202.35	200.88	3.2	3.22
5.83	T	648.8	202.51	201.04	3.2	3.23
5.84	T	650.81	202.67	201.2	3.21	3.23

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
5.85	T	652.82	202.83	201.36	3.22	3.24
5.86	T	654.84	202.99	201.52	3.23	3.25
5.87	T	656.85	203.15	201.67	3.23	3.26
5.88	T	658.87	203.31	201.83	3.24	3.26
5.89	T	660.89	203.47	201.99	3.25	3.27
5.9	T	662.91	203.63	202.15	3.26	3.28
5.91	T	664.94	203.79	202.3	3.26	3.29
5.92	T	666.96	203.95	202.46	3.27	3.29
5.93	T	668.99	204.1	202.62	3.28	3.3
5.94	T	671.01	204.26	202.78	3.29	3.31
5.95	T	673.04	204.42	202.93	3.29	3.32
5.96	T	675.07	204.58	203.09	3.3	3.32
5.97	T	677.1	204.74	203.25	3.31	3.33
5.98	T	679.14	204.9	203.41	3.31	3.34
5.99	T	681.17	205.06	203.57	3.32	3.35
6	T	683.21	205.22	203.72	3.33	3.35
6.01	T	685.25	205.38	203.88	3.34	3.36
6.02	T	687.29	205.54	204.04	3.34	3.37
6.03	T	689.33	205.69	204.2	3.35	3.38
6.04	T	691.37	205.85	204.35	3.36	3.38
6.05	T	693.42	206.01	204.51	3.37	3.39
6.06	T	695.47	206.17	204.67	3.37	3.4
6.07	T	697.51	206.33	204.83	3.38	3.41
6.08	T	699.56	206.49	204.99	3.39	3.41
6.09	T	701.61	206.65	205.14	3.4	3.42
6.1	T	703.67	206.81	205.3	3.4	3.43
6.11	T	705.72	206.97	205.46	3.41	3.43
6.12	T	707.78	207.13	205.62	3.42	3.44
6.13	T	709.83	207.28	205.77	3.42	3.45
6.14	T	711.89	207.44	205.93	3.43	3.46
6.15	T	713.95	207.6	206.09	3.44	3.46
6.16	T	716.02	207.76	206.25	3.45	3.47
6.17	T	718.08	207.92	206.4	3.45	3.48
6.18	T	720.14	208.08	206.56	3.46	3.49
6.19	T	722.21	208.24	206.72	3.47	3.49
6.2	T	724.28	208.4	206.88	3.48	3.5
6.21	T	726.35	208.56	207.04	3.48	3.51
6.22	T	728.42	208.72	207.19	3.49	3.52
6.23	T	730.49	208.87	207.35	3.5	3.52
6.24	T	732.57	209.03	207.51	3.5	3.53
6.25	T	734.65	209.19	207.67	3.51	3.54
6.26	T	736.72	209.35	207.82	3.52	3.54
6.27	T	738.8	209.51	207.98	3.53	3.55
6.28	T	740.88	209.73	208.2	3.53	3.56
6.29	T	742.97	209.94	208.41	3.54	3.56

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
6.3	T	745.05	210.15	208.62	3.55	3.57
6.31	T	747.14	210.35	208.81	3.55	3.58
6.32	T	749.23	210.52	208.99	3.56	3.59
6.33	T	751.32	210.7	209.16	3.57	3.59
6.34	T	753.41	210.87	209.34	3.57	3.6
6.35	T	755.51	211.05	209.51	3.58	3.61
6.36	T	757.61	211.22	209.68	3.59	3.61
6.37	T	759.7	211.4	209.86	3.59	3.62
6.38	T	761.8	211.57	210.03	3.6	3.63
6.39	T	763.91	211.75	210.21	3.61	3.63
6.4	T	766.01	211.92	210.38	3.61	3.64
6.41	T	768.11	212.1	210.55	3.62	3.65
6.42	T	770.22	212.28	210.73	3.63	3.66
6.43	T	772.33	212.45	210.9	3.64	3.66
6.44	T	774.44	212.63	211.08	3.64	3.67
6.45	T	776.55	212.8	211.25	3.65	3.68
6.46	T	778.67	212.98	211.42	3.66	3.68
6.47	T	780.78	213.15	211.6	3.66	3.69
6.48	T	782.9	213.33	211.77	3.67	3.7
6.49	T	785.02	213.5	211.95	3.68	3.7
6.5	T	787.14	213.68	212.12	3.68	3.71
6.51	T	789.26	213.85	212.29	3.69	3.72
6.52	T	791.39	214.03	212.47	3.7	3.72
6.53	T	793.51	214.2	212.64	3.7	3.73
6.54	T	795.64	214.38	212.82	3.71	3.74
6.55	T	797.77	214.55	212.99	3.72	3.75
6.56	T	799.9	214.73	213.16	3.73	3.75
6.57	T	802.03	214.91	213.34	3.73	3.76
6.58	T	804.17	215.08	213.51	3.74	3.77
6.59	T	806.3	215.26	213.69	3.75	3.77
6.6	T	808.44	215.43	213.86	3.75	3.78
6.61	T	810.58	215.61	214.03	3.76	3.79
6.62	T	812.72	215.78	214.21	3.77	3.79
6.63	T	814.87	215.96	214.38	3.77	3.8
6.64	T	817.01	216.13	214.56	3.78	3.81
6.65	T	819.16	216.31	214.73	3.79	3.81
6.66	T	821.31	216.48	214.9	3.79	3.82
6.67	T	823.46	216.66	215.08	3.8	3.83
6.68	T	825.61	216.83	215.25	3.81	3.84
6.69	T	827.76	217.01	215.43	3.81	3.84
6.7	T	829.92	217.18	215.6	3.82	3.85
6.71	T	832.08	217.36	215.77	3.83	3.86
6.72	T	834.24	217.54	215.95	3.83	3.86
6.73	T	836.4	217.71	216.12	3.84	3.87
6.74	T	838.56	217.89	216.3	3.85	3.88

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
6.75	T	840.72	218.06	216.47	3.86	3.88
6.76	T	842.89	218.24	216.64	3.86	3.89
6.77	T	845.06	218.41	216.82	3.87	3.9
6.78	T	847.23	218.59	216.99	3.88	3.9
6.79	T	849.4	218.76	217.17	3.88	3.91
6.8	T	851.57	218.94	217.34	3.89	3.92
6.81	T	853.75	219.11	217.51	3.9	3.93
6.82	T	855.92	219.29	217.69	3.9	3.93
6.83	T	858.1	219.46	217.86	3.91	3.94
6.84	T	860.28	219.64	218.04	3.92	3.95
6.85	T	862.46	219.81	218.21	3.92	3.95
6.86	T	864.65	219.99	218.38	3.93	3.96
6.87	T	866.83	220.17	218.56	3.94	3.97
6.88	T	869.02	220.34	218.73	3.94	3.97
6.89	T	871.21	220.52	218.91	3.95	3.98
6.9	T	873.4	220.69	219.08	3.96	3.99
6.91	T	875.59	220.87	219.25	3.96	3.99
6.92	T	877.78	221.04	219.43	3.97	4
6.93	T	879.98	221.22	219.6	3.98	4.01
6.94	T	882.18	221.39	219.78	3.98	4.01
6.95	T	884.37	221.57	219.95	3.99	4.02
6.96	T	886.58	221.74	220.12	4	4.03
6.97	T	888.78	221.92	220.3	4	4.03
6.98	T	890.98	222.09	220.47	4.01	4.04
6.99	T	893.19	222.27	220.65	4.02	4.05
7	T	895.4	222.44	220.82	4.03	4.05
7.01	T	897.61	222.62	220.99	4.03	4.06
7.02	T	899.82	222.79	221.17	4.04	4.07
7.03	T	902.03	222.97	221.34	4.05	4.08
7.04	T	904.24	223.15	221.52	4.05	4.08
7.05	T	906.46	223.32	221.69	4.06	4.09
7.06	T	908.68	223.49	221.86	4.07	4.1
7.07	T	910.9	223.6	221.96	4.07	4.1
7.08	T	913.12	223.71	222.07	4.08	4.11
7.09	T	915.34	223.81	222.17	4.09	4.12
7.1	T	917.56	223.92	222.28	4.1	4.13
7.11	T	919.79	224.02	222.38	4.11	4.14
7.12	T	922.01	224.13	222.49	4.11	4.14
7.13	T	924.24	224.24	222.59	4.12	4.15
7.14	T	926.47	224.34	222.69	4.13	4.16
7.15	T	928.69	224.45	222.8	4.14	4.17
7.16	T	930.92	224.56	222.9	4.15	4.18
7.17	T	933.15	224.66	223.01	4.15	4.18
7.18	T	935.38	224.77	223.11	4.16	4.19
7.19	T	937.62	224.87	223.22	4.17	4.2

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
7.2	T	939.85	224.98	223.32	4.18	4.21
7.21	T	942.08	225.09	223.43	4.19	4.22
7.22	T	944.32	225.19	223.53	4.19	4.22
7.23	T	946.55	225.3	223.63	4.2	4.23
7.24	T	948.79	225.41	223.74	4.21	4.24
7.25	T	951.03	225.51	223.84	4.22	4.25
7.26	T	953.27	225.62	223.95	4.23	4.26
7.27	T	955.51	225.72	224.05	4.23	4.26
7.28	T	957.75	225.83	224.16	4.24	4.27
7.29	T	959.99	225.94	224.26	4.25	4.28
7.3	T	962.24	226.04	224.37	4.26	4.29
7.31	T	964.48	226.15	224.47	4.26	4.3
7.32	T	966.73	226.26	224.57	4.27	4.3
7.33	T	968.97	226.36	224.68	4.28	4.31
7.34	T	971.22	226.47	224.78	4.29	4.32
7.35	T	973.47	226.58	224.89	4.3	4.33
7.36	T	975.72	226.68	224.99	4.3	4.34
7.37	T	977.97	226.79	225.1	4.31	4.34
7.38	T	980.22	226.89	225.2	4.32	4.35
7.39	T	982.48	227	225.3	4.33	4.36
7.4	T	984.73	227.11	225.41	4.34	4.37
7.41	T	986.99	227.21	225.51	4.34	4.38
7.42	T	989.24	227.32	225.62	4.35	4.38
7.43	T	991.5	227.43	225.72	4.36	4.39
7.44	T	993.76	227.53	225.83	4.37	4.4
7.45	T	996.02	227.64	225.93	4.38	4.41
7.46	T	998.28	227.74	226.04	4.38	4.42
7.47	T	1000.54	227.85	226.14	4.39	4.42
7.48	T	1002.8	227.96	226.24	4.4	4.43
7.49	T	1005.06	228.06	226.35	4.41	4.44
7.5	T	1007.33	228.17	226.45	4.41	4.45
7.51	T	1009.59	228.28	226.56	4.42	4.46
7.52	T	1011.86	228.38	226.66	4.43	4.46
7.53	T	1014.13	228.49	226.77	4.44	4.47
7.54	T	1016.4	228.59	226.87	4.45	4.48
7.55	T	1018.67	228.7	226.98	4.45	4.49
7.56	T	1020.94	228.81	227.08	4.46	4.5
7.57	T	1023.21	228.91	227.18	4.47	4.5
7.58	T	1025.48	229.02	227.29	4.48	4.51
7.59	T	1027.76	229.13	227.39	4.49	4.52
7.6	T	1030.03	229.23	227.5	4.49	4.53
7.61	T	1032.31	229.34	227.6	4.5	4.54
7.62	T	1034.58	229.45	227.71	4.51	4.54
7.63	T	1036.86	229.55	227.81	4.52	4.55
7.64	T	1039.14	229.66	227.91	4.52	4.56

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
7.65	T	1041.42	229.76	228.02	4.53	4.57
7.66	T	1043.7	229.87	228.12	4.54	4.58
7.67	T	1045.99	229.98	228.23	4.55	4.58
7.68	T	1048.27	230.08	228.33	4.56	4.59
7.69	T	1050.55	230.19	228.44	4.56	4.6
7.7	T	1052.84	230.3	228.54	4.57	4.61
7.71	T	1055.12	230.4	228.65	4.58	4.61
7.72	T	1057.41	230.51	228.75	4.59	4.62
7.73	T	1059.7	230.61	228.85	4.6	4.63
7.74	T	1061.99	230.72	228.96	4.6	4.64
7.75	T	1064.28	230.83	229.06	4.61	4.65
7.76	T	1066.57	230.93	229.17	4.62	4.65
7.77	T	1068.87	231.04	229.27	4.63	4.66
7.78	T	1071.16	231.15	229.38	4.63	4.67
7.79	T	1073.45	231.25	229.48	4.64	4.68
7.8	T	1075.75	231.36	229.59	4.65	4.69
7.81	T	1078.05	231.46	229.69	4.66	4.69
7.82	T	1080.34	231.57	229.79	4.67	4.7
7.83	T	1082.64	231.68	229.9	4.67	4.71
7.84	T	1084.94	231.78	230	4.68	4.72
7.85	T	1087.24	231.89	230.11	4.69	4.72
7.86	T	1089.55	232	230.21	4.7	4.73
7.87	T	1091.85	232.1	230.32	4.7	4.74
7.88	T	1094.15	232.21	230.42	4.71	4.75
7.89	T	1096.46	232.31	230.52	4.72	4.76
7.9	T	1098.77	232.42	230.63	4.73	4.76
7.91	T	1101.07	232.53	230.73	4.74	4.77
7.92	T	1103.38	232.63	230.84	4.74	4.78
7.93	T	1105.69	232.74	230.94	4.75	4.79
7.94	T	1108	232.85	231.05	4.76	4.8
7.95	T	1110.31	232.95	231.15	4.77	4.8
7.96	T	1112.62	233.06	231.26	4.77	4.81
7.97	T	1114.94	233.17	231.36	4.78	4.82
7.98	T	1117.25	233.27	231.46	4.79	4.83
7.99	T	1119.57	233.38	231.57	4.8	4.83
8	T	1121.89	233.48	231.67	4.8	4.84
8.01	T	1124.2	233.59	231.78	4.81	4.85
8.02	T	1126.52	233.7	231.88	4.82	4.86
8.03	T	1128.84	233.8	231.99	4.83	4.87
8.04	T	1131.16	233.91	232.09	4.84	4.87
8.05	T	1133.48	234.02	232.2	4.84	4.88
8.06	T	1135.81	234.12	232.3	4.85	4.89
8.07	T	1138.13	234.23	232.4	4.86	4.9
8.08	T	1140.46	234.33	232.51	4.87	4.91
8.09	T	1142.78	234.44	232.61	4.87	4.91

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
8.1	T	1145.11	234.55	232.72	4.88	4.92
8.11	T	1147.44	234.65	232.82	4.89	4.93
8.12	T	1149.77	234.76	232.93	4.9	4.94
8.13	T	1152.1	234.87	233.03	4.91	4.94
8.14	T	1154.43	234.97	233.13	4.91	4.95
8.15	T	1156.76	235.08	233.24	4.92	4.96
8.16	T	1159.09	235.18	233.34	4.93	4.97
8.17	T	1161.43	235.29	233.45	4.94	4.98
8.18	T	1163.76	235.4	233.55	4.94	4.98
8.19	T	1166.1	235.5	233.66	4.95	4.99
8.2	T	1168.44	235.61	233.76	4.96	5
8.21	T	1170.78	235.72	233.87	4.97	5.01
8.22	T	1173.12	235.82	233.97	4.97	5.01
8.23	T	1175.46	235.93	234.07	4.98	5.02
8.24	T	1177.8	236.04	234.18	4.99	5.03
8.25	T	1180.14	236.14	234.28	5	5.04
8.26	T	1182.49	236.25	234.39	5.01	5.05
8.27	T	1184.83	236.35	234.49	5.01	5.05
8.28	T	1187.18	236.46	234.6	5.02	5.06
8.29	T	1189.52	236.57	234.7	5.03	5.07
8.3	T	1191.87	236.67	234.81	5.04	5.08
8.31	T	1194.22	236.78	234.91	5.04	5.08
8.32	T	1196.57	236.89	235.01	5.05	5.09
8.33	T	1198.92	236.99	235.12	5.06	5.1
8.34	T	1201.27	237.08	235.2	5.07	5.11
8.35	T	1203.63	237.16	235.28	5.08	5.12
8.36	T	1205.98	237.23	235.35	5.08	5.12
8.37	T	1208.34	237.31	235.42	5.09	5.13
8.38	T	1210.69	237.38	235.49	5.1	5.14
8.39	T	1213.05	237.46	235.56	5.11	5.15

*****WinXSPRO*****

C:\WinXSPRO\MidRun2.out
 Input File: C:\WinXSPRO\MidRun.sec
 Run Date: 10/17/14
 Analysis Procedure: Hydraulics
 Cross Section Number: 1
 Survey Date: 9/08/14

Subsections/Dividing positions

Resistance Method: Manning's n

SECTION A
 Low Stage n 0.035
 High Stage n 0.035

Unadjusted horizontal distances used

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)
2.8	T	251.45	140.9	140.26	1.78	1.79
2.81	T	252.86	140.99	140.34	1.79	1.8
2.82	T	254.26	141.09	140.43	1.8	1.81
2.83	T	255.67	141.18	140.51	1.81	1.82
2.84	T	257.07	141.28	140.6	1.82	1.83
2.85	T	258.48	141.37	140.68	1.83	1.84
2.86	T	259.89	141.47	140.76	1.84	1.85
2.87	T	261.29	141.56	140.85	1.85	1.86
2.88	T	262.7	141.68	140.96	1.85	1.86
2.89	T	264.11	141.8	141.08	1.86	1.87
2.9	T	265.53	141.92	141.19	1.87	1.88
2.91	T	266.94	142.03	141.31	1.88	1.89
2.92	T	268.35	142.15	141.42	1.89	1.9
2.93	T	269.77	142.27	141.54	1.9	1.91
2.94	T	271.18	142.39	141.66	1.9	1.91
2.95	T	272.6	142.5	141.77	1.91	1.92
2.96	T	274.02	142.62	141.89	1.92	1.93
2.97	T	275.44	142.74	142	1.93	1.94
2.98	T	276.86	142.86	142.12	1.94	1.95
2.99	T	278.28	142.97	142.23	1.95	1.96
3	T	279.71	143.09	142.35	1.95	1.96
3.01	T	281.13	143.21	142.46	1.96	1.97
3.02	T	282.56	143.33	142.58	1.97	1.98
3.03	T	283.98	143.44	142.69	1.98	1.99
3.04	T	285.41	143.56	142.81	1.99	2

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
3.05	T	286.84	143.68	142.93	2	2.01
3.06	T	288.27	143.8	143.04	2	2.02
3.07	T	289.7	143.91	143.16	2.01	2.02
3.08	T	291.13	144.03	143.27	2.02	2.03
3.09	T	292.57	144.15	143.39	2.03	2.04
3.1	T	294	144.27	143.5	2.04	2.05
3.11	T	295.44	144.38	143.62	2.05	2.06
3.12	T	296.87	144.5	143.73	2.05	2.07
3.13	T	298.31	144.62	143.85	2.06	2.07
3.14	T	299.75	144.74	143.96	2.07	2.08
3.15	T	301.19	144.85	144.08	2.08	2.09
3.16	T	302.63	144.97	144.19	2.09	2.1
3.17	T	304.08	145.09	144.31	2.1	2.11
3.18	T	305.52	145.21	144.43	2.1	2.12
3.19	T	306.97	145.32	144.54	2.11	2.12
3.2	T	308.41	145.44	144.66	2.12	2.13
3.21	T	309.86	145.56	144.77	2.13	2.14
3.22	T	311.31	145.68	144.89	2.14	2.15
3.23	T	312.76	145.79	145	2.15	2.16
3.24	T	314.21	145.91	145.12	2.15	2.17
3.25	T	315.66	146.03	145.23	2.16	2.17
3.26	T	317.11	146.15	145.35	2.17	2.18
3.27	T	318.57	146.27	145.46	2.18	2.19
3.28	T	320.02	146.38	145.58	2.19	2.2
3.29	T	321.48	146.5	145.7	2.19	2.21
3.3	T	322.94	146.62	145.81	2.2	2.21
3.31	T	324.4	146.74	145.93	2.21	2.22
3.32	T	325.86	146.85	146.04	2.22	2.23
3.33	T	327.32	146.97	146.16	2.23	2.24
3.34	T	328.78	147.09	146.27	2.24	2.25
3.35	T	330.24	147.21	146.39	2.24	2.26
3.36	T	331.71	147.32	146.5	2.25	2.26
3.37	T	333.18	147.44	146.62	2.26	2.27
3.38	T	334.64	147.56	146.73	2.27	2.28
3.39	T	336.11	147.68	146.85	2.28	2.29
3.4	T	337.58	147.79	146.97	2.28	2.3
3.41	T	339.05	147.91	147.08	2.29	2.31
3.42	T	340.52	148.03	147.2	2.3	2.31
3.43	T	342	148.15	147.31	2.31	2.32
3.44	T	343.47	148.26	147.43	2.32	2.33
3.45	T	344.94	148.38	147.54	2.32	2.34
3.46	T	346.42	148.5	147.66	2.33	2.35
3.47	T	347.9	148.62	147.77	2.34	2.35
3.48	T	349.38	148.73	147.89	2.35	2.36
3.49	T	350.86	148.85	148	2.36	2.37

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
3.5	T	352.34	148.97	148.12	2.37	2.38
3.51	T	353.82	149.09	148.23	2.37	2.39
3.52	T	355.3	149.2	148.35	2.38	2.4
3.53	T	356.79	149.32	148.47	2.39	2.4
3.54	T	358.27	149.44	148.58	2.4	2.41
3.55	T	359.76	149.56	148.7	2.41	2.42
3.56	T	361.25	149.67	148.81	2.41	2.43
3.57	T	362.74	149.79	148.93	2.42	2.44
3.58	T	364.23	149.91	149.04	2.43	2.44
3.59	T	365.72	150.03	149.16	2.44	2.45
3.6	T	367.21	150.14	149.27	2.45	2.46
3.61	T	368.7	150.26	149.39	2.45	2.47
3.62	T	370.2	150.38	149.5	2.46	2.48
3.63	T	371.69	150.5	149.62	2.47	2.48
3.64	T	373.19	150.62	149.74	2.48	2.49
3.65	T	374.69	150.73	149.85	2.49	2.5
3.66	T	376.19	150.85	149.97	2.49	2.51
3.67	T	377.69	150.97	150.08	2.5	2.52
3.68	T	379.19	151.09	150.2	2.51	2.52
3.69	T	380.69	151.2	150.31	2.52	2.53
3.7	T	382.2	151.32	150.43	2.53	2.54
3.71	T	383.7	151.44	150.54	2.53	2.55
3.72	T	385.21	151.56	150.66	2.54	2.56
3.73	T	386.72	151.67	150.77	2.55	2.56
3.74	T	388.23	151.79	150.89	2.56	2.57
3.75	T	389.74	151.91	151.01	2.57	2.58
3.76	T	391.25	152.03	151.12	2.57	2.59
3.77	T	392.76	152.14	151.24	2.58	2.6
3.78	T	394.27	152.26	151.35	2.59	2.61
3.79	T	395.79	152.38	151.47	2.6	2.61
3.8	T	397.3	152.5	151.58	2.61	2.62
3.81	T	398.82	152.61	151.7	2.61	2.63
3.82	T	400.34	152.73	151.81	2.62	2.64
3.83	T	401.86	152.85	151.93	2.63	2.65
3.84	T	403.38	152.97	152.04	2.64	2.65
3.85	T	404.9	153.08	152.16	2.64	2.66
3.86	T	406.42	153.2	152.27	2.65	2.67
3.87	T	407.94	153.32	152.39	2.66	2.68
3.88	T	409.47	153.44	152.51	2.67	2.68
3.89	T	410.99	153.55	152.62	2.68	2.69
3.9	T	412.52	153.67	152.74	2.68	2.7
3.91	T	414.05	153.79	152.85	2.69	2.71
3.92	T	415.58	153.91	152.97	2.7	2.72
3.93	T	417.11	154.02	153.08	2.71	2.72
3.94	T	418.64	154.14	153.2	2.72	2.73

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
3.95	T	420.17	154.26	153.31	2.72	2.74
3.96	T	421.71	154.38	153.43	2.73	2.75
3.97	T	423.24	154.49	153.54	2.74	2.76
3.98	T	424.78	154.61	153.66	2.75	2.76
3.99	T	426.32	154.73	153.78	2.76	2.77
4	T	427.86	154.85	153.89	2.76	2.78
4.01	T	429.4	154.97	154.01	2.77	2.79
4.02	T	430.94	155.08	154.12	2.78	2.8
4.03	T	432.48	155.17	154.21	2.79	2.8
4.04	T	434.02	155.26	154.3	2.8	2.81
4.05	T	435.57	155.35	154.39	2.8	2.82
4.06	T	437.11	155.44	154.47	2.81	2.83
4.07	T	438.66	155.53	154.56	2.82	2.84
4.08	T	440.2	155.62	154.65	2.83	2.85
4.09	T	441.75	155.71	154.74	2.84	2.85
4.1	T	443.3	155.81	154.83	2.85	2.86
4.11	T	444.85	155.9	154.91	2.85	2.87
4.12	T	446.4	155.99	155	2.86	2.88
4.13	T	447.95	156.08	155.09	2.87	2.89
4.14	T	449.5	156.18	155.19	2.88	2.9
4.15	T	451.05	156.77	155.78	2.88	2.9
4.16	T	452.62	157.36	156.36	2.88	2.89
4.17	T	454.18	157.94	156.94	2.88	2.89
4.18	T	455.75	158.53	157.53	2.87	2.89
4.19	T	457.33	159.12	158.11	2.87	2.89
4.2	T	458.92	159.71	158.7	2.87	2.89
4.21	T	460.51	160.29	159.28	2.87	2.89
4.22	T	462.1	160.88	159.87	2.87	2.89
4.23	T	463.71	161.47	160.45	2.87	2.89
4.24	T	465.31	162.05	161.03	2.87	2.89
4.25	T	466.93	162.64	161.62	2.87	2.89
4.26	T	468.55	163.23	162.2	2.87	2.89
4.27	T	470.17	163.82	162.79	2.87	2.89
4.28	T	471.8	164.4	163.37	2.87	2.89
4.29	T	473.44	164.99	163.96	2.87	2.89
4.3	T	475.08	165.56	164.53	2.87	2.89
4.31	T	476.73	165.73	164.69	2.88	2.89
4.32	T	478.38	165.9	164.86	2.88	2.9
4.33	T	480.03	166.06	165.02	2.89	2.91
4.34	T	481.68	166.23	165.19	2.9	2.92
4.35	T	483.33	166.4	165.35	2.9	2.92
4.36	T	484.99	166.56	165.52	2.91	2.93
4.37	T	486.64	166.73	165.68	2.92	2.94
4.38	T	488.3	166.9	165.85	2.93	2.94
4.39	T	489.96	167.06	166.01	2.93	2.95

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
4.4	T	491.62	167.23	166.18	2.94	2.96
4.41	T	493.28	167.4	166.34	2.95	2.97
4.42	T	494.95	167.56	166.51	2.95	2.97
4.43	T	496.62	167.73	166.68	2.96	2.98
4.44	T	498.28	167.9	166.84	2.97	2.99
4.45	T	499.95	168.06	167.01	2.97	2.99
4.46	T	501.62	168.23	167.17	2.98	3
4.47	T	503.3	168.4	167.34	2.99	3.01
4.48	T	504.97	168.56	167.5	3	3.01
4.49	T	506.65	168.73	167.67	3	3.02
4.5	T	508.33	168.9	167.83	3.01	3.03
4.51	T	510.01	169.06	168	3.02	3.04
4.52	T	511.69	169.23	168.16	3.02	3.04
4.53	T	513.37	169.4	168.33	3.03	3.05
4.54	T	515.05	169.56	168.49	3.04	3.06
4.55	T	516.74	169.73	168.66	3.04	3.06
4.56	T	518.43	169.9	168.82	3.05	3.07
4.57	T	520.12	170.06	168.99	3.06	3.08
4.58	T	521.81	170.23	169.15	3.07	3.08
4.59	T	523.5	170.4	169.32	3.07	3.09
4.6	T	525.2	170.56	169.48	3.08	3.1
4.61	T	526.89	170.73	169.65	3.09	3.11
4.62	T	528.59	170.9	169.82	3.09	3.11
4.63	T	530.29	171.06	169.98	3.1	3.12
4.64	T	531.99	171.23	170.15	3.11	3.13
4.65	T	533.69	171.4	170.31	3.11	3.13
4.66	T	535.4	171.56	170.48	3.12	3.14
4.67	T	537.1	171.73	170.64	3.13	3.15
4.68	T	538.81	171.89	170.81	3.13	3.15
4.69	T	540.52	172.06	170.97	3.14	3.16
4.7	T	542.23	172.23	171.14	3.15	3.17
4.71	T	543.94	172.39	171.3	3.16	3.18
4.72	T	545.66	172.56	171.47	3.16	3.18
4.73	T	547.37	172.73	171.63	3.17	3.19
4.74	T	549.09	172.89	171.8	3.18	3.2
4.75	T	550.81	173.06	171.96	3.18	3.2
4.76	T	552.53	173.23	172.13	3.19	3.21
4.77	T	554.25	173.39	172.29	3.2	3.22
4.78	T	555.98	173.56	172.46	3.2	3.22
4.79	T	557.7	173.73	172.62	3.21	3.23
4.8	T	559.43	173.89	172.79	3.22	3.24
4.81	T	561.16	174.06	172.95	3.22	3.24
4.82	T	562.89	174.23	173.12	3.23	3.25
4.83	T	564.62	174.39	173.29	3.24	3.26
4.84	T	566.36	174.56	173.45	3.24	3.27

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
4.85	T	568.09	174.73	173.62	3.25	3.27
4.86	T	569.83	174.89	173.78	3.26	3.28
4.87	T	571.57	175.06	173.95	3.26	3.29
4.88	T	573.31	175.23	174.11	3.27	3.29
4.89	T	575.05	175.39	174.28	3.28	3.3
4.9	T	576.8	175.56	174.44	3.29	3.31
4.91	T	578.54	175.73	174.61	3.29	3.31
4.92	T	580.29	175.89	174.77	3.3	3.32
4.93	T	582.04	176.06	174.94	3.31	3.33
4.94	T	583.79	176.23	175.1	3.31	3.33
4.95	T	585.54	176.39	175.27	3.32	3.34
4.96	T	587.29	176.56	175.43	3.33	3.35
4.97	T	589.05	176.73	175.6	3.33	3.35
4.98	T	590.81	176.89	175.76	3.34	3.36
4.99	T	592.57	177.06	175.93	3.35	3.37
5	T	594.33	177.23	176.09	3.35	3.38
5.01	T	596.09	177.39	176.26	3.36	3.38
5.02	T	597.85	177.56	176.43	3.37	3.39
5.03	T	599.62	177.73	176.59	3.37	3.4
5.04	T	601.38	177.89	176.76	3.38	3.4
5.05	T	603.15	178.06	176.92	3.39	3.41
5.06	T	604.92	178.22	177.09	3.39	3.42
5.07	T	606.7	178.39	177.25	3.4	3.42
5.08	T	608.47	178.56	177.42	3.41	3.43
5.09	T	610.24	178.72	177.58	3.41	3.44
5.1	T	612.02	178.89	177.75	3.42	3.44
5.11	T	613.8	179.06	177.91	3.43	3.45
5.12	T	615.58	179.22	178.08	3.43	3.46
5.13	T	617.36	179.39	178.24	3.44	3.46
5.14	T	619.15	179.56	178.41	3.45	3.47
5.15	T	620.93	179.72	178.57	3.45	3.48
5.16	T	622.72	179.89	178.74	3.46	3.48
5.17	T	624.51	180.06	178.9	3.47	3.49
5.18	T	626.3	180.22	179.07	3.48	3.5
5.19	T	628.09	180.39	179.23	3.48	3.5
5.2	T	629.88	180.56	179.4	3.49	3.51
5.21	T	631.68	180.72	179.56	3.5	3.52
5.22	T	633.48	180.89	179.73	3.5	3.52
5.23	T	635.27	181.06	179.9	3.51	3.53
5.24	T	637.07	181.22	180.06	3.52	3.54
5.25	T	638.88	181.39	180.23	3.52	3.54
5.26	T	640.68	181.56	180.39	3.53	3.55
5.27	T	642.48	181.72	180.56	3.54	3.56
5.28	T	644.29	181.89	180.72	3.54	3.57
5.29	T	646.1	182.06	180.89	3.55	3.57

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
5.3	T	647.91	182.22	181.05	3.56	3.58
5.31	T	649.72	182.39	181.22	3.56	3.59
5.32	T	651.53	182.56	181.38	3.57	3.59
5.33	T	653.35	189.32	188.15	3.45	3.47
5.34	T	655.24	189.47	188.3	3.46	3.48
5.35	T	657.12	189.63	188.45	3.47	3.49
5.36	T	659.01	189.78	188.6	3.47	3.49
5.37	T	660.89	189.93	188.75	3.48	3.5
5.38	T	662.78	190.09	188.9	3.49	3.51
5.39	T	664.67	190.24	189.05	3.49	3.52

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Lower Reach Flow Data

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Project	Ellsworth Flow Study		
Transect Name	Lower Reach Riffle	Date	9/9/2014
Purpose / Project	Verification flow measurement reportedly 150 cfs	Time	Begin 8:00 End
Conditions / Test	Minimum flow		
Transect Location	Adjacent to Shore Road		
Zero Station Location			
Verification Team	Gagnon/Sears/MacVane	Total Flow =	333.4 cfs

Data								
Field Measurements					Calculations			
Personnel / Method	Node	Station Distance (ft) (tag line)	Station Depth (ft)	Mean Station Velocity (ft/sec)	Incremental Nodal Area (ft ²)	Incremental Mean Nodal Velocity (ft/sec)	Incremental Nodal Flow (cfs)	Total Accumulated Flow (cfs)
Manual	0		0.00	0.000	0.00	0.00	0.00	0.00
Manual	1	31.7	0.60	0.010	1.59	0.01	0.01	0.01
Manual	2	50.0	0.90	0.510	9.75	0.26	2.54	2.54
Manual	3	55.0	0.90	1.220	4.50	0.87	3.89	6.44
Manual	4	60.0	0.70	1.190	4.00	1.21	4.82	11.26
Manual	5	65.0	1.20	1.520	4.75	1.36	6.44	17.69
Manual	6	70.0	2.20	1.660	8.50	1.59	13.52	31.21
Manual	7	75.0	1.80	1.140	10.00	1.40	14.00	45.21
Manual	8	83.0	5.30	0.870	28.40	1.01	28.54	73.75
Manual	9	90.0	5.00	1.815	36.05	1.34	48.40	122.15
Manual	10	100.0	5.80	0.810	54.00	1.31	70.88	193.02
Manual	11	104.0	3.20	0.200	18.00	0.51	9.09	202.11
Manual	12	109.0	4.00	0.035	18.00	0.12	2.12	204.23
Manual	13	114.0	5.50	0.110	23.75	0.07	1.72	205.95
Manual	14	119.0	6.00	0.045	28.75	0.08	2.23	208.18
Manual	15	124.0	6.00	0.245	30.00	0.15	4.35	212.53
Manual	16	129.0	6.50	0.440	31.25	0.34	10.70	223.23
Manual	17	134.0	5.6	0.155	30.25	0.30	9.00	232.23
Manual	18	139.0	3	0.06	21.50	0.11	2.31	234.54
Manual	19	144.0	1.8	0.04	12.00	0.05	0.60	235.14
Manual	20	149.0	2.8	0.03	11.50	0.04	0.40	235.54
Manual	21	154.0	3.5	0.885	15.75	0.46	7.21	242.75
Manual	22	159.0	2.5	0.1	15.00	0.49	7.39	250.14
Manual	23	164.0	2.5	0.37	12.50	0.24	2.94	253.07
Manual	24	169.0	2.5	0.85	12.50	0.61	7.63	260.70
Manual	25	174.0	2.2	0.78	11.75	0.82	9.58	270.27
Manual	26	182.0	3.6	1.13	23.20	0.96	22.16	292.43
Manual	27	187.0	3.2	0.965	17.00	1.05	17.81	310.24
Manual	28	192.0	2	1.2	13.00	1.08	14.07	324.31
Manual	29	197.0	1.3	0.56	8.25	0.88	7.26	331.57
Manual	30	203.5	0.7	0.01	6.50	0.29	1.85	333.42
Manual	31	204.7	0	0	0.42	0.01	0.00	333.42
Manual	32				0.00	0.00	0.00	333.42
Manual	33				0.00	0.00	0.00	333.42
Manual	34				0.00	0.00	0.00	333.42
Manual	35				0.00	0.00	0.00	333.42
Manual	36				0.00	0.00	0.00	333.42
Manual	37				0.00	0.00	0.00	333.42
Manual	38				0.00	0.00	0.00	333.42
Manual	39				0.00	0.00	0.00	333.42
Manual	40				0.00	0.00	0.00	333.42
Manual	41				0.00	0.00	0.00	333.42
Manual	42				0.00	0.00	0.00	333.42
Manual	43				0.00	0.00	0.00	333.42
Manual	44				0.00	0.00	0.00	333.42
Manual	45				0.00	0.00	0.00	333.42
Manual	46				0.00	0.00	0.00	333.42
Manual	47				0.00	0.00	0.00	333.42
Manual	48				0.00	0.00	0.00	333.42
Manual	49				0.00	0.00	0.00	333.42
Manual	50				0.00	0.00	0.00	333.42
Manual	51				0.00	0.00	0.00	333.42

Comment
 LEW Bedrock
 Bedrock slope

 Boulders/bedrock outcrop

 TWG
 Large boulders; US eddie measurement on a rock, D>6ft
 Large boulders; US eddie
 Large boulders; US eddie
 Large boulders; US eddie
 Large boulders; US eddie
 Channel through US boulders
 Large boulders; US eddie
 Large boulders; US eddie
 Large boulders; US eddie
 channel to right of US boulders, on bedrock
 bedrock
 bedrock
 bedrock
 bedrock near large boulder
 TWG of right minor channel
 bedrock
 bedrock
 bedrock
 REW

Project	Ellsworth Flow Study			
Transect Name	Lower Reach Pool	Date	9/9/2014	
Purpose / Project	Verification flow measurement reportedly 150 cfs	Time	Begin	11:00
Conditions / Test	Minimum flow			
Transect Location	Adjacent to Shore Road			
Zero Station Location				
Verification Team	Gagnon/Sears/MacVane	Total Flow =	315.2	cfs

Data									Comment
Field Measurements					Calculations				
Personnel / Method	Node	Station Distance (ft) (tag line)	Station Depth (ft)	Mean Station Velocity (ft/sec)	Incremental Nodal Area (ft ²)	Incremental Mean Nodal Velocity (ft/sec)	Incremental Nodal Flow (cfs)	Total Accumulated Flow (cfs)	
Manual	0	7.6	0.00	0.000	0.00	0.00	0.00	0.00	
Manual	1	11.0	0.90	0.000	1.53	0.00	0.00	0.00	LEW
Manual	2	16.0	0.90	0.000	4.50	0.00	0.00	0.00	Cove/rock outcrop US and DS
Manual	3	21.0	1.40	0.000	5.75	0.00	0.00	0.00	Cove/rock outcrop US and DS
Manual	4	26.0	1.70	0.000	7.75	0.00	0.00	0.00	Cove/rock outcrop US and DS
Manual	5	31.0	2.20	0.000	9.75	0.00	0.00	0.00	Cove/rock outcrop US and DS
Manual	6	36.0	2.00	0.000	10.50	0.00	0.00	0.00	Cove/rock outcrop US and DS
Manual	7	41.0	2.80	0.000	12.00	0.00	0.00	0.00	
Manual	8	46.0	6.00	0.000	22.00	0.00	0.00	0.00	
Manual	9	51.0	8.00	-0.135	35.00	-0.07	-2.36	-2.36	Flow is US Eddy
Manual	10	56.0	8.30	-0.110	40.75	-0.12	-4.99	-7.35	Flow is US Eddy
Manual	11	61.0	11.00	0.050	48.25	-0.03	-1.45	-8.80	
Manual	12	66.0	10.00	0.065	52.50	0.06	3.02	-5.78	
Manual	13	71.0	10.00	0.040	50.00	0.05	2.63	-3.16	
Manual	14	76.0	9.90	0.085	49.75	0.06	3.11	-0.05	
Manual	15	81.0	10.50	0.195	51.00	0.14	7.14	7.09	
Manual	16	87.0	10.60	0.145	63.30	0.17	10.76	17.85	
Manual	17	92.0	8.7	0.24	48.25	0.19	9.29	27.14	
Manual	18	97.0	8.7	0.265	43.50	0.25	10.98	38.12	
Manual	19	102.0	9.4	0.345	45.25	0.31	13.80	51.93	
Manual	20	107.0	11.1	0.53	51.25	0.44	22.42	74.35	
Manual	21	112.0	10.3	0.53	53.50	0.53	28.36	102.70	TWG
Manual	22	117.0	10.9	0.63	53.00	0.58	30.74	133.44	
Manual	23	122.0	10	0.75	52.25	0.69	36.05	169.49	
Manual	24	127.0	9	0.97	47.50	0.86	40.85	210.34	
Manual	25	132.0	9.8	0.96	47.00	0.97	45.36	255.70	
Manual	26	137.0	7.7	0.855	43.75	0.91	39.70	295.40	
Manual	27	142.0	2.5	0.56	25.50	0.71	18.04	313.44	
Manual	28	146.9	0	0	6.13	0.28	1.72	315.16	REW
Manual	29				0.00	0.00	0.00	315.16	
Manual	30				0.00	0.00	0.00	315.16	
Manual	31				0.00	0.00	0.00	315.16	
Manual	32				0.00	0.00	0.00	315.16	
Manual	33				0.00	0.00	0.00	315.16	
Manual	34				0.00	0.00	0.00	315.16	
Manual	35				0.00	0.00	0.00	315.16	
Manual	36				0.00	0.00	0.00	315.16	
Manual	37				0.00	0.00	0.00	315.16	
Manual	38				0.00	0.00	0.00	315.16	
Manual	39				0.00	0.00	0.00	315.16	
Manual	40				0.00	0.00	0.00	315.16	
Manual	41				0.00	0.00	0.00	315.16	
Manual	42				0.00	0.00	0.00	315.16	
Manual	43				0.00	0.00	0.00	315.16	
Manual	44				0.00	0.00	0.00	315.16	
Manual	45				0.00	0.00	0.00	315.16	
Manual	46				0.00	0.00	0.00	315.16	
Manual	47				0.00	0.00	0.00	315.16	
Manual	48				0.00	0.00	0.00	315.16	
Manual	49				0.00	0.00	0.00	315.16	
Manual	50				0.00	0.00	0.00	315.16	
Manual	51				0.00	0.00	0.00	315.16	

Ellsworth
Lower Reach

Survey Date: 9/9/2014

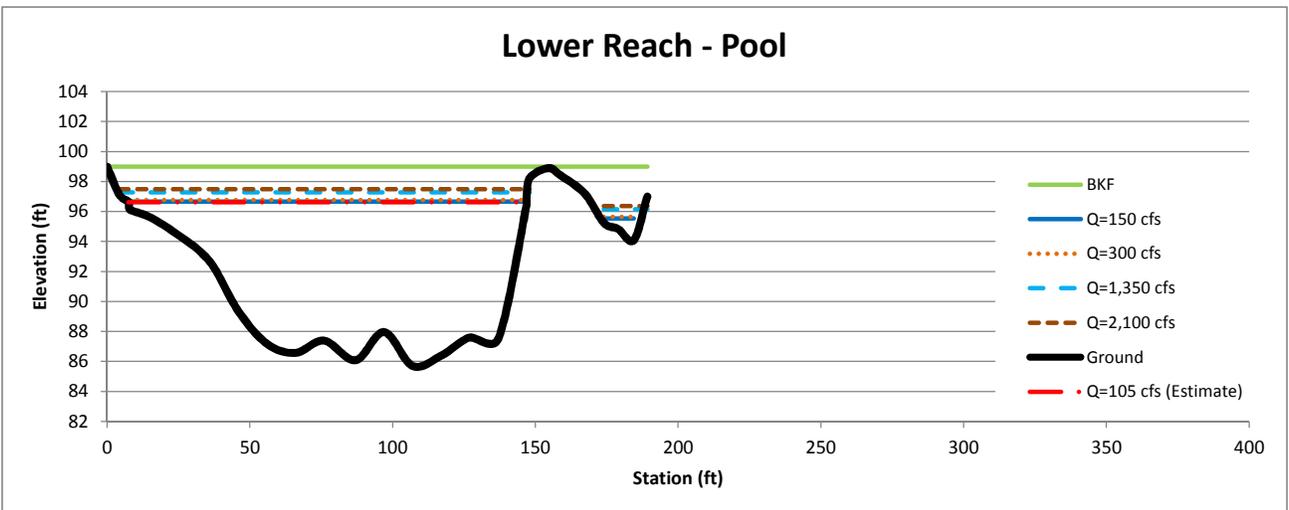
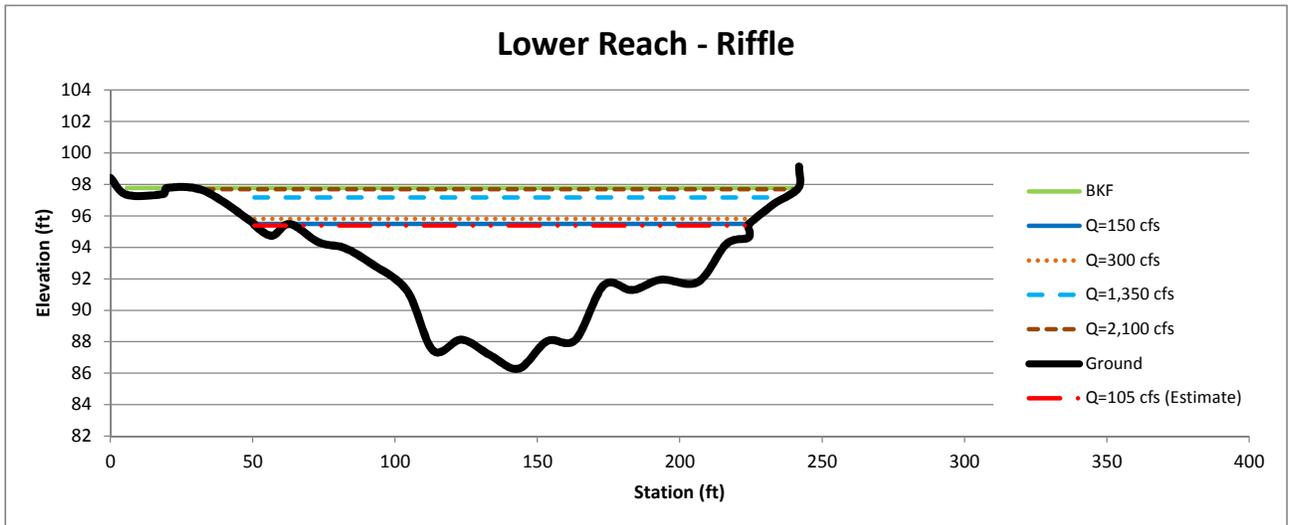
BM1 100

Riffle		HI1 102.1		9/9/2014	9/10/2014	9/11/2014	9/11/2014	Plot
Station (ft)	FS	El	Notes	SG Reading (cm)				Station (ft)
				9.5	19.6	60.7	77	
-19.4	3.68	98.42	Rock BM G	Q=150 cfs	Q=300 cfs	Q=1,350 cfs	Q=2,100 cfs	BKF
-13.6	4.75	97.35	BKF					5.8
-0.9	4.71	97.39	LT Boulders					18.5
0.6	4.31	97.79						20
13.7	4.51	97.59	EV/Bedrock					33.1
31.2	6.61	95.49	LEW WS					50.6
31.2	6.685	95.415	LEW CG					50.6
37.3	7.36	94.74	CG Bedrock					56.7
43.7	6.61	95.49	CG Bedrock					63.1
53.8	7.77	94.33	CG Bedrock					73.2
63	8.14	93.96	CG Bedrock					82.4
71.9	9.09	93.01	CG					91.3
84.8	10.85	91.25	TW					104.2
94	14.66	87.44	CG					113.4
104	13.96	88.14	CG					123.4
114	14.95	87.15	CG					133.4
124	15.81	86.29	CG					143.4
134	14.06	88.04	CG					153.4
144	13.97	88.13	CG					163.4
154	10.49	91.61	CG					173.4
164	10.81	91.29	CG					183.4
174	10.15	91.95	CG					193.4
187	10.3	91.8	CG					206.4
197	7.88	94.22	CG Bedrock					216.4
204.7	7.48	94.62	REW CG					224.1
204.7	6.79	95.31	REW WS					224.1
204.8	6.62	95.48	EV/ LT					224.2
213.8	5.32	96.78	LT					233.2
222.3	4.32	97.78	Toe BKF Slope					241.7
222.5	4.27	99.14	BKF RP G					241.9
222.5	2.96	97.83	RP Top					241.9

Ellsworth
Lower Reach

Survey Date: 9/9/2014

Pool	HI3 100.81		9/9/2014	9/10/2014	9/11/2014	9/11/2014	
Station (ft)	FS	El	Notes	SG Reading (cm)			
				8	11.05	26.6	33
				Q=150 cfs	Q=300 cfs	Q=1,350 cfs	Q=2,100 cfs BKF
0	3.11	98.99	BKF at Tree				
4.3	4.98	97.12	Toe LT				
7.5	5.44	96.66	LEW WS				
7.6	5.72	96.38	LEW CG				
8.2	6	96.1	CG at SG				
15	6.48	95.62	CG				
25.1	7.69	94.41	CG				
36	9.45	92.65	CG				
46	12.75	89.35	CG				
56	14.93	87.17	CG				
66	15.53	86.57	CG				
76	14.71	87.39	CG				
87	16.02	86.08	CG				
97	14.14	87.96	CG				
107	16.4	85.7	CG				
117	15.72	86.38	CG				
127	14.5	87.6	CG				
137	14.59	87.51	CG				
146.9	5.66	96.44	REW CG				
146.9	5.4	96.7	REW WS				
148	3.87	98.23	LT Rocks				
154.6	3.2	98.9	Rocks				
158.6	3.66	98.44	Rocks				
167.3	4.9	97.2	Rocks Midslope				
174	6.85	95.25	EW Rock toe				
179	7.26	94.84	Puddle G				
184.5	6.72	94.09	EW				
189.2	3.81	97	BKF RP G				
189.2	3.36	97.45	RP Top				



*****WinXSPRO*****

C:\WinXPro\LowRif2.out
 Input File: C:\WinXPro\LowRif.sec
 Run Date: 10/17/14
 Analysis Procedure: Hydraulics
 Cross Section Number: 1
 Survey Date: 9/08/14

Subsections/Dividing positions

Resistance Method: Manning's n
 SECTION A
 Low Stage n 0.035
 High Stage n 0.035

Unadjusted horizontal distances used

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)
9.1	T	739.4	174.58	171.6	4.24	4.31
9.11	T	741.11	174.86	171.87	4.24	4.31
9.12	T	742.83	175.13	172.13	4.24	4.32
9.13	T	744.56	175.37	172.36	4.25	4.32
9.14	T	746.28	175.56	172.54	4.25	4.33
9.15	T	748.01	175.76	172.71	4.26	4.33
9.16	T	749.74	175.95	172.89	4.26	4.34
9.17	T	751.47	176.15	173.07	4.27	4.34
9.18	T	753.2	176.34	173.25	4.27	4.35
9.19	T	754.93	176.54	173.43	4.28	4.35
9.2	T	756.67	176.79	173.67	4.28	4.36
9.21	T	758.41	176.95	173.82	4.29	4.36
9.22	T	760.15	177.1	173.97	4.29	4.37
9.23	T	761.89	177.25	174.13	4.3	4.38
9.24	T	763.63	177.41	174.28	4.3	4.38
9.25	T	765.37	177.56	174.43	4.31	4.39
9.26	T	767.12	177.72	174.59	4.32	4.39
9.27	T	768.87	177.87	174.74	4.32	4.4
9.28	T	770.61	178.02	174.89	4.33	4.41
9.29	T	772.36	178.18	175.04	4.33	4.41
9.3	T	774.12	178.33	175.2	4.34	4.42
9.31	T	775.87	178.49	175.35	4.35	4.42
9.32	T	777.62	178.64	175.5	4.35	4.43
9.33	T	779.38	178.79	175.65	4.36	4.44
9.34	T	781.14	178.95	175.81	4.37	4.44

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
9.35	T	782.9	179.1	175.96	4.37	4.45
9.36	T	784.66	179.26	176.11	4.38	4.46
9.37	T	786.42	179.41	176.26	4.38	4.46
9.38	T	788.18	179.56	176.42	4.39	4.47
9.39	T	789.95	179.72	176.57	4.4	4.47
9.4	T	791.72	179.87	176.72	4.4	4.48
9.41	T	793.48	180.02	176.87	4.41	4.49
9.42	T	795.25	180.18	177.03	4.41	4.49
9.43	T	797.02	180.33	177.18	4.42	4.5
9.44	T	798.8	180.49	177.33	4.43	4.5
9.45	T	800.57	180.64	177.48	4.43	4.51
9.46	T	802.35	180.79	177.64	4.44	4.52
9.47	T	804.13	180.95	177.79	4.44	4.52
9.48	T	805.9	181.1	177.94	4.45	4.53
9.49	T	807.69	181.26	178.09	4.46	4.54
9.5	T	809.47	181.41	178.25	4.46	4.54
9.51	T	811.25	181.56	178.4	4.47	4.55
9.52	T	813.04	181.72	178.55	4.47	4.55
9.53	T	814.82	181.87	178.71	4.48	4.56
9.54	T	816.61	182.03	178.86	4.49	4.57
9.55	T	818.4	182.18	179.01	4.49	4.57
9.56	T	820.19	182.33	179.16	4.5	4.58
9.57	T	821.98	182.49	179.32	4.5	4.58
9.58	T	823.78	182.64	179.47	4.51	4.59
9.59	T	825.58	182.8	179.62	4.52	4.6
9.6	T	827.37	182.95	179.77	4.52	4.6
9.61	T	829.17	183.1	179.93	4.53	4.61
9.62	T	830.97	183.26	180.08	4.53	4.61
9.63	T	832.77	183.41	180.23	4.54	4.62
9.64	T	834.58	183.56	180.38	4.55	4.63
9.65	T	836.38	183.72	180.54	4.55	4.63
9.66	T	838.19	183.87	180.69	4.56	4.64
9.67	T	840	184.03	180.84	4.56	4.64
9.68	T	841.81	184.18	180.99	4.57	4.65
9.69	T	843.62	184.33	181.15	4.58	4.66
9.7	T	845.43	184.49	181.3	4.58	4.66
9.71	T	847.24	184.64	181.45	4.59	4.67
9.72	T	849.06	184.8	181.6	4.59	4.68
9.73	T	850.88	184.95	181.76	4.6	4.68
9.74	T	852.7	185.1	181.91	4.61	4.69
9.75	T	854.52	185.26	182.06	4.61	4.69
9.76	T	856.34	185.41	182.21	4.62	4.7
9.77	T	858.16	185.57	182.37	4.62	4.71
9.78	T	859.99	185.72	182.52	4.63	4.71
9.79	T	861.81	185.87	182.67	4.64	4.72

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
9.8	T	863.64	186.03	182.83	4.64	4.72
9.81	T	865.47	186.18	182.98	4.65	4.73
9.82	T	867.3	186.34	183.13	4.65	4.74
9.83	T	869.13	186.49	183.28	4.66	4.74
9.84	T	870.97	186.64	183.44	4.67	4.75
9.85	T	872.8	186.8	183.59	4.67	4.75
9.86	T	874.64	186.95	183.74	4.68	4.76
9.87	T	876.48	187.1	183.89	4.68	4.77
9.88	T	878.32	187.26	184.05	4.69	4.77
9.89	T	880.16	187.41	184.2	4.7	4.78
9.9	T	882	187.57	184.35	4.7	4.78
9.91	T	883.85	187.72	184.5	4.71	4.79
9.92	T	885.69	187.87	184.66	4.71	4.8
9.93	T	887.54	188.03	184.81	4.72	4.8
9.94	T	889.39	188.18	184.96	4.73	4.81
9.95	T	891.24	188.34	185.11	4.73	4.81
9.96	T	893.09	188.49	185.27	4.74	4.82
9.97	T	894.95	188.64	185.42	4.74	4.83
9.98	T	896.8	188.8	185.57	4.75	4.83
9.99	T	898.66	188.95	185.72	4.76	4.84
10	T	900.52	189.11	185.88	4.76	4.84
10.01	T	902.38	189.26	186.03	4.77	4.85
10.02	T	904.24	189.41	186.18	4.77	4.86
10.03	T	906.1	189.57	186.33	4.78	4.86
10.04	T	907.97	189.72	186.49	4.79	4.87
10.05	T	909.83	189.88	186.64	4.79	4.87
10.06	T	911.7	190.03	186.79	4.8	4.88
10.07	T	913.57	190.18	186.95	4.8	4.89
10.08	T	915.44	190.34	187.1	4.81	4.89
10.09	T	917.31	190.49	187.25	4.82	4.9
10.1	T	919.19	190.64	187.4	4.82	4.9
10.11	T	921.06	190.8	187.56	4.83	4.91
10.12	T	922.94	190.95	187.71	4.83	4.92
10.13	T	924.82	191.11	187.86	4.84	4.92
10.14	T	926.7	191.26	188.01	4.85	4.93
10.15	T	928.58	191.41	188.17	4.85	4.93
10.16	T	930.46	191.57	188.32	4.86	4.94
10.17	T	932.34	191.72	188.47	4.86	4.95
10.18	T	934.23	191.88	188.62	4.87	4.95
10.19	T	936.12	192.03	188.78	4.87	4.96
10.2	T	938.01	192.18	188.93	4.88	4.96
10.21	T	939.9	192.34	189.08	4.89	4.97
10.22	T	941.79	192.49	189.23	4.89	4.98
10.23	T	943.68	192.65	189.39	4.9	4.98
10.24	T	945.58	192.8	189.54	4.9	4.99

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
10.25	T	947.47	192.95	189.69	4.91	4.99
10.26	T	949.37	193.11	189.84	4.92	5
10.27	T	951.27	193.26	190	4.92	5.01
10.28	T	953.17	193.42	190.15	4.93	5.01
10.29	T	955.08	193.57	190.3	4.93	5.02
10.3	T	956.98	193.72	190.46	4.94	5.02
10.31	T	958.89	193.88	190.61	4.95	5.03
10.32	T	960.79	194.03	190.76	4.95	5.04
10.33	T	962.7	194.19	190.91	4.96	5.04
10.34	T	964.61	194.34	191.07	4.96	5.05
10.35	T	966.52	194.49	191.22	4.97	5.05
10.36	T	968.44	194.65	191.37	4.98	5.06
10.37	T	970.35	194.8	191.52	4.98	5.07
10.38	T	972.27	194.95	191.68	4.99	5.07
10.39	T	974.19	195.11	191.83	4.99	5.08
10.4	T	976.11	195.26	191.98	5	5.08
10.41	T	978.03	195.42	192.13	5	5.09
10.42	T	979.95	195.57	192.29	5.01	5.1
10.43	T	981.87	195.72	192.44	5.02	5.1
10.44	T	983.8	195.88	192.59	5.02	5.11
10.45	T	985.73	196.03	192.74	5.03	5.11
10.46	T	987.65	196.19	192.9	5.03	5.12
10.47	T	989.58	196.34	193.05	5.04	5.13
10.48	T	991.52	196.49	193.2	5.05	5.13
10.49	T	993.45	196.65	193.36	5.05	5.14
10.5	T	995.38	196.82	193.52	5.06	5.14
10.51	T	997.32	196.99	193.69	5.06	5.15
10.52	T	999.26	197.16	193.86	5.07	5.15
10.53	T	1001.2	197.33	194.03	5.07	5.16
10.54	T	1003.14	197.5	194.2	5.08	5.17
10.55	T	1005.08	197.67	194.37	5.08	5.17
10.56	T	1007.03	197.84	194.53	5.09	5.18
10.57	T	1008.97	198	194.7	5.1	5.18
10.58	T	1010.92	198.17	194.87	5.1	5.19
10.59	T	1012.87	198.34	195.04	5.11	5.19
10.6	T	1014.82	198.51	195.21	5.11	5.2
10.61	T	1016.78	198.68	195.38	5.12	5.2
10.62	T	1018.73	198.85	195.54	5.12	5.21
10.63	T	1020.69	199.02	195.71	5.13	5.22
10.64	T	1022.65	199.19	195.88	5.13	5.22
10.65	T	1024.61	199.36	196.05	5.14	5.23
10.66	T	1026.57	199.53	196.22	5.14	5.23
10.67	T	1028.53	199.7	196.39	5.15	5.24
10.68	T	1030.5	199.87	196.55	5.16	5.24
10.69	T	1032.47	200.04	196.72	5.16	5.25

EXHIBIT 2

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)
10.7	T	1034.43	200.21	196.89	5.17	5.25
10.71	T	1036.4	200.38	197.06	5.17	5.26
10.72	T	1038.38	200.55	197.23	5.18	5.26
10.73	T	1040.35	200.72	197.4	5.18	5.27
10.74	T	1042.32	200.89	197.56	5.19	5.28
10.75	T	1044.3	201.06	197.73	5.19	5.28
10.76	T	1046.28	201.23	197.9	5.2	5.29
10.77	T	1048.26	201.4	198.07	5.2	5.29
10.78	T	1050.24	201.57	198.24	5.21	5.3
10.79	T	1052.23	201.74	198.41	5.22	5.3
10.8	T	1054.21	201.9	198.57	5.22	5.31
10.81	T	1056.2	202.07	198.74	5.23	5.31
10.82	T	1058.19	202.24	198.91	5.23	5.32
10.83	T	1060.18	202.41	199.08	5.24	5.33
10.84	T	1062.17	202.58	199.25	5.24	5.33
10.85	T	1064.16	202.75	199.42	5.25	5.34
10.86	T	1066.16	202.92	199.58	5.25	5.34
10.87	T	1068.16	203.09	199.75	5.26	5.35
10.88	T	1070.15	203.26	199.92	5.26	5.35
10.89	T	1072.15	203.43	200.09	5.27	5.36
10.9	T	1074.16	203.6	200.26	5.28	5.36
10.91	T	1076.16	203.77	200.43	5.28	5.37
10.92	T	1078.17	203.94	200.6	5.29	5.37
10.93	T	1080.17	204.11	200.76	5.29	5.38
10.94	T	1082.18	204.28	200.93	5.3	5.39
10.95	T	1084.19	204.45	201.1	5.3	5.39
10.96	T	1086.21	204.62	201.27	5.31	5.4
10.97	T	1088.22	204.79	201.44	5.31	5.4
10.98	T	1090.23	204.96	201.61	5.32	5.41
10.99	T	1092.25	205.13	201.77	5.32	5.41
11	T	1094.27	205.3	201.94	5.33	5.42
11.01	T	1096.29	205.47	202.11	5.34	5.42
11.02	T	1098.31	205.63	202.28	5.34	5.43
11.03	T	1100.34	205.8	202.45	5.35	5.44
11.04	T	1102.36	205.97	202.62	5.35	5.44
11.05	T	1104.39	206.14	202.78	5.36	5.45
11.06	T	1106.42	206.45	203.09	5.36	5.45
11.07	T	1108.47	209.85	206.49	5.28	5.37
11.08	T	1110.55	213.25	209.88	5.21	5.29
11.09	T	1112.67	216.65	213.28	5.14	5.22
11.1	T	1114.82	219.92	216.55	5.07	5.15
11.11	T	1116.99	220.18	216.81	5.07	5.15
11.12	T	1119.16	220.44	217.07	5.08	5.16
11.13	T	1121.33	220.71	217.33	5.08	5.16
11.14	T	1123.5	220.97	217.59	5.08	5.16

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
11.15	T	1125.68	221.23	217.85	5.09	5.17
11.16	T	1127.86	221.5	218.11	5.09	5.17
11.17	T	1130.04	221.76	218.37	5.1	5.17
11.18	T	1132.23	222.02	218.63	5.1	5.18
11.19	T	1134.42	222.29	218.89	5.1	5.18
11.2	T	1136.61	222.55	219.15	5.11	5.19
11.21	T	1138.8	222.81	219.41	5.11	5.19
11.22	T	1141	223.08	219.67	5.11	5.19
11.23	T	1143.19	223.34	219.93	5.12	5.2
11.24	T	1145.4	223.61	220.19	5.12	5.2
11.25	T	1147.6	223.87	220.45	5.13	5.21
11.26	T	1149.81	224.13	220.71	5.13	5.21
11.27	T	1152.01	224.4	220.97	5.13	5.21
11.28	T	1154.23	224.66	221.23	5.14	5.22
11.29	T	1156.44	224.92	221.49	5.14	5.22
11.3	T	1158.66	225.21	221.78	5.14	5.22
11.31	T	1160.88	226.05	222.61	5.14	5.21
11.32	T	1163.11	226.88	223.44	5.13	5.21
11.33	T	1165.35	227.72	224.27	5.12	5.2
11.34	T	1167.6	228.55	225.1	5.11	5.19
11.35	T	1169.85	229.39	225.93	5.1	5.18
11.36	T	1172.12	230.22	226.77	5.09	5.17
11.37	T	1174.39	231.06	227.6	5.08	5.16
11.38	T	1176.67	231.89	228.43	5.07	5.15
11.39	T	1178.96	232.73	229.26	5.07	5.14
11.4	T	1181.26	233.56	230.09	5.06	5.13
11.41	T	1183.56	234.4	230.93	5.05	5.13
11.42	T	1185.87	235.23	231.76	5.04	5.12
11.43	T	1188.2	236.06	232.59	5.03	5.11
11.44	T	1190.53	236.9	233.42	5.03	5.1
11.45	T	1192.87	237.73	234.25	5.02	5.09
11.46	T	1195.21	238.57	235.09	5.01	5.08
11.47	T	1197.57	239.4	235.92	5	5.08
11.48	T	1199.93	240.24	236.75	4.99	5.07
11.49	T	1202.3	241.07	237.58	4.99	5.06
11.5	T	1204.68	241.79	238.29	4.98	5.06
11.51	T	1207.07	241.86	238.35	4.99	5.06
11.52	T	1209.45	241.92	238.4	5	5.07
11.53	T	1211.84	241.99	238.46	5.01	5.08
11.54	T	1214.22	242.05	238.51	5.02	5.09
11.55	T	1216.61	242.12	238.57	5.02	5.1
11.56	T	1219	242.18	238.62	5.03	5.11
11.57	T	1221.38	242.25	238.68	5.04	5.12
11.58	T	1223.77	242.32	238.73	5.05	5.13
11.59	T	1226.16	242.38	238.79	5.06	5.13

*****WinXSPRO*****

C:\WinXPro\LowPool2.out
 Input File: C:\WinXPro\LowPool.sec
 Run Date: 10/17/14
 Analysis Procedure: Hydraulics
 Cross Section Number: 1
 Survey Date: 9/08/14

Subsections/Dividing positions

Resistance Method: Manning's n

SECTION A
 Low Stage n 0.035
 High Stage n 0.035

Unadjusted horizontal distances used

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)
10.9	T	1056.94	165.55	158.57	6.38	6.67
10.91	T	1058.53	165.62	158.63	6.39	6.67
10.92	T	1060.11	165.7	158.68	6.4	6.68
10.93	T	1061.7	165.77	158.73	6.4	6.69
10.94	T	1063.29	165.85	158.79	6.41	6.7
10.95	T	1064.88	165.92	158.84	6.42	6.7
10.96	T	1066.47	166	158.9	6.42	6.71
10.97	T	1068.05	166.13	159.02	6.43	6.72
10.98	T	1069.65	166.27	159.14	6.43	6.72
10.99	T	1071.24	166.4	159.26	6.44	6.73
11	T	1072.83	166.54	159.38	6.44	6.73
11.01	T	1074.43	166.68	159.5	6.45	6.74
11.02	T	1076.02	166.81	159.63	6.45	6.74
11.03	T	1077.62	166.95	159.76	6.45	6.75
11.04	T	1079.22	167.09	159.89	6.46	6.75
11.05	T	1080.82	167.23	160.01	6.46	6.75
11.06	T	1082.42	167.36	160.14	6.47	6.76
11.07	T	1084.02	167.5	160.27	6.47	6.76
11.08	T	1085.63	167.64	160.39	6.48	6.77
11.09	T	1087.23	167.78	160.52	6.48	6.77
11.1	T	1088.84	167.91	160.65	6.48	6.78
11.11	T	1090.44	168.05	160.78	6.49	6.78
11.12	T	1092.05	168.19	160.9	6.49	6.79
11.13	T	1093.66	168.33	161.03	6.5	6.79
11.14	T	1095.27	168.46	161.16	6.5	6.8

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
11.15	T	1096.89	168.6	161.29	6.51	6.8
11.16	T	1098.5	168.74	161.41	6.51	6.81
11.17	T	1100.12	168.88	161.54	6.51	6.81
11.18	T	1101.73	169.01	161.67	6.52	6.81
11.19	T	1103.35	169.15	161.79	6.52	6.82
11.2	T	1104.97	169.29	161.92	6.53	6.82
11.21	T	1106.59	169.42	162.05	6.53	6.83
11.22	T	1108.21	169.56	162.18	6.54	6.83
11.23	T	1109.83	169.7	162.3	6.54	6.84
11.24	T	1111.46	169.84	162.43	6.54	6.84
11.25	T	1113.08	169.97	162.56	6.55	6.85
11.26	T	1114.71	170.11	162.69	6.55	6.85
11.27	T	1116.34	170.25	162.81	6.56	6.86
11.28	T	1117.97	170.39	162.94	6.56	6.86
11.29	T	1119.6	170.52	163.07	6.57	6.87
11.3	T	1121.23	170.66	163.19	6.57	6.87
11.31	T	1122.86	170.79	163.31	6.57	6.88
11.32	T	1124.49	170.92	163.42	6.58	6.88
11.33	T	1126.13	171.05	163.53	6.58	6.89
11.34	T	1127.77	171.17	163.64	6.59	6.89
11.35	T	1129.4	171.3	163.75	6.59	6.9
11.36	T	1131.04	171.43	163.86	6.6	6.9
11.37	T	1132.68	171.56	163.97	6.6	6.91
11.38	T	1134.32	171.69	164.08	6.61	6.91
11.39	T	1135.96	171.82	164.19	6.61	6.92
11.4	T	1137.61	171.95	164.31	6.62	6.92
11.41	T	1139.25	172.07	164.42	6.62	6.93
11.42	T	1140.9	172.2	164.53	6.63	6.93
11.43	T	1142.54	172.28	164.59	6.63	6.94
11.44	T	1144.19	172.37	164.66	6.64	6.95
11.45	T	1145.84	172.45	164.72	6.64	6.96
11.46	T	1147.48	172.53	164.79	6.65	6.96
11.47	T	1149.13	172.62	164.85	6.66	6.97
11.48	T	1150.78	172.7	164.92	6.66	6.98
11.49	T	1152.43	172.78	164.98	6.67	6.99
11.5	T	1154.08	172.87	165.04	6.68	6.99
11.51	T	1155.73	172.99	165.14	6.68	7
11.52	T	1157.38	173.1	165.25	6.69	7
11.53	T	1159.04	173.22	165.35	6.69	7.01
11.54	T	1160.69	173.34	165.45	6.7	7.02
11.55	T	1162.35	173.46	165.55	6.7	7.02
11.56	T	1164	173.58	165.65	6.71	7.03
11.57	T	1165.66	173.7	165.75	6.71	7.03
11.58	T	1167.32	173.81	165.85	6.72	7.04
11.59	T	1168.98	173.93	165.95	6.72	7.04

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
11.6	T	1170.64	174.05	166.05	6.73	7.05
11.61	T	1172.3	174.17	166.15	6.73	7.06
11.62	T	1173.96	174.29	166.25	6.74	7.06
11.63	T	1175.63	174.41	166.35	6.74	7.07
11.64	T	1177.29	174.52	166.45	6.75	7.07
11.65	T	1178.96	174.64	166.55	6.75	7.08
11.66	T	1180.62	174.76	166.65	6.76	7.08
11.67	T	1182.29	174.88	166.75	6.76	7.09
11.68	T	1183.96	175	166.85	6.77	7.1
11.69	T	1185.63	175.12	166.95	6.77	7.1
11.7	T	1187.3	175.23	167.05	6.78	7.11
11.71	T	1188.97	175.35	167.15	6.78	7.11
11.72	T	1190.64	175.47	167.25	6.79	7.12
11.73	T	1192.32	175.59	167.35	6.79	7.12
11.74	T	1193.99	175.71	167.45	6.8	7.13
11.75	T	1195.66	175.82	167.55	6.8	7.14
11.76	T	1197.34	175.94	167.65	6.81	7.14
11.77	T	1199.02	176.06	167.75	6.81	7.15
11.78	T	1200.7	176.18	167.85	6.82	7.15
11.79	T	1202.38	176.3	167.96	6.82	7.16
11.8	T	1204.06	176.42	168.06	6.83	7.16
11.81	T	1205.74	176.53	168.16	6.83	7.17
11.82	T	1207.42	176.65	168.26	6.83	7.18
11.83	T	1209.1	176.77	168.36	6.84	7.18
11.84	T	1210.79	176.89	168.46	6.84	7.19
11.85	T	1212.47	177.01	168.56	6.85	7.19
11.86	T	1214.16	177.13	168.66	6.85	7.2
11.87	T	1215.85	177.24	168.76	6.86	7.2
11.88	T	1217.54	177.36	168.86	6.86	7.21
11.89	T	1219.23	177.48	168.96	6.87	7.22
11.9	T	1220.92	177.6	169.06	6.87	7.22
11.91	T	1222.61	177.72	169.16	6.88	7.23
11.92	T	1224.3	177.84	169.26	6.88	7.23
11.93	T	1225.99	177.95	169.36	6.89	7.24
11.94	T	1227.69	178.07	169.46	6.89	7.24
11.95	T	1229.38	178.19	169.56	6.9	7.25
11.96	T	1231.08	178.31	169.66	6.9	7.26
11.97	T	1232.78	178.43	169.76	6.91	7.26
11.98	T	1234.48	178.55	169.86	6.91	7.27
11.99	T	1236.18	178.66	169.96	6.92	7.27
12	T	1237.88	178.78	170.06	6.92	7.28
12.01	T	1239.58	178.9	170.16	6.93	7.28
12.02	T	1241.28	179.02	170.26	6.93	7.29
12.03	T	1242.98	179.14	170.36	6.94	7.3
12.04	T	1244.69	179.26	170.46	6.94	7.3

EXHIBIT 2

STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
12.05	T	1246.39	179.37	170.56	6.95	7.31
12.06	T	1248.1	179.49	170.67	6.95	7.31
12.07	T	1249.81	179.61	170.77	6.96	7.32
12.08	T	1251.52	179.73	170.87	6.96	7.32
12.09	T	1253.23	179.85	170.97	6.97	7.33
12.1	T	1254.94	179.96	171.07	6.97	7.34
12.11	T	1256.65	180.08	171.17	6.98	7.34
12.12	T	1258.36	180.2	171.27	6.98	7.35
12.13	T	1260.07	180.32	171.37	6.99	7.35
12.14	T	1261.79	180.44	171.47	6.99	7.36
12.15	T	1263.5	180.56	171.57	7	7.36
12.16	T	1265.22	180.67	171.67	7	7.37
12.17	T	1266.94	180.79	171.77	7.01	7.38
12.18	T	1268.66	180.91	171.87	7.01	7.38
12.19	T	1270.38	181.03	171.97	7.02	7.39
12.2	T	1272.1	181.15	172.07	7.02	7.39
12.21	T	1273.82	181.27	172.17	7.03	7.4
12.22	T	1275.54	181.38	172.27	7.03	7.4
12.23	T	1277.26	181.5	172.37	7.04	7.41
12.24	T	1278.99	181.62	172.47	7.04	7.42
12.25	T	1280.71	181.74	172.57	7.05	7.42
12.26	T	1282.44	181.86	172.67	7.05	7.43
12.27	T	1284.17	181.98	172.77	7.06	7.43
12.28	T	1285.9	182.09	172.87	7.06	7.44
12.29	T	1287.63	182.21	172.97	7.07	7.44
12.3	T	1289.36	182.33	173.07	7.07	7.45
12.31	T	1291.09	182.45	173.17	7.08	7.46
12.32	T	1292.82	182.57	173.27	7.08	7.46
12.33	T	1294.56	182.69	173.38	7.09	7.47
12.34	T	1296.29	182.8	173.48	7.09	7.47
12.35	T	1298.03	182.92	173.58	7.1	7.48
12.36	T	1299.76	183.04	173.68	7.1	7.48
12.37	T	1301.5	183.16	173.78	7.11	7.49
12.38	T	1303.24	183.28	173.88	7.11	7.5
12.39	T	1304.98	183.4	173.98	7.12	7.5
12.4	T	1306.72	183.51	174.08	7.12	7.51
12.41	T	1308.46	183.63	174.18	7.13	7.51
12.42	T	1310.2	183.75	174.28	7.13	7.52
12.43	T	1311.95	183.87	174.38	7.14	7.52
12.44	T	1313.69	183.99	174.48	7.14	7.53
12.45	T	1315.44	184.1	174.58	7.15	7.53
12.46	T	1317.18	184.22	174.68	7.15	7.54
12.47	T	1318.93	184.34	174.78	7.15	7.55
12.48	T	1320.68	184.46	174.88	7.16	7.55
12.49	T	1322.43	184.58	174.98	7.16	7.56

EXHIBIT 2

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)
12.5	T	1324.18	184.7	175.08	7.17	7.56
12.51	T	1325.93	184.81	175.18	7.17	7.57
12.52	T	1327.68	184.93	175.28	7.18	7.57
12.53	T	1329.44	185.05	175.39	7.18	7.58
12.54	T	1331.19	185.26	175.58	7.19	7.58
12.55	T	1332.95	185.46	175.77	7.19	7.58
12.56	T	1334.71	185.67	175.96	7.19	7.59
12.57	T	1336.47	185.87	176.15	7.19	7.59
12.58	T	1338.23	186.08	176.34	7.19	7.59
12.59	T	1340	186.28	176.54	7.19	7.59
12.6	T	1341.77	186.49	176.73	7.19	7.59
12.61	T	1343.53	186.69	176.92	7.2	7.59
12.62	T	1345.3	186.9	177.11	7.2	7.6
12.63	T	1347.08	187.1	177.3	7.2	7.6
12.64	T	1348.85	187.31	177.49	7.2	7.6
12.65	T	1350.63	187.51	177.69	7.2	7.6
12.66	T	1352.41	187.72	177.88	7.2	7.6
12.67	T	1354.19	187.92	178.07	7.21	7.6
12.68	T	1355.97	188.13	178.26	7.21	7.61
12.69	T	1357.75	188.33	178.45	7.21	7.61
12.7	T	1359.54	188.54	178.64	7.21	7.61
12.71	T	1361.33	188.74	178.84	7.21	7.61
12.72	T	1363.11	188.95	179.03	7.21	7.61
12.73	T	1364.91	189.15	179.22	7.22	7.62
12.74	T	1366.7	189.36	179.41	7.22	7.62
12.75	T	1368.5	189.58	179.62	7.22	7.62
12.76	T	1370.29	189.8	179.83	7.22	7.62
12.77	T	1372.09	190.03	180.04	7.22	7.62
12.78	T	1373.89	190.25	180.25	7.22	7.62
12.79	T	1375.7	190.47	180.45	7.22	7.62
12.8	T	1377.5	190.69	180.66	7.22	7.62
12.81	T	1379.31	190.91	180.87	7.22	7.63
12.82	T	1381.12	191.13	181.08	7.23	7.63
12.83	T	1382.94	191.36	181.29	7.23	7.63
12.84	T	1384.75	191.58	181.5	7.23	7.63
12.85	T	1386.57	191.8	181.71	7.23	7.63
12.86	T	1388.38	192.02	181.91	7.23	7.63
12.87	T	1390.2	192.24	182.12	7.23	7.63
12.88	T	1392.03	192.46	182.33	7.23	7.63
12.89	T	1393.85	192.69	182.54	7.23	7.64
12.9	T	1395.68	192.91	182.75	7.23	7.64
12.91	T	1397.51	193.13	182.96	7.24	7.64
12.92	T	1399.34	193.35	183.17	7.24	7.64
12.93	T	1401.17	193.57	183.37	7.24	7.64
12.94	T	1403.01	193.79	183.58	7.24	7.64

EXHIBIT 2

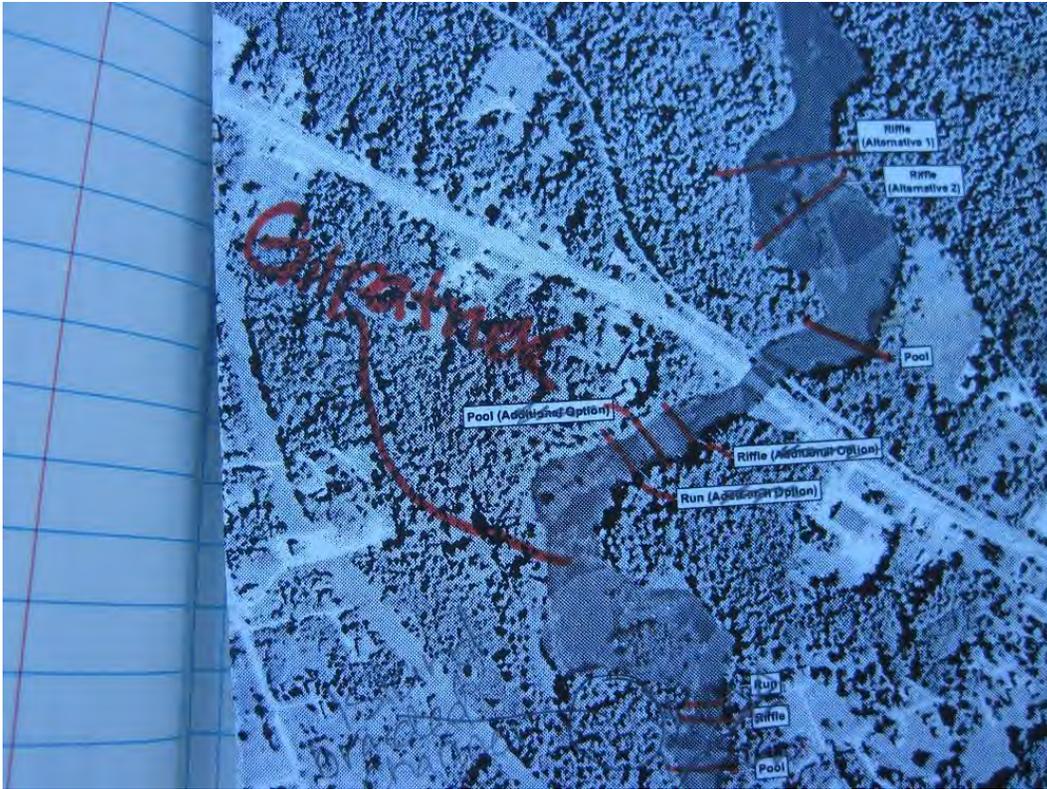
STAGE	#SEC	AREA	PERIM	WIDTH	R	DHYD
(ft)		(sq ft)	(ft)	(ft)	(ft)	(ft)
12.95	T	1404.84	194.02	183.79	7.24	7.64
12.96	T	1406.68	194.24	184	7.24	7.65
12.97	T	1408.53	194.46	184.21	7.24	7.65
12.98	T	1410.37	194.68	184.42	7.24	7.65
12.99	T	1412.21	194.9	184.62	7.25	7.65
13	T	1414.06	195.12	184.83	7.25	7.65
13.01	T	1415.91	195.35	185.04	7.25	7.65
13.02	T	1417.76	195.57	185.25	7.25	7.65
13.03	T	1419.62	195.79	185.46	7.25	7.65
13.04	T	1421.47	196.01	185.67	7.25	7.66
13.05	T	1423.33	196.23	185.88	7.25	7.66
13.06	T	1425.19	196.45	186.08	7.25	7.66
13.07	T	1427.05	196.68	186.29	7.26	7.66
13.08	T	1428.92	196.9	186.5	7.26	7.66
13.09	T	1430.79	197.12	186.71	7.26	7.66
13.1	T	1432.65	197.34	186.92	7.26	7.66
13.11	T	1434.52	197.56	187.13	7.26	7.67
13.12	T	1436.4	197.78	187.34	7.26	7.67
13.13	T	1438.27	198.01	187.54	7.26	7.67
13.14	T	1440.15	198.23	187.75	7.27	7.67
13.15	T	1442.03	198.45	187.96	7.27	7.67
13.16	T	1443.91	198.67	188.17	7.27	7.67
13.17	T	1445.79	198.89	188.38	7.27	7.67
13.18	T	1447.68	199.11	188.59	7.27	7.68
13.19	T	1449.56	199.34	188.79	7.27	7.68
13.2	T	1451.45	199.55	188.99	7.27	7.68
13.21	T	1453.34	199.58	189.02	7.28	7.69
13.22	T	1455.23	199.62	189.04	7.29	7.7
13.23	T	1457.13	199.65	189.06	7.3	7.71
13.24	T	1459.02	199.69	189.09	7.31	7.72
13.25	T	1460.91	199.72	189.11	7.31	7.73
13.26	T	1462.8	199.76	189.13	7.32	7.73
13.27	T	1464.69	199.79	189.16	7.33	7.74
13.28	T	1466.58	199.83	189.18	7.34	7.75
13.29	T	1468.48	199.86	189.2	7.35	7.76
13.3	T	1470.37	199.88	189.2	7.36	7.77
13.31	T	1472.26	199.9	189.2	7.36	7.78
13.32	T	1474.15	199.92	189.2	7.37	7.79
13.33	T	1476.05	199.94	189.2	7.38	7.8
13.34	T	1477.94	199.96	189.2	7.39	7.81
13.35	T	1479.83	199.98	189.2	7.4	7.82
13.36	T	1481.72	200	189.2	7.41	7.83
13.37	T	1483.62	200.02	189.2	7.42	7.84
13.38	T	1485.51	200.04	189.2	7.43	7.85
13.39	T	1487.4	200.06	189.2	7.43	7.86

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Gilpatrick Photographs

September 8, 2014

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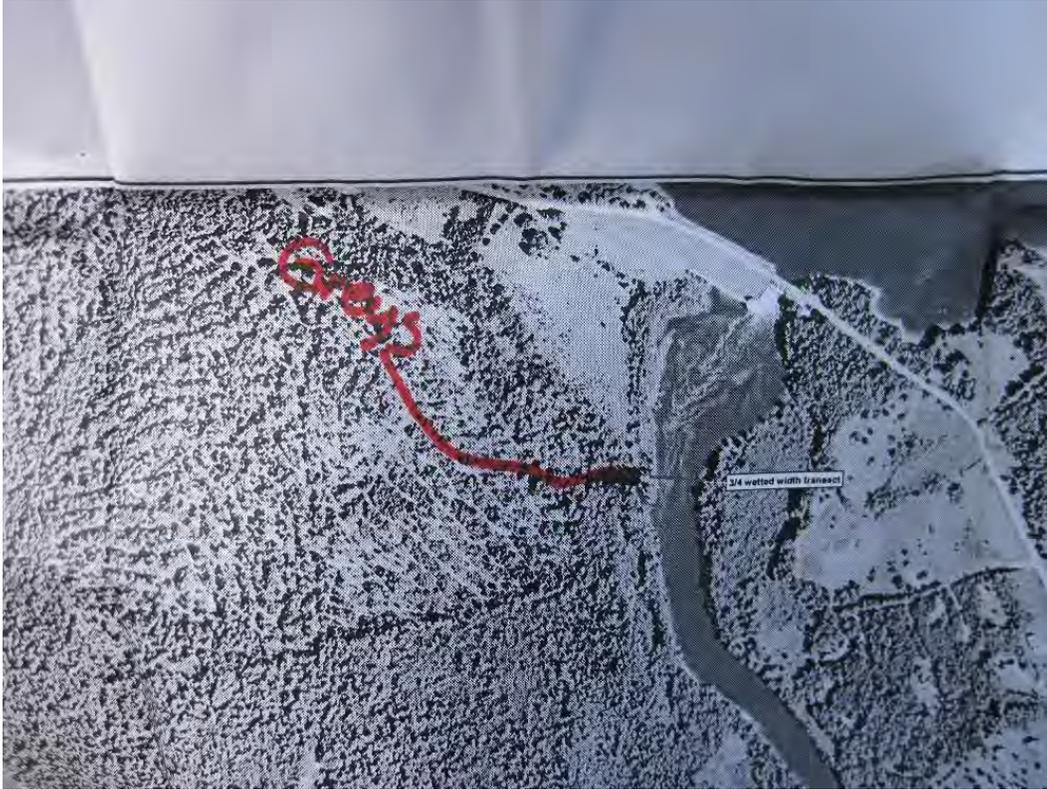


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Greys Photographs

September 8, 2014

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Moore Photographs

September 8, 2014

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Shackford Photographs

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APPENDIX E-5

**TURBINE INTAKE AND FISHWAY ENTRANCE WATER VELOCITY
MEASUREMENTS**

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MEMORANDUM	
TO:	Frank Dunlap, Licensing Specialist, Black Bear Hydro Partners LLC
FROM:	Jesse Wechsler, Fish and Aquatic Scientist, Kleinschmidt
DATE:	December 24, 2015
RE:	Turbine Intake and Downstream Fishway Entrance Water Velocity Measurements Ellsworth Hydroelectric Project (FERC No. 2727), Ellsworth, Maine

INTRODUCTION

The Ellsworth Project is located on the Union River in Maine, approximately 5 river kilometers (3.1 miles) upstream of Union River Bay and the Atlantic Ocean. Black Bear Hydro Partners LLC (Black Bear), an affiliate of the Brookfield Renewable Energy Group, operates the Ellsworth Project pursuant to the license issued by the Federal Energy Regulatory Commission (FERC) in 1987. The license expires on December 31, 2017; therefore, Black Bear is filing an application to FERC to relicense the Ellsworth Project. The Ellsworth Project consists of the Ellsworth dam, which forms Lake Leonard, and Graham Lake dam, which forms Graham Lake. Black Bear generates clean, renewable hydroelectric energy at the Ellsworth dam with four turbine/generator units with a total licensed nameplate capacity of 8.9 megawatts (MW).

Several migratory fish species currently occur in the Union River, including American eel and sea-run alewives; Atlantic salmon also occur but are uncommon. Black Bear provides downstream fish passage at the Ellsworth dam through three 3-foot-wide surface-weirs. Two of the weirs are located at the west powerhouse intake to Units 2, 3, and 4; the third entrance is located at the east powerhouse intake near Unit 1 (Figure 1). Fish that enter the two weirs at the west powerhouse intake are conveyed within an 18-inch-diameter pipe that crosses the downstream face of the non-overflow section of dam and powerhouse and discharges into a flume just below the dam crest elevation; the flume discharges in the tailrace (Figure 1). Each weir is opened approximately 21 inches and passes approximately 20 cubic feet a second (cfs) during the downstream fish passage season.

As part of the Initial Study Report (ISR),¹ Black Bear compared estimates of intake velocity in front of the trashracks to the swimming speed of American eel, Atlantic salmon, and river herring to evaluate the risk of entrainment through the intakes and impingement. Black Bear estimated the intake velocity by dividing the hydraulic capacity of each turbine by the gross area of each trashrack. This is a standard method for estimating intake velocity. In their December 30, 2014, Study Plan Determination, FERC noted that variation in trashrack spacing in combination with flows through the downstream fish bypass entrances could create an intake velocity field that may not be calculated accurately using turbine flow capacity and gross intake dimensions.² To verify the velocity of the water in front of the intakes, FERC requested that Black Bear conduct field measurements across the intake surfaces and at the three entrances of the Ellsworth dam downstream fish bypass. The National Marine Fisheries Service (NMFS) also recommended in its November 3, 2014, filing that Black Bear collect empirical measurements of velocities in front of the intakes to help understand entrainment risk at the Ellsworth Project.³

¹ Submitted to FERC on September 4, 2014.

² December 30, 2014 Determination on Requests for Study Modifications and New Studies for the Ellsworth Hydroelectric Project.

³ November 3, 2014 Comments, Request for Study Clarification, and Modification regarding Black Bear Hydro Partners September 4, 2014 Initial Study Report for the Ellsworth Hydroelectric Project.

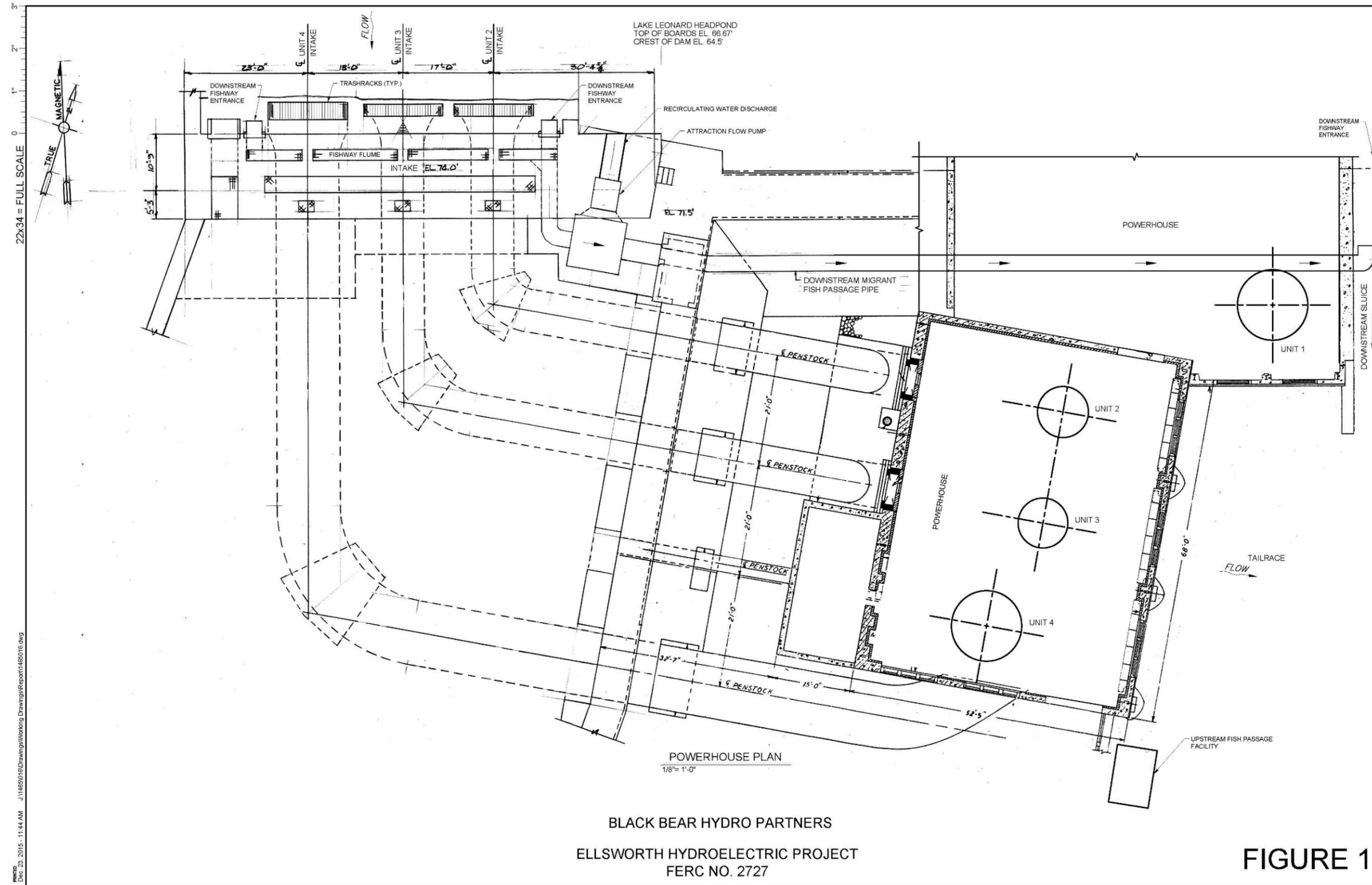


FIGURE 1 PLAN VIEW OF THE ELLSWORTH INTAKES AND DOWNSTREAM FISH BYPASS ENTRANCES, UNION RIVER, ELLSWORTH, MAINE

The top of the trashracks at the Ellsworth dam start at an elevation of approximately 60.7', approximately 6.0' below the normal full pond elevation of Leonard Lake, elevation 66.7'. (Figure 2). The bottom of the trashracks for unit 4 is at approximately 45.0' (Figure 2). The clear-bar rack spacing of the trashracks differs amongst the four turbine intakes at the Ellsworth dam.⁴ The vertical bars of the trashrack in front of Unit 1 are spaced at 2.44 inches; the vertical bars in front of Units 2, 3, and 4 are spaced at 1 inch in the upper section and then increase to 2.37 inches at 14.0' of water depth (compared to a normal head pond elevation of 66.7'). Black Bear cleans debris from the trashracks in front of Units 2, 3, and 4 with a rail-mounted hydraulic trashrake. In the ISR, Black Bear calculated the average velocity in front of the trashracks to be 2.97 feet per second (fps) in front of Unit 2 and Unit 3; 2.79 fps in front of Unit 4, and 1.16 fps in front of Unit 1.

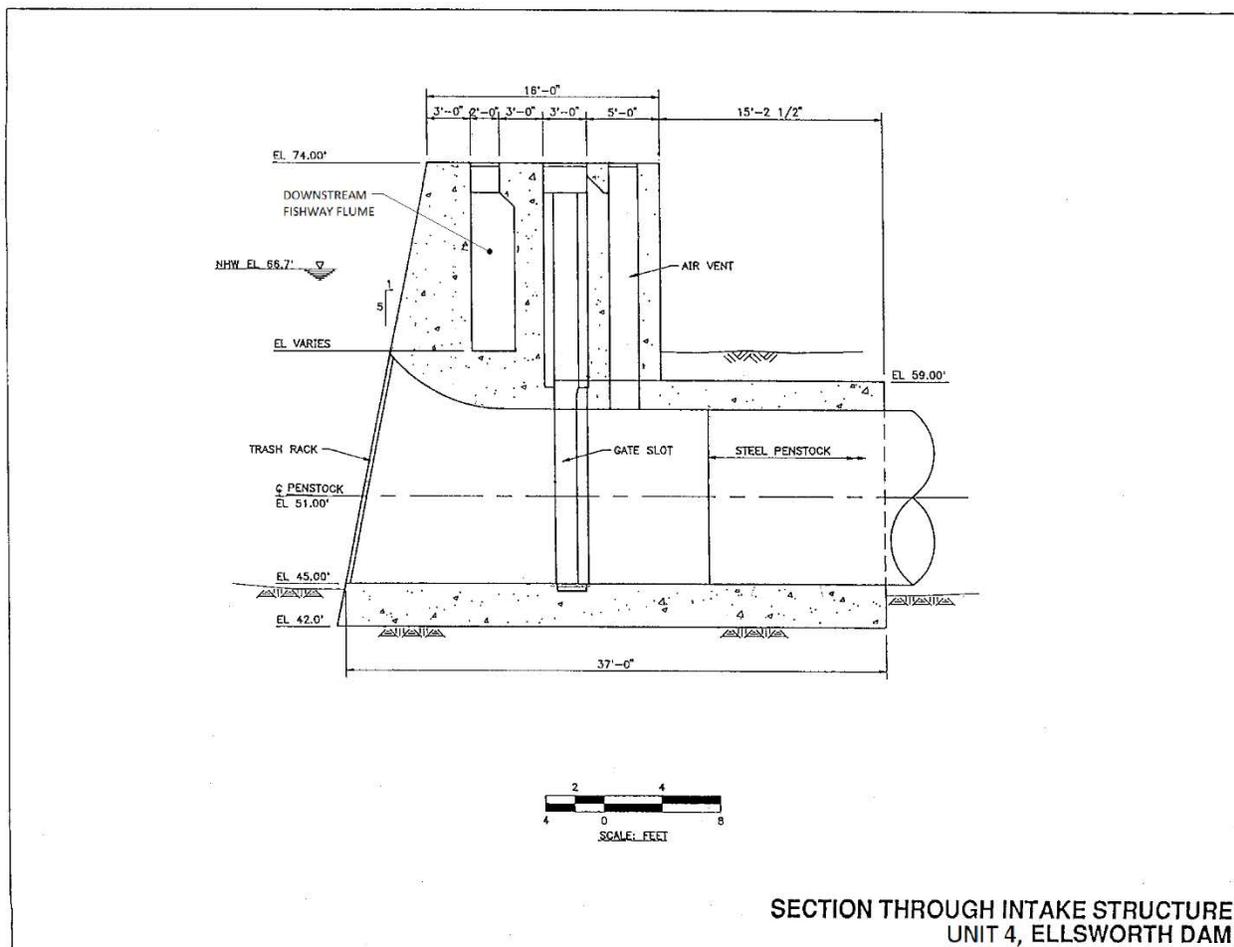


FIGURE 2 CROSS-SECTION THROUGH THE UNIT 4 INTAKE AT THE ELLSWORTH DAM

⁴ All references to the spacing between the trashrack bars are to the “clear” space between the bars.

METHODS

Researchers mounted a Marsh McBirney digital flow meter to the trashrake at the Ellsworth dam to measure water velocity in front of Units 2, 3, and 4. The sensor probe was attached to a small frame mounted directly to the trashrake (Photo 1). The trashrake was lowered vertically in the water column and moved horizontally across the rack face during data collection. This method has been used successfully at other FERC-licensed hydroelectric projects in recent years to measure water velocity in front of the intakes of hydropower facilities (e.g., Anson Project, FERC No. 2365; Grandfather Falls Project, FERC No. 1966). The sensor was positioned approximately 3 feet upstream of the trashrack.

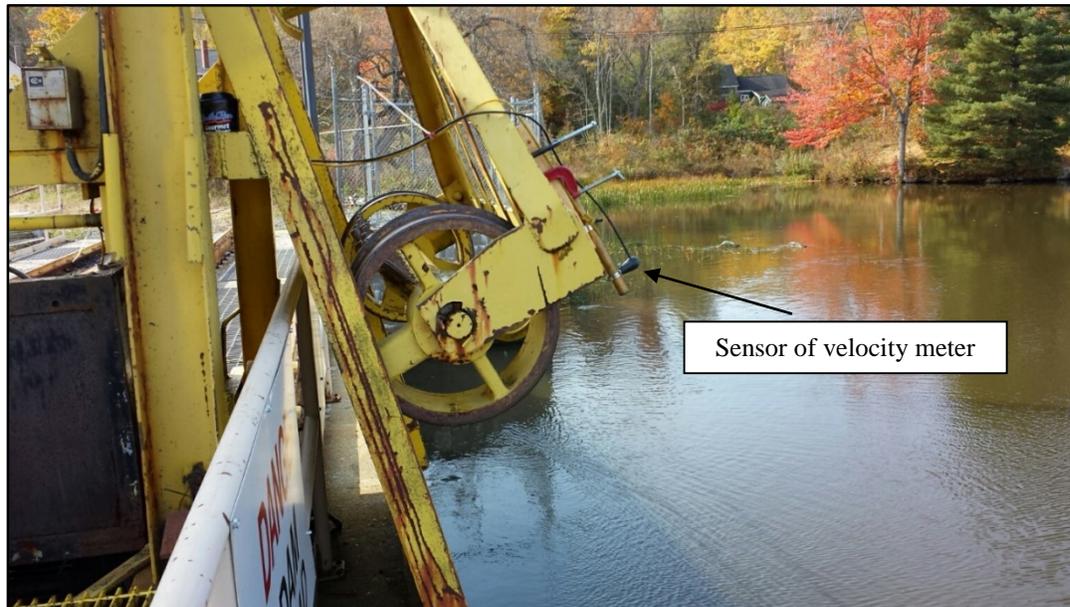


PHOTO 1 TRASHRAKE AT ELLSWORTH DAM WITH MOUNTED VELOCITY PROBE, OCTOBER 2015

Researchers measured water velocity at 2.5-foot intervals from a water depth of 5.0 feet to a water depth of approximately 20.0 feet. These measurements were then repeated at approximately 3.0-foot intervals across the horizontal faces of the trashracks at Units 2, 3, and 4. Researchers also measured water velocity with a pole-mounted Marsh McBirney flow meter at six positions in each entrance of the three downstream fish bypass weirs. Velocity measurements were taken at least twice at each position along the face of the trashrack and in the fishway entrances. Each single velocity measurement was equivalent to the composite average over 15 seconds. Measurements were then averaged to arrive at a single value. Black Bear operated all three units at or near maximum generation during the measurements (Table 1).

TABLE 1 GENERATION AND FLOW THROUGH THE UNITS DURING VELOCITY MEASUREMENTS, ELLSWORTH PROJECT

UNIT NUMBER	GENERATION (MEGAWATTS)	GATE OPENING (PERCENT)	APPROXIMATE FLOW (CFS)
2	2.10	86.6	480
3	1.95	94.3	430
4	2.70	95.0	640

Researchers did not measure water velocity in front of the Unit 1 intake because it is only accessible by diving. Velocity measurements at Unit 4 are considered to be representative of the velocity in front of Unit 1 because of the similarity between the units; both are fixed-propeller units of equal size. Researchers did not take measurements across the last 6 feet of the Unit 2 intake because a head pond transducer mounted there prevents access by the rack rake; therefore, the velocity probe could not be deployed in that area.

RESULTS

Researchers took 240 water velocity measurements at 93 discrete positions in front of the trashracks at Units 2, 3, and 4. Average water velocity ranged from -0.13 to 2.43 fps (Figure 3 and Table 2). The maximum average water velocity measurement ranged from 2.08 fps (Unit 3) to 2.43 fps (Unit 4) (Table 2). The minimum average water velocity measurement in front of the trashracks ranged from -0.13 fps (Unit 3) to 0.49 fps (Unit 4) (Table 2). These low values were recorded near the interface of the upper sections of the trashracks and the submerged concrete wall, where a noticeable backwater occurs. Figure 3 shows the velocity measurements and the positions where the measurements were taken across the face of the racks.

TABLE 2 SUMMARY OF INTAKE WATER VELOCITY MEASUREMENTS, ELLSWORTH PROJECT

UNIT NUMBER	2	3	4	ALL 3
Number of positions on rack face	22	36	35	93
Minimum average velocity measurement (fps)	0.10	-0.13	0.49	-0.13
Maximum average velocity measurement (fps)	2.27	2.08	2.43	2.43

The average water velocity measurements were less than 2.49 fps at all positions in front of the trashracks (Table 3). Most average water velocity values were between 1.50 and 1.99 fps (n=29, or 31.2 percent), followed by values between 1.00 and 1.49 fps (n=20, or 21.5 percent), values between 0.5 and 0.99 fps (n=19, or 20.4 percent), values less than 0.49 fps (n=13, or 14.0 percent), and values between 2.00 and 2.49 fps (n=12, or 12.9 percent). Table 3 shows the count, relative percentage, cumulative count, and cumulative percentage of all 93 average water velocity values.

TABLE 3 FREQUENCY DISTRIBUTION OF VELOCITY MEASUREMENTS AT THE TURBINE INTAKES, ELLSWORTH PROJECT

RANGE OF VELOCITY MEASUREMENTS (FPS)	TOTAL COUNT	RELATIVE PERCENTAGE	CUMULATIVE COUNT	CUMULATIVE PERCENTAGE
< 0.49	13	14.0%	13	14.0%
0.5 to 0.99	19	20.4%	32	34.4%
1.00 to 1.49	20	21.5%	52	55.9%
1.50 to 1.99	29	31.2%	81	87.1%
2.00 to 2.49	12	12.9%	93	100.0%
> 2.49	0	0.0%	-	-
Total	93	100.0%		

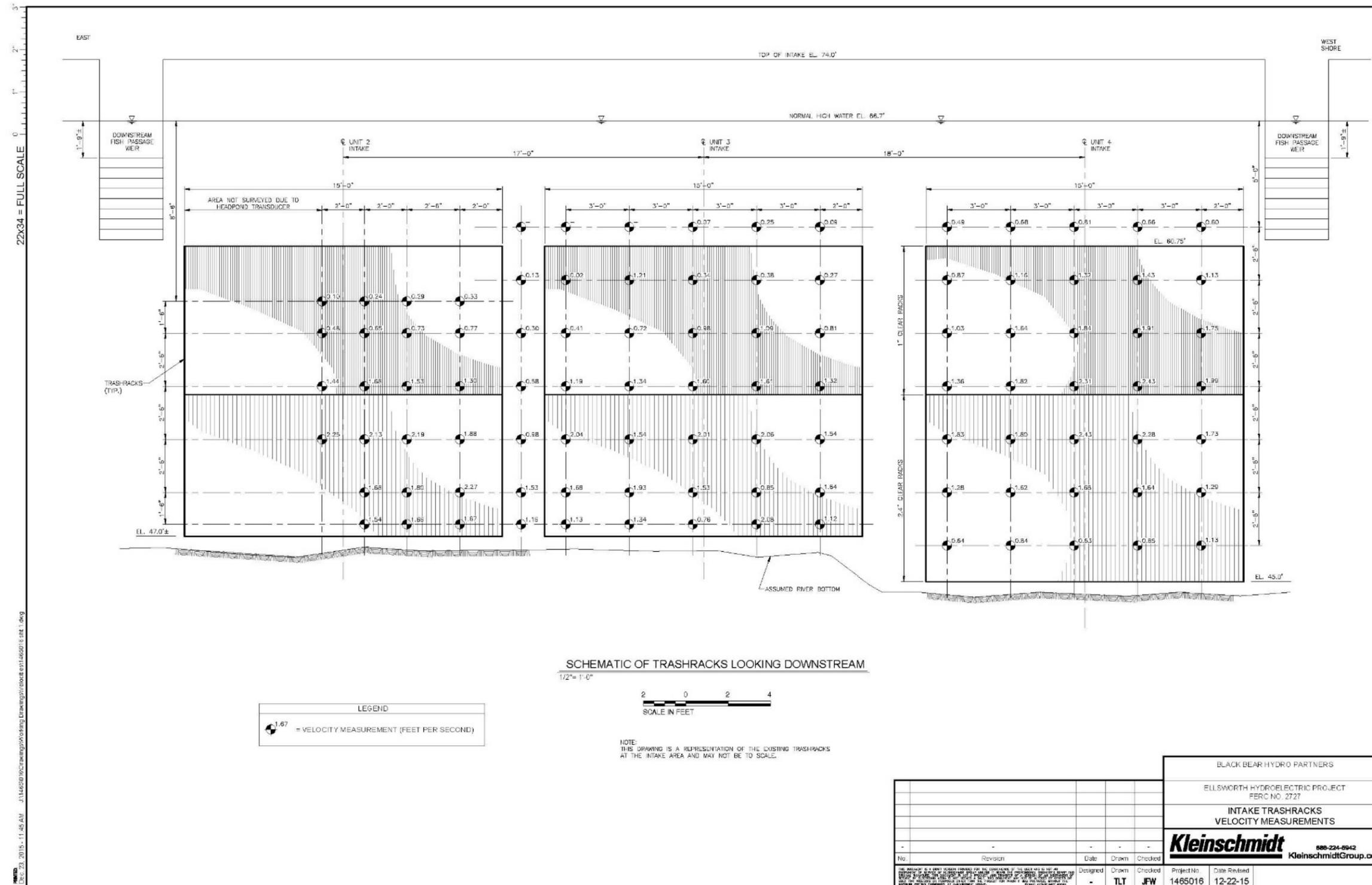


FIGURE 3 INTAKE VELOCITY MEASUREMENTS AT THE ELLSWORTH DAM, ELLSWORTH, MAINE

Researchers also measured water velocity at 18 discrete positions in or near the entrances of the three downstream fishway weirs. Water velocity ranged from 0.9 to 3.8 fps; water velocities were notably faster at the entrance near Unit 1 (Table 4). The depth of the measurements ranged from 6 to 24 inches (Table 4).

TABLE 4 WATER VELOCITY MEASUREMENTS IN THE FISH BYPASS ENTRANCES, ELLSWORTH PROJECT

FISHWAY ENTRANCE 1 (NEAR UNIT 1)				
	<i>Depth(ft)</i>	<i>Velocity(fps)</i>	<i>Depth(ft)</i>	<i>Velocity(fps)</i>
Left Side	0.5	3.8	1.5	2.31
Middle	0.5	3.7	1.5	2.34
Right Side	0.5	3.6	1.5	2.41
Average	-	3.7	-	2.35
FISHWAY ENTRANCE 2 (NEAR UNIT 2)				
	<i>Depth(ft)</i>	<i>Velocity(fps)</i>	<i>Depth(ft)</i>	<i>Velocity(fps)</i>
Left Side	0.5	1.1	2.0	1.0
Middle	0.5	0.9	2.0	0.9
Right Side	0.5	1.3	2.0	0.7
Average	-	1.1	-	0.8
FISHWAY ENTRANCE 3 (NEAR UNIT 4)				
	<i>Depth(ft)</i>	<i>Velocity(fps)</i>	<i>Depth(ft)</i>	<i>Velocity(fps)</i>
Left Side	0.5	2.0	2.0	1.3
Middle	0.5	1.5	2.0	1.4
Right Side	0.5	2.2	2.0	1.4
Average	-	1.9	-	1.4

SUMMARY

Water velocity across the face of the racks was fairly consistent, demonstrating that the variation in trashrack spacing combined with flows through the downstream fish bypass entrances does not create abnormal flow vectors in the intake area. Few intake velocity values were faster than 2 fps, which is sometimes identified as an important threshold for evaluating entrainment risk for some fish species. Most of the higher velocity values (10 of 12, or 83 percent; Table 3) were at a water depths of 15 feet or more, below where most surface oriented fish would pass. The remaining two values were at a water depth of 12.5 feet. Water velocity around the fishway entrances near Units 2, 3, and 4 was similar to the velocity measurements across the intake. Water velocity in the fishway entrance near Unit 1 (average of 3.7 fps at surface; average of 2.35 at bottom) was higher than all other velocity measurements.

The field measurements of intake approach velocity were taken from the trash rake, approximately 3 feet in front of the trashracks, while the calculated approach velocities were estimated at the trashrack face. Since approach velocity decreases with increasing distance from the racks, the difference between calculated and field measured velocity is reasonable and suggests consistency between methods.

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APPENDIX E-6

UPSTREAM ATLANTIC SALMON PASSAGE STUDY 2015

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ELLSWORTH HYDROELECTRIC PROJECT

FERC NO. 2727

Upstream Atlantic Salmon Passage Study

2015 Daily Log Summary

Prepared by:

Black Bear Hydro Partners LLC

Lewiston, ME

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Ellsworth Project
Upstream Atlantic Salmon Passage Study
2015 Daily Log Summary

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Ellsworth Project
Upstream Atlantic Salmon Passage Study
2015 Daily Log Summary

1.0 - INTRODUCTION

During the 2015 upstream fish passage season, between May 1st and October 31st, seasonal fishway technicians operated the Ellsworth upstream fish passage facilities daily from sunrise to sunset. During this time, technicians managed fish passage attraction pumps, controlled the entrance attraction gate level, and monitored tailwater levels below the dam. Additionally, technicians checked the fishway trap four times a day (approximately once every 3 hours), during which time they monitored water temperature, tidal stage, river flows (cfs), number of units discharging, and made note of any spill conditions on the dam face. If any migratory fish were present in the trap during a lift, the species, number, condition, and any marks or characteristics indicating wild, hatchery, or aquaculture escapes were documented. The techs were all properly trained by the Maine Department of Marine Resources (MDMR) on salmon identification, handling, and transport. Throughout the day, techs also visually surveyed the fishway trap and the river below the dam for any fish activity (i.e. species observed, approximate number of river herring in the trap, density of river herring in front of the fishway, any fish behavior occurring in the trap or the river, and any predatory species present).

During the season, technicians performed routine weekly inspections on fish transportation trailers, oxygen systems, and aeration systems. Technicians were also responsible for gathering catch data and trap operations during the City of Ellsworth's annual alewife harvest. The harvesters use the upstream fish passage facilities as a trap and harvest facility during the months of May and June during daylight hours, Monday through Friday. During harvest time, a private contractor is hired to truck alewives to Graham Lake on Saturdays and Sundays (MDMR regulation). Technicians were responsible for recording and reporting stocking numbers during this time. During any harvest or stocking operation trap lift, technicians visually inspected the trap (while three feet of water remained in the trap) for any Atlantic salmon prior to removing the trap fully from the water.

2.0 - DESCRIPTION OF FISH PASSAGE FACILITIES

The upstream fish passage at the Project is a vertical slot design with a 3-foot-wide entrance and a trapping hopper located at the end of the passage. The entrance is located on the west side of the powerhouse and capable of passing up to 50 cubic feet per second (cfs). The entrance gate is adjusted, when water levels warrant, maintaining a wave ripple effect that

extends as far as possible out into the tailrace. This usually requires about an 18 inch differential between the fishway and tailrace water levels. (The tailwater of the Ellsworth dam is influenced by tidewater). The entrance gate is manually adjusted with a hand wheel or with an electric actuator with local controls. The entrance runs into a single gallery that runs along the driveway of the powerhouse. The first attraction pump is a Worthington Model 20KLD24 attraction water pump that is capable of passing up to 28 cfs through a pipe to the diffusion chamber above the trap. The second attraction pump, Flygt Model 4451, takes water from the tailrace and pumps it into the fishway just above the entrance gate area through a diffuser system with a capacity of approximately 22 cfs. This simulates more flow in the fishway for attracting fish to the entrance areas. The fishway flow is approximately 50 cfs under normal operating conditions. There are two fish trap hoppers used. The stocking hopper is constructed with solid aluminum sides, which allows water to remain in the hopper tank when lifted for stocking. The second hopper is constructed with metal screen material which allows for the water to drain off when the hopper is lifted from the hopper pit during the City of Ellsworth's alewife harvest. The stocking hopper was used on Saturdays and Sundays during the harvest operations and seven days a week during non-harvest operation.

When stocking or transporting, fish are lifted out of the hopper pit, in the metal hopper tank, and then transferred into one of two different transport tank types. Two round tanks used for river herring and a rectangular tank used for salmon. The round transport tanks have a volume of 99.5 cubic feet and the rectangular tank has a volume of 66 cubic feet. The river herring transport tanks are used in tandem as necessary, thereby allowing one to be enroute to Graham Lake while the other is available at all times for fish entering the fishway.

3.0 – DAILY LOG REVIEW (Organized by Month)

May 1st – May 31st

On May 7th, the first river herring of the season were seen holding in the current at the entrance to the upstream fish passage (50-100 fish seen). At this time, the water temperature was 11 degrees Celsius. On May 10th, the density of river herring in the river increased, river herring began entering the fishway, and upstream trucking of river herring began for the season. Water temperature at this time was 12 degrees Celsius. By May 31st, 446,513 river herring had been moved through the Ellsworth upstream fish passage facility. 297,270 of these fish were trucked to Graham Lake, while the remaining 149,243 were sold as lobster bait by the City of Ellsworth. On May 31st, the water temperature had reached 18 degrees Celsius (warmest temperature of the season) and river herring densities were the highest seen all season.

During observations of the river, it was noted that the river herring tended to run strongest in the evenings and moved stronger during an incoming tide. Increasing river

temperature was also noted to increase river herring densities during warm sunny days. It was also noted that, on most evenings, river herring stopped entering the fishway and began dropping downriver around sunset. River flows did not seem to have as strong of a correlation to river herring densities as the previously mentioned environmental factors, however, when plant operations increased the amount of water moving through the units, there was a subsequent increase in river herring densities occasionally noted by the technicians. During the month of May, river flows fluctuated between 271 cfs and 1,262 cfs. During all flows, the river herring tended to migrate upstream on the fishway side of the river (deeper water is present here) and hold in front of the fishway entrance. During spill events, the river herring did not appear to migrate towards the dam face.

At no point during the month of May was an Atlantic salmon observed by the fishway technicians. Osprey, bald eagles, harbor seals, cormorants, blue herons, and a number of gull species, were seen feeding on the river herring below the dam during the month of May.

June 1st – June 30th

On June 1st, 40,905 river herring were passed through the upstream fish passage facility. During the following days, heavy rain and cold temperatures dropped the river temperature from 18 degrees Celsius to 15 degrees Celsius. This drop in river temperature appeared to slow the river herring migration substantially. Throughout the month of June, river temperatures slowly increased to a high temperature of 19 degrees Celsius on June 29th. By June 30th, 102,927 river herring had been moved through the Ellsworth upstream fish passage facility. 26,315 of these fish were trucked to Graham Lake, while the remaining 76,612 were sold as lobster bait by the City of Ellsworth. On June 30th, water temps were 18 degrees Celsius and river herring densities were the lowest seen since the beginning of the migration.

During observations of the river, it was again noted that the river herring tended to run strongest in the evenings and moved stronger during an incoming tide. Increasing river temperature was again noted to increase river herring densities during warm sunny days. Decreasing river temperatures were also noted to decrease densities of river herring seen below the dam. It was again noted that, on most evenings, river herring stopped entering the fishway and began dropping downriver around sunset. River flows did not seem to have as strong of a correlation to river herring densities as the previously mentioned environmental factors. During the month of June, river flows fluctuated between 196 cfs and 1,262 cfs. During all flows, the river herring again tended to migrate upstream on the fishway side of the river and hold in front of the fishway entrance. During spill events, the river herring did not appear to migrate towards the dam face.

During the month of June, large numbers of post spawn adult river herring could be seen dropping through the downstream fish passage facilities.

At no point during the month of June was an Atlantic salmon observed by the fishway technicians. Osprey, bald eagles, harbor seals, cormorants, blue herons, and a number of gull species, were seen feeding on the river herring below the dam during the month of June.

July 1st – July 31st

During the month of July, 5,575 river herring were passed through the upstream fish passage facility. These fish were all trucked to Graham Lake. During the month of July, river temperatures surpassed 23.0 degrees Celsius on thirteen different days. Per the operations procedures outlined in the "Atlantic Salmon Trap Operating and Fish-Handling Protocols" provided by MDMR, operation of the upstream fishway was stopped when temperatures exceeded 23.0 degrees Celsius. Observations of the fishway entrance area and tailwaters continued on a routine basis, even when the fishway was not operating, with observations being made approximately once every three hours.

During observations of the river, it was again noted that the river herring tended to run strongest in the evenings and moved stronger during an incoming tide. It was again noted that, on most evenings, river herring stopped entering the fishway and began dropping downriver around sunset. On July 7th, flows through the plant were brought to minimum flow, after technicians noted injured YOY (young of the year) river herring in the tailrace. On July 28th, the plant was brought off of minimum flow, however, at this point in the season the adult river herring run had stopped and no impact on upstream migration could be noted.

At no point during the month of July was an Atlantic salmon observed by the fishway technicians. Osprey, bald eagles, harbor seals, cormorants, blue herons, and a number of gull species, were seen feeding on the river herring below the dam during the month of July.

August 1st – August 31st

During the month of August, no migratory fish were passed through the upstream fish passage facility. During this time, river temperatures surpassed 23.0 degrees Celsius on twenty-eight different days. Per the operations procedures outlined in the "Atlantic Salmon Trap Operating and Fish-Handling Protocols" provided by MDMR, operation of the upstream fishway was stopped when temperatures exceeded 23.0 degrees Celsius. Observations of the fishway entrance area and tailwaters continued on a routine basis, even when the fishway was not operating, with observations being made approximately once every three hours.

During observations of the river, YOY river herring could be seen using the downstream fish passage facility.

At no point during the month of August was an Atlantic salmon observed by the fishway technicians. Osprey, bald eagles, cormorants, blue herons, and a number of gull species, were seen feeding on the YOY river herring below the dam during the month of August.

September 1st – September 30th

During the month of September, no migratory fish were passed through the upstream fish passage facility. During this time, river temperatures surpassed 23.0 degrees Celsius on eleven different days. Per the operations procedures outlined in the "Atlantic Salmon Trap Operating and Fish-Handling Protocols" provided by MDMR, operation of the upstream fishway was stopped when temperatures exceeded 23.0 degrees Celsius. Observations of the fishway entrance area and tailwaters continued on a routine basis, even when the fishway was not operating, with observations being made approximately once every three hours.

During observations of the river, YOY river herring could be seen using the downstream fish passage facility.

At no point during the month of September was an Atlantic salmon observed by the fishway technicians. Osprey, bald eagles, cormorants, blue herons, and a number of gull species, were seen feeding on the YOY river herring below the dam during the month of September.

October 1st – October 31st

During the month of October, no migratory fish were passed through the upstream fish passage facility. Observations of the fishway entrance area and tailwaters continued on a routine basis, even when the fishway was not operating, with observations being made approximately once every three hours.

During observations of the river, YOY river herring could be seen using the downstream fish passage facility.

At no point during the month of October was an Atlantic salmon observed by the fishway technicians. Osprey, bald eagles, cormorants, blue herons, and a number of gull species, were seen feeding on the YOY river herring below the dam during the month of October.

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APPENDIX E-7

UPSTREAM FISH PASSAGE ALTERNATIVES STUDY - REVISED

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**ELLSWORTH HYDROELECTRIC PROJECT
FERC No. 2727**

UPSTREAM FISH PASSAGE ALTERNATIVES STUDY

**Prepared for:
BLACK BEAR HYDRO PARTNERS, LLC
Lewiston, Maine**

**Prepared by:
HDR ENGINEERING, INC.
Portland, Maine**

DECEMBER 2015



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**ELLSWORTH HYDROELECTRIC PROJECT
UPSTREAM FISH PASSAGE ALTERNATIVES STUDY**

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1.0 INTRODUCTION

1.1 Study Purpose

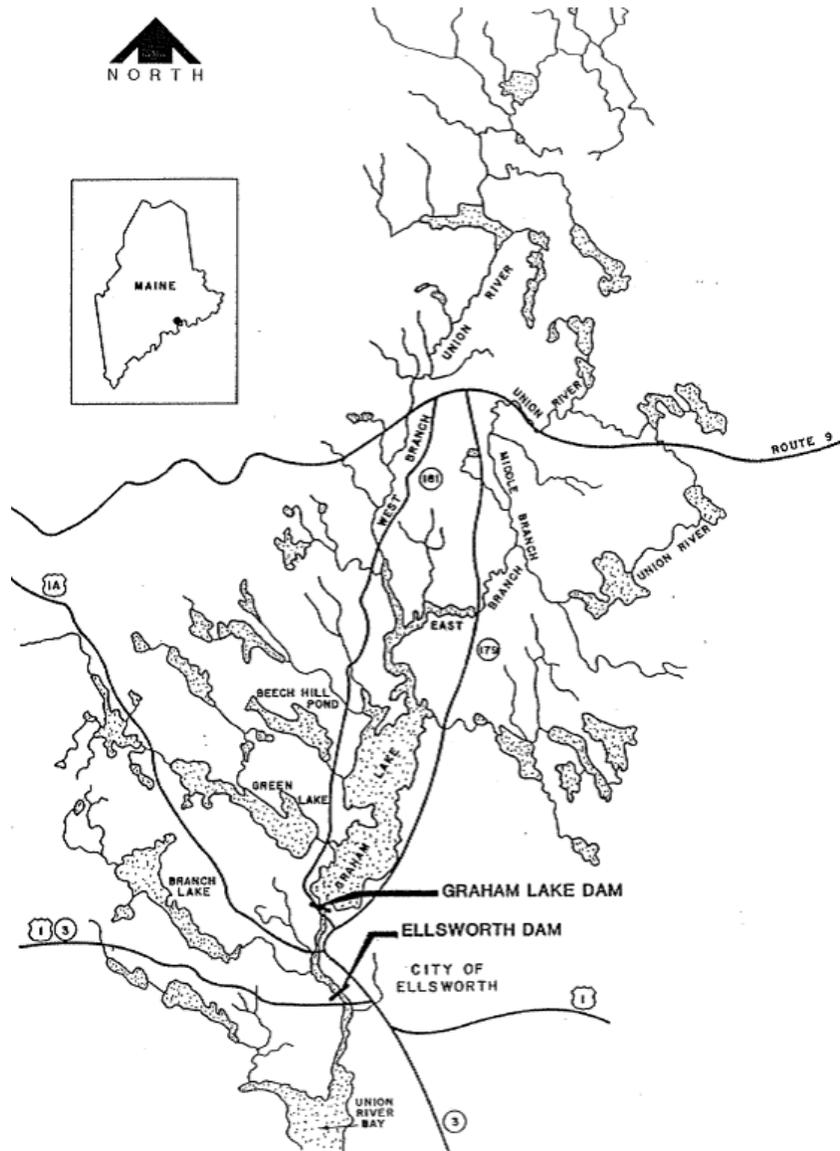
As part of the relicensing process of the Ellsworth Project (FERC No. 2727), Black Bear conducted a study to investigate the feasibility of an expanded upstream fish passage program in the Union River at Ellsworth and Graham Lake Dams. This included the identification of feasible upstream passage alternatives at both dams, including dam removal and developing estimates of the capital, operational, and maintenance costs of each alternative. This effort involved reviewing previously developed fish passage design concepts considered for the Ellsworth Project in the past and updating them, as well as an assessment of any newer fish passage technologies that may be appropriate for the site. The review was a broad-brush treatment of the topic for screening at the conceptual level of design with “order-of-magnitude” costs associated with each design.

The study results were reported in the Updated Study Report (USR), which was submitted to FERC on August 27, 2015. The report has been revised to address comments received during the USR meeting held on September 23, 2015, and in subsequent comment letters from FERC and stakeholders.

1.2 Ellsworth Project Site Description

The Ellsworth Project consists of the Ellsworth Dam, the Graham Lake Dam, and appurtenant facilities. The Ellsworth Dam has an integral intake structure and powerhouse and creates the impoundment, Lake Leonard. Graham Lake Dam is located on the Union River about 4 miles upstream of Ellsworth Dam, creating the water storage reservoir known as Graham Lake (Figure 1).

**FIGURE 1
PROJECT LOCATION MAP**



Ellsworth Dam and Lake Leonard

Construction of the Ellsworth Dam was completed in 1907. The Ellsworth Development has a concrete dam 65 feet high and 377 feet long (with a 275-foot long section of spillway). Ellsworth Dam was modified in 1991 to enhance stability by filling the interior of the dam with mass concrete. Post-tensioned anchors were also installed to gain additional sliding resistance in several of the bays where space was limited. The dam forms Lake Leonard, which extends

approximately 1 mile above Ellsworth Dam and has a surface area of 90 acres at a normal water surface elevation 66.7'. The powerhouse is a reinforced concrete and concrete block masonry powerhouse containing four turbine-generator units, which have a total rated capacity of 8,900 kilowatts (kW) (Table 1), with gross annual energy production of about 30,333,000 kilowatt-hours (kWH).

**TABLE 1
CHARACTERISTICS OF THE ELLSWORTH PROJECT**

Facility Characteristics	Ellsworth Dam	Graham Lake Dam
Reservoir Surface Length	1 mile	10 miles
Reservoir Surface Area	90 acres	10,000 acres
Reservoir Normal Surface Water Elevation	66.7' (includes 1.7-foot flashboards)	104.2'
Length of Dam	377 feet	750 feet
Height of Dam	65 feet	30 feet
Total Rated Capacity	8,900 kW (4 units) <ul style="list-style-type: none"> • Unit 1 – 2,500 kW unit (vertical shaft propeller) • Unit 2 – 2,000 kW unit (Kaplan) • Unit 3 – 2,000 kW unit (Kaplan) • Unit 4 – 2,400 kW unit (vertical shaft propeller) 	NA
Trashrack Spacing	Variable – Typical configuration based on normal pond elevation: Top 6-8 feet is concrete Unit 1 – 2.44 in. Units 2-4 – 1.00 in.(top)/2.37 in. (bottom)	NA

Graham Lake Dam and Graham Lake

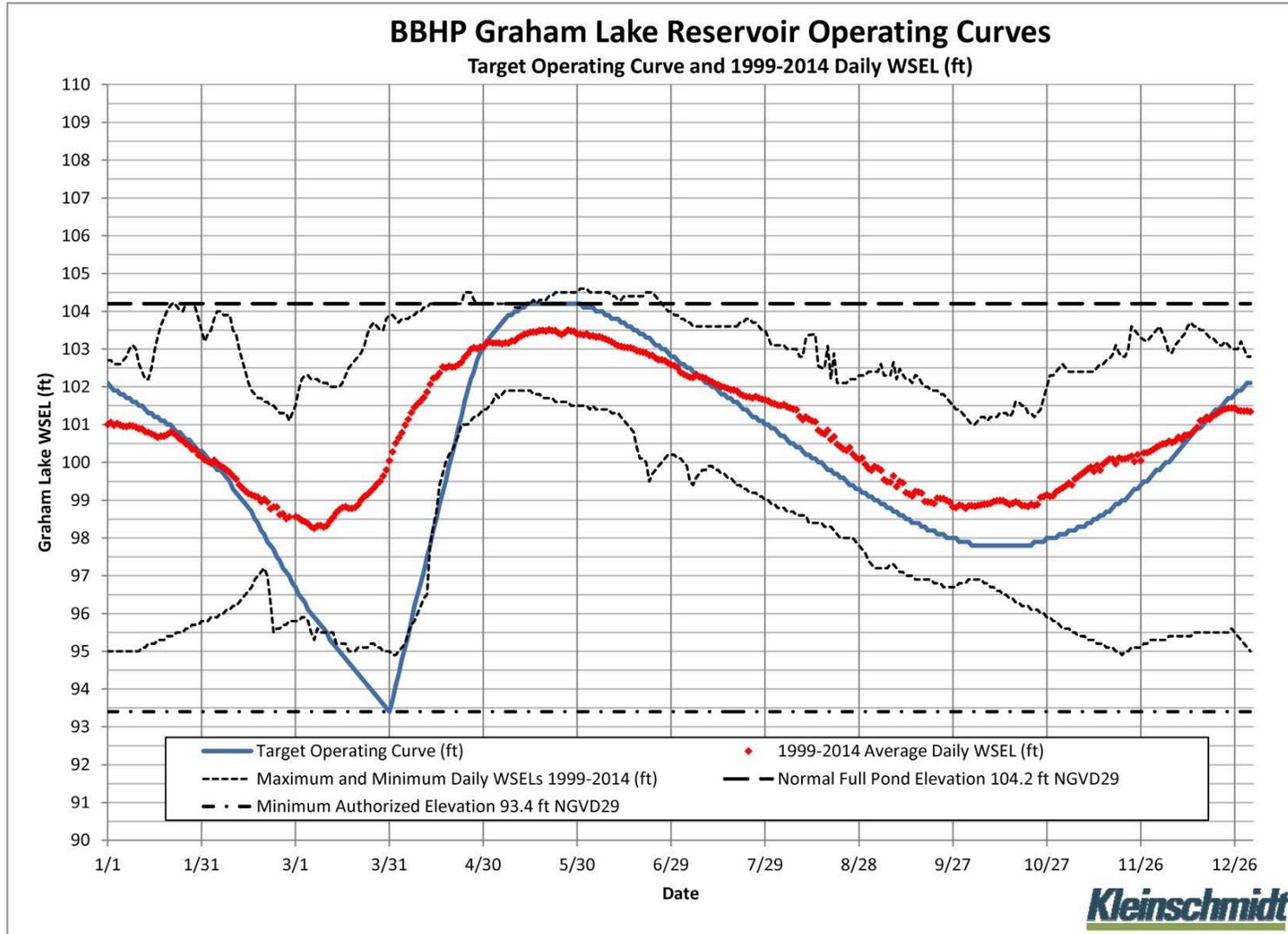
The Graham Lake Dam was completed in 1924 and is located about four miles upstream from the Ellsworth Dam. Graham Lake Dam is 30 feet high and consists of a 670-foot-long earth dike and an 80-foot-long concrete gate structure. The concrete gate structure contains three 20-foot-wide radial (Tainter) gates and an eight-foot-wide sluice that is used for downstream fish passage. This dam was modified in 1992, adding flood control structures on the downstream side of the original dam to address stabilization concerns. The flood control structure consists of

an approximately 720-foot long flood wall, which is connected to the existing Graham Lake Dam outlet gates by a wing wall extension and a permanent cofferdam cell. The Graham Lake reservoir is approximately 10 miles long with a surface area of approximately 10,000 acres at maximum water surface elevation of 104.2' (Table 1). There are no generating facilities at the Graham Lake Development.

Project Operations

The Ellsworth Project operates as both a water storage facility and as a peaking generation facility, depending on available inflows, while maintaining minimum flows. Timed releases at Graham Lake are used at Ellsworth Dam for power production. The releases may result in minor (approximately 1 foot) surface elevation changes in Lake Leonard. During high-flow conditions, primarily in the spring and fall, the Project may operate at full load up to 24 hours a day. Graham Lake generally follows an operating guide curve that can result in fluctuations approaching 11 feet over the course of a year (Figure 2). As per Articles 401 and 402 of the 1987 Order Issuing New License, minimum flows and water levels are required and maintained by Black Bear. Article 401 specifies a continuous minimum flow release of 105 cubic feet per second (cfs) from the Ellsworth Dam and Graham Dam from July 1 through April 30 and a continuous minimum flow release of 250 cfs from May 1 through June 30 for the protection of fishery resources. Article 402 of the FERC license specifies that the licensee operates the Ellsworth Project so that the following water levels are maintained: Lake Leonard 1-foot fluctuation (el. 65.7 to 66.7 feet) and Graham Lake 10.8-foot fluctuation (el. 93.4 to 104.2 feet msl).

FIGURE 2
HISTORIC OPERATING CURVES, GRAHAM LAKE



Project Downstream Passage

Black Bear operates downstream passage facilities at both Ellsworth Dam (Figures 3 and 4) and Graham Lake Dam (Figure 5). Downstream measures at the Ellsworth Dam consist of two stoplog-controlled surface weirs above Units 2 through 4 and a transport pipe leading to a plunge pool immediately downstream of the dam, as well as a third surface weir adjacent to the Unit 1 intake that discharges directly to the same plunge pool. In addition, a permanent stainless steel inlet screen was installed over the intake of the cooling water system at the Ellsworth Dam on May 26, 2015, as a downstream passage protection measure, following review and consultation with the resources agencies, including guidance provided by the USFWS and the National Marine Fisheries Service (NMFS).

In addition to the activities associated with operation and maintenance of the fish passage facilities at the Ellsworth Dam, Black Bear operates a surface weir (located in a former log sluice bay) suitable to provide downstream passage of out-migrating Atlantic salmon and river herring (alewife and blueback herring) on the west end of the Graham Lake Dam gate structure. The development of this passage route was completed in 2003, coinciding with an increase in upstream stocking of river herring. The weir is similar to the downstream passage system at the Ellsworth Dam in that it is a surface weir that contains stoplogs, which enables Black Bear to adjust the opening as necessary. The opening empties into a downstream plunge pool and provides migrants with another route of passage in addition to the existing gates, which are operated to pass water used for generation purposes at the Ellsworth Dam (Figure 4). It further enhances existing passage at the site by providing out-migrating fish constant uninhibited passage, in addition to passage opportunities through water releases using the gates during normal Project operations. The downstream fishways are operated from April 1 to December 31 annually, as river conditions allow.

**FIGURE 3
VIEW OF COLLECTION CHAMBER AND ENTRANCE TO DOWNSTREAM FISH
PASSAGE PIPE AT THE ELLSWORTH DAM**



**FIGURE 4
VIEW OF DISCHARGE FROM DOWNSTREAM FISH PASSAGE PIPE (ARROW) AT
THE ELLSWORTH DAM**

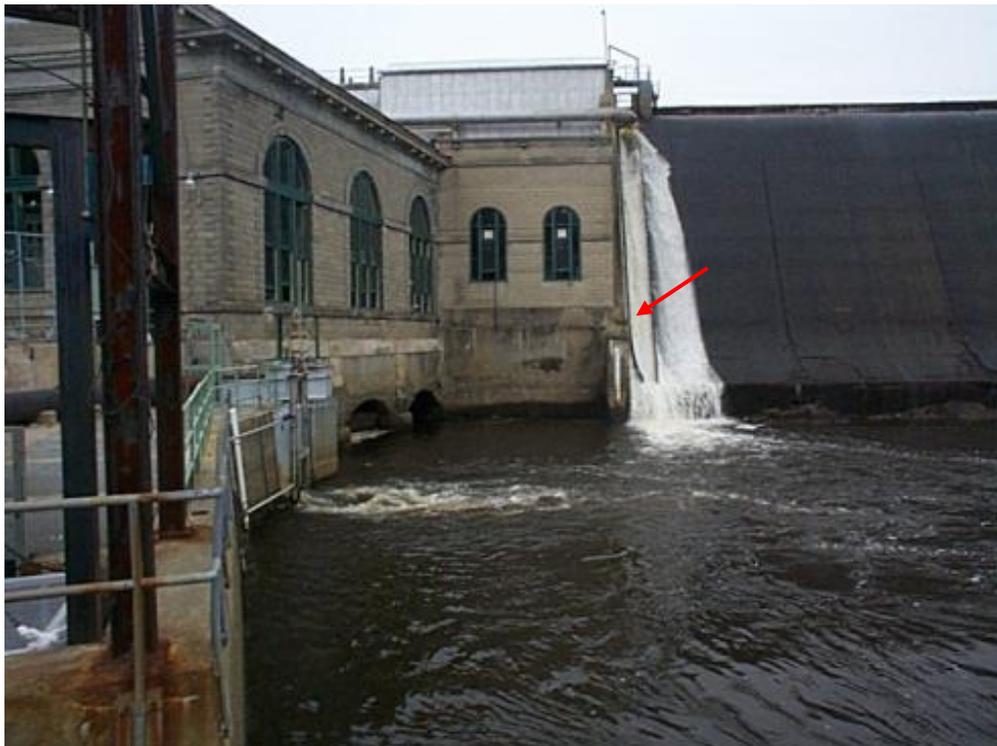


FIGURE 5
VIEW OF DOWNSTREAM SIDE OF THE GRAHAM LAKE DAM, WHERE THE
DOWNSTREAM BYPASS IS INTEGRAL WITH THE RELEASE GATES (ARROW)



Project Upstream Passage

The Ellsworth Dam trap and transport facility is equipped with a four-baffle vertical slot upstream fishway leading to a trap fitted with a hopper and hoisting structure to facilitate fish transport in circular transport tanks (Figures 6 and 7). The fishway entrance is immediately adjacent to the powerhouse tailrace with a pumped attraction flow of up to 50 cfs. The upstream fishway and fish trapping facility were originally constructed at the Ellsworth Dam (Lake Leonard) in 1974 to provide a supplemental source of Atlantic salmon broodstock for use in the restoration of populations to the Penobscot and other Maine rivers (Baum 1982). Atlantic salmon broodstock collection was discontinued at Ellsworth in 1991, and since that time the upstream fishway is now used primarily during the river herring migration, but also to collect any salmon that might use the facility for potential upriver transport (depending on origin of fish) in the Union River. Between 2006 and 2011, no salmon returned to the Union River. Since then, three hatchery origin salmon (not ESA protected) were captured in 2012, one salmon (wild) returned in 2013, two (one wild and one hatchery) in 2014 (URFCC 2015), and no salmon returns in 2015. Adult Atlantic salmon that are captured in the fishway are examined to

determine origin, and the Maine Department of Marine Resources (MaineDMR) determines whether Atlantic salmon caught in the fishway are released downstream of the Ellsworth Dam, upstream of the Graham Lake Dam, or, if of aquaculture origin, removed by Maine DMR.

FIGURE 6
VIEW OF FISHWAY HOPPER IN OPERATION USED FOR TRANSFERRING FISH
TO THE HOLDING TANK AT THE ELLSWORTH DAM



Graham Lake Dam does not have an upstream fishway because fish are transported from the Ellsworth trap and transport facility to locations above the Graham Lake Dam. Black Bear manages the upstream passage facility at Ellsworth Dam in consultation with the agencies through the Union River Management Plan. River herring are trapped and transported to Lake Leonard and Graham Lake. Lake Leonard and Graham Lake are the primary stocking locations for river herring in the Union River drainage and contain the majority of potential spawning habitat. In 2014, the upstream fishway was operated for river herring stocking and harvesting beginning in early May through mid-June, and then Black Bear continued to operate the fishway through November 4 for Atlantic salmon (URFCC 2015). In 2015, Black Bear conducted an upstream Atlantic salmon passage evaluation and operated the fishway from May 1 through

FIGURE 7
OVERVIEW OF FISHWAY TRAP AND TRANSFER FACILITY AT THE
ELLSWORTH POWERHOUSE TAILRACE



October 31¹. According to the fishway operator, the presence of river herring near the fishway is typically sporadic after early June as the migration slows to an end.

Under current operations, the trap facility is also used for commercial harvest of river herring and, therefore, handles more fish than the required spawning escapement. This is currently accomplished by temporal separation of trap and truck operations and commercial harvest on different days. Also, the priority of trapping operations is to first transport a majority of the escapement to upstream spawning habitat before initiating harvest of river herring. After stocking approximately 2/3 of the required river herring escapement, the fishway operations are adjusted for harvest operations, and a different fishway hopper system is installed to provide for harvesting. Fish trap and transport for stocking is then continued on Saturdays and weekdays as

¹ Consistent with Maine DMR protocols, the fishway is not operated when temperatures exceed 23°C (73°F), which occurred sporadically in July and September and the majority of August. However, observations of the fishway entrance and tailwater areas were conducted routinely.

needed (at which time the hopper system used for stocking is reinstalled), until the total target spawning escapement of river herring is reached. This protocol ensures that the majority of fish are stocked prior to harvesting activities, while also providing that a substantial amount (about 1/3) of river herring are transported throughout various portions of the entire migration season.

The Project's fish passage facilities are managed in consultation with the agencies² through the *Comprehensive Fishery Management Plan for the Union River Drainage 2000-2005*, which is updated every five years. The current plan covers the three-year period of 2015-2017 due to the expiration of the Project license in December 2017 (URFCC 2015). In 2014, the upstream fishway was operated for river herring (alewife and blueback herring) stocking and harvesting beginning in early May through mid-June, and then Black Bear continued to operate the fishway through November 4 for Atlantic salmon (URFCC 2015). In 2015, Black Bear conducted an upstream Atlantic salmon passage evaluation and operated the fishway from May 1 through October 31. The downstream fishways are operated from April 1 to December 31 annually, as river conditions allow. Also in 2015, Black Bear developed a site specific operation and maintenance plan for the fishways for the Project and hired dedicated staff to operate the project fish passage facilities; these staff members were dedicated to fishway operations, oversight, fish trap tending, and transporting the fish upriver.

One operational issue for the current Ellsworth fishway is the appropriate action to take if an Atlantic salmon is captured when ambient water temperature exceeds 73° F. The current Maine DMR protocol is to not handle Atlantic salmon at fish passage facilities when the river temperature exceeds 73°F. While there is a low probability of salmon captures when water temperature exceeds 73°F (few salmon have been collected in the Union River at or above this temperature historically), Black Bear plans to modify its operational and handling procedures in case such a situation occurs in the future.

In 2015, the *Comprehensive Fishery Management Plan for the Union River Drainage 2015-2017* (URFCC 2015) increased the targeted spawning escapement from 150,000 to 315,000 river herring. To accomplish this increase in spawning escapement, trap and transport operations have been modified. Beginning in 2015, the first 150,000 river herring were transported upstream to

² Includes NMFS, USFWS, and Maine DMR

Graham Lake and other upper basin lakes (as determined by the URFCC) before commercial harvest commenced. At that time, commercial harvest began on weekdays and upstream passage only (live transport and stocking) continued on Saturdays and Sundays through June 10. Beginning on June 10, commercial harvest ended and all river herring captured (up to 1,600 fish) are transported to Lake Leonard where the late run blueback herring spawning habitat is more suitable than the larger lakes upstream.

Commercial Harvest Operations

Alewives and blueback herring, collectively referred to and managed as river herring, supports an active commercial fishery at Ellsworth Dam. The commercial fishery is managed by the Maine DMR in cooperation with the City of Ellsworth. The City of Ellsworth holds the commercial fishing rights for river herring harvest on the Union River and historically assumed responsibility for stocking adult fish in upstream spawning habitat to maintain the fishery under a cooperative agreement with the Maine DMR. The licensee is now responsible for the transport of the spawning escapement upstream while the City continues to operate the commercial harvest. The annual commercial harvest, which occurs at the Ellsworth Dam trap and transport facility, has ranged from 5,000 to 1,066,297 fish since 1974 (URFCC 2010, 2015), with the catch being sold as bait for the lobster fishery.

Operation of the current Ellsworth fish trap and transport fishway facility has successfully developed and maintained a self-sustained river herring population and commercial fishery, which is among the largest in the country. Further, the Atlantic States Marine Fisheries Commission (ASMFC) assessed the status of populations of river herring along the Atlantic Coast and concluded that the population of alewife in the Union River has increased between 1975 to the early 2000s. The ASMFC also concluded that the Union River has exhibited a stable population of alewife for the past 10 years (ASMFC 2012 *cited in* FERC's September 4, 2013 Study Plan Determination).

1.3 Upstream Fishway Design Parameters

A baseline plan view of the Ellsworth Dam, powerhouse, and tailwater is shown in Figure 8.

Design species, populations, and seasons

Targeted species for passage under the current management plan (URFCC 2015) are river herring and Atlantic salmon.

Design Population:

- Atlantic salmon: 750
- River herring: 2,315,000 (315,000 escapement, 2,000,000 harvest)

Season:

- Atlantic salmon: May 1 through October 31, daily, dawn to dusk
- River herring: May 1 through June 10, daily, dawn to dusk
 - All river herring transported upstream until 150,000 have passed, then Saturday and Sunday only while commercial harvest is allowed Monday – Friday, through June 10 to achieve a total spawning escapement of 315,000. Beginning June 10, all river herring transported to Lake Leonard up to 1,600 fish.

Site hydraulics:

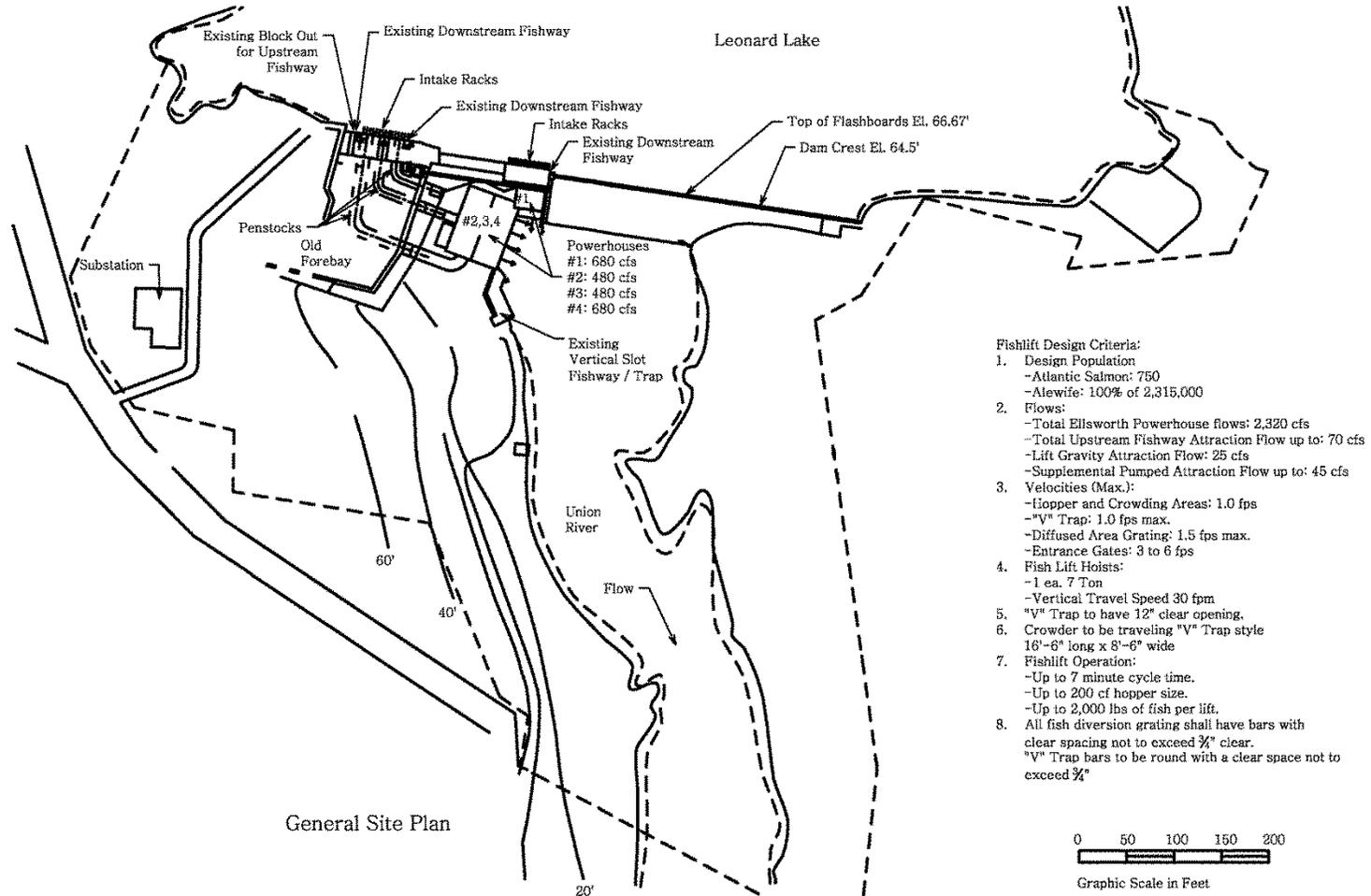
- Both Graham and Ellsworth Dams minimum flow is 250 cfs from May 1 through June 30, and 105 cfs July 1 through April 30.
- Ellsworth powerhouse hydraulic capacity is 2,460 cfs.

Current fishway pumped attraction flow is up to 45 to 50 cfs, depending on tailwater elevation.

Maximum Fishway Velocities (as applicable):

- Hopper and crowder areas – 1.0 foot per second (fps)
- V-trap – 1.0 fps
- Diffused attraction flow grating – 0.5 to 1.5 fps
- Entrance gate – 3 to 6 fps

**FIGURE 8
BASELINE PLAN VIEW OF ELLSWORTH DAM**



2.0 TRAP AND TRANSPORT ALTERNATIVES

2.1 Concerns with Existing Facility

Agency-expressed concerns with the current Ellsworth trap and transport fishway have centered on two issues: (1) the overall capacity of the fishway to safely handle the full escapement/harvest design populations of river herring and Atlantic salmon; and, (2) the safe, timely, and effective handling and passage of Atlantic salmon. The first issue relates to how the harvestable surplus of river herring (up to 2,000,000 fish) are handled and whether the trap and transport facility must be sized to accommodate the harvestable run in addition to the spawning escapement of 315,000 fish. As presented in the Initial Study Report (ISR), the existing trap and transport facility is of sufficient size to pass the USFWS design criteria peak hourly rate of 4,725 river herring per hour (315,000 escapement only) with a 12-minute cycle time with a hopper capacity of only 61 cubic feet during lifting. Empirical data from the 2014 passage season demonstrated that up to 26,000 fish could be transported in a 5-hour day or approximately 5,200 fish per hour. Additionally, a post-transport survival study demonstrated that 24 hour survival of the transported river herring was greater than 97.5%. Under current operational protocol, separation of the upstream passage of the spawning escapement and the commercial harvest is accomplished temporally with harvest and transport conducted on different days. In 2015, the spawning escapement target was more than doubled from 150,000 to 315,000 river herring, and in this first year, the new escapement goal was accomplished with 329,160 fish transported upstream and a commercial harvest of 225,855 fish was also achieved for a total run size of approximately 555,015 river herring. While the 2015 season experience clearly demonstrated the capacity to handle over a half million river herring and the doubled spawning escapement, the hopper volume may also be physically expanded in length, width, and height within the existing fish trap footprint to provide additional capacity as discussed below.

Regarding the safe, timely, and effective passage of Atlantic salmon at Ellsworth, the primary concern is the safe handling of trapped salmon, especially during harvest operations and the potential for migration delay due to fishway crowding or infrequent trap and transport operation. Under current operations, the trap and hopper are visually inspected for Atlantic salmon and if one is spotted, the hopper is left in the water and the salmon is dip-netted out and placed in a holding tank. The salmon is then measured, examined for fin clips, fin wear, or other markings,

a scale sample is taken, and the magnified scale image and fish photo is digitally captured. This information is transmitted to the MDMR who will then determine whether the Atlantic salmon caught in the fishway is to be released downstream of the Ellsworth Dam (hatchery or aquaculture escapees), moved via transport tank truck upstream (wild origin) and released in the West Branch of the Union River, approximately 17 miles upstream, or removed. Generally this process takes one to two hours, and in the case of wild Atlantic salmon, they arrive in upstream habitat more quickly than if they had passed volitionally and swam the entire distance.

The current trap and transport facilities and operating protocols at Ellsworth have proven to be reliable and functional by handling river herring runs from 190,000 to 1,200,000 river herring and 0 to 8 Atlantic salmon annually from 2000 to 2015. Historically, this facility has handled up to 263 adult Atlantic salmon broodstock in a year. However, fishery resource agency concerns over the adequacy of the existing fishway facility to handle design populations remain. These concerns are addressed in the subsections below.

2.2 Hopper Improvements and Fish Trap Capacity

Since its original construction in 1974, different hoppers have been used at the Ellsworth fish trap for different purposes including: Atlantic salmon hatchery broodstock collections, trap and transport of river herring to Graham Lake, trap and transport of Atlantic salmon to the West Branch Union River, and commercial harvest of river herring. Since commercial harvest and trap and transport occur at the same location, fisheries resource managers have determined that the entire run, (escapement and harvested fish), must be included in the fishway capacity sizing. NMFS in their November 4, 2014 comments on the ISR, provided fish trap capacity calculations for the Ellsworth design population of river herring that was prepared by the USFWS Region 5 fishway hydraulic engineer. The capacity calculations included not only hopper sizing criteria, but also holding pool and vertical slot fishway sizing criteria as follows:

USFWS capacity criteria for 2,315,000 river herring, assuming 15-minute lift cycle

- Fishway Pool = 222 cubic feet
- Holding Pool = 416 cubic feet
- Hopper = 166 cubic feet

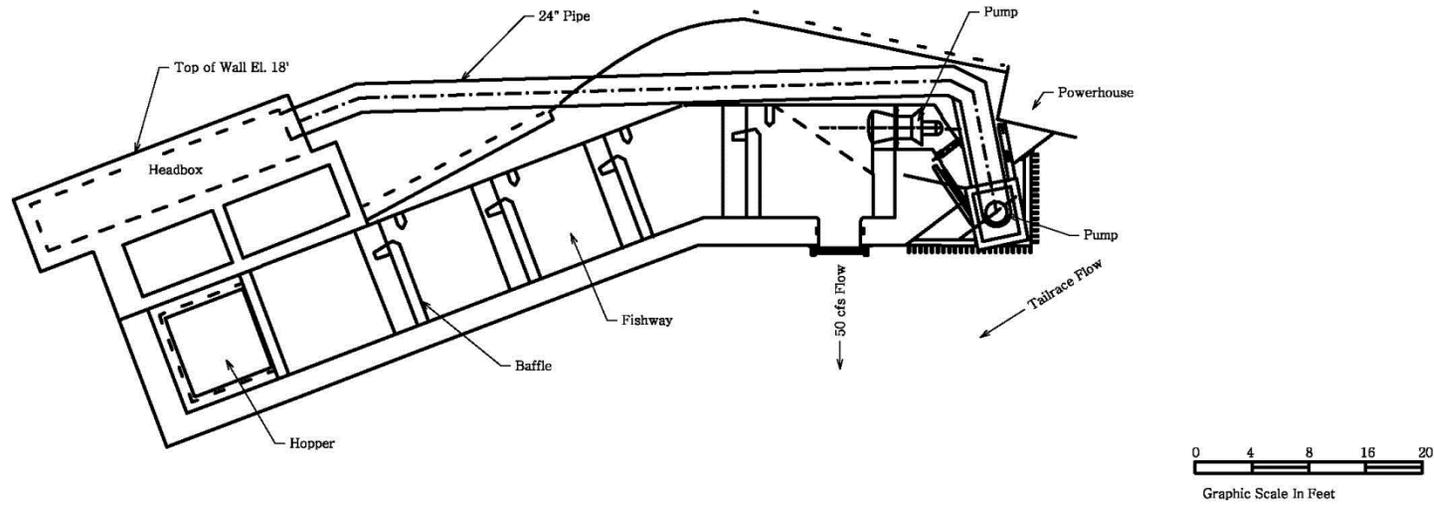
To determine whether the Ellsworth trap and transport facility is compatible with the USFWS criteria above, the existing fish trap dimensions (Figure 9) were determined for the fishway pools, holding pool, and hopper pool (to determine the largest hopper size that would fit in the pool). These dimensions were field verified, including water depth measurements under normal operating flows. The capacity of the existing Ellsworth fish trap was calculated as follows:

Ellsworth fish trap capacity

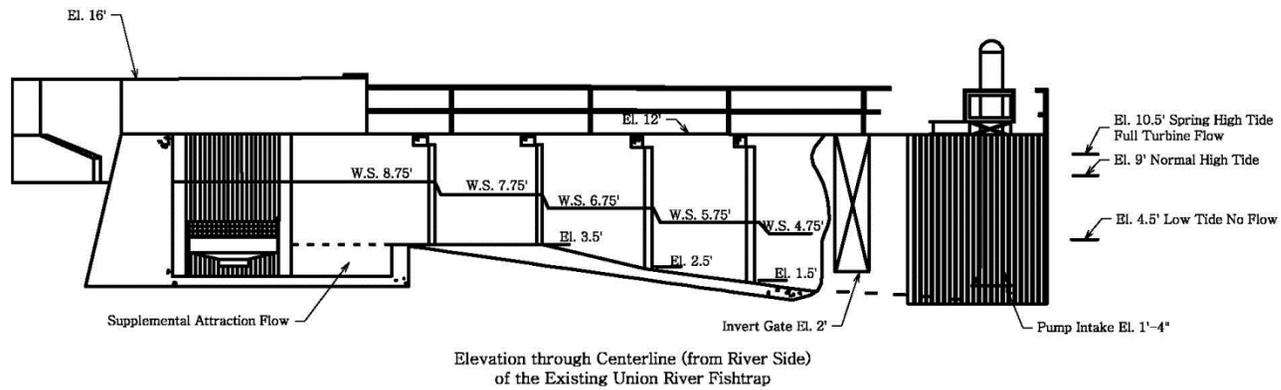
- Fishway Pool = 8.0 (l) x 8.0 (w) x 4.25 (d) = 272 cubic feet
- Holding Pool = 10.0 (l) x 8.0 (w) x 5.25 (d) = 420 cubic feet
- Hopper = 7.0 (l) x 8.0 (w) x 5.25 (d) = 294 cubic feet

While the hopper currently in use at Ellsworth (61 cubic feet during lifting) is smaller than the calculated capacity above, a larger hopper (and a larger hoist) could be fabricated and installed at the existing facility that would meet the 166 cubic foot criteria. These capacities meet or exceed USFWS criteria for the river herring design population of 2,315,000 fish with surplus capacity available for the Atlantic salmon 750 fish design population during the time when the two species' upstream migration periods overlap. Since these criteria are based on the projected single peak hour of abundance of the entire passage season, during the remainder of the season there will be even more surplus capacity for Atlantic salmon.

FIGURE 9
ELLSWORTH EXISTING FISH TRAP DIMENSIONS



Plan View of Existing Union River Fishtrap



Elevation through Centerline (from River Side)
of the Existing Union River Fishtrap

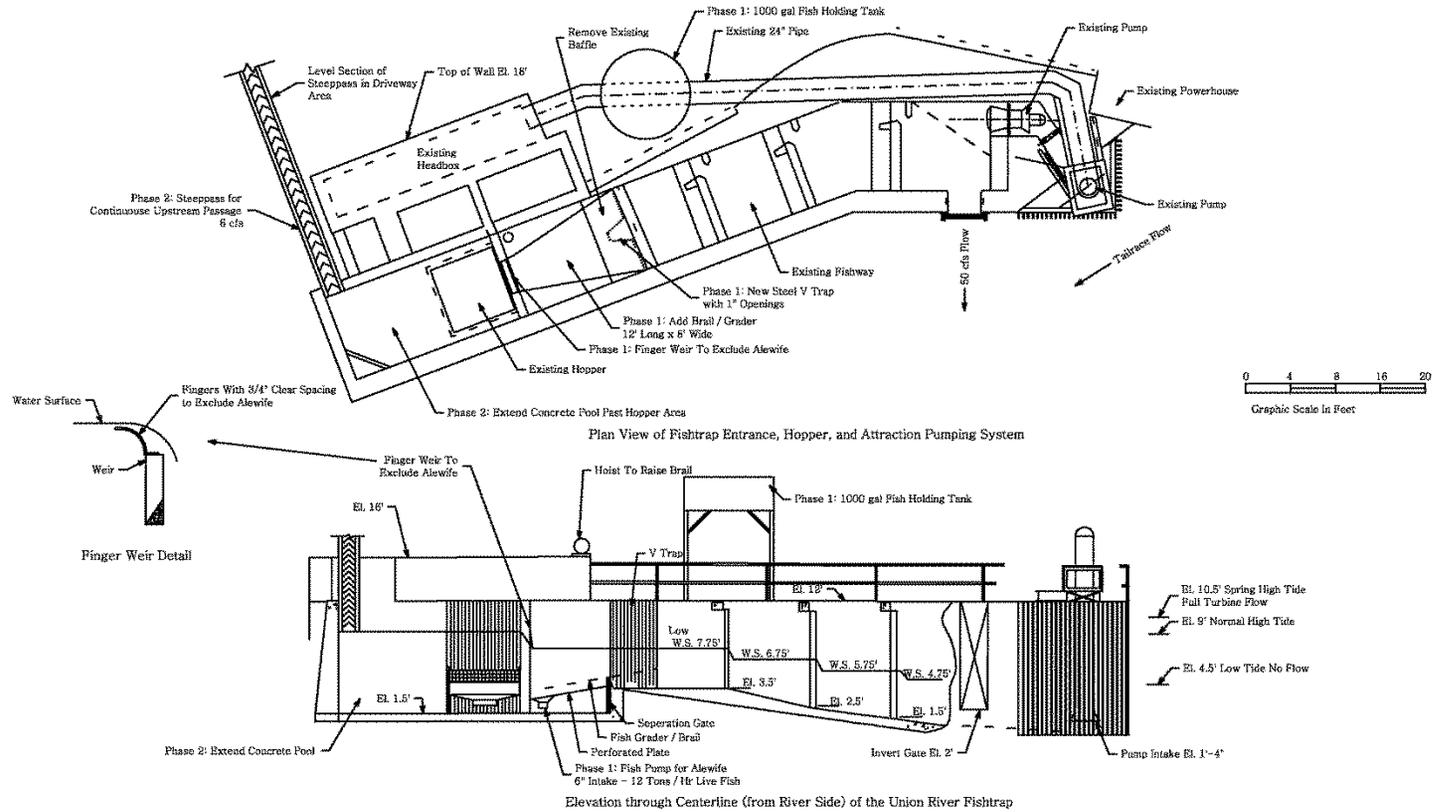
2.3 Separation of River Herring from Atlantic Salmon Passage

Separation of river herring transport and harvest activities from Atlantic salmon passage is thought to be a way of reducing potential harm or delay to Atlantic salmon upstream passage. Figure 10 illustrates a two-phased approach to accomplishing this species separation based on fish size and swimming ability. In Phase 1, the separation of Atlantic salmon and river herring is accomplished and both species are transported by vehicle in tanks to upstream habitat. In Phase 2, the trap is enlarged and modified to accommodate a fish ladder entrance allowing Atlantic salmon to volitionally swim upstream following separation from river herring.

2.3.1 Phase 1 – Exclude river herring from hopper and pump from holding pool

The system sketched on Figure 10 modifies the upper fish trap pools to have a 12-foot-long x 8-foot-wide x 4.25-foot-deep fish-holding pool. To accomplish this, the upper vertical slot baffle is removed and replaced with a “V” trap to capture both river herring and Atlantic salmon. The hopper entrance is also replaced with weir flow from the hopper pool by installing a finger weir (Clay 1995; Bell 1986) to restrict river herring from the hopper. The finger weir was originally designed to keep adult salmon from dropping out of a trap. When used at Ellsworth, river herring would be restricted by the close spacing of the finger weir bars and weir height; however, Atlantic salmon will easily pass over the weir. Thus with a finger weir, salmon can go into the hopper area but not river herring. The floor of the holding pool also has grader bars spaced to restrict salmon, but allow river herring to pass through. As the floor bail is lifted, alewife pass through the bars and any reluctant salmon are raised to the surface to pass the weir or can be dip netted. Atlantic salmon may then be lifted out in the hopper for examination and subsequent transfer to a tank vehicle for transport to a designated stocking location.

FIGURE 10
ELLSWORTH MODIFIED TRAP TO SEPARATE RIVER HERRING AND ATLANTIC SALMON



River herring remaining in the holding pool pass into a fish pump intake at the bottom of the pool. A 6-inch-diameter, 5 horsepower (hp) Aqua-Life, fish-friendly pump with a capacity of 12 tons of 1.5-pound live fish per hour (or 48,000 smaller river herring) is used to pass the live fish into a 1,000 gallon holding tank. From the holding tank, the river herring can be loaded into transport tanks for upstream stocking or may be harvested. The fish pump capacity is above the 21,000 river herring vertical slot capacity so it's possible to cycle the brail and fish pumping. Therefore, fish can be held alive when a truck is not available.

2.3.2 Phase 2 – Add Volitional Fish Ladder to Expanded Hopper Pool

Phase 2 modifications shown on Figure 10 would involve removal of the hopper and expansion of the hopper pool with construction of a fish ladder entrance at the end of the pool. This would accommodate either a steepass or standard Denil ladder entrance for volitional upstream passage of Atlantic salmon to Lake Leonard as described below in Section 3.1.

3.0 FISH LADDER ALTERNATIVES

Two fish ladder alternatives are evaluated for both Ellsworth Dam and Graham Lake Dam: steepass Denil and standard Denil ladders. A third alternative, a pool and weir fishway was considered, but determined not to be a viable alternative for the Ellsworth Project as discussed below.³

In response to the Updated Study Report the NMFS commented that an Ice Harbor or similar pool and weir fishway be considered in this evaluation because of their proven success passing salmon on the West Coast and the potential for similar success passing Atlantic salmon in the Northeast. However, in the Northeast, where multi-species passage goals are typical, Ice Harbor or pool & weir fishways at small high head dams are uncommon. Those that do exist (Turners

³ The initial Alternatives Study as included in the August 2015 Updated Study Report evaluated two ladder alternatives, steepass Denil and standard Denil ladders. In its comments on the USR the NMFS recommended that the Alternatives Study should include an evaluation of an Ice Harbor or other pool and weir fishway. The FERC determination on requested study modifications issued December 8, 2015, discussed the request and recommended that Black Bear either provide a conceptual design and associated cost estimate for an Ice Harbor or other pool and weir fishway, or specifically describe the issues that would make such a fishway infeasible or ineffective at the Ellsworth Project.

Falls and Amoskeag) have experienced poor passage effectiveness results for non-salmonid species, or are located upstream of shad and river herring historical range (Vernon, and Wilder). The modified Ice Harbor ladder at Turners Falls Cabot Station has been studied, modified, and restudied extensively during the last 20-plus years, yet shad passage effectiveness remains poor at only 10 to 20%. During the period of record when river herring were abundant in the Connecticut River (100,000 to 600,000 per year at Holyoke - 1983 to 1993), passage at the Cabot Ice Harbor fishway was less than 1.5% of those available fish (106 to 7,091 river herring per year). This has led the CRASC Technical Subcommittee for River Herring to limit their short term river herring restoration efforts to areas downstream of Turners Fall due in part to “existing fish passage concerns at Turners Falls Dam fishways” (February 10, 2015 status report). While studied less intensely, the pool & weir fishway at Amoskeag Dam on the Merrimack River is experiencing similar problems. 2015 fish passage statistics indicate 17,310 American shad and 31,668 river herring were passed at the downstream dam at Lowell, yet none of these fish were passed at the Amoskeag pool & weir fishway.

In addition to poor performance for passage of non-salmonid species, site specific conditions and operations of the Ellsworth Project limit the feasibility of Ice Harbor or pool & weir fishways. These fishways do not operate well under large fluctuations of headwater or tailwater elevations. A design solution for the fluctuating tailwater at the Ellsworth dam would be to incorporate a section of vertical slot fishway that spans the fluctuation range similar to the existing trap and transfer facility entrance in the Ellsworth Dam tailwater. The 11 foot seasonal headwater range at Graham Lake Dam would present a formidable design challenge for an Ice Harbor or pool and weir fishway exit structure. The design would need to incorporate some way of adding or removing weirs as the water levels change. Black Bear Hydro is not aware of any existing pool and weir fishway that has been constructed under such a large headwater range, suggesting that the Ice Harbor or pool & weir design is not feasible at Graham Lake Dam. At best, a design solution would be extremely expensive, likely increasing costs 50% to 100% over comparable Denil or fish lift designs.

In summary, an Ice Harbor or similar pool & weir fishway may perform well for Atlantic salmon passage, but this design has a poor record for non-salmonid fish passage effectiveness. An Ice Harbor or pool & weir design could be used at Ellsworth Dam to provide volitional passage to Lake Leonard for Atlantic salmon only, similar to the steepass and Denil designs discussed

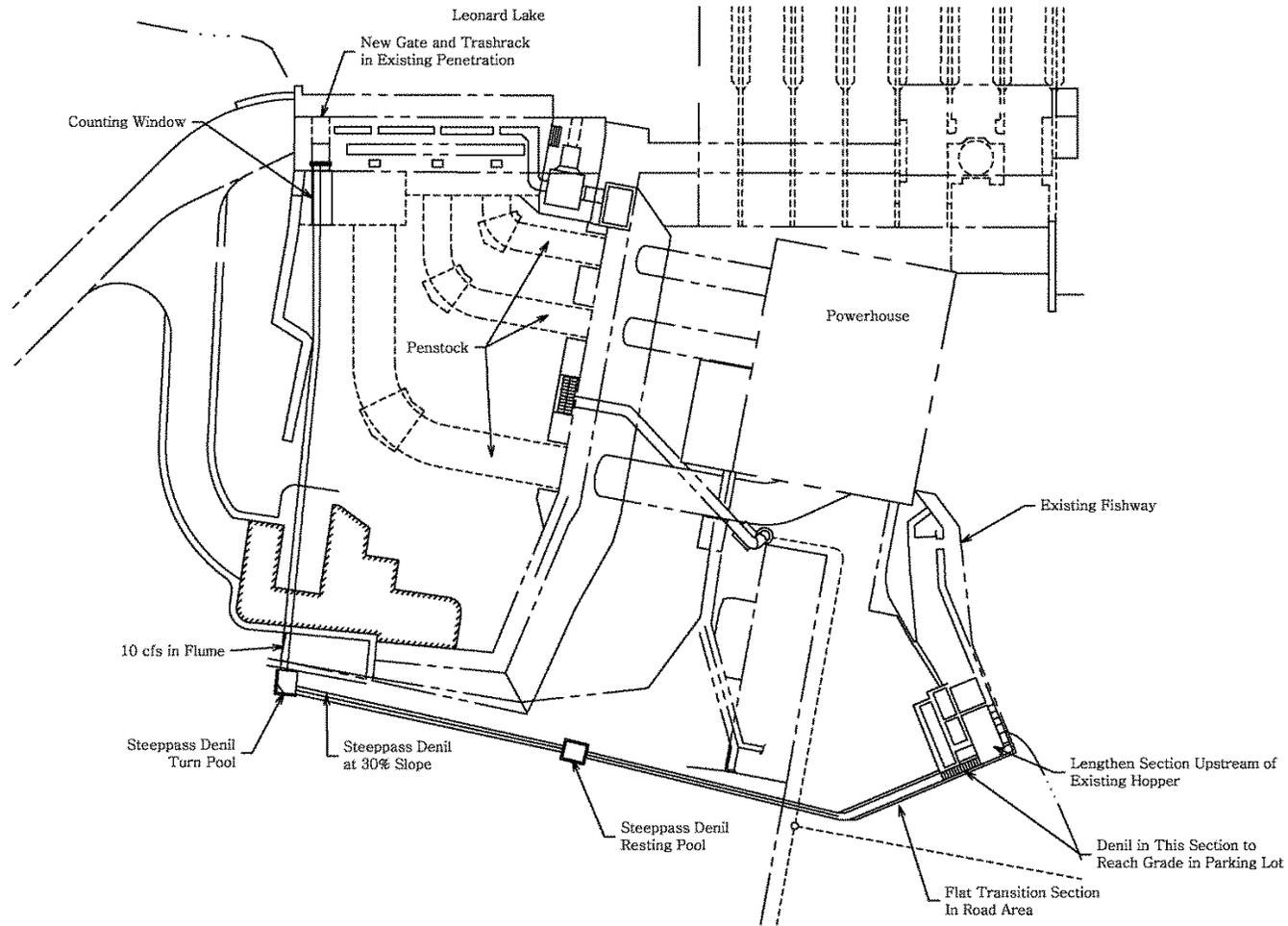
below; however, Ice Harbor or pool & weir design fishways do not perform well with large headwater or tailwater variation and would be excessively expensive to design and construct. Therefore, Ice Harbor and pool & weir fishway designs have not been evaluated further for the Ellsworth Project.

3.1 Ellsworth

Steppass Denil

The steppass Denil ladder alternative is intended to provide volitional passage to Lake Leonard for Atlantic salmon only. A plan view layout concept for a steppass Denil ladder is shown in Figure 11. The ladder entrance is located at the back of the extended hopper pool described above in Section 2.3. In this alternative, the hopper is removed from the trap and river herring are excluded by the finger weir and pumped out of the holding pool for transport or harvest. Just inside the ladder entrance there is a short section of steppass to reach the appropriate grade for the sluice crossing under the entrance road. From the road, a 170-foot-long steppass on a 30% slope ascends the steep bank just southwest of the powerhouse. There is one resting pool half way up the ladder and a turning pool at the top, transitioning into a sluice that runs across the old forebay fill area, to a counting window, and then exit through an existing knock-out penetration in the intake structure into Lake Leonard. The hydraulic capacity of the steppass and sluiceway is 5 to 10 cfs depending on the level of Lake Leonard at the sluiceway exit.

FIGURE 11
ELLSWORTH STEEPPASS DENIL LADDER ALTERNATIVE



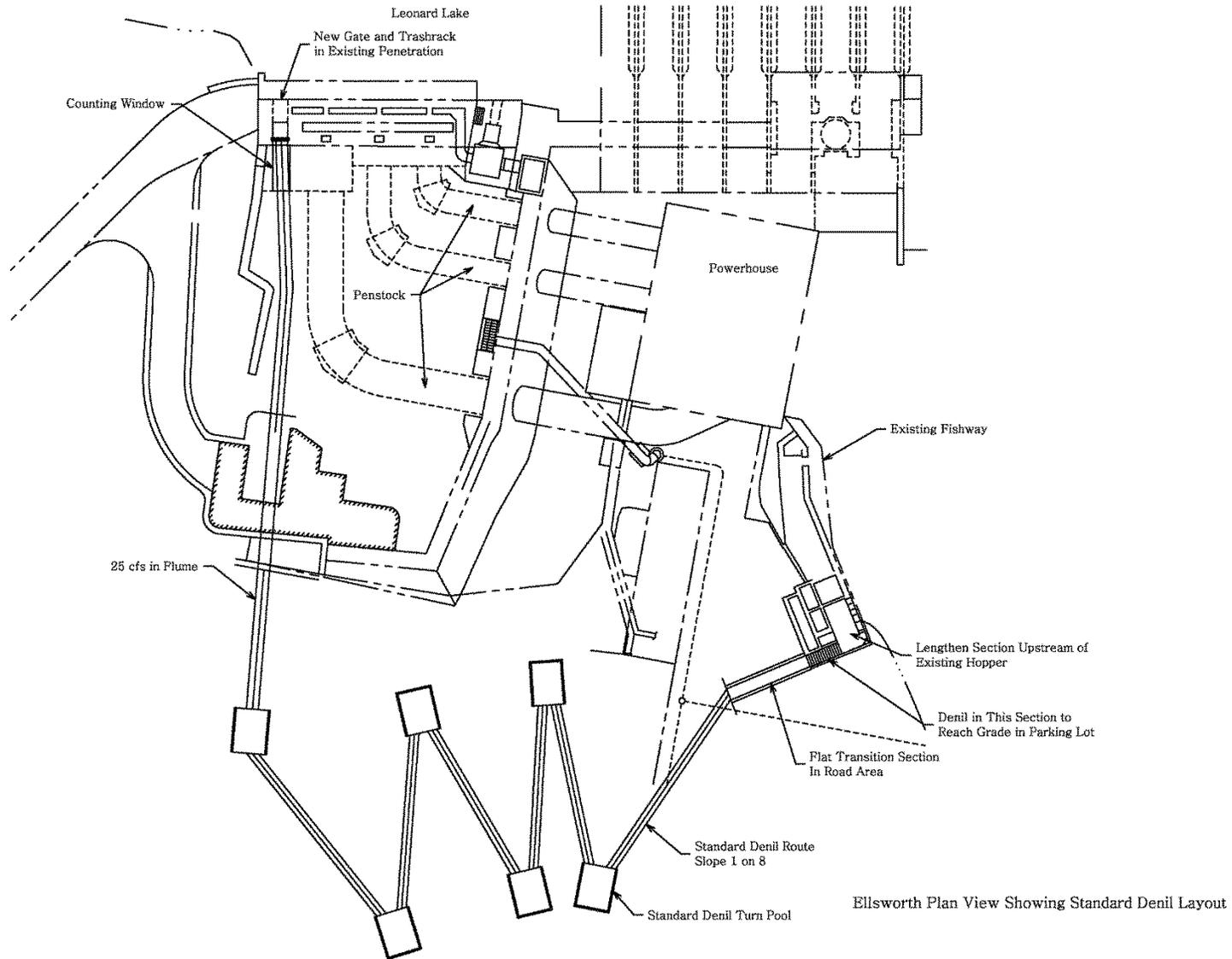
Ellsworth Plan View Showing Steeppass Denil Layout
at 30% Slope

Standard Denil

The standard Denil ladder alternative is similar to the steep pass except that the ladder is much longer due to a more gradual slope of 1 on 8 (12.5%) and a much higher hydraulic capacity of 25 to 30 cfs. A plan view layout concept for a standard Denil ladder is shown in Figure 12. The ladder entrance is located at the back of the extended hopper pool described above in Section 2.3. In this alternative, the hopper is removed from the trap, and river herring are excluded by the finger weir and pumped out of the holding pool for transport or harvest. Just inside the ladder entrance there is a short section of standard Denil to reach the appropriate grade for the sluice crossing under the entrance road. From the road, the Denil ladder runs 385 linear feet through six turning / resting pools at 8 feet vertical / 64 feet horizontal intervals resulting in a “W” shape layout, ascending the steep bank just southwest of the powerhouse. At the top elevation, the ladder transitions into a sluice carrying 25 to 30 cfs that runs across the old forebay fill area, to a counting window, and then exits through an existing knock-out penetration in the intake structure into Lake Leonard.

With the standard Denil conceptual design described above, river herring are removed from the fishway in what was the original trap holding pool via a fish-friendly pump for both transport of the required spawning escapement (315,000 fish) upstream and for commercial harvest of the remaining surplus fish. In theory, however, the standard Denil could volitionally pass the spawning escapement upstream, eliminating the need for the fish pump system and subsequent transport of fish. The USFWS recommends a standard Denil capacity limit of 200,000 river herring; however, there is empirical data for a similar standard Denil at Woodland Dam on the St. Croix River that passed over 1,000,000 river herring in a single season two times, once in 1986 and a second time in 1988. This data strongly suggests that a standard Denil at Ellsworth could easily pass the required 315,000 spawning escapement upstream, in addition to the 750 design population of Atlantic salmon.

FIGURE 12
ELLSWORTH STANDARD DENIL LADDER ALTERNATIVE



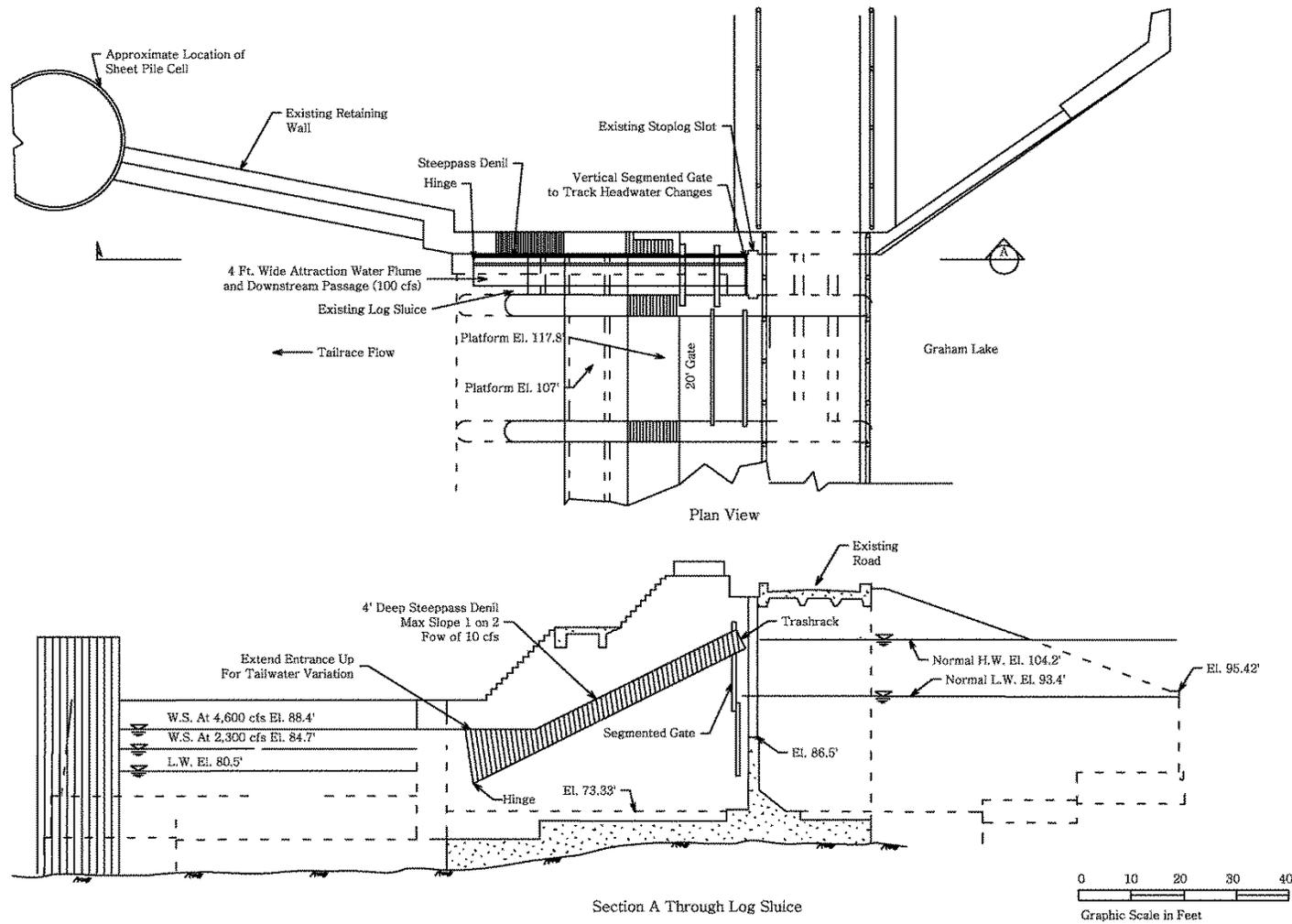
3.2 Graham Lake

One of the benefits of trap and transport from Ellsworth Dam is that anadromous fish can be returned to the Union River above both Ellsworth and Graham Lake Dams quickly and with nearly 100% passage efficiency. With the provision of volitional passage via fish ladders at Ellsworth Dam comes the requirement of volitional passage at Graham Lake Dam to get anadromous species to their spawning and rearing habitat. The two subsections below discuss concepts for a steppass Denil and standard Denil fishway at Graham Lake Dam. The biggest challenge for both of these fishway designs is the headwater fluctuation in Graham Lake that can vary up to 11 feet below full pond elevation. While both Denil designs below are able to accommodate the full headwater range of 11 feet by adjusting fishway slope to follow headwater variation, they are also designed to be at near optimal slope at the target headwater elevations of 104 to 98 feet for May 1 through October 31 (Figure 2).

3.2.1 Steppass Denil

The steppass Denil would be located in the log sluice bay of the Graham Lake Dam gate structure, where the current minimum flow and downstream passage are released through a surface weir notch in the stoplogs near the top of the log sluice. The conceptual layout of the steppass is shown in Figure 13. The steppass itself is 22 inches wide, 48 inches deep, and 60 feet long with a hinged foundation at the downstream entrance, and the top is built into a segmented gate installed just downstream of the stoplogs. The side walls of the steppass are built up at the lower end to maintain function at high tailwater elevations. While the steppass is designed to adjust over the full operational range of 5 to 24 feet of head (8% to 40% slope) during the vast majority of the fish passage season, Graham Lake will be between elevation 98 and 104 feet and the steppass slope will be between 22% and 33%. The steppass only passes 5 to 10 cfs, and in order to supplement this flow, a 4-foot-wide flume that will pass 100 cfs would run parallel to the steppass. This flume will provide a fishway attraction flow, minimum instream flow, and serve to pass downstream migrant fish. Flow into the flume would be controlled by a bottom drop gate. This system is not a traditional supplemental attraction flow system, but should draw fish to the area where they can enter the adjacent steppass.

FIGURE 13
GRAHAM STEEPPASS DENIL PLAN

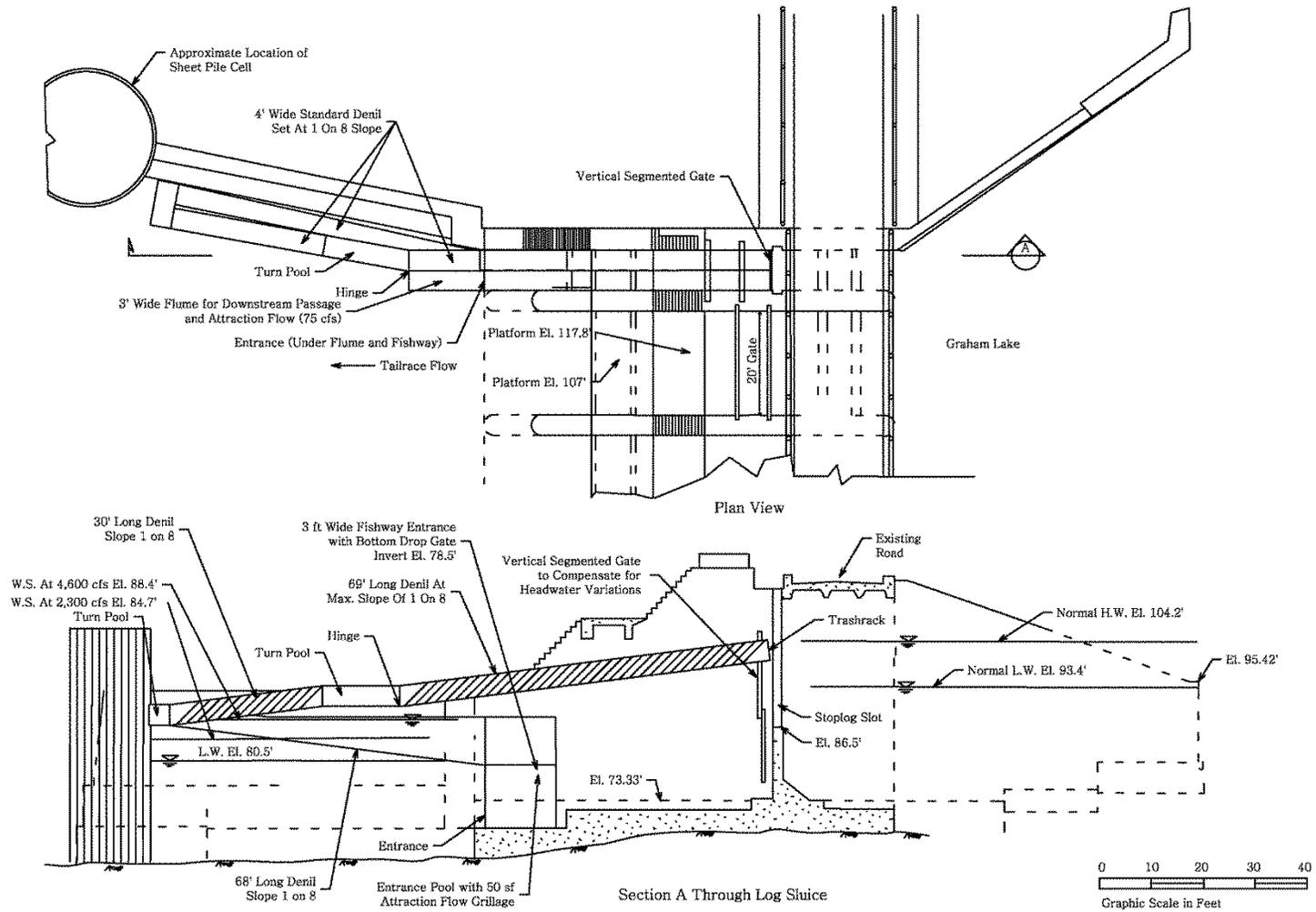


3.2.2 Standard Denil

The standard 4-foot-wide, 6-foot-deep Denil fishway conceptual layout in the log sluice bay at Graham Lake is illustrated in Figure 14. The Denil is designed with a slope not to exceed 1 on 8 and has resting pools at 8-foot-head intervals. The site head varies from a maximum head of 24 feet to a minimum of 5 feet. In order to accommodate the changing headwater elevation in Graham Lake, the upper 70 linear feet of Denil is hinged at the lower end with the upper exit of the Denil sitting on a segmented gate installed just downstream of the stoplogs. This permits the Denil to match the potential 11 foot headwater change. At full pond elevation, the slope of this hinged section is 1 on 8 and at minimum pond elevation it is almost flat with a 1 on 70 slope. In the normal lake level operating range during fish passage season, the slope varies from 1 on 8 at elevation 104 feet to approximately 1 on 25 at elevation 98 feet.

The Denil passes only 25 to 35 cfs. To supplement this flow for fish attraction, downstream passage, and minimum flow requirements, a 3-foot-wide flume with capacity to pass 75 cfs has been added to the log sluice, running parallel to the upper section of the Denil discharging in the vicinity of the entrance to the ladder. This system would screen off approximately 50 cfs supplemental attraction flow for the fishway entrance chamber to achieve a total attraction flow of 75 cfs. The Denil has a traditional entrance structure with an automatic entrance gate and supplemental attraction flow to accommodate tailwater changes.

FIGURE 14
GRAHAM STANDARD DENIL PLAN



4.0 LIFT ALTERNATIVES

The following two fish lift concepts are nearly identical to the designs that were developed for the Ellsworth Project in 1994 and 1995 in consultation with resource agencies and ultimately approved by FERC in an order issued on January 26, 1996. However, the FERC order was subsequently challenged by the licensee and reversed in court and the fishway was not built.

4.1 Ellsworth Fish Lift with Cable Car Hopper

The fish lift design concept at Ellsworth Dam is illustrated in Figures 15 and 16. Contrary to the other fishway concepts developed for Ellsworth (Denil, steep pass, and trap/transport) that utilized the same fish trap entrance and vertical slot baffles leading to the holding and hopper pools, this fish lift concept involves a substantial redesign of the fishway entrance and trap area. The fishway entrance gate is reoriented to discharge downstream parallel to the fishway wall and increased to 3 feet wide allowing a 70 to 75 cfs attraction flow (approximately 3% of powerhouse hydraulic capacity). Additionally, the vertical slot baffles, outer wall, and floor of the existing trap entryway will be demolished to widen the channel to 10 feet, level the floor, and add new attraction flow diffusers and traveling V-trap crowder system leading to a new 200-cubic-foot hopper. The current lift structure would be removed and a new 7-ton hoist and tram tower would be constructed to provide the lower support for a 7-ton industrial tramway adapted from a mining industry design. Near the top of the hill, southwest of the powerhouse, the second tram tower and receiving platform would be constructed just below Lake Leonard surface elevation to receive the hopper and fish. From the upper platform, the hopper is discharged into an 8-foot-wide sluiceway conveying 25 cfs from the fishway exit at a penetration through the intake structure. A counting window is located on the sluiceway just before the exit into Lake Leonard. An 18-inch pipe running from the downstream end of the sluice to the diffusion chamber at the lower hopper pool would receive the 25 cfs flow from the sluice as attraction flow. The existing supplemental attraction flow pumps would provide the 50 cfs balance of the required 75 cfs attraction flow at the fishway entrance.

FIGURE 15
ELLSWORTH FISH LIFT CONCEPT PLAN

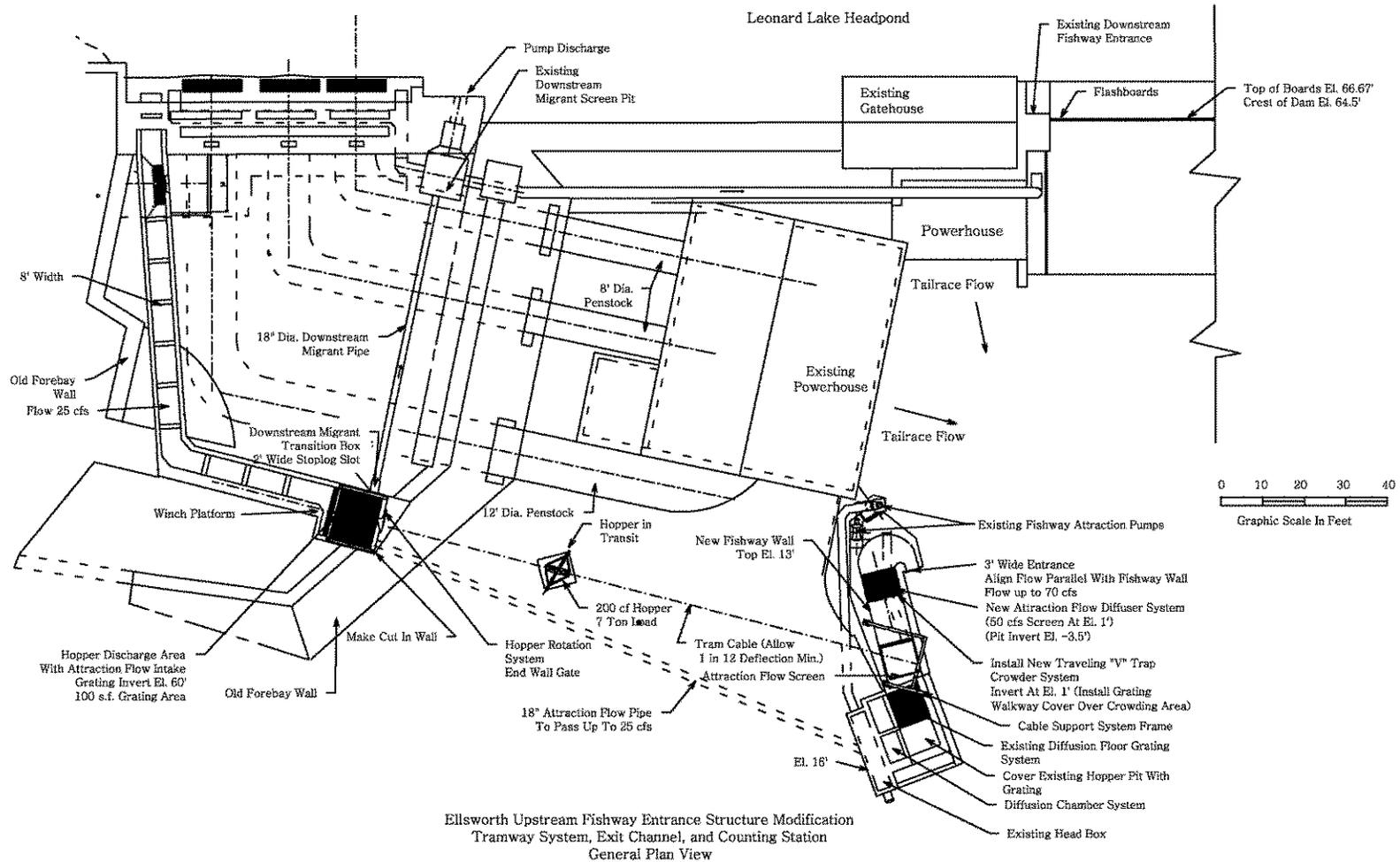
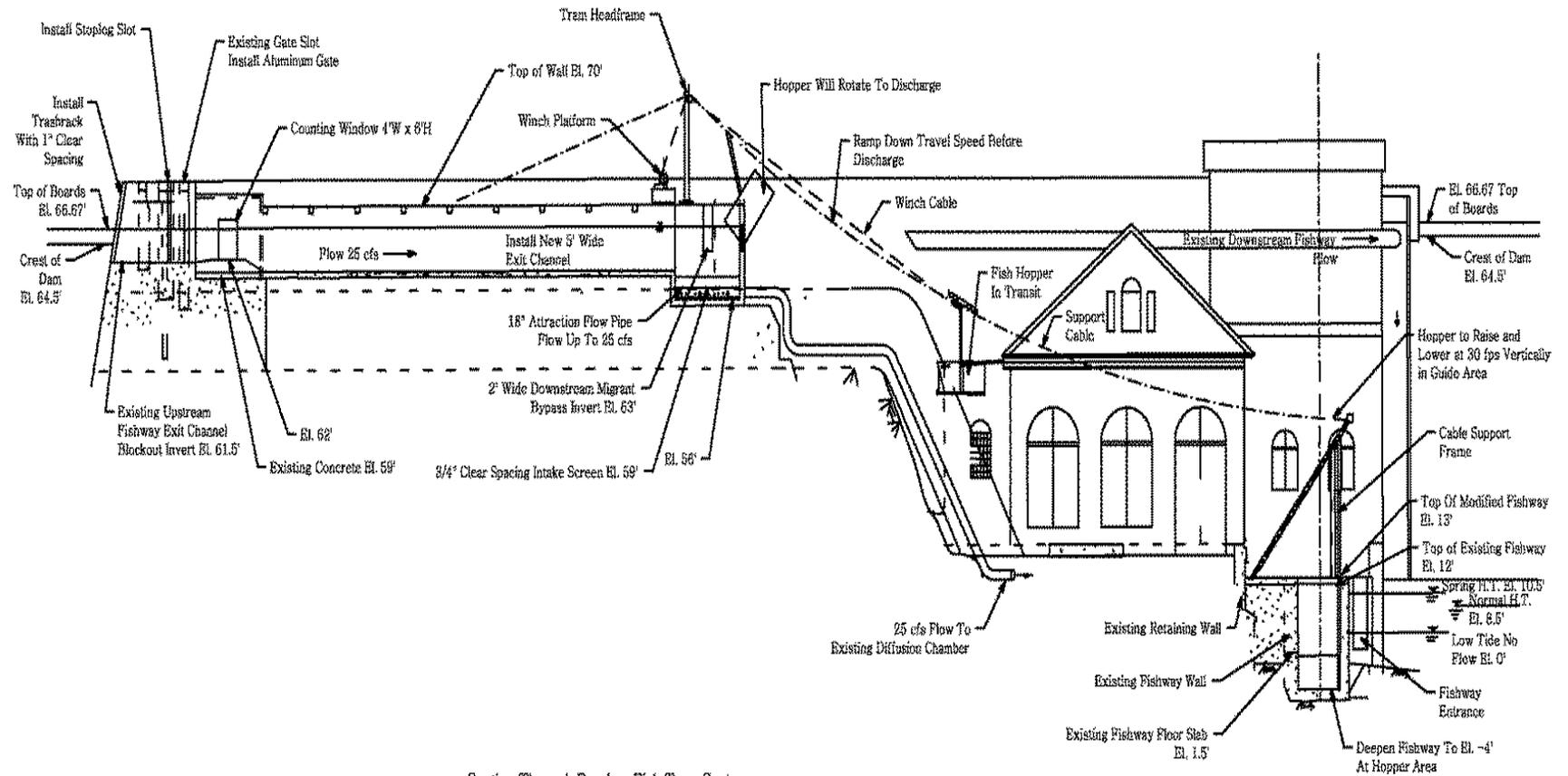


FIGURE 16
ELLSWORTH FISH LIFT CONCEPT SECTION



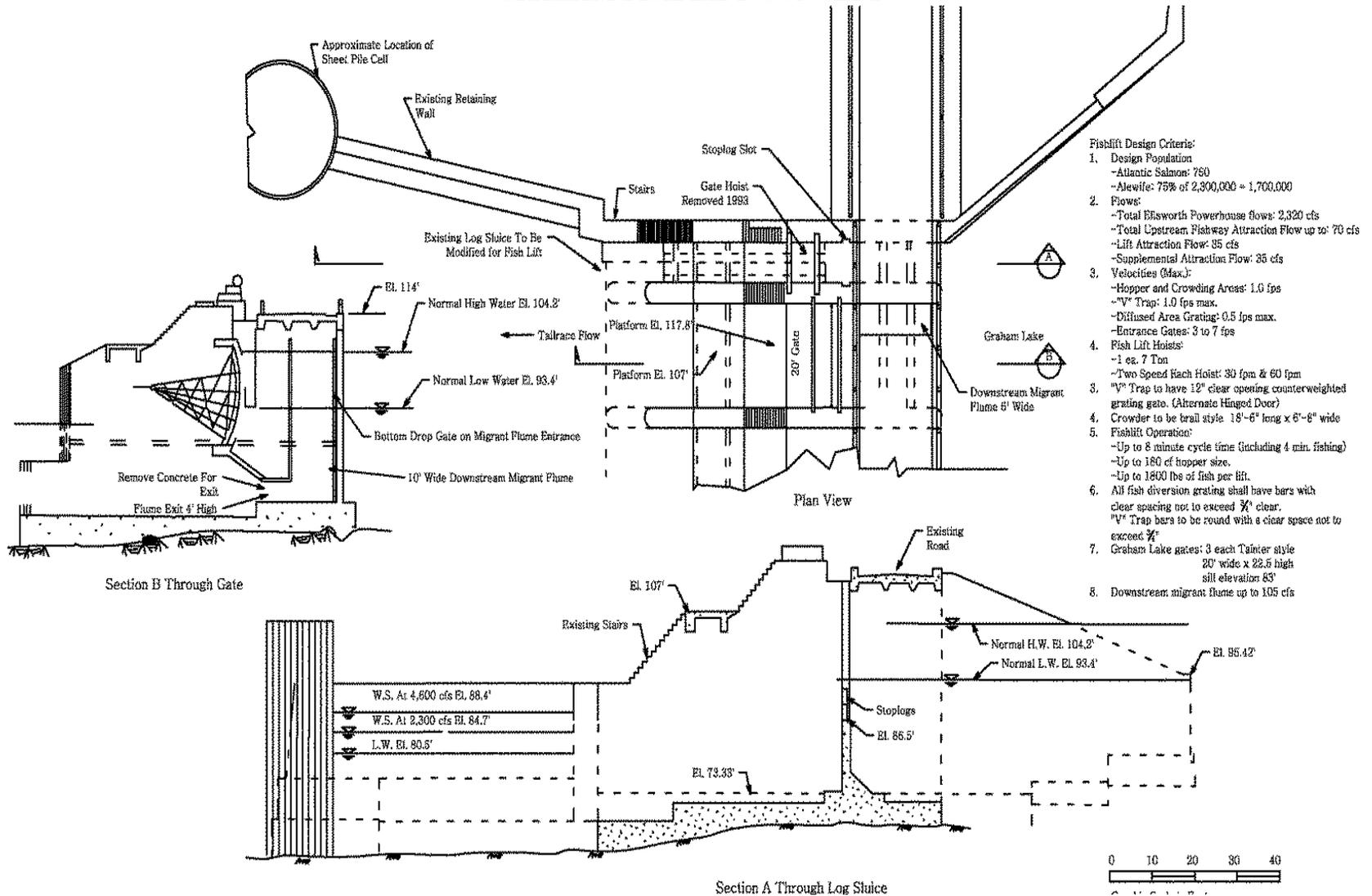
4.2 Graham Lake Fish Lift

The Graham Lake Dam fish lift concept shown in Figures 17 and 18 is designed to be constructed in the existing log sluice bay. This log sluice is presently being used for downstream fish passage, so a new structure for downstream fish passage is illustrated to be built in the adjacent Tainter gate bay.

For construction, the existing upstream timber stoplogs would be replaced with aluminum logs for an upstream dewatering barrier. A downstream cofferdam would be constructed on the existing concrete gate apron. There is a structural concern with the walls when they are dewatered, so internal bracing would have to be installed. To accommodate general maintenance, a head gate would be installed just downstream of the stoplogs.

The fish lift entrance gate is a typical segmented bottom drop gate with an electric actuator. The gate is designed to pass 70 cfs attraction flow. Just downstream of the fish lift entrance gate there is a stoplog slot to allow for maintenance of the gate. The lift utilizes a rail-type crowder with a 180-cubic-foot hopper. The lift adjusts fish discharge elevations to accommodate the 11-foot headwater fluctuation range. This lift is sized to accommodate up to a design population of 1,700,000 river herring (75% of the Ellsworth lift) and 750 Atlantic salmon. There is no counting station at the Graham Lake fish lift. Estimates of fishway effectiveness would be achieved by PIT tagging fish at Ellsworth and monitoring for PIT tags at Graham.

FIGURE 17
GRAHAM FISH LIFT CONCEPT



5.0 DECOMMISSIONING

5.1 Ellsworth Dam

The Ellsworth Dam is an Ambursen dam, constructed by the Ambursen Hydraulic Construction Company under direction from the Chief Engineer, James A. Leonard, with construction beginning in February 1907 and completed on November 14, 1907⁴. Construction of the project involved excavation of over 3,000 cubic yards of bedrock for use as aggregate in the concrete. Three low-level sluices were constructed in bays 14 through 16, and river flow was diverted during construction through the buttresses in the dam and ultimately through the three low-level sluices.

In the early 1990s, a majority of the Ambursen dam was filled with concrete to comply with FERC stability guidelines specific to Ambursen dams to address sliding stability and lateral earthquake stability. All the bays of the dam received concrete fill, with some bays also receiving post-tensioned rock anchors. The low-level sluices were also filled with concrete.

5.1.1 Full Dam Removal

A conceptual cost estimate was prepared to estimate the costs of full dam removal at the Ellsworth Hydro project, including all appurtenances. The costs for removal include:

- Main dam removal;
- Powerhouse removal;
- Fishway removal;
- Penstock removal;
- Forebay wall and intake wall removal;
- Forebay fill removal;
- Substation removal; and
- River bank restoration.

The demolition costs include water handling during construction, which was estimated to be managed by releases through the existing hydro equipment flow passages, operation of the

⁴ Ambursen Hydraulic Company report on the Bar Harbor and Union River Power Company dam, undated.

upstream storage project, and the installation and operation of siphons during construction. The siphons were required, as the project has no low-level outlets and is incapable of passing flow lower than the invert of the hydro intake structures. Costs were included for removal of the turbine equipment and modifications to the turbine head cover to be able to pass flow without unit braking or unit runaway. The siphons were required to be reset multiple times during the demolition of the dam for flow diversion, due the head limitation of the operation of siphons. A temporary 120-foot-long bridge across the powerhouse tailrace and gravel road along the toe of the dam was planned to provide access to the dam for the removal of concrete demolition debris. The powerhouse, penstocks, old forebay walls, intake wall, fishway, and miscellaneous concrete walls were estimated to be removed and the debris hauled off-site to an approved disposal facility.

The cost opinion for this alternative does not include any sediment dredging post-demolition work along the dewatered reservoir or recreational access to the site. The potential cost of providing a temporary means of fish passage during demolition was also not included.

5.1.2 Partial Dam Removal

The conceptual costs for the partial dam removal of the Ellsworth Dam were estimated to include:

- Removal of a portion of the main dam, bays 8 through 22, leaving a portion of the east abutment in place and the balance of the dam, intake, penstocks, and powerhouse. Demolition and water handling is the same as in the full removal.
- The generating equipment would be removed as in the full removal, primarily for safe discharge capacity during dewatering.
- The intake structure and appurtenances, including the old forebay walls, would be left in place with portions of the penstocks plugged and filled with concrete for safety.
- The fishway facilities would be removed and the area restored, as in the full removal.
- The substation equipment and appurtenances would be removed and restored, similar to the full removal.
- Security fencing of the intake and forebay would remain.

The cost opinion for this alternative does not include any sediment dredging post-demolition work along the dewatered reservoir or recreational access to the site. The potential cost of providing a temporary means of fish passage during demolition was also not included.

5.2 Graham Lake Dam

Graham Lake Dam is an earthen embankment dam constructed as a storage project to augment flows to the downstream Ellsworth Hydro project. The project consists of an earthen embankment and a gated discharge structure. The original gated structure failed in 1923 during high flows and was rebuilt and extended to a bedrock foundation. In the early 1990s concerns about the stability of the earthen embankment and the potential for liquefaction of the embankment materials led to the construction of a downstream gravity dam and modifications to the existing embankment dam in 1992 to comply with updated FERC stability criteria. The downstream gravity dam includes a permanent cellular cofferdam segment.

5.2.1 Full Dam Removal

The full removal of the Graham Lake Dam includes:

- Removal of the embankment fill material;
- Removal of the concrete gated structure;
- Removal of the downstream gravity dam and permanent cellular cofferdam; and
- Removal of the concrete connector wall between the gated structure and the permanent cellular cofferdam.

The demolition costs include the water handling during demolition to dewater Graham Lake through operation of the three Tainter gates and subsequent removal of the Tainter gates to facilitate diversion of flows. Following lowering of the reservoir, the earthen embankment would be excavated with a section of the excavation deep enough to use for flow diversion to dewater, demolish, and remove the concrete gated structure and foundations. The concrete gravity section would be excavated to provide access to demolish and remove the remaining concrete structure, including the permanent cellular cofferdam and closure wall. Costs include grading and loam and seed for the site, but no additional costs were included for landscaping.

The cost opinion for this alternative does not include any sediment dredging post-demolition work along the dewatered reservoir or recreational access to the site. The potential cost of providing a temporary means of fish passage during demolition was also not included.

5.2.2 Partial Dam Removal

The conceptual cost estimate for the partial removal of the Graham Lake Dam includes costs for:

- Removal of the concrete gated discharge structure and three radial gates;
- Removal of a portion of the embankment dam and riprapping of the sloped face of the remaining earthen embankment; and
- Removal of the concrete connection wall between the gated structure and the permanent cellular cofferdam.

The partial removal concept includes removal of a portion of the earthen embankment which abuts the concrete gated discharge structure and the permanent cellular cofferdam. This section of the removed earthen dam will provide flow diversion during the demolition and removal of the concrete gated section and foundation. The demolition of the concrete gated section and foundation will require the construction of temporary upstream and downstream cofferdams to dewater the gate section and foundations.

The cost opinion for this alternative does not include any sediment dredging post-demolition work along the dewatered reservoir or recreational access to the site. The potential cost of providing a temporary means of fish passage during demolition was also not included.

6.0 ESTIMATED COSTS OF ALTERNATIVES

6.1 Capital Costs

Estimated capital costs for each fish passage alternative are summarized in Table 2. The direct costs are based on experience with similar projects to develop estimates of unit costs and labor.

Indirect costs were estimated at:

30%	Conceptual design level contingency
10%	Mobilization and demobilization
5%	Permitting
15%	Engineering
10%	Contractor profit
2%	Brookfield project management

Annual O&M costs at Ellsworth would be expected to be similar to what it cost to run the existing trap and transport facility in 2015, which was approximately \$90,000. Graham Lake O&M costs would be approximately 50% of Ellsworth or approximately \$45,000 depending on the final design alternative selected.

TABLE 2
ESTIMATED CONCEPTUAL LEVEL COST
OPINIONS FOR EACH FISH PASSAGE ALTERNATIVE

Fish Passage alternative	Ellsworth Dam	Graham Lake Dam
Trap & Truck – Separation of Alewife and Salmon	\$225,000	N/A
Steeppass Denil	\$1,500,000	\$1,500,000
Standard Denil	\$1,800,000	\$2,200,000
Fish Lift	\$3,700,000	\$2,300,000
Decommissioning and Full Removal	\$12,300,000	\$10,400,000
Decommissioning and Partial Removal	\$8,000,000	\$3,200,000

6.2 Renewable Energy Costs

The Ellsworth Project has a total rated capacity of 8,900 kW, with gross annual energy production of about 30,333,000 kWh. Project decommissioning would mean the loss of this clean, reliable, and renewable hydropower energy source. All other passage alternatives considered would have negligible impacts on the current level of renewable energy production.

7.0 FISH PASSAGE EFFECTIVENESS AND EFFECTS ON OTHER ANADROMOUS SPECIES

This section evaluates the effectiveness of the fish passage alternatives on the target species, Atlantic salmon and river herring, as well as potential effects on other anadromous species known to frequent the Union River or rivers in the vicinity of Ellsworth, such as American shad, Atlantic and shortnose sturgeon, sea lamprey, rainbow smelt, tomcod, and striped bass. Historic use of the Union River above the Ellsworth Project is unknown for many of these species due to the higher gradient of the river at the dam site, which may have naturally inhibited migrations for weaker swimming species, and sparse historical data. Regardless of historic presence, each of these fishway alternatives offers the potential for future access to waters above Ellsworth Dam on a selective basis, due to the maintenance of trapping and transport operations on all but the fully volitional lift option. It is important to note that for all the Ellsworth fishway alternatives evaluated except the fish lift, a short section of 3 or 4 vertical slot baffles in the entrance must be passed before reaching the subsequent hopper, ladder, or transport/harvest station.

For the two primary target species, Atlantic salmon and river herring, passage effectiveness should be high. Atlantic salmon and river herring will readily pass the vertical slot entrance baffles as demonstrated over the operating history of the current facility. Lifts with optional sorting and transport facilities are common in Maine because of their proven effectiveness at fishways such as Cataract and Skelton on the Saco River, Lockwood on the Kennebec River, and Milford on the Penobscot River. With use of the finger weir to isolate salmon from all other species, upstream passage via either a steep pass or Denil ladder will work well for salmon. In the Maine DMR inventory of fishways in Maine shown in Table 3, it can be seen that Denil ladders are currently in use at the first dam on seven rivers. While the table ranks American shad passage effectiveness as moderate to low, these ladders were typically installed for the primary purpose of passing Atlantic salmon (and/or river herring) as these species readily pass a Denil ladder with high efficiency.

**TABLE 3
MAINE DMR FISHWAY INVENTORY**

River/Watershed	Distance to first mainstem dam (km)	First Mainstem Dam Name	Fish Passage Type	Shad Passage Potential	Dam Ownership	FERC License	FERC License Renewal
Salmon Falls/Piscataqua River	26.8	South Berwick Dam	Denil	Moderate	Consolidated Hydro New Hampshire, Inc	Yes	11/30/2037
Salmon Falls/Piscataqua River	26.6	Great Works Pond Dam	None	None	Great Works Hydro Co.	No	
Webhanet River	None						
Little River	3.3	Skimmers Mill Dam	None	None	Not listed	No	
Mousam River	6.8	Kessler Dam	None	None	Kennebunk Light and Power District	Yes (3 dams)	3/31/22
Kennebunk River	27.9	Days Mill	None	None	Private	No	
Saco River	9.3	Cataract Project	Fish Lift, Denil, 2 fish locks	Low to Moderate	Brookfield Renewable Energy	Yes (4 dams)	11/30/29
Scarborough Marsh/Nonesuch R.	None						
Presumpscot River	12.6	Cumberland Mills	Denil Fishway	Moderate	S. D. Warren	No	
Royal River	4.9	Bridge Street Dam	Denil Fishway	Low	Town of Falmouth	No	
Androscoggin River	48.2	Brunswick Project	Vertical slot	Low (Documented)	Brookfield Renewable Energy	Yes	2/28/29
Kennebec River	140.8	Lockwood Project	Fish Lift	Low	Brookfield Renewable Energy	Yes	10/31/36
Sebasticook River	173.6	Benton Falls	Fish Lift	Moderate	Essex Hydro Associates	Yes	2/28/34
Sheepscot River	44.0	Head Tide Dam	Slots	Moderate	Town of Alna	No	
St. George River	48.3	Sennebec Pond Dam	Rock Ramp	High	Sennebec Lake Assoc.	No	
Ducktrap River	17.9	Dickey Mill Dam	None	None	Not listed	No	
Penobscot Watershed	68.5	Milford Dam	Fish Lift	Low to Moderate	Bangor Hydro Electric Co.	Yes	4/1/38
Union River	7.3	Ellsworth Dam	Denil, Trap and Truck	Not Passed Upstream	Black Bear Hydro	Yes	12/31/18 (consulting)
Tunk Stream	None						
Narraguagus River	10.6	Cherryfield Dam	Denil Fishway	Moderate	Town of Cherryfield	No	
Pleasant River	None						
East Machias River	None						
Dennys River	None						
Pennamaquan River	2.9	Pembroke Cottage Dam	Denil Fishway	Moderate	Private	No	
St. Croix River	30.8	Milltown Power Station Dam	Denil Fishway	Moderate	New Brunswick Electric Co.	No	

Source: Maine DMR 2013. American Shad Habitat Plan, Prepared September 16, 2013, submitted to the Atlantic States Marine Fisheries Commission as a requirement of Amendment 3 to the Interstate Management Plan for Shad and River Herring, approved by ASMFC February 6, 2014.

Steeppass experience for Atlantic salmon passage in Maine is rare; however, this ladder design was specifically developed for salmon in Alaska where they are widely used and very successful,

including use at barriers in excess of 60 feet high. As discussed earlier, river herring would be passed via transport trucks for the two ladder alternatives. For the volitional lift option, the vertical slot entrance is removed in favor of a deeper and larger standard lift entrance, a method frequently used to pass salmon and river herring successfully throughout the Northeast.

For American shad, the existing fishway, as well as the two salmon ladder alternatives with separation of sorting and transportation upstream, would function with low to moderate effectiveness. The vertical slot baffles will readily pass American shad, however a 0.75-foot-head differential between pools will typically pass shad more effectively as opposed to the 1.0-foot-head differential currently in place. For the volitional lift option, with proper entrance hydraulics, American shad passage effectiveness would be high. It should be noted, however, that according to the Maine DMR's shad habitat management plan (Maine DMR 2013) only 2 miles of river above Ellsworth Dam (to the top of Lake Leonard) is currently suitable for American shad, and there is no information provided on historical use of the river by shad. Therefore, the appropriate number of shad to be passed at Ellsworth Dam has not been determined.

For the remaining species - Atlantic and shortnose sturgeon, sea lamprey, rainbow smelt, tomcod, and striped bass, historic use of the Union River above the Ellsworth Project is largely unknown. Therefore, the potential benefits or risks, or need for upstream passage would need to be carefully considered. Atlantic sturgeon, shortnose sturgeon, striped bass, and sea lamprey are all known to pass through vertical slot fishways; however, the relative effectiveness for these species is generally unknown. Both rainbow smelt and tomcod are primarily tidewater estuarine species, they are relatively weak swimmers and passage effectiveness through a vertical slot fishway is likely poor. It is not known if these species even reach the base of Ellsworth Dam or if upstream passage would be appropriate from a fisheries management perspective. The volitional fish lift would likely pass these species because the vertical slot entrance is removed in favor of a deeper and larger standard lift entrance if they are able to negotiate the entrance hydraulics.

Dam removal passage effectiveness and environmental effects are considered separately in Section 8.0 below.

8.0 ENVIRONMENTAL BENEFITS AND IMPACTS

This section evaluates the potential benefits and impacts associated with dam removal alternatives in relation to the following resource areas:

- River herring production;
- Resident fisheries;
- Fish passage;
- Recreation;
- Sedimentation and water quality;
- Wetlands;
- Cultural resources; and
- Socioeconomic resources.

Each of these resource areas is considered in the subsections below.

8.1 River Herring Production

Current river herring management goals are intertwined with the amount of available spawning and rearing habitat upstream of the Ellsworth Dam, which would be greatly impacted by the removal of Graham Lake and Ellsworth Dams. According to the Comprehensive Fisheries Management Plan for the Union River Drainage (Management Plan) there are eight lakes totaling 10,204 acres in surface area under active river herring management in the Union River drainage. Lake Leonard and Graham Lake comprise 7,983 surface acres (78%) of this total. The Management Plan estimates that the full river herring production capability of the seven Phase I lakes is approximately 2,398,011 fish of which 2,040,860 are harvestable surplus. River herring production estimates for Lake Leonard and Graham Lake is 1,875,958 fish (based on lake area), and is also 78% of the total river basin potential (URFCC 2015).

The current acreage of Graham Lake at full pond is approximately 10,000 acres; however, during the spring and summer rearing period for river herring, the lake is being drawn down approximately 6 feet. For the purposes of estimating river herring production potential, an intermediate surface area of 7,865 acres is used (URFCC 2015). Using GIS and historical

mapping (Figure 19), the surface water area of Graham Lake would decrease to 367 acres after dam removal, reducing the potential production of river herring to 86,245, which is approximately a 95% reduction in river herring production in Graham Lake. Similarly for Lake Leonard (Figure 20), which is currently estimated at 118 acres in size in the Management Plan (URFCC 2015), dam removal would reduce the acreage to about 14 acres, resulting in a potential river herring production of only 3,290 fish. This is an 88% reduction from the current production estimate for Lake Leonard of 27,730 fish, based on 235 fish per acre (URFCC 2015). Considering both lakes, Project decommissioning would result in the loss of 1,875,958 river herring for a 78% overall reduction in the seven Phase I lakes of the Union River Basin.

8.2 Resident Fisheries

In the Ellsworth Project area, warmwater species such as smallmouth bass, chain pickerel, and white perch are resident species in Graham Lake and Lake Leonard that provide sport fishing opportunities (Black Bear 2012). Largemouth bass were introduced illegally into Graham Lake in 2009 or 2010 and are expanding rapidly (personal communication with Greg Burr, Maine Department of Inland Fisheries and Wildlife [Maine DIFW] July 3, 2014). Good white perch fishing exists at Graham Lake, which also has a productive pickerel fishery (URFCC 2010), as well as a brown bullhead fishery (personal communication with Dick Fennelly, July 23, 2014). Removal of the two dams would transform this current lacustrine habitat to strictly lotic habitat and dramatically change the characteristics of the current resident fish community. Over all, decommissioning would convert 10,118 acres of lacustrine habitat to 381 acres of lotic habitat, a 95% reduction in surface area.

The benefits of dam removal include expanding the connectivity of habitat between the former sites of Graham Lake and Lake Leonard, as well as eliminating mortality risks due to turbine entrainment, and this section of the Union River would be restored to a free-flowing reach. Although suitable habitat for resident species exists both upstream and downstream from the Project, dam removal may allow for some species to locate new spawning and resident habitats that are currently inaccessible.

FIGURE 19
1911 USGS MAP OF GRAHAM LAKE VICINITY PRIOR TO DAM CONSTRUCTION

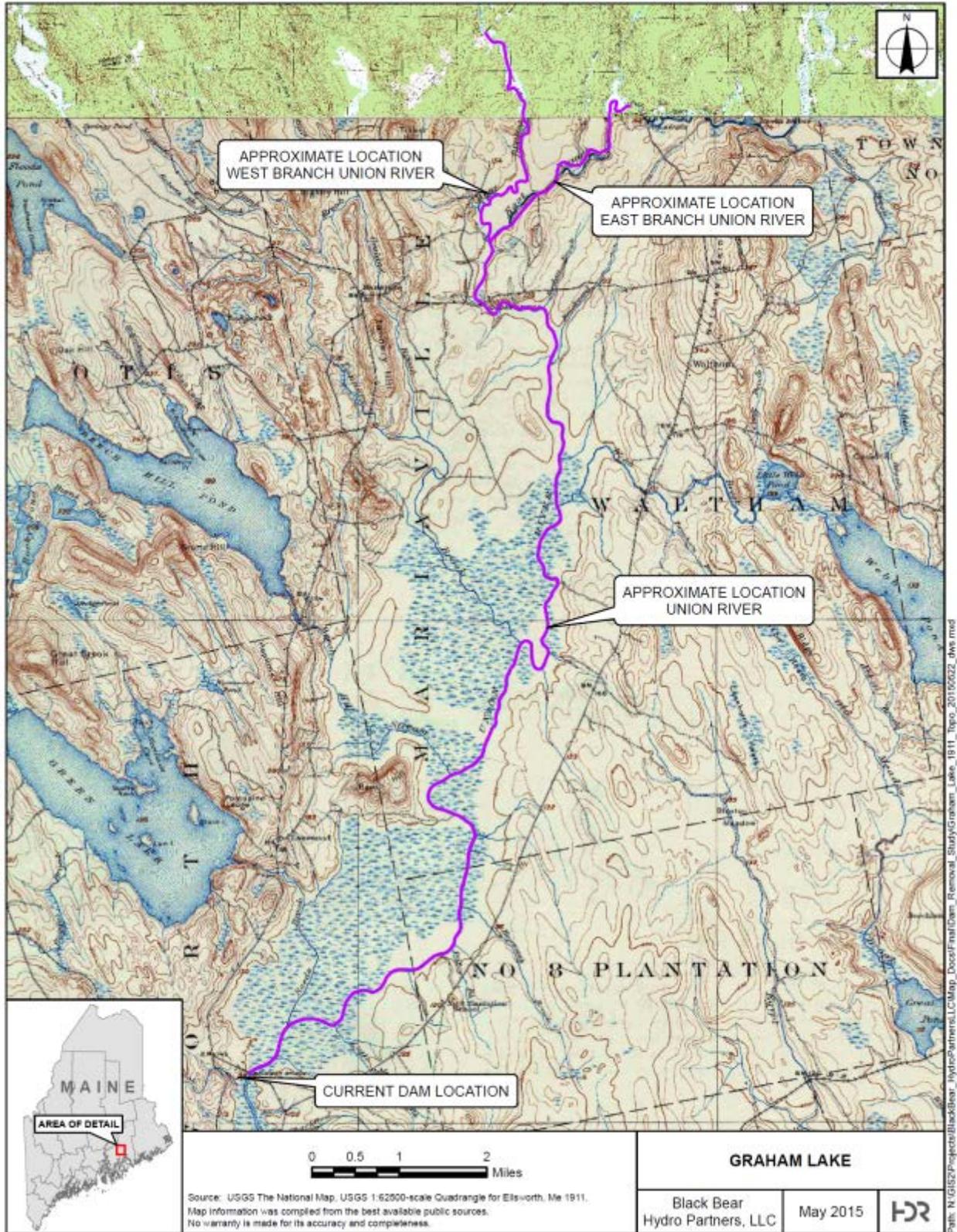
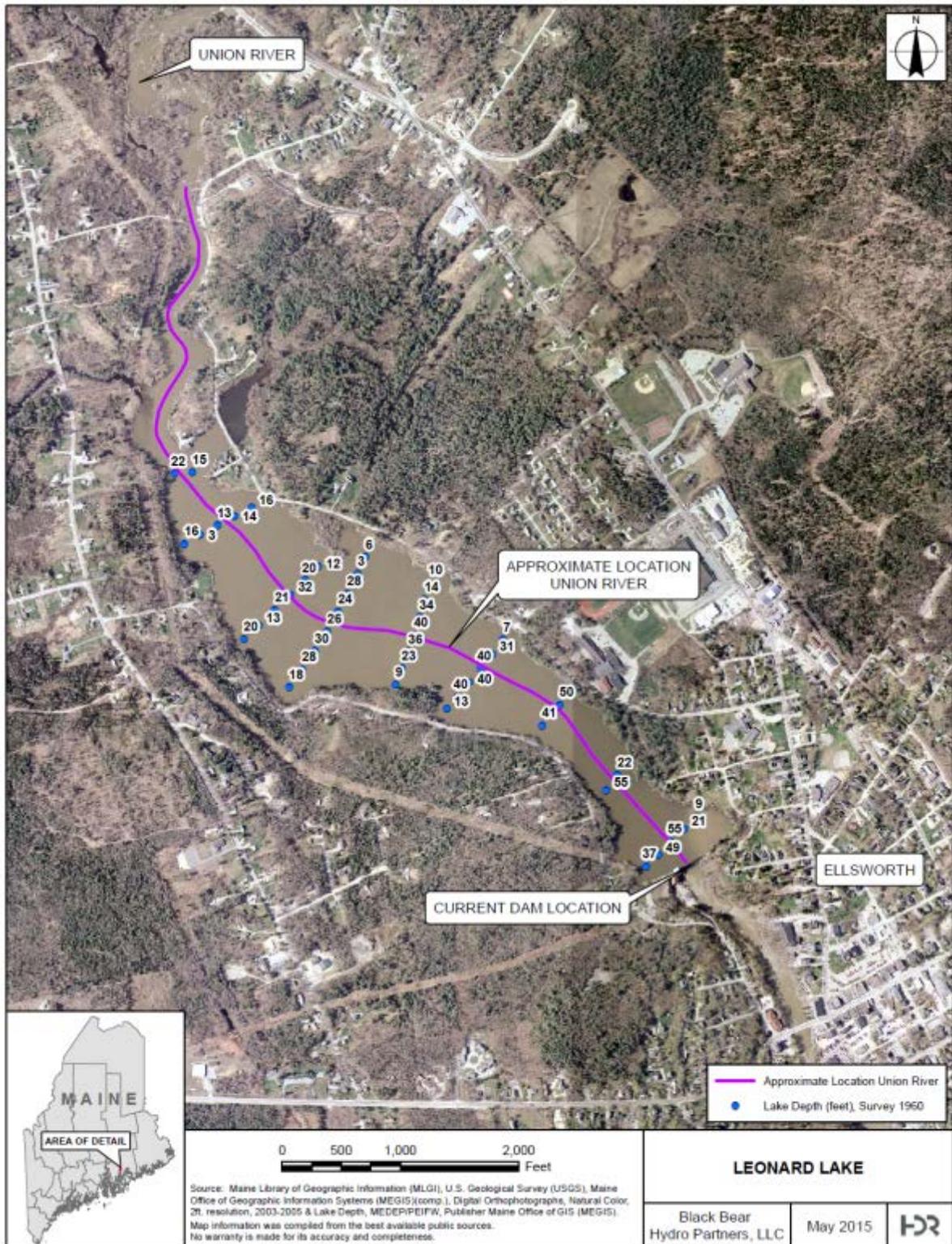


FIGURE 20
AERIAL PHOTOGRAPH OF LAKE LEONARD SHOWING BATHYMETRY
SOUNDINGS AND APPROXIMATE RIVER CHANNEL LOCATION



8.3 Fish Passage

Decommissioning of the Ellsworth Project and removal of the Graham Lake and Ellsworth Dams would restore volitional accessibility and fish passage to historical habitat ranges for several diadromous and other migratory fish species, including sea-run Atlantic salmon, river herring, American eel, and possibly American shad. Atlantic and shortnose sturgeon, sea lamprey, rainbow smelt, tomcod, and striped bass are also known to frequent rivers in the vicinity of Ellsworth; however, their historic or potential future use of the Union River above the Ellsworth Project is unknown due to the higher gradient of the river at the dam site which may have naturally inhibited migrations for weaker swimming species. Dam removal would also facilitate downstream migration of these species back to the Atlantic Ocean by avoiding any potential injury or mortality from impingement or turbine entrainment.

8.4 Recreation

The Ellsworth Project provides a variety of public recreation opportunities. The area surrounding the Project is a mixture of year-round and seasonal residential development and undeveloped forest land. The Project is easily accessible from US Route 1 to the south and State Route 9 to the north via Route 179 along the easterly side of the Project and Route 180/181 on the westerly side of the Project. Public access to the Project is available over a combination of public highways, city streets, and private roads, as well as by boat from several launching areas on the impoundments. Black Bear provides public recreation access at several locations for motorized and non-motorized boating and shoreline fishing. Project recreation facilities owned and managed by Black Bear include: a carry-in boat launch off Shore Road on the Lake Leonard impoundment; the Graham Lake Dam boat launch on Graham Lake; and a canoe portage trail around Graham Lake Dam. The existing canoe portage trail also serves as an angler access trail to the Union River downstream of Graham Lake Dam. Municipal, state, and private lands provide additional recreation access to the Project. These include: a picnic area/day use site (municipal) on Shore Road on the east shore of Lake Leonard opposite the Middle School; Infant Street access (municipal) on both sides of the Union River; Fletcher's Landing (State), an unimproved boat launch on Graham Lake; Mariaville carry-in boat launch (municipal) on the west side of Graham Lake; and a carry-in (private) on the West Branch of the Union River. At present, canoeists or kayakers can portage around the Graham Lake Dam at a Project portage

trail, and at Ellsworth Dam using an informal portage route. Bass fishing tournaments are hosted in Graham Lake, also indicating that there are abundant bass, and MAINE DIFW (2015) reports that Graham Lake has good action for medium-size bass.

Opportunities for boating, kayaking, fishing, water sports, snowmobiling, ice skating, ice fishing, and other water-related recreational activities exist at Lake Leonard and Graham Lake. Although these recreational opportunities may still be available if the dams are removed, they would be changed significantly and would be at a much smaller scale, decreasing the total amount of recreational opportunities in the area. One recreational benefit from removal of the dams would be the increase of river-based canoe and kayak opportunities.

Fishing is the most popular recreational activity observed in the Project's vicinity. Removal of the dams would create a shallow, riverine habitat in Graham Lake and Lake Leonard, characterized by a riffle/run complex and higher flow velocities in some locations. Based on the historic topographical map of the Graham Lake area (Figure 19), this section of the Union River would likely revert to a flat water meandering stream through wetlands. Popular game fish species such as smallmouth bass, chain pickerel, lake trout, splake, and white perch would likely be displaced to elsewhere in the river system, or greatly reduced in number due to habitat loss. While smallmouth bass would still persist in the river habitat their numbers would substantially diminish due to the loss of 95% of their current habitat area. Fishing from larger power boats and bass tournament fishing would be eliminated. While removal of the dams may displace some game fish, this alternative would create additional habitat for other species such as salmon, brook trout, and white sucker.

8.5 Sedimentation and Water Quality

Complete removal of Graham Lake and Lake Leonard Dams would likely have limited effects on water quality in the Union River. Water quality in rivers is influenced by a variety of factors including the flow regime. Sampling conducted in 2013 revealed that Graham Lake weakly stratifies during the summer months, but due to the shallowness of the lake and long fetch from multiple directions, the stratification often breaks down during windy periods that prevail on the lake. The results of the 2013 sampling for Graham Lake are consistent with previous sampling

efforts dating back to the 1970s. Sampling conducted in Lake Leonard revealed that the lake did stratify over much of the summer. Removal of the dams would mean that the free-flowing Union River would not stratify and would likely have lower water temperatures and somewhat higher dissolved oxygen levels. One factor that could adversely affect water quality is the potential release of sediments currently trapped in the lakebeds of the impoundments, especially the larger Graham Lake. Removal of the dams could suspend these sediments into the water column and wash them downstream and into the estuary and harbor.

8.6 Wetlands

Wetland types found within the Project boundary include Lacustrine, Riverine, Estuarine, Palustrine Unconsolidated Bottom (PUB), Palustrine Aquatic Bed (PAB), Palustrine Emergent (PEM), Palustrine Scrub-Shrub (PSS), and Palustrine Forested (PFO). The vast majority of palustrine wetlands within the Project boundary are associated with Graham Lake, and the various types are generally found together as wetland complexes. There are also several islands in Graham Lake consisting of PEM, PSS, and PFO wetland types. Many of the wetlands associated with Graham Lake are narrow fringes along the lake itself or along tributary streams; some areas comprised of numerous wetland classes are more extensive. Narrow fringes of wetland are located along Lake Leonard and the Union River in some areas; these areas are classified as PAB, PEM, and PSS (Black Bear 2014).

The wetland types observed in the Project vicinity were observed to reflect the natural community expectations for this area and in an impoundment environment in the northeastern United States. Removal of the two dams would essentially convert the reservoir into a riverine and riparian habitat. Under this scenario, riverine species may increase at the expense of reservoir taxa. Dewatering and elimination of a reservoir results in dramatic changes soon after dam removal, as extensive areas of sediment and previously submerged structures are exposed. Organisms present in the reservoir prior to removal may be washed downstream or stranded during surface water drawdown. Mortality rates of virtually all reservoir populations, except fish, would likely be high if dewatering of the reservoir is rapid. When a dam is removed, the river begins to recreate a channel by cutting into the mound of accumulated sediment and transporting it downstream. Exposed sediment lateral to the forming channel dries and, over

time, becomes more physically stable as vegetation grows in, giving rise to a new floodplain (Stanley and Doyle 2003).

Since much of the Graham Lake impounded area was historically a flat heath bog-type habitat (Figure 19), the hydrology would revert back to a similar regime. However, it is uncertain what type of vegetation and soil characteristics would evolve in the lake bed as sediment accumulation over the years of impoundment would likely have changed the topography and soil conditions from the pre-impoundment condition.

8.7 Cultural Resources

During the summer and fall of 2013, Black Bear conducted a Phase I archaeological survey of the Ellsworth Project. As part of the initial survey, Black Bear conducted background research and identified a number of previously known Precontact sites located at the Project vicinity. In addition, at the request of the Maine State Historic Preservation Officer (SHPO), Black Bear reviewed select existing archaeological reports and amateur artifact collections from the Project area. A desktop sensitivity analysis followed by field inspection and survey work led to the identification of three new Precontact sites. The sites range in age from the Late Archaic to Contact periods. All three sites were recommended for further evaluation (Phase II) to determine their potential eligibility for listing to the National Register of Historic Places (NRHP). Phase II investigation of the three new sites took place in the summer of 2015 and two of the sites were recommended as eligible for listing.

Decommissioning considered in this study report could have an adverse effect on the cultural resources present in the Project area by changing the land use and hydrology. Equally likely is the possibility of exposing undiscovered cultural resources that have been inundated since the impoundments were built.

8.8 Socioeconomic Resources

The Project is currently utilized by the City of Ellsworth, fishermen, and recreationists. Existing shoreline development is currently limited almost exclusively to private residences and seasonal cottages. Other than recreation, private waterfront real estate development, and the seasonal

harvesting of alewives for lobster bait and American eel elvers for export, there are no significant non-Project socioeconomic resources or uses of the Ellsworth Project.

The Project provides a positive economic benefit to the City of Ellsworth each spring as alewives are harvested below the Ellsworth Dam on the Union River. Alewives have been harvested in Maine for economic purposes for many years. There is high demand for alewives for use as lobster bait. The City of Ellsworth holds a license for harvesting alewives in the Union River and in turn issues permits to fish alewives for commercial purposes, earning 40% of the license holder's revenue as a permit fee (College of the Atlantic 2004). The following table shows annual revenue to the city from the alewife harvest for the past 10 years.

**TABLE 4
CITY OF ELLSWORTH REVENUE FROM ALEWIFE HARVEST**

Year	Revenue
2005	\$9,500
2006	\$2,778
2007	\$21,053
2008	\$20,287
2009	\$12,355
2010	\$13,306
2011	\$11,700
2012	\$58,799
2013	\$31,816
2014	\$35,872
Total	\$217,466

*Data supplied by City of Ellsworth

Migrating American juvenile eel, also known as elvers, are also harvested by licensed fishermen on the Union River (Bangor Daily News 2012). The 2015 Maine elver harvest season, which ended May 31, was valued at over \$11 million for the season, according to Maine DMR (2015). The recreational opportunities in the Project vicinity attract visitors for camping, birding, wildlife viewing, boating, and fishing.

Removal of the dams would result in a loss of socioeconomic value to the area due mainly to the loss of recreational opportunities, water front real estate, and the loss of alewife harvesting at the Ellsworth Dam. The loss of property values on Graham Lake and Lake Leonard would likely

have the greatest socioeconomic impact to the area, as these properties would lose lake front views and access when the lakes are drained and restored to a riverine environment.

9.0 REFERENCES CITED

Bangor Daily News. 2012. Elvers fetching more than \$2,000 per pound. [Online] URL:<http://bangordailynews.com/2012/03/23/news/hancock/elvers-fetching-more-than-2000-per-pound/>.

Baum, E. T. 1982. The Union River: An Atlantic salmon management plan. Atlantic Sea Run Salmon Commission. Bangor, Maine. 27 pp.

Bell, Milo. 1986. Fisheries Handbook of Engineering Requirements and Biological Criteria. US Army Corps of Engineers, Portland, OR.

Black Bear Hydro Partners, LLC (Black Bear). 2012. Pre-Application Document for the Ellsworth Hydroelectric Project (FERC No. 2727).

_____. 2014. Initial Study Report (ISR), Ellsworth Hydroelectric Project, FERC No. 2727. September 2014.

Burr, Greg, MAINE DIFW, Personal Communication, July 3 and 23, 2014; July 18, 2013; March 7, 2013.

Clay, Charles. 1995. Design of Fishways and Other Fish Facilities. Lewis Publishers, Boca Raton, FL.

College of the Atlantic. 2004. Alewife Restoration in the Union River Watershed.

Federal Energy Regulatory Commission (FERC) 2013. Study Plan Determination for the Ellsworth Hydroelectric Project. September 4, 2013. Issued to Black Bear Hydro Partners, LLC.

Fennelly, Dick, Retired Maine Guide. Personal Communication, July 23, 2014.

Maine Department of Inland Fish and Wildlife (MAINE DIFW). 2015. Regional Fishing Information - Region C (The Downeast Region). [Online] URL: http://www.maine.gov/ifw/fishing/regional_information/region_c.htm. Accessed April 2015.

Maine Department of Marine Resources (Maine DMR). 2013. American Shad Habitat Plan, Prepared September 16, 2013, submitted to the Atlantic States Marine Fisheries Commission as a requirement of Amendment 3 to the Interstate Management Plan for Shad and River Herring, approved by ASMFC February 6, 2014.

Maine Department of Marine Resources (Maine DMR). 2015. Maine's Elver Fishery Increases in Value by Nearly \$3 Million. Online. <http://www.maine.gov/dmr/news/2015/2015ElverSeason.htm>. June 2, 2015.

Stanley, E.H. and M.W. Doyle. 2003. Trading Off: The Ecological Effects of Dam Removal. *Frontiers in Ecology and the Environment* 1: 15-22.

Union River Fisheries Coordinating Committee (URFCC). 2010. Comprehensive fishery management plan for the Union River drainage: 2011-2014. 31pp.

_____. 2015. Comprehensive fishery management plan for the Union River drainage: 2015-2017. 35 pp.

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APPENDIX E-8

2015 ADULT AMERICAN EEL DOWNSTREAM PASSAGE STUDY

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2015 ADULT AMERICAN EEL DOWNSTREAM PASSAGE STUDY

PRELIMINARY REPORT

ELLSWORTH HYDROELECTRIC PROJECT

(FERC No. 2727)

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December 2015

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**2015 ADULT AMERICAN EEL DOWNSTREAM PASSAGE STUDY
PRELIMINARY REPORT
ELLSWORTH HYDROELECTRIC PROJECT**

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2015 ADULT AMERICAN EEL DOWNSTREAM PASSAGE STUDY**ELLSWORTH HYDROELECTRIC PROJECT****1.0 INTRODUCTION**

The Ellsworth Project is on the Union River in Maine, approximately 5 river kilometers (3.1 miles) upstream of Union River Bay and the Atlantic Ocean (Figure 1). Black Bear Hydro Partners LLC (Black Bear), an affiliate of the Brookfield Renewable Energy Group, operates the Ellsworth Project pursuant to the license issued by the Federal Energy Regulatory Commission (FERC) in 1987. The license expires on December 31, 2017; therefore, Black Bear is filing an application to FERC in December 2015 to relicense the Ellsworth Project.

The Ellsworth Project consists of the Ellsworth dam, which forms Lake Leonard, and Graham Lake dam, which forms Graham Lake (Figure 1). Black Bear generates clean, renewable hydroelectric energy at the Ellsworth dam with four turbine-generator units with a total authorized nameplate capacity of 8.9 megawatts (MW). There are no turbines at Graham Lake dam; three Tainter gates are used to regulate downstream river flows to support generation at the Ellsworth development in accordance with the existing license conditions; water is also passed through a 4-foot-wide weir that serves as the downstream fish bypass.

American eel, a migratory species, is present in the Union River. Juvenile eels return to rivers in Maine in the spring and summer, mature in freshwater for 5 to 40 years (Haro 2003), and then migrate to the Sargasso Sea as silver-phased adults. The peak silver eel outmigration in Maine is in the late summer and fall. American eel is an important commercial fish species in Maine, and the Atlantic States Marine Fisheries Commission considers the stock to be depleted (ASMFC 2014). Although the American eel stock hit a low in 1997, it is reported to have increased 41 percent since that time (AESA 2015). The U.S. Fish and Wildlife Service (USFWS) recently determined that American eels did not warrant protection under the Endangered Species Act (80 FR 60834).



FIGURE 1. LOCATION OF THE ELLSWORTH HYDROELECTRIC PROJECT, UNION RIVER, ELLSWORTH, MAINE.

Black Bear provides downstream fish passage at the Ellsworth dam through three, 3-foot-wide surface-weirs. Two of the weirs are located at the powerhouse intake to Units 2, 3, and 4; the third entrance is located at the powerhouse intake near Unit 1. Black Bear normally opens each entrance to the fishway 21 inches, which provides approximately 20 cfs through each opening. Downstream passage at Graham Lake dam consists of a 4-foot-wide surface weir. The weir structure is 7.5 feet deep and contains stoplogs that can be adjusted to accommodate the varying lake levels; the weir can pass up to 50 cfs. The downstream fishways are operated from April 1 to December 31 annually, as river conditions allow.

FERC and the National Marine Fisheries Service (NMFS) requested that Black Bear study the downstream passage of adult silver American eels at the Ellsworth Project as part of the relicensing effort.¹ Black Bear submitted a draft study plan to the Maine Department of Marine Resources, USFWS, and NMFS on August 4, 2015. Black Bear modified the study plan based on the comments received and filed the final study plan with FERC on September 14, 2015. On behalf of Black Bear and pursuant to the study plan, Kleinschmidt used radio telemetry to study the downstream passage of silver American eels in the fall of 2015. The objective of the 2015 study was to identify the routes that American eels use to pass downstream at the Graham Lake dam and Ellsworth dam and to determine whether they survive passage at each dam.

The September 2015 Study Plan anticipates that the study will be conducted in two phases. This preliminary report describes the results of the first phase of the study. The objectives and methodology of the second phase of the study, either to evaluate eel injury by passage route at the Ellsworth dam development, or to further evaluate passage routes and survival at the Ellsworth dam development, will be finalized after review of the phase 1 study results and agency consultation regarding study needs.

¹ See FERC's Determination on Requests for Study Modifications and New Studies for the Ellsworth Hydroelectric Project (issued 12/30/2014); see NMFS's Comments, Request for Study Clarification, and Modification regarding Black Bear's September 4, 2014 Initial Study Report for the Ellsworth Hydroelectric Project (filed 11/03/2014).

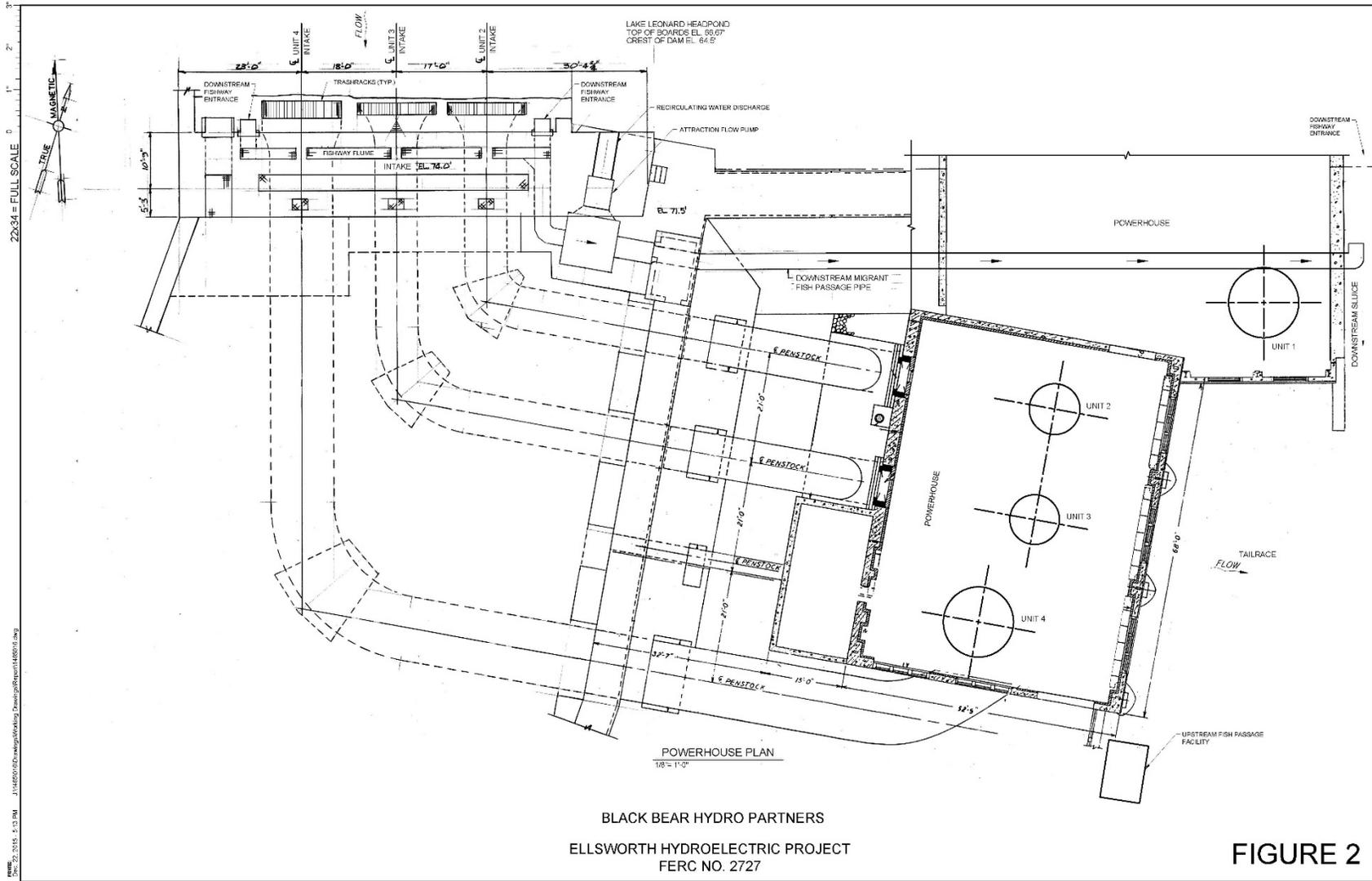


FIGURE 2. ELLSWORTH DEVELOPMENT INTAKES AND DOWNSTREAM FISH BYPASS ENTRANCES, UNION RIVER, ELLSWORTH, MAINE.

2.0 METHODS

2.1 SAMPLE SIZE AND SOURCE OF EELS

Researchers tagged and tracked the movements of 50 adult American eels within the study area. The sample size of 50 aligned with NMFS's recommendations in its November 3, 2014 letter requesting the study. The sample size of 50 is also comparable to that used in downstream eel passage studies completed at hydroelectric facilities in Maine in recent years (Kleinschmidt 2011, Kleinschmidt 2013) and with fish passage studies of other adult fish species in Maine (Brookfield 2015). An additional 10 eels were held as controls to evaluate the effects of transporting, handling, and tagging the eels. Eels were collected in mid-September by deploying a trap in the St. Croix River near Baileyville, Maine, which is approximately 100 kilometers (62 miles) northeast of the Ellsworth Project. The Maine Department of Inland Fish and Wildlife issued a scientific collectors permit authorizing the collection and transport of the eels.

2.2 HOLDING, TAGGING, AND RELEASING EELS

Researchers transported adult eels from Baileyville to the Ellsworth Project in a 190-gallon insulated transport tank prior to tagging. Once on site, eels were transferred from the transport tank to several 30-gallon perforated holding bins that were submerged in a 300-gallon holding tank filled with water pumped continuously from the Union River. Eels were held overnight in Union River water and tagged the next day.

In preparation for surgery to implant the tags, individual eels were anesthetized with MS-222² for approximately 5 minutes. Following sedation, total length, weight, and the horizontal and vertical diameter of the eyes were measured. Body length and eye diameter were used to calculate a Pankhurst Index value for each eel to provide an indication of migratory status; the Pankhurst Index is a ratio that is based on the diameter of the eyes in relation to total body length. A value of 6.5 or greater typically indicates a mature silver eel (Pankhurst 1982).

² Tricaine-S (tricaine methanesulfonate) is an FDA-approved fish anesthetic used for temporarily immobilizing fish, amphibians, and other aquatic cold-blooded animals.

Telemetry tags were surgically implanted through a 3/4-inch incision in the ventral-abdominal region, approximately 1.5 inches anterior to the vent and slightly off the mid-line. The incision was closed with two or three surgical sutures by instrument tie. Following surgery, researchers flushed the MS-222 from the gills with fresh river water and placed eels back into the holding bins for recovery. All eels fully recovered within approximately 5 to 10 minutes. Tagged eels were then held for a minimum of 24 hours before being released to assess whether tag insertion and handling caused any short-term adverse effects and to allow eels to recover adequately. Two control groups of five adult eels were tagged and held for approximately 10 days to assess whether tag insertion and handling caused any longer-term effects. All tags were checked for functionality during the surgical procedure. Eels were tagged and released in three groups, starting on September 29; the last release was made on October 15 (Table 1). Each group of eels was released by boat approximately 0.8 kilometers (0.5 miles) upstream of Graham Lake dam at around sunset (Figure 3).

TABLE 1. SUMMARY OF EEL RELEASES, 2015 DOWNSTREAM EEL PASSAGE STUDY, ELLSWORTH PROJECT.

GROUP NO.	TAG DATE	RELEASE DATE (TIME)	NO. RELEASED	WEATHER CONDITIONS
1	9/29	10/1 (1953)	15	rainy/overcast
2	10/7	10/8 (1856)	20	clear and cool
3	10/14	10/15 (1817)	15	clear and cool

2.3 MONITORING DOWNSTREAM PASSAGE OF TAGGED EELS

Researchers used 16 automated radio-telemetry receiver and antenna arrays (i.e., stations) to monitor the downstream passage and survival of American eels at the Graham Lake and Ellsworth dams. Receivers were positioned to document eel passage through the existing downstream fish bypasses, the Ellsworth turbine units, the minimum flow gate at Graham Lake dam, and the spillways or spill gates at both dams. Specifically, researchers installed receivers and antennas at the following stations (Figure 3 and Figure 4):

- Station 1 – an aerial Yagi antenna located immediately upstream of the Graham Lake dam; the antenna was pointed upstream to detect eels approaching Graham Lake dam;

- Station 2 – stripped, coaxial-wire dropper antenna located within the Graham Lake downstream fish passage weir;
- Station 3 – stripped, coaxial-wire dropper antenna located immediately downstream of Tainter gate No. 3 at the Graham Lake dam, which is used to pass minimum flows;
- Station 4 – stripped, coaxial-wire dropper antenna located immediately downstream of Tainter gate No. 2 at the Graham Lake dam, which is used to pass flood flows or to provide water for generation at the Ellsworth dam;
- Station 5 (Downstream Station 1) – an aerial Yagi antenna located approximately 4.8 river kilometers downstream of Graham Lake dam and 1.75 river kilometers upstream of the Ellsworth dam to confirm eel passage and survival via any route at Graham Lake;
- Station 6 – approximately 260 meters upstream of the Ellsworth dam to detect approaching eels;
- Station 7 – within the entrance to the downstream fish bypass entrance near the Unit 1 intake at Ellsworth dam;
- Station 8 – within the downstream fish bypass near the Unit 2, 3, and 4 intakes at Ellsworth dam;
- Station 9 – within the intake air vent of turbine Unit 1;³
- Station 10 – within the intake air vent of turbine Unit 2;
- Station 11 – within the intake air vent of turbine Unit 3;
- Station 12 – within the intake air vent of turbine Unit 4;
- Station 13 – an aerial Yagi antenna at the Ellsworth powerhouse tailrace to detect eels that passed through the turbines;
- Station 14 (Downstream Station 2) – an aerial Yagi antenna approximately 160 meters downstream of the Ellsworth dam to detect eels that passed downstream by any route, including spill over the dam;
- Station 15 (Downstream Station 3) – an aerial Yagi antenna approximately 415 meters downstream of the Ellsworth dam to detect eels that passed downstream by any route;
- Station 16 (Downstream Station 4) – an aerial Yagi antenna approximately 700 meters downstream of the Ellsworth dam to confirm downstream passage and survival.

Monitoring of tagged eels in the Union River occurred from October 1 through November 12.

³ The air vents are located approximately 15 feet downstream of the trash racks for each turbine unit.



FIGURE 3. LOCATION OF RADIO-TELEMTRY RECEIVERS AROUND GRAHAM LAKE DAM, UNION RIVER, ELLSWORTH, MAINE.

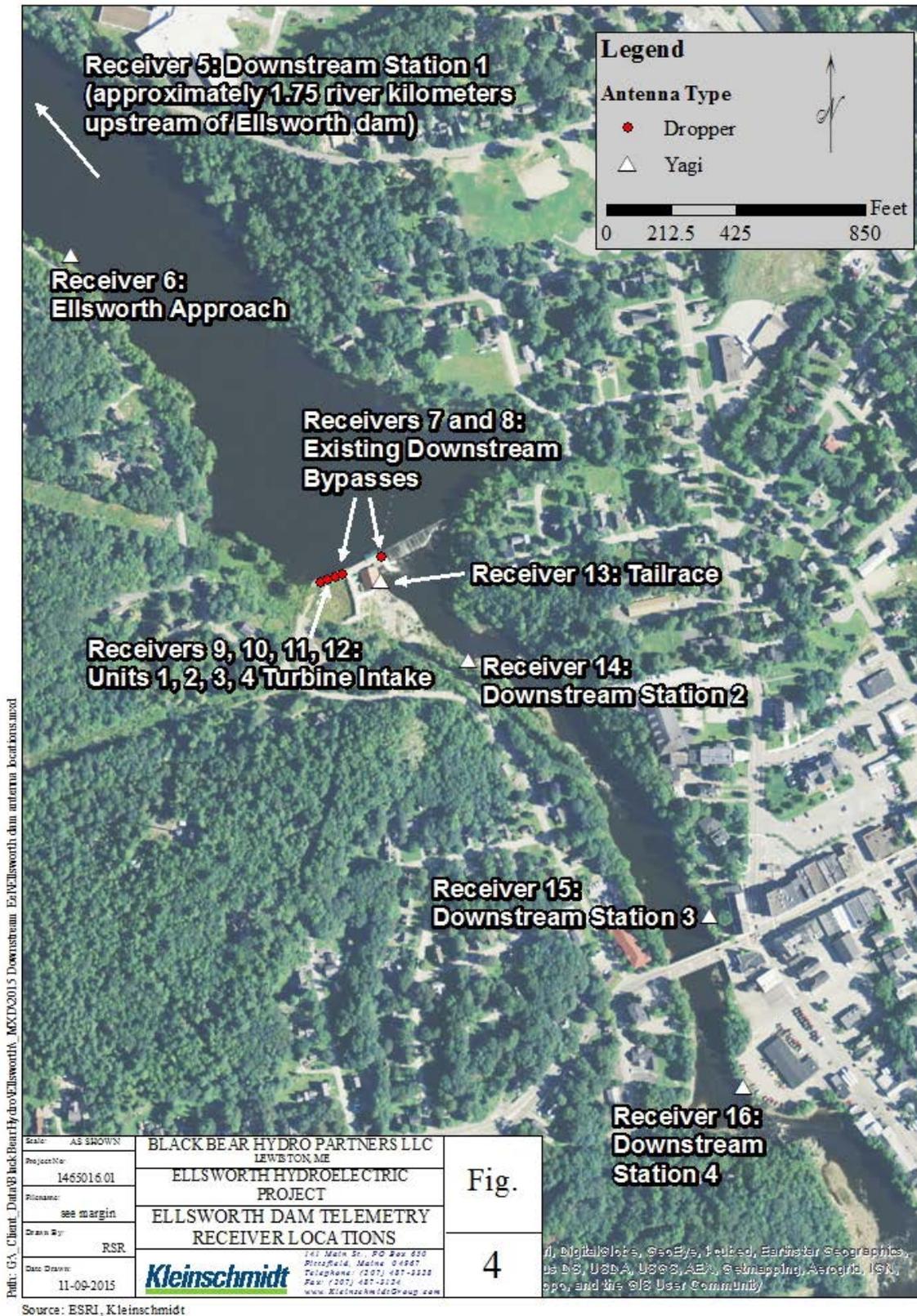


FIGURE 4. LOCATION OF RADIO-TELEMETRY RECEIVERS IN LAKE LEONARD AND AROUND ELLSWORTH DAM, UNION RIVER, ELLSWORTH, MAINE.

2.4 MANUAL TRACKING

Researchers completed frequent boat and pedestrian tracking surveys to locate tagged eels and verify whether they survived passage past the dams (Figure 4). The manual tracking survey area included (1) the lowermost 800 meters of Graham Lake; (2) Lake Leonard; (3) the Ellsworth tailwater; (4) the 700-meter reach of the Union River between the Ellsworth dam and Downstream Station 4; (5) the Union River near the Ellsworth marina, which is approximately 1.2 river kilometers (0.75 miles) downstream of the Ellsworth dam; and (6) the 3.5-river kilometer (2.2 mile) reach downstream from Downstream Station 4 (Figure 5). Manual surveys between the dam and the marina were completed by foot two or three times a week during the study (Table 2). Boat tracking surveys in the Union River downstream of the marina and in Lake Leonard and Graham Lake were completed periodically, as conditions allowed. During each manual tracking event, biologists recorded the location and status (alive/mortality) of tagged fish.

TABLE 2. DATES AND LOCATIONS OF MANUAL TRACKING SURVEYS DURING THE DOWNSTREAM EEL PASSAGE STUDY, UNION RIVER, ELLSWORTH, MAINE.

DATE	SURVEY LOCATION
10/07/15	Perimeter of Lake Leonard
10/09/15	Tailrace to marina
10/12/15	Tailrace to marina
10/14/15	Lower Graham Lake to DS1 Ellsworth approach Tailrace to DS4
10/15/15	Graham Lake Lake Leonard Between Graham Lake approach and DS1
10/16/15	Tailrace to marina
10/19/15	DS4 to marina
10/21/15	DS4 to marina
10/23/15	Tailrace to marina Lake Leonard
10/26/15	lower most 3.5 kilometers of Union River
10/28/15	Tailrace to marina
10/30/15	Tailrace to marina
11/02/15	Tailrace to marina lower most 3.5 kilometers of Union River Lower Graham Lake to DS1
11/05/15	Tailrace to marina
11/12/15	Tailrace to marina

2.5 EQUIPMENT SPECIFICATIONS AND RANGE TESTING

Researchers used 14 Sigma Eight Orion and two Lotek radio-telemetry receivers for the study. The Sigma Eight receivers are broadband receivers that can simultaneously monitor all radio frequencies in use. This feature results in high detection efficiency, particularly in zones where passage may be rapid, because the receivers do not have to switch frequencies when scanning. Lotek SRX 600 receivers were used at Downstream Stations 3 and 4 and during manual tracking surveys; these receivers were programmed to switch between individual frequencies. All receivers were: field-tested prior to the release of tagged eels to validate detection and verify receiver coverage; powered by 12-volt, deep-cycle marine batteries; and time-synchronized so that detections at multiple receivers could be compared chronologically. Dissolved ions in the water can reduce the range of radio-telemetry tags. Researchers measured water conductivity at Downstream Stations 3 and 4 (stations in the tidal zone) during the set up and testing. Values ranged from 30 to 1,200 microsiemens/centimeter. Although some of these values were higher than expected (i.e., at high-tide), tags were consistently detected throughout the study and at high-tide with Lotek SRX 600 receivers at Downstream Stations 3 and 4 and during manual tracking efforts from Ellsworth dam to the Union River Bay.

Researchers used Sigma Eight Pisces sensor radio-telemetry tags that were approximately 12 millimeters (mm) in diameter by 45 mm long with a trailing whip antenna. Estimated battery life was approximately 100 days. Five radio frequencies with unique number codes on each frequency were used to identify individual eels. Tags were programmed to transmit a radio signal at 1-second intervals to increase the likelihood of detecting eels in high velocity areas (i.e., Graham Lake gates, the downstream fish bypasses, and turbine units). Each tag was equipped with a motion sensor, and the tag was programmed to transmit a signal once every 10 seconds if eels became immobile for more than 36 hours. For purposes of this study, eels that became immobile were classified as mortalities. Motion for these sensor tags is identified with a non-mercury based “tilt switch” consisting of a ball bearing within a canister containing two electrodes. A change of state is defined as making or breaking an electrical connection between the two electrodes through the ball bearing, which occurs when the tagged animal moves. Raw motion activity signals from the sensor are processed based upon laboratory experiments with fish to remove effects of noise and represent real fish activity. Although false-positives can occur using sensor tags (i.e., an immobile tag can transmit as an active tag if the tag is moved), this

feature allowed for a better understanding of the fate of tagged eels as they moved downstream through the Ellsworth Project.

2.6 DATA ANALYSIS

Researchers downloaded data from each receiver two to three times a week. Data for individual detections included date, time, location, frequency, code, and power (signal strength). Data processing and analysis were completed with MS Access, which allowed for filtering and data sorting by individual eel. Route-of-passage determinations were based on sequential and chronological detections through the receiver arrays. If the last detection of an eel was a string of sequential immobility codes (i.e., 10 second interval burst rate), the eel was considered to have expired. A tally of eel passage through available routes (e.g., downstream fish bypasses, minimum flow gates, spill gates, spillways, and turbine passage) and information pertaining to the fate of tagged fish (e.g., passage survival) was developed to summarize the study results.

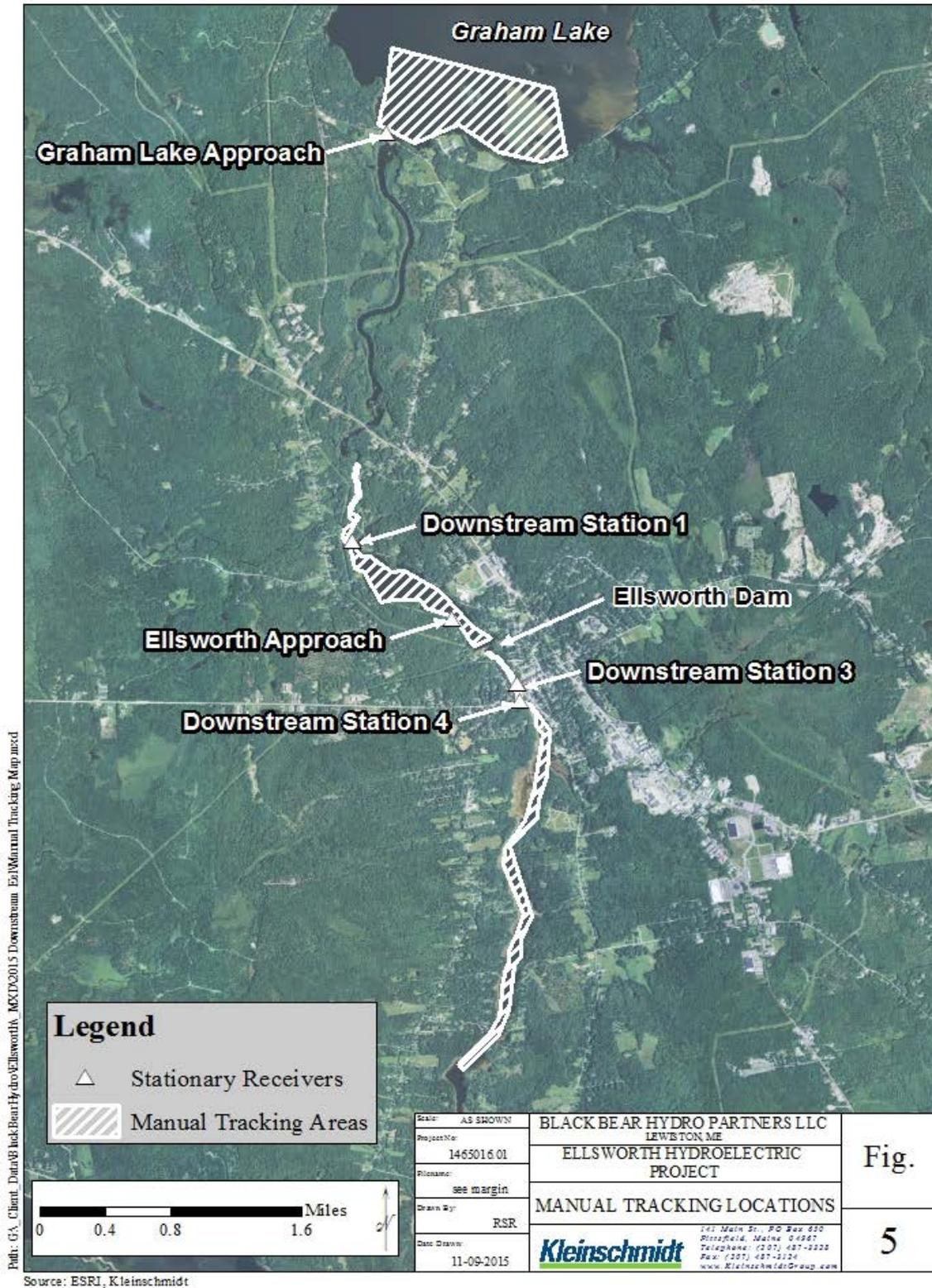


FIGURE 5. AREAS SURVEYED DURING MANUAL TRACKING, UNION RIVER, ELLSWORTH, MAINE.

2.7 PROJECT OPERATIONS DURING THE STUDY AND DESCRIPTION OF TURBINE UNITS

The Ellsworth Project has four turbine-units; Units 1 and 4 are fixed-propeller units, and Units 2 and 3 are adjustable Kaplan units (Table 3). Units 1 and 4 rotate at 200 revolutions per minute (rpm), which is considerably less than the speeds of Units 2 and 3 (360 rpm) (Table 3). Units 1 and 4 are rated for 685 cfs each, and Units 2 and 3 are rated for up to 545 cfs each for a total station flow of 2,460 cfs (Table 3). During the late-summer and fall, river flow is typically less than the flow needed to run the Ellsworth Project at its full capacity of 8.9 MW. Accordingly, Black Bear generates power at the Ellsworth dam by using a combination of turbine-generator units, depending on river flow and available storage.

TABLE 3. SUMMARY OF TURBINE ATTRIBUTES, ELLSWORTH PROJECT.

VARIABLE	UNIT 1	UNIT 2	UNIT 3	UNIT 4
Unit type	Propeller	Kaplan	Kaplan	Propeller
Gross head (feet)	62.5	62.5	62.5	62.5
Rated head (feet)	60	60	60	60
Maximum flow (cfs)	685	545	545	685
Runner diameter (feet)	4.65	5	5	4.65
Runner speed (rpm)	200	360	360	200
Number of turbine blades	4	4	4	4

Black Bear evaluated downstream eel passage during three nighttime (i.e., 6 PM to 6 AM) scenarios representative of typical river conditions and operations during the late summer and fall (Table 4). Each of the three eel releases was coordinated with a change in operations. Black Bear adjusted the gate settings of Tainter gate No. 2 at Graham Lake to provide water for operations at Ellsworth dam during the three operational scenarios. Tainter gate No. 3 was opened approximately 5 inches to provide the seasonal minimum flow of 105 cfs from Graham Lake, and the surface fish bypass weir at Graham Lake was open during the study.

Just prior to the first release, 6 inches of rain fell in the study area; consequently, the Ellsworth Project was operated at maximum capacity with all four units running and no spill (i.e., operational scenario No. 1). On October 23, Black Bear returned the Ellsworth Project to normal, low-flow operations typical for the time of year. Generation during the study ranged from 1.7 to

8.7 MW (Table 4). The average opening for Tainter gate No. 2 at Graham Lake ranged from 0.6 to 3.7 feet. Appendix A provides a listing of daily operations of the Ellsworth Project during the study.

TABLE 4. SUMMARY OF OPERATIONS DURING THE 2015 DOWNSTREAM AMERICAN EEL PASSAGE STUDY, ELLSWORTH PROJECT.

OPERATIONAL SCENARIO	EEL RELEASE	DATES OF OPERATION	UNITS OPERATING	AVERAGE GENERATION (MW)	PERCENT OF MAXIMUM GENERATION*	GRAHAM LAKE GATE NO. 2 OPENING (FT)
1	10/1	10/1 – 10/6	1, 2, 3, 4	8.7	97.0%	3.7
2	10/8	10/7 – 10/12	2, 3, 4	5.7	64.5%	2.6
3	10/15	10/13 – 10/23	2, 3	3.6	40.7%	1.7
LOW FLOW	–	10/23 – 11/01	3**	1.7	19.1%	0.6

* Average nightly generation from 6 PM – 6AM.

** Unit 4 also operated for two days (Oct. 31 and Nov 1).

3.0 RESULTS

3.1 EEL LENGTH, WEIGHT, AND EYE DIAMETER

Tagged adult eels ranged in length from 700 mm (27.5 inches) to 1,041 mm (41.0 inches), with an average length of 828 mm (32.5 inches). Tagged eels ranged in weight from 500 grams (1.1 pounds) to 2,100 grams (4.6 pounds), with an average weight of 1,114 grams (2.5 pounds). The Pankhurst Index value for 5 eels was less than 6.5 (Table 5), indicating a non-migratory phase; however, these 5 eels moved downstream through Graham Lake dam and passed the Ellsworth dam. Table 5 lists length, weight, eye diameter, Pankhurst Index value, and tag information for each eel.

3.2 EFFECTIVE SAMPLE SIZE

Two of the 50 tagged eels did not migrate out of Graham Lake after being released, and one escaped from the holding tanks; therefore, the effective sample size for the evaluation of route selection and passage survival was 47 eels.

3.3 CONTROL FISH

All 10 control fish were healthy and active at the end of the 10-day holding period. These eels were released into the Union River 300 feet downstream of the Ellsworth dam. Upon release, all control eels immediately swam away or found cover under large boulders. No signs of adverse effects of transporting, handling, or tagging the eels were observed.

3.4 MIGRATORY BEHAVIOR

The majority of tagged eels released into Graham Lake were detected approaching Graham Lake dam within 12 hours of release (n=30, or 63.8 percent), indicating that they began their downstream migration quickly after release (Table 6). Cumulatively, 44 of 47 eels (93.6 percent) migrated out of Graham Lake within 72 hours of being released (Table 6). The remaining three eels moved after 3 or more days.

TABLE 5. MORPHOLOGICAL AND TAG INFORMATION FOR ADULT SILVER EELS.

Release No.	Eel No.	Frequency	Code	Length (mm)	Weight (g)	Eye Width (mm)	Eye Height (mm)	Pankhurst index
Release 1 (10/1)	1	149.320	50	900	1480	12	10	10.6
	2	149.320	51	850	1200	9	10	8.3
	3	149.320	60	965	1600	11	11	9.8
	4	149.340	65	900	1100	9	10	7.9
	5	149.340	70	750	1150	7	8	5.9*
	6	149.340	75	750	1650	10	10	10.5
	7	149.480	80	800	900	9	7	6.3*
	8	149.480	85	810	1000	9	10	8.7
	9	149.480	90	750	900	9	9	8.5
	10	149.400	95	857	1100	10	10	9.2
	11	149.400	100	965	1700	10	10	8.1
	12	149.400	105	711	800	11	10	12.2
	13	149.460	110	787	1200	9	10	9.0
	14	149.460	115	735	700	8	8	6.8
	15	149.460	120	889	1300	11	11	10.7
Release 2 (10/8)	16	149.320	125	816	1000	10	10	9.6
	17	149.320	130	835	1150	10	10	9.4
	18	149.320	135	863	1350	10	10	9.1
	19	149.320	140	774	900	9	9	8.2
	20	149.340	145	875	1300	10	11	9.9
	21	149.340	150	784	890	9	9	8.1
	22	149.340	155	830	1100	10	10	9.5
	23	149.340	160	1041	1300	10	10	7.5
	24	149.400	165	792	900	10	11	10.9
	25	149.400	170	885	1300	10	10	8.9
	26	149.400	175	725	820	9	9	8.8
	27	149.400	180	825	1100	9	9	7.7
	28	149.460	185	830	1000	10	9	8.5
	29	149.460	190	892	1430	11	11	10.6
	30	149.460	195	860	1400	10	9	8.2
	31	149.460	200	845	1000	10	9	8.4
	32	149.480	205	735	900	9	9	8.7
	33	149.480	210	840	1350	10	10	9.3
	34	149.480	212	875	1500	11	11	10.9
	35	149.480	207	795	900	9	9	8.0
Release 3 (10/15)	36	149.320	92	700	650	7	6	4.7*
	37	149.320	102	997	2100	14	13	14.3
	38	149.320	203	735	900	9	10	9.6
	39	149.340	62	767	700	8	9	7.4
	40	149.340	72	740	1100	9	10	9.6
	41	149.340	123	790	800	8	8	6.4*
	42	149.400	97	838	900	10	10	9.4
	43	149.400	118	805	1000	10	9	8.8
	44	149.400	113	770	1000	10	10	10.2
	45	149.460	133	880	1150	9	9	7.2
	46	149.460	157	734	600	7	7	5.2*
	47	149.460	163	900	1600	11	11	10.6
	48	149.480	178	840	1050	10	9	8.4
	49	149.480	167	770	500	9	9	8.3
	50	149.480	184	1000	1300	10	11	8.7
Average				828	1114	-	-	-
Minimum				700	500	-	-	-
Maximum				1041	2100	-	-	-

* Although the Pankhurst Index value was less than 6.5, all 5 eels migrated downstream.

TABLE 6. INITIATION OF MIGRATORY MOVEMENTS BY ADULT SILVER AMERICAN EELS AFTER RELEASE IN THE UNION RIVER.

MIGRATORY TIMING	NUMBER OF EELS	CUMULATIVE NUMBER OF EELS	PERCENTAGE OF EELS	CUMULATIVE PERCENTAGE OF EELS
0.25 to 12 hours	30	30	63.8%	63.8%
13 to 24 hours	2	32	4.3%	68.1%
25 to 48 hours	10	42	21.3%	89.4%
49 to 72 hours	2	44	4.3%	93.6%
> 72 hours	3	100	6.4%	100.0%
TOTAL	47	-	100.0%	-

3.5 PASSAGE ROUTE AND SURVIVAL

3.5.1 GRAHAM LAKE DAM

Adult eels used the downstream fish bypass weir, Tainter gate No. 2, and Tainter gate No. 3 to pass Graham Lake dam (Tainter gate No. 1 was closed during the entire study period). Fourteen passed through Tainter gate No. 2, which was open for the entire study; 14 passed through Tainter gate No. 3, which was open for approximately 90 percent of the study period; and 7 passed through the surface fish bypass weir (Table 7), which was open for the entire study. Twelve eels passed through the Graham Lake dam undetected by the telemetry receivers at the dam; however, given the velocity of the water passing through the Tainter gates (estimated in excess of 20 feet per second), it is not surprising that some eels passed without being detected at the dam. All 47 eels (100 percent) migrated through Graham Lake dam, survived passage, and moved downstream to the Ellsworth dam, a distance of approximately 7 river kilometers (4.3 miles).

TABLE 7. ROUTE OF PASSAGE SELECTION BY ADULT AMERICAN EELS, GRAHAM LAKE DAM, UNION RIVER.

ROUTE OF PASSAGE	NUMBER DETECTED	PERCENT DETECTED	PERCENT PASSAGE SURVIVAL
Tainter gate No. 2	14	30%	100%
Tainter gate No. 3	14	30%	100%
Fish bypass weir	7	15%	100%
Unidentified route	12	26%	100%
TOTAL	47	100%	100%

3.5.2 ELLSWORTH DAM

All 47 eels migrating downstream from Graham Lake also passed through the Ellsworth development; 43 of these were documented passing through the turbines (Table 8). Most eels passed through Unit 3 (n=17, or 36.2%). Slightly fewer eels passed through Unit 4 (n=14, 29.8 percent), and 12 passed through Unit 2 (n=12, or 25.5 percent). Four eels were not detected as they moved through the Ellsworth development; however, they were detected at stations downstream. Researchers documented no eels using the downstream fish bypass. Using a combination of manual and automated tracking (i.e., detections on the receivers positioned downstream of the Ellsworth dam), researchers documented 21 eels that had not survived passage through the turbines. Based on the data from the stationary receivers and from manual tracking, turbine passage survival was 25 percent for Unit 2, 47 percent for Unit 3, and 86 percent for Unit 4 (Table 8). Overall, 53 percent of the tagged eels survived passage at the Ellsworth development (Table 8). Eighty-eight percent of the eels migrated through the Ellsworth development between the hours of 6 PM and 6 AM (n=38) (Table 9).

TABLE 8. ROUTE OF PASSAGE SELECTION AND PASSAGE SURVIVAL FOR SILVER EELS, ELLSWORTH DAM, UNION RIVER.

ROUTE OF PASSAGE	NUMBER OF EELS	PERCENT OF EELS	PASSAGE SURVIVAL	PERCENT PASSAGE SURVIVAL
Unit 1	0	0%	–	–
Unit 2	12	25.5%	3 of 12	25%
Unit 3	17	36.2%	8 of 17	47%
Unit 4	14	29.8%	12 of 14	86%
Unidentified	4	8.5%	1 of 2*	50%
TOTAL	47	100%	24 of 45	53%

* Turbine passage survival determined for 2 of 4 eels only. Fate of two eels in the tailrace at study termination undetermined.

TABLE 9. PASSAGE TIMING OF TAGGED AMERICAN EELS AT THE ELLSWORTH DAM, UNION RIVER.

TIME OF DAY	NUMBER OF EELS	PERCENTAGE OF EELS	CUMULATIVE PERCENTAGE OF EELS
18:00-21:00	10	23.3%	23.3%
21:01-00:00	11	25.6%	48.9%
00:01-03:00	12	27.9%	76.8%
03:01-06:00	5	11.6%	88.4%
Other	5	11.6%	100.0%
TOTAL	43*	100.0%	-

* Four (4) eels were not detected as they passed the Ellsworth development, so time of passage is unknown.

On October 26 and November 2, researchers manually tracked the lowermost 3.5 river kilometers (2.2 miles) of the Union River by boat. The October 26 survey was conducted during low tide, and the November 2 survey took place during high tide. In total, nine eels were detected during these two surveys; three survivors and six mortalities. The fate of two eels that were still in the tailrace area on November 12, which was the final tracking survey, is unknown. These two eels were first detected in the tailrace on October 20 and October 25.

Eels passed through the turbines somewhat uniformly during each of the three different operational scenarios: 14 passed with all units running; 12 passed with Units 2, 3, and 4 running; 14 passed with Units 2 and 3 running; and 3 passed after Black Bear returned to its normal low-flow operating scenario (Table 10). With all four units running (i.e., operational scenario No. 1), 10 of 14 eels passed through Unit 4, and 9 of 10 survived passage. Appendix B provides a summary of passage route and survival of individual silver eels at Graham Lake and Ellsworth dams. Appendix C provides passage summaries for all 47 eels that passed the Ellsworth Project.

TABLE 10. DOWNSTREAM EEL PASSAGE COMPARED TO OPERATIONS, ELLSWORTH PROJECT.

OPERATIONAL SCENARIO	UNITS OPERATING	AVERAGE GENERATION (MW)	UNIT 1	UNIT 2	UNIT 3	UNIT 4	TOTAL
1	1, 2, 3, 4	8.7	0	3	1	10	14
2	2, 3, 4	5.7	0	4	5	3	12
3	2, 3	3.6	0	5	9	0	14
LOW FLOW	3	1.7	0	0	2	1	3
TOTAL			0	12	17	14	43*

* Four (4) eels were not detected as they passed the Ellsworth development, so their route is unknown.

4.0 REFERENCES

- American Eel Sustainability Association (AESAs). 2015. Rebuilding of Eel Stocks. Available online [URL]: <http://americaneel.org/understand-the-issues/eel-science/rebuilding-of-eel-stocks/>. Accessed November 10, 2015.
- Brookfield Renewable Energy Group. 2015. Final Atlantic Salmon Passage Study Report for the Lower Penobscot River, submitted to FERC March 2015.
- Haro, A. 2003. Downstream migration of silver-phase anguillid eels. Pages 215-222 in: Aida, K., K. Tsukamoto, and K. Yamauchi, eds. Eel Biology. Springer, Tokyo.
- Kleinschmidt. 2011. Final Interim Downstream Bypass Eel Passage Effectiveness Study Report, Anson Hydroelectric Project (FERC No. 2365) and Abenaki Hydroelectric Project (FERC No. 2364). Final Report, Submitted to FERC June 2011.
- Kleinschmidt. 2013. Final Downstream Eel Passage Study Report, Anson Hydroelectric Project (FERC No. 2365) and Abenaki Hydroelectric Project (FERC No. 2364) Final Report, Submitted to FERC May 2013.
- Pankhurst, N. W. 1982. Relation of visual changes to the onset of sexual maturation in the European eel, *Anguilla anguilla*, Journal of Fish Biology 21:127-140.

APPENDIX A
SUMMARY OF NIGHTLY AVERAGE GENERATION,
OCTOBER 1 – NOVEMBER 1

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EXHIBIT 2

Operational Scenario	Date	Unit 1			Unit 2		
		Gen (MW)	Flow (cfs)	Percent gate	Gen (MW)	Flow (cfs)	Percent gate
All 4 units (full gate)	10/1-10/2	2.2	520	88.8	1.8	406	91.4
	10/2-10/3	2.2	520	95.8	2.0	432	95.6
	10/3-10/4	2.2	514	95.8	2.1	473	97.1
	10/4-10/5	2.2	517	95.7	2.1	477	85.3
	10/5-10/6	2.2	514	89.5	2.1	477	77.4
	Average	2.2	517	94.2	2.1	465	88.9
Units 2, 3, and 4 (reduced flow)	10/6-10/7	0.0	0	0.0	0.0	0	2.8
	10/7-10/8	0.0	0	0.0	0.0	0	-1.0
	10/8-10/9	0.0	0	0.0	2.0	446	72.9
	10/9-10/10	0.0	0	0.0	2.2	493	78.5
	10/10-10/11	0.0	0	0.0	2.2	489	80.2
	10/11-10/12	0.0	0	0.0	1.7	375	62.6
Average	0.0	0	0.0	2.0	451	73.5	
Unit 2 and Unit 3 only	10/12-10/13	0.0	0	0.0	2.2	492	79.0
	10/13-10/14	0.0	0	0.0	2.1	484	72.6
	10/14-10/15	0.0	0	0.0	2.1	484	71.4
	10/15-10/16	0.0	0	0.0	2.1	469	71.3
	10/16-10/17	0.0	0	0.0	2.1	469	70.6
	10/17-10/18	0.0	0	0.0	2.1	466	71.4
	10/18-10/19	0.0	0	0.0	2.1	462	69.6
	10/19-10/20	0.0	0	0.0	2.1	465	78.0
	10/20-10/21	0.0	0	0.0	2.1	464	73.9
	10/21-10/22	0.0	0	0.0	2.1	486	74.4
Average	0.0	0	0.0	2.1	474	73.2	
Unit 3 only	10/22-10/23	0.0	0	0.0	0.0	0	1.9
	10/23-10/24	0.0	0	0.0	0.0	0	-0.4
	10/24-10/25	0.0	0	0.0	0.0	0	-0.6
	10/25-10/26	0.0	0	0.0	0.0	0	-0.2
	10/26-10/27	0.0	0	0.0	0.0	0	-0.1
	10/27-10/28	0.0	0	0.0	0.0	0	1.1
	10/28-10/29	0.0	0	0.0	0.0	0	1.0
	10/29-10/30	0.0	0	0.0	0.0	0	1.6
	10/30-10/31	0.0	0	0.0	0.0	0	1.6
	10/31-11/01	0.0	0	0.0	0.0	0	1.4
Average	0.0	0	0.0	0.0	0	0.7	

* Tainter Gate No. 3 (minimum flow gate) was opened (5 inches) during the study.

* Downstream fish bypass at Graham Lake opened during the study.

EXHIBIT 2

Operational Scenario	Date	Unit 3			Unit 4		
		Gen (MW)	Flow (cfs)	Percent gate	Gen (MW)	Flow (cfs)	Percent gate
All 4 units (full gate)	10/1-10/2	1.9	416	92.2	2.5	589	89.3
	10/2-10/3	1.9	425	98.8	2.5	577	97.4
	10/3-10/4	1.9	425	98.8	2.4	575	97.4
	10/4-10/5	1.9	426	98.6	2.5	578	97.5
	10/5-10/6	1.9	425	98.8	2.5	579	97.7
	Average	1.9	425	98.7	2.5	577	97.5
Units 2, 3, and 4 (reduced flow)	10/6-10/7	1.3	300	59.5	0.0	0	0.2
	10/7-10/8	0.6	154	37.1	0.0	0	0.2
	10/8-10/9	1.6	363	73.1	2.2	515	66.9
	10/9-10/10	1.9	419	89.2	1.5	351	45.6
	10/10-10/11	1.8	401	74.1	1.8	413	53.6
	10/11-10/12	1.9	425	88.0	2.3	551	72.4
Average	1.5	344	70.2	1.9	457	59.6	
Unit 2 and Unit 3 only	10/12-10/13	1.7	370	71.1	0.0	0	0.2
	10/13-10/14	1.7	388	73.0	0.0	0	0.2
	10/14-10/15	1.6	351	64.1	0.0	0	0.2
	10/15-10/16	1.5	332	63.3	0.0	0	0.2
	10/16-10/17	1.2	266	53.0	0.0	0	0.1
	10/17-10/18	1.3	284	55.9	0.0	0	0.1
	10/18-10/19	1.5	336	62.2	0.0	0	0.0
	10/19-10/20	1.5	329	59.6	0.0	0	0.1
	10/20-10/21	1.6	360	66.8	0.2	37	6.4
	10/21-10/22	1.2	275	56.5	0.3	74	10.9
Average	1.5	329	62.6	0.1	11	1.8	
Unit 3 only	10/22-10/23	0.8	194	43.2	0.0	0	0.1
	10/23-10/24	1.2	268	51.9	0.0	0	0.1
	10/24-10/25	1.2	264	50.8	0.0	0	0.1
	10/25-10/26	1.2	265	51.3	0.0	0	0.1
	10/26-10/27	0.8	187	41.6	0.0	0	0.0
	10/27-10/28	0.8	186	41.3	0.0	0	0.0
	10/28-10/29	1.1	249	50.2	0.0	0	0.1
	10/29-10/30	2.1	485	96.0	0.0	0	0.1
	10/30-10/31	1.8	410	80.0	2.1	498	62.7
	10/31-11/01	1.8	392	68.0	2.1	499	62.7
Average	1.3	290	57.4	0.4	100	12.6	

* Tainter Gate No. 3 (minimu

* Downstream fish bypass at

Operational Scenario	All Units Combined				Graham Lake
	Date	Gen (MW)	Percent total generation (%)	Flow (cfs)	Tainter Gate No. 2 Opening (ft.)*
All 4 units (full gate)	10/1-10/2	8.4	94.9%	1967	3.1
	10/2-10/3	8.6	96.1%	1964	3.5
	10/3-10/4	8.7	97.4%	1997	3.7
	10/4-10/5	8.7	97.9%	2009	3.7
	10/5-10/6	8.7	97.7%	2006	4.0
	Average	8.7	97.3%	1994	3.7
Units 2, 3, and 4 (reduced flow)	10/6-10/7	1.3	14.7%	317	0.0
	10/7-10/8	0.6	7.3%	164	0.0
	10/8-10/9	5.8	65.1%	1336	2.8
	10/9-10/10	5.5	62.1%	1280	2.5
	10/10-10/11	5.7	64.3%	1313	2.5
	10/11-10/12	5.9	66.5%	1362	2.7
Average	5.7	64.5%	1322	2.6	
Unit 2 and Unit 3 only	10/12-10/13	3.8	42.9%	872	1.7
	10/13-10/14	3.9	43.7%	883	1.7
	10/14-10/15	3.7	41.8%	846	1.7
	10/15-10/16	3.6	40.1%	811	1.6
	10/16-10/17	3.2	36.5%	745	1.6
	10/17-10/18	3.3	37.4%	760	1.6
	10/18-10/19	3.6	40.1%	808	1.7
	10/19-10/20	3.5	39.8%	804	1.7
	10/20-10/21	3.8	43.2%	883	1.8
	10/21-10/22	3.7	41.2%	865	1.8
Average	3.6	40.7%	828	1.7	
Unit 3 only	10/22-10/23	0.8	9.3%	205	0.5
	10/23-10/24	1.2	13.2%	279	0.6
	10/24-10/25	1.2	13.0%	274	0.6
	10/25-10/26	1.2	13.0%	276	0.6
	10/26-10/27	0.8	8.9%	198	0.5
	10/27-10/28	0.8	8.8%	197	0.5
	10/28-10/29	1.1	12.2%	259	0.5
	10/29-10/30	2.1	24.1%	671	0.0
	10/30-10/31	3.9	44.3%	919	1.3
	10/31-11/01	3.9	43.8%	902	1.3
Average	1.7	19.1%	418	0.6	

* Tainter Gate No. 3 (minimum)

* Downstream fish bypass at

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APPENDIX B
ROUTE OF PASSAGE AND SURVIVAL OF TAGGED ADULT EELS
AT THE ELLSWORTH PROJECT

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APPENDIX B. DOWNSTREAM AMERICAN EEL PASSAGE AND SURVIVAL RESULTS, ELLSWORTH PROJECT, OCTOBER 2015.

	Eel No.	Code	Graham Lake Passage Route	Graham Lake Passage Route Time	Ellsworth Passage Route	Ellsworth Passage Route Time	Passage Survival?	Migration Time from GL1 to DS4 (hours)	
Release 1	1	50	Gate 2	10/2/2015 2:55	Unit 4	10/3/2015 1:40	Successful passage (10/4 7:40)	59.5	
	2	51	Unidentified	Unidentified	Unit 4	10/2/2015 0:08	Successful passage (10/2 0:18)	4.5	
	3	60	Gate 2	10/1/2015 11:36	Unit 2	10/2/2015 20:23	Mortality (marina 10/12)	-	
	4	65	Gate 2	10/1/2015 20:30	Unit 2	10/10/2015 23:09	Mortality (marina 10/26)	-	
	5	70	Gate 2	10/1/2015 20:50	Unit 4	10/2/2015 1:56	Successful passage (10/2 5:00)	8.5	
	6	75	Gate 2	10/2/2015 5:26	Unit 2	10/2/2015 8:37	Successful passage (10/2 8:47)	3.5	
	7	80	Gate 2	10/1/2015 20:56	Unit 4	10/1/2015 23:42	Successful passage (10/1 23:43)	3.5	
	8	85	Gate 2	10/2/2015 0:50	Unit 4	10/2/2015 11:41	Successful passage (10/2 18:43)	18	
	9	90	Gate 2	10/2/2015 4:38	Unit 4	10/2/2015 19:53	Successful passage 10/4 13:00	58	
	10	95	Gate 2	10/2/2015 1:05	Unit 4	10/2/2015 20:47	Successful passage (10/2 21:01)	20	
	11	100	Gate 2	10/1/2015 22:59	Unit 4	10/2/2015 22:05	Successful passage (10/2 22:14)	23.5	
	12	105	Unidentified	10/2/2015 0:42	Unit 3	10/2/2015 3:54	Mortality (marina 10/26)	-	
	13	110	Gate 3	10/1/2015 20:52	Unit 4	10/1/2015 23:44	Mortality (tailrace 10/12)	-	
	14	115	Gate 2	10/1/2015 22:05	Unit 2	10/2/2015 1:26	Mortality (marina 10/21)	-	
	15	120	Gate 2	10/2/2015 1:20	Unit 4	10/2/2015 21:18	Successful passage (10/2 21:26)	20	
Release 2	16	125	Escaped prior to release						
	17	130	Gate 3	10/8/2015 20:38	Unit 3	10/10/2015 1:01	Mortality (marina 10/26)	-	
	18	135	Gate 3	10/8/2015 21:50	Unit 4	10/9/2015 1:25	Successful passage (10/9 1:38)	4	
	19	140	Unidentified	Unidentified	Unit 3	10/14/2015 23:25	Successful passage (10/14 23:37)	19	
	20	145	Unidentified	Unidentified	Unit 3	10/10/2015 4:47	Mortality (marina 10/16)	-	
	21	150	Unidentified	Unidentified	Unit 4	10/11/2015 18:14	Successful passage (10/11 18:29)	13	
	22	155	Did not migrate from Graham Lake						
	23	160	Gate 2	10/9/2015 20:18	Unit 3	10/24/2015 19:14	Mortality (tailrace 11/12)	-	
	24	165	Unidentified	Unidentified	Unit 2	10/16/2015 17:42	Mortality (marina 11/5)	-	
	25	170	Gate 3	10/9/2015 1:22	Unit 2	10/9/2015 19:42	Mortality (tailrace 11/1)	-	
	26	175	Gate 3	10/10/2015 3:28	Unit 3	10/10/2015 19:01	Successful passage (10/11 14:49)	36	
	27	180	Gate 3	10/9/2015 21:03	Unit 3	10/10/2015 0:11	Mortality (Unit 3 10/10)	-	
	28	185	Gate 2	10/10/2015 3:19	Unidentified	Unidentified	Successful passage (10/25 20:40)	378	
	29	190	Unidentified	Unidentified	Unit 3	10/16/2015 3:09	Mortality (marina 10/21)	-	
	30	195	Fish Bypass	10/9/2015 21:21	Unit 4	10/10/2015 0:23	Mortality (marina 10/21)	-	
	31	200	Fish Bypass	10/9/2015 20:44	Unit 2	10/10/2015 1:11	Successful passage (10/10 1:27)	5	
	32	205	Unidentified	Undetected	Unit 2	10/10/2015 4:12	Mortality (marina 10/16)	-	
	33	210	Did not migrate from Graham Lake						
34	212	Unidentified	Unidentified	Unit 3	10/9/2015 2:27	Successful passage (10/9 2:52)	5		
35	207	Fish Bypass	10/10/2015 7:49	Unit 3	10/18/2015 22:22	Successful passage (10/19 3:05)	248		
Release 3	36	92	Gate 3	10/16/2015 19:56	Unit 2	10/18/2015 4:09	Successful passage (10/18 4:58)	46	
	37	102	Gate 3	10/15/2015 21:38	Unidentified	Unidentified	Mortality (DS4 11/2)	-	
	38	203	Fish Bypass	10/15/2015 20:02	Unit 3	10/25/2015 20:07	Last detected in tailrace (10/25-11/12)	-	
	39	62	Gate 3	10/16/2015 15:32	Unit 3	10/16/2015 22:23	Successful passage (10/16 22:31)	20	
	40	72	Gate 3	10/15/2015 19:15	Unit 2	10/15/2015 23:44	Mortality (DS3 11/12)	-	
	41	123	Unidentified	Unidentified	Unit 3	10/16/2015 21:55	Mortality (tailrace 11/2)	-	
	42	97	Unidentified	Unidentified	Unidentified	Unidentified	Successful passage (10/17 10:39)	17	
	43	118	Gate 3	10/16/2015 8:17	Unit 3	10/16/2015 21:03	Successful passage (10/16 23:06)	25	
	44	113	Gate 3	10/19/2015 12:03	Unidentified	Unidentified	Last detected in tailrace (10/2-11/12)	-	
	45	133	Fish Bypass	10/16/2015 23:29	Unit 2	10/17/2015 16:00	Mortality (tailrace 10/20)	-	
	46	157	Unidentified	10/16/2015 0:50	Unit 3	10/16/2015 19:53	Mortality (tailrace 10/23)	-	
	47	163	Fish Bypass	10/16/2015 19:10	Unit 3	10/17/2015 1:34	Mortality (marina 10/21)	-	
	48	178	Fish Bypass	10/31/2015 4:14	Unit 4	10/31/2015 9:16	Successful passage (10/31 17:22)	13	
	49	167	Gate 3	10/17/2015 1:48	Unit 2	10/17/2015 20:45	Mortality (DS2 10/23)	-	
	50	184	Gate 3	10/17/15 19:07	Unit 3	10/18/15 0:10	Successful passage (10/18 00:21)	5.5	

APPENDIX C
DATA EXCERPTS OF DOWNSTREAM EEL PASSAGE

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TABLE C1. PASSAGE SUMMARY FOR EEL 149.320 50

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/2/2015 2:54:33	1	Graham Lake Approach	-83	Released 10/1/2015 19:53
10/2/2015 2:54:34	1	Graham Lake Approach	-82	
10/2/2015 2:54:35	1	Graham Lake Approach	-83	
10/2/2015 2:54:36	1	Graham Lake Approach	-84	
10/2/2015 2:54:37	1	Graham Lake Approach	-87	
10/2/2015 2:55:28	4	Graham Lake Gate 2	-62	Graham Lake Passage
10/2/2015 19:07:24	5	Downstream Station #1	-93	
10/2/2015 19:07:25	5	Downstream Station #1	-89	
10/2/2015 19:07:26	5	Downstream Station #1	-93	
10/2/2015 19:07:27	5	Downstream Station #1	-88	
10/2/2015 19:07:28	5	Downstream Station #1	-87	
10/3/2015 0:53:47	6	Ellsworth Approach	-66	
10/3/2015 0:53:48	6	Ellsworth Approach	-65	
10/3/2015 0:53:49	6	Ellsworth Approach	-63	
10/3/2015 0:53:50	6	Ellsworth Approach	-65	
10/3/2015 1:41:03	12	Ellsworth Unit 4	-59	Ellsworth Dam Passage
10/3/2015 1:41:04	12	Ellsworth Unit 4	-59	
10/3/2015 1:41:05	12	Ellsworth Unit 4	-59	
10/3/2015 1:41:06	12	Ellsworth Unit 4	-60	
10/3/2015 1:43:12	13	Ellsworth Tailrace	-60	
10/3/2015 1:43:13	13	Ellsworth Tailrace	-60	
10/3/2015 1:43:14	13	Ellsworth Tailrace	-60	
10/3/2015 1:43:15	13	Ellsworth Tailrace	-62	
10/3/2015 1:49:52	14	Downstream Station #2	-78	
10/3/2015 1:49:53	14	Downstream Station #2	-75	
10/3/2015 1:50:00	14	Downstream Station #2	-79	
10/4/2015 7:13:26	15	Downstream Station #3	128	
10/4/2015 7:13:36	15	Downstream Station #3	123	
10/4/2015 7:13:43	15	Downstream Station #3	118	
10/4/2015 7:45:55	16	Downstream Station #4	164	
10/4/2015 7:46:05	16	Downstream Station #4	154	
10/4/2015 7:46:06	16	Downstream Station #4	155	Successful Passage
10/4/2015 7:46:14	16	Downstream Station #4	151	
10/4/2015 7:46:24	16	Downstream Station #4	157	
10/4/2015 7:46:32	16	Downstream Station #4	122	

TABLE C2. PASSAGE SUMMARY FOR EEL 149.320 51

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/1/2015 19:33:41	1	Graham Lake Approach	-89	Released 10/1/2015 19:53
10/1/2015 19:33:42	1	Graham Lake Approach	-90	
10/1/2015 19:33:44	1	Graham Lake Approach	-88	
10/1/2015 19:33:45	1	Graham Lake Approach	-87	
10/1/2015 19:33:46	1	Graham Lake Approach	-88	
10/1/2015 19:33:48	1	Graham Lake Approach	-90	
10/1/2015 22:11:51	5	Downstream #1	-81	Passage – Unknown Route
10/1/2015 22:11:52	5	Downstream #1	-79	
10/1/2015 22:11:53	5	Downstream #1	-79	
10/1/2015 22:11:55	5	Downstream #1	-79	
10/1/2015 22:11:56	5	Downstream #1	-80	
10/1/2015 22:11:57	5	Downstream #1	-78	
10/1/2015 22:11:58	5	Downstream #1	-80	
10/2/2015 0:02:12	6	Ellsworth Approach	-96	
10/2/2015 0:02:13	6	Ellsworth Approach	-85	
10/2/2015 0:02:14	6	Ellsworth Approach	-90	
10/2/2015 0:02:15	6	Ellsworth Approach	-90	
10/2/2015 0:08:32	12	Ellsworth Unit 4	-61	Ellsworth Dam Passage
10/2/2015 0:08:33	12	Ellsworth Unit 4	-60	
10/2/2015 0:08:34	12	Ellsworth Unit 4	-60	
10/2/2015 0:09:24	13	Ellsworth Tailrace	-74	
10/2/2015 0:09:25	13	Ellsworth Tailrace	-62	
10/2/2015 0:09:26	13	Ellsworth Tailrace	-61	
10/2/2015 0:09:28	13	Ellsworth Tailrace	-71	
10/2/2015 0:17:54	14	Downstream #2	-68	
10/2/2015 0:17:56	14	Downstream #2	-68	
10/2/2015 0:17:57	14	Downstream #2	-62	
10/2/2015 0:17:58	14	Downstream #2	-65	
10/2/2015 0:20:52	15	Downstream #3	119	
10/2/2015 0:21:13	15	Downstream #3	137	
10/2/2015 0:21:22	15	Downstream #3	140	
10/2/2015 0:21:31	15	Downstream #3	135	
10/2/2015 0:21:39	15	Downstream #3	127	
10/2/2015 0:21:52	16	Downstream #4	72	Successful Passage
10/2/2015 0:23:32	16	Downstream #4	74	

TABLE C3. PASSAGE SUMMARY FOR EEL 149.320 60

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/1/2015 23:33:35	1	Graham Lake Approach	-62	Released 10/1/2015 19:53
10/1/2015 23:33:36	1	Graham Lake Approach	-60	
10/1/2015 23:33:37	1	Graham Lake Approach	-63	
10/1/2015 23:33:40	1	Graham Lake Approach	-61	
10/1/2015 23:33:42	1	Graham Lake Approach	-67	
10/1/2015 23:37:11	4	Graham Lake Gate 2	-66	Graham Lake Passage
10/1/2015 23:37:16	4	Graham Lake Gate 2	-73	
10/2/2015 6:27:31	5	Downstream #1	-84	
10/2/2015 6:27:32	5	Downstream #1	-81	
10/2/2015 6:27:33	5	Downstream #1	-80	
10/2/2015 6:27:35	5	Downstream #1	-79	
10/2/2015 6:27:36	5	Downstream #1	-81	
10/2/2015 20:17:33	6	Ellsworth Approach	-86	
10/2/2015 20:17:34	6	Ellsworth Approach	-86	
10/2/2015 20:17:35	6	Ellsworth Approach	-86	
10/2/2015 20:17:36	6	Ellsworth Approach	-87	
10/2/2015 20:17:37	6	Ellsworth Approach	-86	
10/2/2015 20:23:50	10	Ellsworth Unit 2	-62	Ellsworth Dam Passage
10/2/2015 20:23:51	10	Ellsworth Unit 2	-57	
10/2/2015 20:23:53	10	Ellsworth Unit 2	-66	
10/2/2015 20:24:12	13	Ellsworth Tailrace	-61	
10/2/2015 20:24:13	13	Ellsworth Tailrace	-73	
10/2/2015 20:24:16	13	Ellsworth Tailrace	-62	
10/2/2015 20:24:18	13	Ellsworth Tailrace	-65	
10/2/2015 20:24:19	13	Ellsworth Tailrace	-62	
10/2/2015 20:25:51	14	Downstream #2	-78	
10/2/2015 20:25:52	14	Downstream #2	-76	
10/2/2015 20:25:57	14	Downstream #2	-79	
10/2/2015 20:25:59	14	Downstream #2	-78	
10/2/2015 20:37:33	15	Downstream #3	175	
10/2/2015 20:37:44	15	Downstream #3	170	
10/2/2015 20:37:53	15	Downstream #3	176	
10/2/2015 20:38:02	15	Downstream #3	188	
10/2/2015 20:38:10	15	Downstream #3	185	
10/2/2015 20:43:11	16	Downstream #4	187	
10/2/2015 20:43:12	16	Downstream #4	129	
10/2/2015 20:43:38	16	Downstream #4	213	
10/2/2015 20:43:47	16	Downstream #4	235	
10/12/2015		Marina – manual tracking		Mortality

TABLE C4. PASSAGE SUMMARY FOR EEL 149.340 65

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/1/2015 20:25:57	1	Graham Lake Approach	-78	Released 10/1/2015 19:53
10/1/2015 20:25:58	1	Graham Lake Approach	-76	
10/1/2015 20:26:00	1	Graham Lake Approach	-74	
10/1/2015 20:26:01	1	Graham Lake Approach	-73	
10/1/2015 20:26:02	1	Graham Lake Approach	-76	
10/1/2015 20:26:04	1	Graham Lake Approach	-75	
10/1/2015 20:26:05	1	Graham Lake Approach	-79	
10/1/2015 20:28:57	4	Graham Lake Gate 2	-62	Graham Lake Passage
10/1/2015 20:29:01	4	Graham Lake Gate 2	-67	
10/1/2015 20:29:02	4	Graham Lake Gate 2	-69	
10/1/2015 20:29:05	4	Graham Lake Gate 2	-69	
10/5/2015 7:13:41	5	Downstream #1	-84	
10/5/2015 7:13:42	5	Downstream #1	-86	
10/5/2015 7:13:43	5	Downstream #1	-87	
10/5/2015 7:13:44	5	Downstream #1	-86	
10/5/2015 7:13:45	5	Downstream #1	-85	
10/5/2015 7:13:46	5	Downstream #1	-84	
10/10/2015 22:58:15	6	Ellsworth Approach	-91	
10/10/2015 22:58:17	6	Ellsworth Approach	-93	
10/10/2015 22:58:18	6	Ellsworth Approach	-93	
10/10/2015 23:09:16	10	Ellsworth Unit 2	-59	Ellsworth Dam Passage
10/10/2015 23:09:17	10	Ellsworth Unit 2	-57	
10/10/2015 23:10:03	13	Ellsworth Tailrace	-72	
10/10/2015 23:10:05	13	Ellsworth Tailrace	-63	
10/10/2015 23:10:06	13	Ellsworth Tailrace	-67	
10/10/2015 23:10:07	13	Ellsworth Tailrace	-70	
10/10/2015 23:10:09	13	Ellsworth Tailrace	-70	
10/10/2015 23:13:09	14	Downstream #2	-71	
10/10/2015 23:13:10	14	Downstream #2	-77	
10/10/2015 23:13:18	14	Downstream #2	-79	
10/10/2015 23:28:33	16	Downstream #4	235	
10/10/2015 23:28:42	16	Downstream #4	254	
10/10/2015 23:29:09	16	Downstream #4	255	
10/10/2015 23:29:26	16	Downstream #4	254	
10/12/2015		Marina – manual tracking		Mortality

TABLE C5. PASSAGE SUMMARY FOR EEL 149.340 70

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/1/2015 20:47:57	1	Graham Lake Approach	-79	Released 10/1/2015 19:53
10/1/2015 20:47:58	1	Graham Lake Approach	-80	
10/1/2015 20:47:59	1	Graham Lake Approach	-78	
10/1/2015 20:48:00	1	Graham Lake Approach	-77	
10/1/2015 20:48:02	1	Graham Lake Approach	-80	
10/1/2015 20:48:03	1	Graham Lake Approach	-81	
10/1/2015 20:50:50	4	Graham Lake Gate 2	-73	Graham Lake Passage
10/1/2015 22:50:19	5	Downstream #1	-83	
10/1/2015 22:50:20	5	Downstream #1	-83	
10/1/2015 22:50:21	5	Downstream #1	-84	
10/1/2015 22:50:22	5	Downstream #1	-82	
10/1/2015 22:50:23	5	Downstream #1	-80	
10/2/2015 0:55:00	6	Ellsworth Approach	-81	
10/2/2015 0:55:01	6	Ellsworth Approach	-81	
10/2/2015 0:55:02	6	Ellsworth Approach	-80	
10/2/2015 0:55:03	6	Ellsworth Approach	-83	
10/2/2015 0:55:04	6	Ellsworth Approach	-80	
10/2/2015 1:56:52	12	Ellsworth Unit 4	-59	Ellsworth Dam Passage
10/2/2015 1:56:53	12	Ellsworth Unit 4	-59	
10/2/2015 1:56:55	12	Ellsworth Unit 4	-60	
10/2/2015 1:57:34	13	Ellsworth Tailrace	-60	
10/2/2015 1:57:37	13	Ellsworth Tailrace	-62	
10/2/2015 1:57:40	13	Ellsworth Tailrace	-77	
10/2/2015 4:55:27	14	Downstream #2	-77	
10/2/2015 4:55:33	14	Downstream #2	-80	
10/2/2015 4:55:42	14	Downstream #2	-80	
10/2/2015 4:57:26	15	Downstream #3	150	
10/2/2015 4:57:35	15	Downstream #3	138	
10/2/2015 4:57:53	15	Downstream #3	137	
10/2/2015 5:01:15	16	Downstream #4	224	
10/2/2015 5:01:24	16	Downstream #4	232	Successful Passage
10/2/2015 5:01:34	16	Downstream #4	228	
10/2/2015 5:01:42	16	Downstream #4	247	

TABLE C6. PASSAGE SUMMARY FOR EEL 149.340 75

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/2/2015 5:23:18	1	Graham Lake Approach	-92	Released 10/1/2015 19:53
10/2/2015 5:23:19	1	Graham Lake Approach	-94	
10/2/2015 5:23:20	1	Graham Lake Approach	-93	
10/2/2015 5:23:22	1	Graham Lake Approach	-95	
10/2/2015 5:23:23	1	Graham Lake Approach	-94	
10/2/2015 5:26:22	4	Graham Lake Gate 2	-70	Graham Lake Passage
10/2/2015 5:26:23	4	Graham Lake Gate 2	-69	
10/2/2015 5:26:24	4	Graham Lake Gate 2	-69	
10/2/2015 7:08:54	5	Downstream Station #1	-83	
10/2/2015 7:08:55	5	Downstream Station #1	-84	
10/2/2015 7:08:56	5	Downstream Station #1	-82	
10/2/2015 7:08:57	5	Downstream Station #1	-83	
10/2/2015 8:26:21	6	Ellsworth Approach	-97	
10/2/2015 8:26:22	6	Ellsworth Approach	-87	
10/2/2015 8:26:23	6	Ellsworth Approach	-86	
10/2/2015 8:26:24	6	Ellsworth Approach	-86	
10/2/2015 8:26:25	6	Ellsworth Approach	-85	
10/2/2015 8:36:57	10	Ellsworth Unit 2	-76	
10/2/2015 8:36:58	10	Ellsworth Unit 2	-62	
10/2/2015 8:36:59	10	Ellsworth Unit 2	-63	
10/2/2015 8:37:01	10	Ellsworth Unit 2	-56	
10/2/2015 8:37:02	10	Ellsworth Unit 2	-57	Ellsworth Dam Passage
10/2/2015 8:37:03	10	Ellsworth Unit 2	-66	
10/2/2015 8:37:05	10	Ellsworth Unit 2	-71	
10/2/2015 8:37:32	13	Ellsworth Tailrace	-68	
10/2/2015 8:37:33	13	Ellsworth Tailrace	-68	
10/2/2015 8:37:36	13	Ellsworth Tailrace	-75	
10/2/2015 8:37:38	13	Ellsworth Tailrace	-63	
10/2/2015 8:37:39	13	Ellsworth Tailrace	-69	
10/2/2015 8:39:16	14	Downstream Station #2	-78	
10/2/2015 8:39:17	14	Downstream Station #2	-69	
10/2/2015 8:39:19	14	Downstream Station #2	-73	
10/2/2015 8:39:20	14	Downstream Station #2	-80	
10/2/2015 8:41:58	15	Downstream Station #3	117	
10/2/2015 8:42:08	15	Downstream Station #3	161	
10/2/2015 8:42:15	15	Downstream Station #3	153	
10/2/2015 8:42:25	15	Downstream Station #3	140	
10/2/2015 8:42:26	16	Downstream Station #4	150	Successful Passage
10/2/2015 8:42:44	16	Downstream Station #4	103	
10/2/2015 8:43:02	16	Downstream Station #4	116	
10/2/2015 8:43:38	16	Downstream Station #4	79	
10/2/2015 8:44:14	16	Downstream Station #4	97	

TABLE C7. PASSAGE SUMMARY FOR EEL 149.480 80

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/1/2015 20:50:07	1	Graham Lake Approach	-82	Released 10/1/2015 19:53
10/1/2015 20:50:08	1	Graham Lake Approach	-82	
10/1/2015 20:50:09	1	Graham Lake Approach	-82	
10/1/2015 20:50:10	1	Graham Lake Approach	-87	
10/1/2015 20:50:12	1	Graham Lake Approach	-88	
10/1/2015 20:50:13	1	Graham Lake Approach	-79	
10/1/2015 20:56:06	4	Graham Lake Gate 2	-66	Graham Lake Passage
10/1/2015 20:56:08	4	Graham Lake Gate 2	-67	
10/1/2015 20:56:15	4	Graham Lake Gate 2	-70	
10/1/2015 22:39:57	5	Downstream #1	-83	
10/1/2015 22:39:58	5	Downstream #1	-78	
10/1/2015 22:39:59	5	Downstream #1	-79	
10/1/2015 22:40:00	5	Downstream #1	-78	
10/1/2015 22:40:02	5	Downstream #1	-79	
10/1/2015 23:35:24	6	Ellsworth Approach	-84	
10/1/2015 23:35:25	6	Ellsworth Approach	-81	
10/1/2015 23:35:26	6	Ellsworth Approach	-85	
10/1/2015 23:35:27	6	Ellsworth Approach	-91	
10/1/2015 23:42:11	12	Ellsworth Unit 4	-67	Ellsworth Dam Passage
10/1/2015 23:42:12	12	Ellsworth Unit 4	-58	
10/1/2015 23:42:14	12	Ellsworth Unit 4	-68	
10/1/2015 23:43:01	13	Ellsworth Tailrace	-62	
10/1/2015 23:43:02	13	Ellsworth Tailrace	-60	
10/1/2015 23:43:04	13	Ellsworth Tailrace	-79	
10/1/2015 23:43:05	13	Ellsworth Tailrace	-78	
10/1/2015 23:45:00	14	Downstream #2	-80	
10/1/2015 23:45:08	14	Downstream #2	-78	
10/1/2015 23:45:09	14	Downstream #2	-80	
10/1/2015 23:46:49	15	Downstream #3	124	
10/1/2015 23:46:58	15	Downstream #3	137	
10/1/2015 23:47:15	15	Downstream #3	119	
10/1/2015 23:49:00	16	Downstream #4	55	
10/2/2015 12:48:45	16	Downstream #4	49	Successful Passage
10/2/2015 12:49:02	16	Downstream #4	55	
10/2/2015 12:49:11	16	Downstream #4	53	

TABLE C8. PASSAGE SUMMARY FOR EEL 149.480 85

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/2/2015 0:48:14	1	Graham Lake Approach	-91	Released 10/1/2015 19:53
10/2/2015 0:48:16	1	Graham Lake Approach	-92	
10/2/2015 0:48:17	1	Graham Lake Approach	-89	
10/2/2015 0:48:18	1	Graham Lake Approach	-92	
10/2/2015 0:48:19	1	Graham Lake Approach	-88	
10/2/2015 0:50:46	4	Graham Lake Gate 2	-64	Graham Lake Passage
10/2/2015 0:51:01	4	Graham Lake Gate 2	-74	
10/2/2015 2:39:06	5	Downstream #1	-82	
10/2/2015 2:39:07	5	Downstream #1	-85	
10/2/2015 2:39:08	5	Downstream #1	-85	
10/2/2015 2:39:09	5	Downstream #1	-82	
10/2/2015 2:39:10	5	Downstream #1	-81	
10/2/2015 6:23:59	6	Ellsworth Approach	-87	
10/2/2015 6:24:00	6	Ellsworth Approach	-87	
10/2/2015 6:24:01	6	Ellsworth Approach	-86	
10/2/2015 6:24:02	6	Ellsworth Approach	-93	
10/2/2015 11:41:04	12	Ellsworth Unit 4	-64	Ellsworth Dam Passage
10/2/2015 11:41:05	12	Ellsworth Unit 4	-68	
10/2/2015 11:41:06	12	Ellsworth Unit 4	-60	
10/2/2015 11:41:07	12	Ellsworth Unit 4	-60	
10/2/2015 11:41:58	13	Ellsworth Tailrace	-80	
10/2/2015 11:42:00	13	Ellsworth Tailrace	-75	
10/2/2015 11:42:01	13	Ellsworth Tailrace	-73	
10/2/2015 11:42:02	13	Ellsworth Tailrace	-79	
10/2/2015 11:43:45	14	Downstream #2	-75	
10/2/2015 11:43:46	14	Downstream #2	-74	
10/2/2015 11:43:48	14	Downstream #2	-77	
10/2/2015 18:41:10	15	Downstream #3	120	
10/2/2015 18:41:28	15	Downstream #3	121	
10/2/2015 18:41:38	15	Downstream #3	143	
10/2/2015 18:41:46	15	Downstream #3	127	
10/2/2015 18:43:19	16	Downstream #4	182	
10/2/2015 18:43:28	16	Downstream #4	121	Successful Passage
10/2/2015 18:43:46	16	Downstream #4	224	
10/2/2015 18:43:56	16	Downstream #4	255	

TABLE C9. PASSAGE SUMMARY FOR EEL 149.480 90

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/2/2015 4:30:40	1	Graham Lake Approach	-77	Released 10/1/2015 19:53
10/2/2015 4:30:42	1	Graham Lake Approach	-75	
10/2/2015 4:30:43	1	Graham Lake Approach	-79	
10/2/2015 4:30:44	1	Graham Lake Approach	-76	
10/2/2015 4:30:45	1	Graham Lake Approach	-79	
10/2/2015 4:38:44	4	Graham Lake Gate 2	-71	Graham Lake Passage
10/2/2015 4:38:45	4	Graham Lake Gate 2	-73	
10/2/2015 4:38:48	4	Graham Lake Gate 2	-71	
10/2/2015 6:21:37	5	Downstream Station #1	-87	
10/2/2015 6:21:38	5	Downstream Station #1	-86	
10/2/2015 6:21:39	5	Downstream Station #1	-87	
10/2/2015 6:21:40	5	Downstream Station #1	-87	
10/2/2015 6:21:41	5	Downstream Station #1	-86	
10/2/2015 19:45:36	6	Ellsworth Approach	-91	
10/2/2015 19:45:37	6	Ellsworth Approach	-92	
10/2/2015 19:45:38	6	Ellsworth Approach	-93	
10/2/2015 19:45:39	6	Ellsworth Approach	-92	
10/2/2015 19:53:43	12	Ellsworth Unit 4	-59	Ellsworth Dam Passage
10/2/2015 19:53:44	12	Ellsworth Unit 4	-58	
10/2/2015 19:53:45	12	Ellsworth Unit 4	-58	
10/4/2015 12:30:05	14	Downstream Station #2	-80	
10/4/2015 12:30:11	14	Downstream Station #2	-79	
10/4/2015 12:30:13	14	Downstream Station #2	-79	
10/4/2015 12:30:17	14	Downstream Station #2	-79	
10/4/2015 12:39:14	15	Downstream Station #3	136	
10/4/2015 12:39:16	15	Downstream Station #3	141	
10/4/2015 12:39:24	15	Downstream Station #3	131	
10/4/2015 12:39:33	15	Downstream Station #3	145	
10/4/2015 12:39:42	15	Downstream Station #3	144	
10/4/2015 13:00:06	16	Downstream Station #4	169	
10/4/2015 13:00:08	16	Downstream Station #4	101	
10/4/2015 13:00:16	16	Downstream Station #4	221	Successful Passage
10/4/2015 13:00:25	16	Downstream Station #4	247	
10/4/2015 13:00:34	16	Downstream Station #4	252	
10/4/2015 13:00:43	16	Downstream Station #4	254	

TABLE C10. PASSAGE SUMMARY FOR EEL 149.400 95

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/2/2015 1:01:54	1	Graham Lake Approach	-83	Released 10/1/2015 19:53
10/2/2015 1:01:55	1	Graham Lake Approach	-85	
10/2/2015 1:01:56	1	Graham Lake Approach	-86	
10/2/2015 1:01:57	1	Graham Lake Approach	-86	
10/2/2015 1:01:58	1	Graham Lake Approach	-89	
10/2/2015 1:05:33	4	Graham Lake Gate 2	-67	Graham Lake Passage
10/2/2015 1:05:34	4	Graham Lake Gate 2	-70	
10/2/2015 1:05:39	4	Graham Lake Gate 2	-70	
10/2/2015 19:05:38	5	Downstream #1	-82	
10/2/2015 19:05:39	5	Downstream #1	-82	
10/2/2015 19:05:40	5	Downstream #1	-80	
10/2/2015 19:05:41	5	Downstream #1	-81	
10/2/2015 19:05:42	5	Downstream #1	-82	
10/2/2015 19:05:43	5	Downstream #1	-82	
10/2/2015 20:34:55	6	Ellsworth Approach	-99	
10/2/2015 20:34:56	6	Ellsworth Approach	-96	
10/2/2015 20:34:57	6	Ellsworth Approach	-95	
10/2/2015 20:34:58	6	Ellsworth Approach	-90	
10/2/2015 20:47:11	12	Ellsworth Unit 4	-61	Ellsworth Dam Passage
10/2/2015 20:47:12	12	Ellsworth Unit 4	-59	
10/2/2015 20:47:13	12	Ellsworth Unit 4	-60	
10/2/2015 20:48:05	13	Ellsworth Tailrace	-66	
10/2/2015 20:48:06	13	Ellsworth Tailrace	-71	
10/2/2015 20:48:07	13	Ellsworth Tailrace	-76	
10/2/2015 20:48:10	13	Ellsworth Tailrace	-77	
10/2/2015 20:52:25	14	Downstream #2	-76	
10/2/2015 20:52:29	14	Downstream #2	-79	
10/2/2015 20:52:35	14	Downstream #2	-79	
10/2/2015 20:56:24	15	Downstream #3	127	
10/2/2015 20:56:25	15	Downstream #3	128	
10/6/2015 17:28:42	16	Downstream #4	253	
10/6/2015 17:28:52	16	Downstream #4	181	
10/6/2015 17:29:00	16	Downstream #4	255	Successful Passage
10/6/2015 17:29:09	16	Downstream #4	254	
10/6/2015 17:29:18	16	Downstream #4	251	

TABLE C11. PASSAGE SUMMARY FOR EEL 149.400 100

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/1/2015 22:51:25	1	Graham Lake Approach	-89	Released 10/1/2015 19:53
10/1/2015 22:51:26	1	Graham Lake Approach	-92	
10/1/2015 22:51:27	1	Graham Lake Approach	-90	
10/1/2015 22:51:28	1	Graham Lake Approach	-90	
10/1/2015 22:52:00	1	Graham Lake Approach	-84	
10/1/2015 22:52:01	1	Graham Lake Approach	-83	
10/1/2015 22:52:02	1	Graham Lake Approach	-86	
10/1/2015 22:52:03	1	Graham Lake Approach	-80	
10/1/2015 22:52:04	1	Graham Lake Approach	-89	
10/1/2015 22:59:36	4	Graham Lake Gate 2	-74	Graham Lake Passage
10/1/2015 22:59:37	4	Graham Lake Gate 2	-75	
10/1/2015 22:59:38	4	Graham Lake Gate 2	-74	
10/1/2015 22:59:39	4	Graham Lake Gate 2	-66	
10/2/2015 21:00:41	5	Downstream Station #1	-81	
10/2/2015 21:00:43	5	Downstream Station #1	-81	
10/2/2015 21:00:44	5	Downstream Station #1	-84	
10/2/2015 21:00:45	5	Downstream Station #1	-83	
10/2/2015 21:50:35	6	Ellsworth Approach	-96	
10/2/2015 21:50:36	6	Ellsworth Approach	-91	
10/2/2015 21:50:37	6	Ellsworth Approach	-88	
10/2/2015 21:50:38	6	Ellsworth Approach	-89	
10/2/2015 22:05:35	12	Ellsworth Unit 4	-60	Ellsworth Dam Passage
10/2/2015 22:05:36	12	Ellsworth Unit 4	-59	
10/2/2015 22:05:37	12	Ellsworth Unit 4	-59	
10/2/2015 22:06:30	13	Ellsworth Tailrace	-61	
10/2/2015 22:06:31	13	Ellsworth Tailrace	-72	
10/2/2015 22:06:32	13	Ellsworth Tailrace	-71	
10/2/2015 22:06:33	13	Ellsworth Tailrace	-77	
10/2/2015 22:09:38	14	Downstream Station #2	-72	
10/2/2015 22:09:39	14	Downstream Station #2	-77	
10/2/2015 22:09:40	14	Downstream Station #2	-77	
10/2/2015 22:11:01	15	Downstream Station #3	139	
10/2/2015 22:11:10	15	Downstream Station #3	150	
10/2/2015 22:11:19	15	Downstream Station #3	151	
10/2/2015 22:15:55	16	Downstream Station #4	107	
10/2/2015 22:16:13	16	Downstream Station #4	110	Successful Passage
10/2/2015 22:16:31	16	Downstream Station #4	124	
10/2/2015 22:16:41	16	Downstream Station #4	111	

TABLE C12. PASSAGE SUMMARY FOR EEL 149.400 105

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/2/2015 0:38:36	1	Graham Lake Approach	-83	Released 10/1/2015 19:53
10/2/2015 0:38:37	1	Graham Lake Approach	-79	
10/2/2015 0:38:38	1	Graham Lake Approach	-79	
10/2/2015 0:40:44	3	Graham Lake Gate 3	-93	Passage – Unknown Route
10/2/2015 0:40:45	3	Graham Lake Gate 3	-95	
10/2/2015 0:42:36	2	Graham Lake Fishway Weir	-70	
10/2/2015 0:42:53	4	Graham Lake Gate 2	-72	
10/2/2015 0:44:54	3	Graham Lake Gate 3	-94	
10/2/2015 0:53:26	3	Graham Lake Gate 3	-88	
10/2/2015 2:41:31	5	Downstream Station #1	-91	
10/2/2015 2:41:32	5	Downstream Station #1	-89	
10/2/2015 2:41:33	5	Downstream Station #1	-88	
10/2/2015 2:41:34	5	Downstream Station #1	-87	
10/2/2015 3:36:27	6	Ellsworth Approach	-73	
10/2/2015 3:36:28	6	Ellsworth Approach	-66	
10/2/2015 3:36:29	6	Ellsworth Approach	-84	
10/2/2015 3:36:30	6	Ellsworth Approach	-83	
10/2/2015 3:54:17	11	Ellsworth Unit 3	-57	Ellsworth Dam Passage
10/2/2015 3:54:18	11	Ellsworth Unit 3	-57	
10/2/2015 3:54:19	11	Ellsworth Unit 3	-57	
10/2/2015 3:54:20	11	Ellsworth Unit 3	-58	
10/2/2015 3:54:47	13	Ellsworth Tailrace	-65	
10/2/2015 3:54:48	13	Ellsworth Tailrace	-59	
10/2/2015 3:54:49	13	Ellsworth Tailrace	-64	
10/2/2015 3:54:51	13	Ellsworth Tailrace	-72	
10/2/2015 3:56:56	14	Downstream Station #2	-77	
10/2/2015 3:56:58	14	Downstream Station #2	-72	
10/2/2015 3:56:59	14	Downstream Station #2	-77	
10/2/2015 4:00:11	15	Downstream Station #3	126	
10/2/2015 4:00:21	15	Downstream Station #3	145	
10/2/2015 4:00:30	15	Downstream Station #3	131	
10/2/2015 4:02:35	16	Downstream Station #4	211	
10/2/2015 4:02:44	16	Downstream Station #4	190	Successful Passage
10/2/2015 4:02:52	16	Downstream Station #4	206	
10/2/2015 4:03:01	16	Downstream Station #4	211	
11/02/2015		1 KM from marina – manual tracking		Mortality

TABLE C13. PASSAGE SUMMARY FOR EEL 149.460 110

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/1/2015 20:49:21	1	Graham Lake Approach	-71	Released 10/1/2015 19:53
10/1/2015 20:49:22	1	Graham Lake Approach	-70	
10/1/2015 20:49:23	1	Graham Lake Approach	-76	
10/1/2015 20:49:25	1	Graham Lake Approach	-74	
10/1/2015 20:49:26	1	Graham Lake Approach	-69	
10/1/2015 20:49:27	1	Graham Lake Approach	-76	
10/1/2015 20:51:59	3	Graham Lake Gate 3	-76	Graham Lake Passage
10/1/2015 20:52:00	3	Graham Lake Gate 3	-72	
10/1/2015 20:52:01	3	Graham Lake Gate 3	-80	
10/1/2015 20:52:02	3	Graham Lake Gate 3	-80	
10/1/2015 20:52:03	3	Graham Lake Gate 3	-87	
10/1/2015 22:46:01	5	Downstream Station #1	-77	
10/1/2015 22:46:02	5	Downstream Station #1	-77	
10/1/2015 22:46:03	5	Downstream Station #1	-77	
10/1/2015 22:46:05	5	Downstream Station #1	-79	
10/1/2015 22:46:06	5	Downstream Station #1	-88	
10/1/2015 22:46:07	5	Downstream Station #1	-93	
10/1/2015 23:37:57	6	Ellsworth Approach	-86	
10/1/2015 23:37:58	6	Ellsworth Approach	-88	
10/1/2015 23:37:59	6	Ellsworth Approach	-85	
10/1/2015 23:38:00	6	Ellsworth Approach	-84	
10/1/2015 23:38:01	6	Ellsworth Approach	-87	
10/1/2015 23:38:02	6	Ellsworth Approach	-87	
10/1/2015 23:44:44	12	Ellsworth Unit 4	-75	
10/1/2015 23:44:45	12	Ellsworth Unit 4	-71	Ellsworth Dam Passage
10/1/2015 23:44:46	12	Ellsworth Unit 4	-66	
10/1/2015 23:44:47	12	Ellsworth Unit 4	-70	
10/1/2015 23:44:48	12	Ellsworth Unit 4	-58	
10/2/2015 4:34:28	13	Ellsworth Tailrace	-59	
10/2/2015 4:34:29	13	Ellsworth Tailrace	-64	
10/2/2015 4:34:30	13	Ellsworth Tailrace	-62	
10/2/2015 4:34:31	13	Ellsworth Tailrace	-63	
10/2/2015 4:34:33	13	Ellsworth Tailrace	-61	
10/12/2015 10:00:09	13	Ellsworth Tailrace	86	Mortality in Tailrace
10/12/2015 10:00:19	13	Ellsworth Tailrace	80	
10/12/2015 10:00:29	13	Ellsworth Tailrace	133	
10/12/2015 10:00:39	13	Ellsworth Tailrace	131	
10/12/2015 10:00:49	13	Ellsworth Tailrace	156	

TABLE C14. PASSAGE SUMMARY FOR EEL 149.460 115

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/1/2015 22:02:27	1	Graham Lake Approach	-92	Released 10/1/2015 19:53
10/1/2015 22:02:28	1	Graham Lake Approach	-92	
10/1/2015 22:02:30	1	Graham Lake Approach	-90	
10/1/2015 22:02:31	1	Graham Lake Approach	-91	
10/1/2015 22:05:24	4	Graham Lake Gate 2	-73	Graham Lake Passage
10/1/2015 22:05:25	4	Graham Lake Gate 2	-72	
10/1/2015 22:05:27	4	Graham Lake Gate 2	-59	
10/1/2015 22:05:28	4	Graham Lake Gate 2	-75	
10/2/2015 0:09:04	5	Downstream Station #1	-76	
10/2/2015 0:09:05	5	Downstream Station #1	-75	
10/2/2015 0:09:06	5	Downstream Station #1	-76	
10/2/2015 0:09:07	5	Downstream Station #1	-76	
10/2/2015 1:12:21	6	Ellsworth Approach	-85	
10/2/2015 1:12:22	6	Ellsworth Approach	-87	
10/2/2015 1:12:23	6	Ellsworth Approach	-88	
10/2/2015 1:12:25	6	Ellsworth Approach	-93	
10/2/2015 1:26:11	10	Ellsworth Unit 2	-57	Ellsworth Dam Passage
10/2/2015 1:26:12	10	Ellsworth Unit 2	-57	
10/2/2015 1:26:13	10	Ellsworth Unit 2	-56	
10/2/2015 1:26:14	10	Ellsworth Unit 2	-60	
10/2/2015 1:26:40	13	Ellsworth Tailrace	-63	
10/2/2015 1:26:41	13	Ellsworth Tailrace	-61	
10/2/2015 1:26:43	13	Ellsworth Tailrace	-64	
10/2/2015 1:26:44	13	Ellsworth Tailrace	-61	
10/6/2015 12:33:01	14	Downstream Station #2	-77	
10/6/2015 12:33:02	14	Downstream Station #2	-75	
10/6/2015 12:33:03	14	Downstream Station #2	-80	
10/6/2015 12:33:04	14	Downstream Station #2	-78	
10/6/2015 12:40:12	15	Downstream Station #3	151	
10/6/2015 12:40:22	15	Downstream Station #3	151	
10/6/2015 12:40:29	15	Downstream Station #3	151	
10/6/2015 12:40:39	15	Downstream Station #3	156	
10/6/2015 12:56:11	16	Downstream Station #4	193	
10/6/2015 12:56:20	16	Downstream Station #4	189	
10/6/2015 12:56:29	16	Downstream Station #4	171	Successful Passage
10/6/2015 12:56:38	16	Downstream Station #4	254	
10/6/2015 12:56:46	16	Downstream Station #4	253	
10/21/2015		Marina – manual tracking		Mortality

TABLE C15. PASSAGE SUMMARY FOR EEL 149.460 120

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/2/2015 1:16:40	1	Graham Lake Approach	-93	Released 10/1/2015 19:53
10/2/2015 1:16:41	1	Graham Lake Approach	-92	
10/2/2015 1:16:42	1	Graham Lake Approach	-94	
10/2/2015 1:16:44	1	Graham Lake Approach	-90	
10/2/2015 1:20:43	4	Graham Lake Gate 2	-71	Graham Lake Passage
10/2/2015 1:20:45	4	Graham Lake Gate 2	-71	
10/2/2015 1:20:47	4	Graham Lake Gate 2	-71	
10/2/2015 1:20:48	4	Graham Lake Gate 2	-72	
10/2/2015 3:00:51	5	Downstream Station #1	-75	
10/2/2015 3:00:52	5	Downstream Station #1	-75	
10/2/2015 3:00:53	5	Downstream Station #1	-75	
10/2/2015 3:00:54	5	Downstream Station #1	-75	
10/2/2015 3:00:55	5	Downstream Station #1	-75	
10/2/2015 20:59:18	6	Ellsworth Approach	-86	
10/2/2015 20:59:19	6	Ellsworth Approach	-84	
10/2/2015 20:59:20	6	Ellsworth Approach	-83	
10/2/2015 20:59:21	6	Ellsworth Approach	-82	
10/2/2015 21:18:06	12	Ellsworth Unit 4	-60	Ellsworth Dam Passage
10/2/2015 21:18:07	12	Ellsworth Unit 4	-58	
10/2/2015 21:18:08	12	Ellsworth Unit 4	-72	
10/2/2015 21:18:47	13	Ellsworth Tailrace	-72	
10/2/2015 21:18:50	13	Ellsworth Tailrace	-78	
10/2/2015 21:20:38	14	Downstream Station #2	-79	
10/2/2015 21:20:41	14	Downstream Station #2	-77	
10/2/2015 21:20:42	14	Downstream Station #2	-79	
10/2/2015 21:20:43	14	Downstream Station #2	-79	
10/2/2015 21:22:45	15	Downstream Station #3	117	
10/2/2015 21:22:53	15	Downstream Station #3	130	
10/2/2015 21:23:03	15	Downstream Station #3	139	
10/2/2015 21:23:11	15	Downstream Station #3	156	
10/2/2015 21:23:21	15	Downstream Station #3	150	
10/2/2015 21:27:22	16	Downstream Station #4	198	
10/2/2015 21:27:30	16	Downstream Station #4	243	Successful Passage
10/2/2015 21:27:39	16	Downstream Station #4	197	
10/2/2015 21:27:48	16	Downstream Station #4	138	

TABLE C16. PASSAGE SUMMARY FOR EEL 149.320 130

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/8/2015 20:36:32	1	Graham Lake Approach	-87	Released 10/8/2015 18:56
10/8/2015 20:36:33	1	Graham Lake Approach	-87	
10/8/2015 20:36:34	1	Graham Lake Approach	-87	
10/8/2015 20:36:35	1	Graham Lake Approach	-86	
10/8/2015 20:38:42	3	Graham Lake Min Flow Gate 3	-94	Graham Lake Passage
10/8/2015 20:38:46	3	Graham Lake Min Flow Gate 3	-92	
10/8/2015 22:44:18	5	Downstream Station #1	-89	
10/8/2015 22:44:19	5	Downstream Station #1	-88	
10/8/2015 22:44:20	5	Downstream Station #1	-88	
10/8/2015 22:44:21	5	Downstream Station #1	-88	
10/10/2015 0:52:06	6	Ellsworth Approach	-95	
10/10/2015 0:52:07	6	Ellsworth Approach	-90	
10/10/2015 0:52:09	6	Ellsworth Approach	-91	
10/10/2015 0:52:10	6	Ellsworth Approach	-84	
10/10/2015 1:01:48	11	Ellsworth Unit 3	-57	Ellsworth Dam Passage
10/10/2015 1:01:49	11	Ellsworth Unit 3	-57	
10/10/2015 1:02:11	13	Ellsworth Tailrace	-60	
10/10/2015 1:02:12	13	Ellsworth Tailrace	-60	
10/10/2015 1:02:13	13	Ellsworth Tailrace	-60	
10/10/2015 1:02:14	13	Ellsworth Tailrace	-64	
10/10/2015 1:04:31	14	Downstream Station #2	-70	
10/10/2015 1:04:32	14	Downstream Station #2	-76	
10/10/2015 1:04:35	14	Downstream Station #2	-80	
10/10/2015 1:04:42	14	Downstream Station #2	-69	
10/10/2015 1:04:49	14	Downstream Station #2	-75	
10/10/2015 1:04:50	14	Downstream Station #2	-75	
10/10/2015 1:06:38	15	Downstream Station #3	131	
10/10/2015 1:06:56	15	Downstream Station #3	117	
10/10/2015 1:07:13	15	Downstream Station #3	145	
10/10/2015 1:09:42	16	Downstream Station #4	117	
10/10/2015 1:09:49	16	Downstream Station #4	151	
10/10/2015 1:09:59	16	Downstream Station #4	255	
10/10/2015 1:10:07	16	Downstream Station #4	254	
10/10/26/2015		Marina – manual tracking		Mortality

TABLE C17. PASSAGE SUMMARY FOR EEL 149.320 135

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/8/2015 21:48:39	1	Graham Lake Approach	-80	Released 10/8/2015 18:56
10/8/2015 21:48:40	1	Graham Lake Approach	-79	
10/8/2015 21:48:41	1	Graham Lake Approach	-79	
10/8/2015 21:48:42	1	Graham Lake Approach	-80	
10/8/2015 21:50:18	3	Graham Lake Gate 3	-93	Graham Lake Passage
10/8/2015 21:50:26	3	Graham Lake Gate 3	-89	
10/8/2015 23:42:23	5	Downstream Station #1	-82	
10/8/2015 23:42:24	5	Downstream Station #1	-82	
10/8/2015 23:42:26	5	Downstream Station #1	-84	
10/8/2015 23:42:27	5	Downstream Station #1	-82	
10/9/2015 1:19:13	6	Ellsworth Approach	-82	
10/9/2015 1:19:14	6	Ellsworth Approach	-84	
10/9/2015 1:19:15	6	Ellsworth Approach	-82	
10/9/2015 1:19:16	6	Ellsworth Approach	-83	
10/9/2015 1:25:40	12	Ellsworth Unit 4	-64	Ellsworth Dam Passage
10/9/2015 1:25:41	12	Ellsworth Unit 4	-59	
10/9/2015 1:25:42	12	Ellsworth Unit 4	-59	
10/9/2015 1:25:43	12	Ellsworth Unit 4	-60	
10/9/2015 1:26:55	13	Ellsworth Tailrace	-77	
10/9/2015 1:26:56	13	Ellsworth Tailrace	-68	
10/9/2015 1:26:57	13	Ellsworth Tailrace	-67	
10/9/2015 1:26:59	13	Ellsworth Tailrace	-69	
10/9/2015 1:29:15	14	Downstream Station #2	-80	
10/9/2015 1:29:19	14	Downstream Station #2	-77	
10/9/2015 1:29:20	14	Downstream Station #2	-70	
10/9/2015 1:29:23	14	Downstream Station #2	-74	
10/9/2015 1:34:02	15	Downstream Station #3	140	
10/9/2015 1:34:12	15	Downstream Station #3	149	
10/9/2015 1:34:20	15	Downstream Station #3	150	
10/9/2015 1:34:29	15	Downstream Station #3	136	
10/9/2015 1:40:10	16	Downstream Station #4	192	
10/9/2015 1:40:28	16	Downstream Station #4	135	
10/9/2015 1:40:37	16	Downstream Station #4	159	Successful Passage
10/9/2015 1:40:46	16	Downstream Station #4	119	
10/9/2015 1:40:54	16	Downstream Station #4	132	

TABLE C18. PASSAGE SUMMARY FOR EEL 149.320 140

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/14/2015 19:33:35	1	Graham Lake Approach	-85	Released 10/8/2015 18:56
10/14/2015 19:33:36	1	Graham Lake Approach	-85	
10/14/2015 19:33:38	1	Graham Lake Approach	-85	
10/14/2015 19:33:39	1	Graham Lake Approach	-84	
10/14/2015 19:33:40	1	Graham Lake Approach	-84	
10/14/2015 22:02:42	5	Downstream Station #1	-79	Passage – Unknown Route
10/14/2015 22:02:43	5	Downstream Station #1	-79	
10/14/2015 22:02:44	5	Downstream Station #1	-82	
10/14/2015 22:02:45	5	Downstream Station #1	-84	
10/14/2015 23:14:29	6	Ellsworth Approach	-76	
10/14/2015 23:14:30	6	Ellsworth Approach	-79	
10/14/2015 23:14:31	6	Ellsworth Approach	-76	
10/14/2015 23:14:32	6	Ellsworth Approach	-64	
10/14/2015 23:14:34	6	Ellsworth Approach	-71	
10/14/2015 23:25:47	11	Ellsworth Unit 3	-57	Ellsworth Dam Passage
10/14/2015 23:25:49	11	Ellsworth Unit 3	-58	
10/14/2015 23:25:50	11	Ellsworth Unit 3	-57	
10/14/2015 23:28:10	14	Downstream Station #2	-77	
10/14/2015 23:28:11	14	Downstream Station #2	-76	
10/14/2015 23:28:13	14	Downstream Station #2	-73	
10/14/2015 23:28:14	14	Downstream Station #2	-73	
10/14/2015 23:31:27	15	Downstream Station #3	143	
10/14/2015 23:31:36	15	Downstream Station #3	138	
10/14/2015 23:31:45	15	Downstream Station #3	139	
10/14/2015 23:31:54	15	Downstream Station #3	149	
10/14/2015 23:32:04	15	Downstream Station #3	139	
10/14/2015 23:36:35	16	Downstream Station #4	174	
10/14/2015 23:36:44	16	Downstream Station #4	164	
10/14/2015 23:36:53	16	Downstream Station #4	191	Successful Passage
10/14/2015 23:36:54	16	Downstream Station #4	216	
10/14/2015 23:37:03	16	Downstream Station #4	161	
10/14/2015 23:37:11	16	Downstream Station #4	255	

TABLE C19. PASSAGE SUMMARY FOR EEL 149.340 145

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/8/2015 21:01:09	1	Graham Lake Approach	-78	Released 10/8/2015 18:56
10/8/2015 21:01:10	1	Graham Lake Approach	-77	
10/8/2015 21:01:11	1	Graham Lake Approach	-77	
10/8/2015 21:01:12	1	Graham Lake Approach	-77	
10/8/2015 21:01:13	1	Graham Lake Approach	-77	
10/8/2015 21:01:14	1	Graham Lake Approach	-78	
10/8/2015 23:16:02	5	Downstream Station #1	-86	Passage – Unknown Route
10/8/2015 23:16:03	5	Downstream Station #1	-87	
10/8/2015 23:16:04	5	Downstream Station #1	-86	
10/8/2015 23:16:06	5	Downstream Station #1	-86	
10/9/2015 2:43:54	6	Ellsworth Approach	-64	
10/9/2015 2:43:55	6	Ellsworth Approach	-63	
10/9/2015 2:43:56	6	Ellsworth Approach	-62	
10/9/2015 2:43:57	6	Ellsworth Approach	-62	
10/9/2015 2:43:58	6	Ellsworth Approach	-63	
10/9/2015 2:43:59	6	Ellsworth Approach	-64	
10/10/2015 4:47:18	11	Ellsworth Unit 3	-57	
10/10/2015 4:47:42	13	Ellsworth Tailrace	-67	Ellsworth Dam Passage
10/10/2015 4:47:43	13	Ellsworth Tailrace	-67	
10/10/2015 4:47:44	13	Ellsworth Tailrace	-63	
10/10/2015 4:47:45	13	Ellsworth Tailrace	-64	
10/10/2015 12:14:18	14	Downstream Station #2	-77	
10/10/2015 12:14:19	14	Downstream Station #2	-79	
10/10/2015 12:14:21	14	Downstream Station #2	-76	
10/10/2015 19:53:37	15	Downstream Station #3	134	
10/10/2015 19:53:45	15	Downstream Station #3	135	
10/10/2015 19:53:55	15	Downstream Station #3	138	
10/10/2015 19:53:56	15	Downstream Station #3	160	
10/11/2015 2:09:17	16	Downstream Station #4	235	
10/11/2015 2:09:18	16	Downstream Station #4	224	
10/11/2015 2:09:28	16	Downstream Station #4	252	
10/11/2015 2:09:35	16	Downstream Station #4	246	
10/11/2015 2:09:45	16	Downstream Station #4	238	
10/16/2015		Marina – manual tracking		Mortality

TABLE C20. PASSAGE SUMMARY FOR EEL 149.340 150

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/11/2015 5:15:06	1	Graham Lake Approach	-83	Released 10/8/2015 18:56
10/11/2015 5:15:07	1	Graham Lake Approach	-84	
10/11/2015 5:15:08	1	Graham Lake Approach	-86	
10/11/2015 5:15:09	1	Graham Lake Approach	-85	
10/11/2015 7:41:32	5	Downstream Station #1	-83	Passage – Unknown Route
10/11/2015 7:41:33	5	Downstream Station #1	-81	
10/11/2015 7:41:34	5	Downstream Station #1	-80	
10/11/2015 7:41:35	5	Downstream Station #1	-80	
10/11/2015 7:41:36	5	Downstream Station #1	-80	
10/11/2015 9:22:51	6	Ellsworth Approach	-98	
10/11/2015 9:22:54	6	Ellsworth Approach	-98	
10/11/2015 9:23:02	6	Ellsworth Approach	-95	
10/11/2015 9:23:10	6	Ellsworth Approach	-100	
10/11/2015 18:14:51	12	Ellsworth Unit 4	-61	Ellsworth Dam Passage
10/11/2015 18:14:52	12	Ellsworth Unit 4	-59	
10/11/2015 18:14:53	12	Ellsworth Unit 4	-60	
10/11/2015 18:14:54	12	Ellsworth Unit 4	-61	
10/11/2015 18:15:41	13	Ellsworth Tailrace	-64	
10/11/2015 18:15:42	13	Ellsworth Tailrace	-63	
10/11/2015 18:15:43	13	Ellsworth Tailrace	-67	
10/11/2015 18:15:44	13	Ellsworth Tailrace	-66	
10/11/2015 18:22:37	14	Downstream Station #2	-64	
10/11/2015 18:22:38	14	Downstream Station #2	-67	
10/11/2015 18:22:39	14	Downstream Station #2	-72	
10/11/2015 18:22:40	14	Downstream Station #2	-70	
10/11/2015 18:22:41	14	Downstream Station #2	-67	
10/11/2015 18:25:41	15	Downstream Station #3	130	
10/11/2015 18:25:51	15	Downstream Station #3	131	
10/11/2015 18:26:00	15	Downstream Station #3	150	
10/11/2015 18:26:10	15	Downstream Station #3	140	
10/11/2015 18:26:18	15	Downstream Station #3	138	
10/11/2015 18:29:05	16	Downstream Station #4	159	
10/11/2015 18:29:14	16	Downstream Station #4	154	Successful Passage
10/11/2015 18:29:23	16	Downstream Station #4	129	
10/11/2015 18:29:33	16	Downstream Station #4	135	

TABLE C21. PASSAGE SUMMARY FOR EEL 149.340 160

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/9/2015 20:15:49	1	Graham Lake Approach	-93	Released 10/8/2015 18:56
10/9/2015 20:15:50	1	Graham Lake Approach	-93	
10/9/2015 20:15:51	1	Graham Lake Approach	-90	
10/9/2015 20:15:52	1	Graham Lake Approach	-90	
10/9/2015 20:15:54	1	Graham Lake Approach	-86	
10/9/2015 20:18:42	4	Graham Lake Gate 2	-69	Graham Lake Passage
10/9/2015 20:18:43	4	Graham Lake Gate 2	-70	
10/9/2015 22:29:33	5	Downstream Station #1	-89	
10/9/2015 22:29:34	5	Downstream Station #1	-91	
10/9/2015 22:29:35	5	Downstream Station #1	-94	
10/9/2015 22:29:36	5	Downstream Station #1	-95	
10/11/2015 19:26:33	6	Ellsworth Approach	-89	
10/11/2015 19:26:34	6	Ellsworth Approach	-90	
10/11/2015 19:26:35	6	Ellsworth Approach	-86	
10/11/2015 19:26:36	6	Ellsworth Approach	-84	
10/11/2015 19:26:37	6	Ellsworth Approach	-85	
10/24/2015 19:14:57	11	Ellsworth Unit 3	-70	Ellsworth Dam Passage
10/24/2015 19:14:59	11	Ellsworth Unit 3	-57	
10/24/2015 19:15:00	11	Ellsworth Unit 3	-57	
10/24/2015 19:15:02	11	Ellsworth Unit 3	-57	
10/24/2015 19:15:04	11	Ellsworth Unit 3	-65	
10/24/2015 19:15:50	13	Ellsworth Tailrace	-72	
10/24/2015 19:15:51	13	Ellsworth Tailrace	-68	
10/24/2015 19:15:52	13	Ellsworth Tailrace	-76	
10/24/2015 19:15:55	13	Ellsworth Tailrace	-64	
10/24/2015 19:15:56	13	Ellsworth Tailrace	-67	
10/24/2015 19:15:57	13	Ellsworth Tailrace	-65	
11/12/2015 11:30:14		Manual Tracking Near Tailrace	205	Mortality
11/12/2015 11:30:24		Manual Tracking Near Tailrace	254	
11/12/2015 11:30:34		Manual Tracking Near Tailrace	255	
11/12/2015 11:30:44		Manual Tracking Near Tailrace	204	
11/12/2015 11:30:54		Manual Tracking Near Tailrace	203	

TABLE C22. PASSAGE SUMMARY FOR EEL 149.400 165

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/9/2015 22:26:18	1	Graham Lake Approach	-86	Released 10/8/2015 18:56
10/9/2015 22:26:19	1	Graham Lake Approach	-83	
10/9/2015 22:26:20	1	Graham Lake Approach	-83	
10/9/2015 22:26:21	1	Graham Lake Approach	-83	
10/9/2015 22:26:22	1	Graham Lake Approach	-86	
10/10/2015 7:16:09	5	Downstream Station #1	-85	Passage – Unknown Route
10/10/2015 7:16:10	5	Downstream Station #1	-82	
10/10/2015 7:16:11	5	Downstream Station #1	-81	
10/10/2015 7:16:12	5	Downstream Station #1	-84	
10/10/2015 7:16:13	5	Downstream Station #1	-85	
10/12/2015 2:00:58	6	Ellsworth Approach	-83	
10/12/2015 2:00:59	6	Ellsworth Approach	-87	
10/12/2015 2:01:00	6	Ellsworth Approach	-79	
10/12/2015 2:01:01	6	Ellsworth Approach	-79	
10/12/2015 2:01:04	6	Ellsworth Approach	-68	
10/16/2015 17:42:20	10	Ellsworth Unit 2	-70	Ellsworth Dam Passage
10/16/2015 17:42:22	10	Ellsworth Unit 2	-57	
10/16/2015 17:42:43	13	Ellsworth Tailrace	-68	
10/16/2015 17:42:47	13	Ellsworth Tailrace	-62	
10/16/2015 17:42:50	13	Ellsworth Tailrace	-63	
10/16/2015 17:42:55	13	Ellsworth Tailrace	-65	
10/16/2015 17:42:56	13	Ellsworth Tailrace	-68	
10/16/2015 18:11:17	14	Downstream Station #2	-79	
10/16/2015 18:11:18	14	Downstream Station #2	-79	
10/16/2015 18:11:19	14	Downstream Station #2	-80	
10/16/2015 18:11:21	14	Downstream Station #2	-79	
10/16/2015 18:11:22	14	Downstream Station #2	-80	
10/17/2015 18:51:59	15	Downstream Station #3	130	
10/17/2015 18:52:08	15	Downstream Station #3	132	
10/17/2015 18:52:17	15	Downstream Station #3	138	
10/17/2015 18:52:26	15	Downstream Station #3	124	
10/17/2015 18:52:34	15	Downstream Station #3	136	
10/20/2015 13:17:38	16	Downstream Station #4	214	
10/20/2015 13:17:48	16	Downstream Station #4	118	
10/20/2015 13:17:55	16	Downstream Station #4	252	
10/20/2015 13:18:05	16	Downstream Station #4	225	
11/5/2015		Marina – manual tracking		Mortality

TABLE C23. PASSAGE SUMMARY FOR EEL 149.400 170

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/9/2015 1:19:35	1	Graham Lake Approach	-77	Released 10/8/2015 18:56
10/9/2015 1:19:36	1	Graham Lake Approach	-80	
10/9/2015 1:19:39	1	Graham Lake Approach	-92	
10/9/2015 1:19:41	1	Graham Lake Approach	-92	
10/9/2015 1:19:42	1	Graham Lake Approach	-90	
10/9/2015 1:21:25	3	Graham Lake Gate 3	-85	
10/9/2015 1:21:26	3	Graham Lake Gate 3	-82	Passage Graham Lake
10/9/2015 1:21:28	3	Graham Lake Gate 3	-83	
10/9/2015 1:21:34	3	Graham Lake Gate 3	-73	
10/9/2015 1:21:36	3	Graham Lake Gate 3	-91	
10/9/2015 1:21:37	3	Graham Lake Gate 3	-91	
10/9/2015 3:25:38	5	Downstream Station #1	-84	
10/9/2015 3:25:39	5	Downstream Station #1	-86	
10/9/2015 3:25:40	5	Downstream Station #1	-85	
10/9/2015 3:25:41	5	Downstream Station #1	-85	
10/9/2015 3:25:42	5	Downstream Station #1	-84	
10/9/2015 3:25:43	5	Downstream Station #1	-86	
10/9/2015 3:25:44	5	Downstream Station #1	-86	
10/9/2015 19:18:28	6	Ellsworth Approach	-93	
10/9/2015 19:18:29	6	Ellsworth Approach	-87	
10/9/2015 19:18:30	6	Ellsworth Approach	-85	
10/9/2015 19:18:31	6	Ellsworth Approach	-90	
10/9/2015 19:18:32	6	Ellsworth Approach	-90	
10/9/2015 19:18:33	6	Ellsworth Approach	-93	
10/9/2015 19:41:59	10	Ellsworth Unit 2	-74	
10/9/2015 19:42:01	10	Ellsworth Unit 2	-69	Passage Ellsworth Dam
10/9/2015 19:42:07	10	Ellsworth Unit 2	-59	
10/9/2015 22:41:34	13	Ellsworth Tailrace	-64	
10/9/2015 22:41:35	13	Ellsworth Tailrace	-64	
10/9/2015 22:41:37	13	Ellsworth Tailrace	-68	
10/9/2015 22:41:39	13	Ellsworth Tailrace	-64	
10/9/2015 22:41:40	13	Ellsworth Tailrace	-68	
10/9/2015 22:41:41	13	Ellsworth Tailrace	-69	
11/1/2015 11:03:06	13	Ellsworth Tailrace	-64	Mortality in Tailrace
11/1/2015 11:03:16	13	Ellsworth Tailrace	-66	
11/1/2015 11:03:26	13	Ellsworth Tailrace	-63	
11/1/2015 11:03:36	13	Ellsworth Tailrace	-64	
11/1/2015 11:03:46	13	Ellsworth Tailrace	-64	
11/1/2015 11:03:56	13	Ellsworth Tailrace	-63	

TABLE C24. PASSAGE SUMMARY FOR EEL 149.400 175

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/10/2015 3:22:08	1	Graham Lake Approach	-76	Released 10/8/2015 18:56
10/10/2015 3:22:09	1	Graham Lake Approach	-77	
10/10/2015 3:22:10	1	Graham Lake Approach	-73	
10/10/2015 3:22:11	1	Graham Lake Approach	-74	
10/10/2015 3:22:12	1	Graham Lake Approach	-74	
10/10/2015 3:28:07	3	Graham Lake Gate 3	-69	Graham Lake Passage
10/10/2015 5:05:31	5	Downstream Station #1	-86	
10/10/2015 5:05:32	5	Downstream Station #1	-87	
10/10/2015 5:05:33	5	Downstream Station #1	-85	
10/10/2015 5:05:34	5	Downstream Station #1	-85	
10/10/2015 5:05:35	5	Downstream Station #1	-88	
10/10/2015 5:44:22	6	Ellsworth Approach	-93	
10/10/2015 5:44:23	6	Ellsworth Approach	-95	
10/10/2015 5:44:24	6	Ellsworth Approach	-95	
10/10/2015 5:44:25	6	Ellsworth Approach	-91	
10/10/2015 5:44:26	6	Ellsworth Approach	-97	
10/10/2015 19:01:39	11	Ellsworth Unit 3	-58	Ellsworth Dam Passage
10/10/2015 19:01:40	11	Ellsworth Unit 3	-59	
10/10/2015 19:01:41	11	Ellsworth Unit 3	-58	
10/10/2015 19:02:05	13	Ellsworth Tailrace	-63	
10/10/2015 19:02:07	13	Ellsworth Tailrace	-68	
10/10/2015 19:02:08	13	Ellsworth Tailrace	-68	
10/10/2015 19:02:09	13	Ellsworth Tailrace	-64	
10/11/2015 13:10:51	14	Downstream Station #2	-64	
10/11/2015 13:10:52	14	Downstream Station #2	-79	
10/11/2015 13:10:53	14	Downstream Station #2	-75	
10/11/2015 13:10:55	14	Downstream Station #2	-60	
10/11/2015 13:22:50	15	Downstream Station #3	132	
10/11/2015 13:23:00	15	Downstream Station #3	145	
10/11/2015 13:23:25	15	Downstream Station #3	136	
10/11/2015 13:23:54	15	Downstream Station #3	142	
10/11/2015 13:24:02	15	Downstream Station #3	143	
10/11/2015 14:48:31	16	Downstream Station #4	169	
10/11/2015 14:48:40	16	Downstream Station #4	219	Successful Passage
10/11/2015 14:48:49	16	Downstream Station #4	251	
10/11/2015 14:48:50	16	Downstream Station #4	254	

TABLE C25. PASSAGE SUMMARY FOR EEL 149.400 180

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/9/2015 20:41:23	1	Graham Lake Approach	-88	Released 10/8/2015 18:56
10/9/2015 20:41:24	1	Graham Lake Approach	-89	
10/9/2015 20:41:26	1	Graham Lake Approach	-86	
10/9/2015 20:41:27	1	Graham Lake Approach	-88	
10/9/2015 20:41:28	1	Graham Lake Approach	-87	
10/9/2015 20:41:29	1	Graham Lake Approach	-87	
10/9/2015 20:41:30	1	Graham Lake Approach	-90	
10/9/2015 20:41:31	1	Graham Lake Approach	-89	
10/9/2015 20:41:32	1	Graham Lake Approach	-91	
10/9/2015 21:03:23	3	Graham Lake Gate 3	-64	Graham Lake Passage
10/9/2015 21:03:24	3	Graham Lake Gate 3	-72	
10/9/2015 21:03:31	3	Graham Lake Gate 3	-67	
10/9/2015 21:03:39	3	Graham Lake Gate 3	-68	
10/9/2015 23:22:20	5	Downstream Station #1	-92	
10/9/2015 23:22:21	5	Downstream Station #1	-92	
10/9/2015 23:22:22	5	Downstream Station #1	-90	
10/9/2015 23:22:23	5	Downstream Station #1	-86	
10/9/2015 23:22:24	5	Downstream Station #1	-87	
10/9/2015 23:22:26	5	Downstream Station #1	-86	
10/9/2015 23:22:27	5	Downstream Station #1	-84	
10/9/2015 23:58:21	6	Ellsworth Approach	-98	
10/9/2015 23:59:29	6	Ellsworth Approach	-84	
10/9/2015 23:59:30	6	Ellsworth Approach	-86	
10/9/2015 23:59:31	6	Ellsworth Approach	-91	
10/10/2015 0:11:25	11	Ellsworth Unit 3	-58	Ellsworth Dam Passage
10/10/2015 0:11:26	11	Ellsworth Unit 3	-58	
10/10/2015 0:11:27	11	Ellsworth Unit 3	-57	Last Detection - Mortality

TABLE C26. PASSAGE SUMMARY FOR EEL 149.460 185

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/10/2015 3:17:45	1	Graham Lake Approach	-92	Released 10/8/2015 18:56
10/10/2015 3:17:46	1	Graham Lake Approach	-89	
10/10/2015 3:17:47	1	Graham Lake Approach	-87	
10/10/2015 3:17:48	1	Graham Lake Approach	-89	
10/10/2015 3:17:49	1	Graham Lake Approach	-89	
10/10/2015 3:17:50	1	Graham Lake Approach	-89	
10/10/2015 3:19:29	4	Graham Lake Gate 2	-64	Graham Lake Passage
10/25/2015 18:44:18	5	Downstream Station #1	-91	
10/25/2015 18:44:28	5	Downstream Station #1	-80	
10/25/2015 18:44:38	5	Downstream Station #1	-79	
10/25/2015 18:44:48	5	Downstream Station #1	-80	
10/25/2015 18:44:58	5	Downstream Station #1	-83	
10/25/2015 20:03:48	6	Ellsworth Approach	-99	
10/25/2015 20:06:58	6	Ellsworth Approach	-95	
10/25/2015 20:17:06	13	Ellsworth Tailrace	-66	Passage – Unknown Route
10/25/2015 20:17:07	13	Ellsworth Tailrace	-70	
10/25/2015 20:17:08	13	Ellsworth Tailrace	-70	
10/25/2015 20:17:09	13	Ellsworth Tailrace	-67	
10/25/2015 20:17:12	13	Ellsworth Tailrace	-70	
10/25/2015 20:26:07	14	Downstream Station #2	-73	
10/25/2015 20:26:08	14	Downstream Station #2	-71	
10/25/2015 20:26:10	14	Downstream Station #2	-69	
10/25/2015 20:26:11	14	Downstream Station #2	-78	
10/25/2015 20:26:12	14	Downstream Station #2	-77	
10/25/2015 20:31:17	15	Downstream Station #3	129	
10/25/2015 20:31:35	15	Downstream Station #3	129	
10/25/2015 20:32:10	15	Downstream Station #3	122	
10/25/2015 20:32:37	15	Downstream Station #3	128	
10/25/2015 20:40:30	16	Downstream Station #4	248	
10/25/2015 20:40:39	16	Downstream Station #4	218	
10/25/2015 20:40:48	16	Downstream Station #4	184	Successful Passage
10/25/2015 20:40:58	16	Downstream Station #4	255	
10/25/2015 20:41:06	16	Downstream Station #4	239	

TABLE C27. PASSAGE SUMMARY FOR EEL 149.460 190

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/9/2015 5:32:02	1	Graham Lake Approach	-81	Released 10/8/2015 18:56
10/9/2015 5:32:03	1	Graham Lake Approach	-80	
10/9/2015 5:32:04	1	Graham Lake Approach	-80	
10/9/2015 5:32:05	1	Graham Lake Approach	-82	
10/9/2015 5:32:07	1	Graham Lake Approach	-82	
10/9/2015 20:08:29	5	Downstream Station #1	-86	Passage – Unknown Route
10/9/2015 20:08:30	5	Downstream Station #1	-90	
10/9/2015 20:08:31	5	Downstream Station #1	-94	
10/9/2015 20:08:32	5	Downstream Station #1	-89	
10/9/2015 20:08:33	5	Downstream Station #1	-93	
10/9/2015 22:47:09	6	Ellsworth Approach	-90	
10/9/2015 22:47:10	6	Ellsworth Approach	-90	
10/9/2015 22:47:11	6	Ellsworth Approach	-90	
10/9/2015 22:47:12	6	Ellsworth Approach	-92	
10/9/2015 22:47:13	6	Ellsworth Approach	-91	
10/16/2015 3:09:44	11	Ellsworth Unit 3	-58	Ellsworth Dam Passage
10/16/2015 3:09:47	11	Ellsworth Unit 3	-58	
10/16/2015 3:10:09	13	Ellsworth Tailrace	-70	
10/16/2015 3:10:10	13	Ellsworth Tailrace	-66	
10/16/2015 3:10:11	13	Ellsworth Tailrace	-76	
10/16/2015 3:10:14	13	Ellsworth Tailrace	-79	
10/16/2015 3:12:16	14	Downstream Station #2	-77	
10/16/2015 3:12:17	14	Downstream Station #2	-80	
10/16/2015 3:12:18	14	Downstream Station #2	-78	
10/16/2015 3:12:19	14	Downstream Station #2	-76	
10/16/2015 3:14:48	15	Downstream Station #3	146	
10/16/2015 3:14:57	15	Downstream Station #3	146	
10/16/2015 3:15:07	15	Downstream Station #3	165	
10/16/2015 3:15:15	15	Downstream Station #3	142	
10/16/2015 3:15:24	15	Downstream Station #3	170	
10/16/2015 3:56:54	16	Downstream Station #4	242	
10/16/2015 3:57:04	16	Downstream Station #4	239	
10/16/2015 3:57:12	16	Downstream Station #4	238	
10/16/2015 3:57:22	16	Downstream Station #4	240	
10/16/2015 3:57:29	16	Downstream Station #4	223	
10/21/2015		Marina – manual tracking		Mortality

TABLE C28. PASSAGE SUMMARY FOR EEL 149.460 195

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/9/2015 21:19:14	1	Graham Lake Approach	-73	Released 10/8/2015 18:56
10/9/2015 21:19:15	1	Graham Lake Approach	-73	
10/9/2015 21:19:16	1	Graham Lake Approach	-74	
10/9/2015 21:19:17	1	Graham Lake Approach	-74	
10/9/2015 21:21:28	2	Graham Lake Fishway Weir	-58	Graham Lake Passage
10/9/2015 21:21:31	2	Graham Lake Fishway Weir	-58	
10/9/2015 21:21:32	2	Graham Lake Fishway Weir	-57	
10/9/2015 23:25:19	5	Downstream Station #1	-88	
10/9/2015 23:25:20	5	Downstream Station #1	-94	
10/9/2015 23:25:22	5	Downstream Station #1	-86	
10/9/2015 23:25:23	5	Downstream Station #1	-90	
10/10/2015 0:13:07	6	Ellsworth Approach	-85	
10/10/2015 0:13:08	6	Ellsworth Approach	-75	
10/10/2015 0:13:09	6	Ellsworth Approach	-71	
10/10/2015 0:13:10	6	Ellsworth Approach	-73	
10/10/2015 0:23:09	12	Ellsworth Unit 4	-58	Ellsworth Dam Passage
10/10/2015 0:23:10	12	Ellsworth Unit 4	-58	
10/10/2015 0:23:13	12	Ellsworth Unit 4	-59	
10/10/2015 0:23:14	12	Ellsworth Unit 4	-62	
10/10/2015 0:24:12	13	Ellsworth Tailrace	-60	
10/10/2015 0:24:13	13	Ellsworth Tailrace	-67	
10/10/2015 0:24:18	13	Ellsworth Tailrace	-71	
10/10/2015 0:24:19	13	Ellsworth Tailrace	-64	
10/10/2015 0:26:09	14	Downstream Station #2	-77	
10/10/2015 0:26:10	14	Downstream Station #2	-78	
10/10/2015 0:26:17	14	Downstream Station #2	-80	
10/10/2015 0:26:18	14	Downstream Station #2	-80	
10/10/2015 0:28:51	15	Downstream Station #3	141	
10/10/2015 0:28:59	15	Downstream Station #3	153	
10/10/2015 0:29:07	15	Downstream Station #3	141	
10/10/2015 0:29:16	15	Downstream Station #3	140	
10/10/2015 0:29:25	15	Downstream Station #3	161	
10/10/2015 0:32:06	16	Downstream Station #4	175	
10/10/2015 0:32:25	16	Downstream Station #4	159	
10/10/2015 0:32:35	16	Downstream Station #4	199	
10/10/2015 0:32:43	16	Downstream Station #4	255	
10/10/2015 0:32:53	16	Downstream Station #4	255	
10/21/2015		Marina – manual tracking		Mortality

TABLE C29. PASSAGE SUMMARY FOR EEL 149.460 200

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/9/2015 20:42:49	1	Graham Lake Approach	-83	Released 10/8/2015 18:56
10/9/2015 20:42:50	1	Graham Lake Approach	-84	
10/9/2015 20:42:51	1	Graham Lake Approach	-84	
10/9/2015 20:42:53	1	Graham Lake Approach	-86	
10/9/2015 20:42:54	1	Graham Lake Approach	-92	
10/9/2015 20:42:55	1	Graham Lake Approach	-102	
10/9/2015 20:44:38	2	Graham Lake Fishway Weir	-58	Graham Lake Passage
10/9/2015 20:44:39	2	Graham Lake Fishway Weir	-58	
10/9/2015 20:44:40	2	Graham Lake Fishway Weir	-60	
10/9/2015 20:44:42	2	Graham Lake Fishway Weir	-63	
10/9/2015 20:44:43	2	Graham Lake Fishway Weir	-62	
10/9/2015 23:36:39	5	Downstream Station #1	-86	
10/9/2015 23:36:40	5	Downstream Station #1	-86	
10/9/2015 23:36:41	5	Downstream Station #1	-86	
10/9/2015 23:36:42	5	Downstream Station #1	-88	
10/9/2015 23:36:43	5	Downstream Station #1	-87	
10/10/2015 1:02:58	6	Ellsworth Approach	-97	
10/10/2015 1:02:59	6	Ellsworth Approach	-96	
10/10/2015 1:03:00	6	Ellsworth Approach	-98	
10/10/2015 1:03:01	6	Ellsworth Approach	-98	
10/10/2015 1:03:02	6	Ellsworth Approach	-97	
10/10/2015 1:03:03	6	Ellsworth Approach	-98	
10/10/2015 1:11:50	10	Ellsworth Unit 2	-62	Ellsworth Dam Passage
10/10/2015 1:11:52	10	Ellsworth Unit 2	-72	
10/10/2015 1:11:53	10	Ellsworth Unit 2	-62	
10/10/2015 1:11:54	10	Ellsworth Unit 2	-57	
10/10/2015 1:11:56	10	Ellsworth Unit 2	-56	
10/10/2015 1:12:20	13	Ellsworth Tailrace	-72	
10/10/2015 1:12:21	13	Ellsworth Tailrace	-77	
10/10/2015 1:12:22	13	Ellsworth Tailrace	-64	
10/10/2015 1:12:23	13	Ellsworth Tailrace	-68	
10/10/2015 1:12:27	13	Ellsworth Tailrace	-71	
10/10/2015 1:12:29	13	Ellsworth Tailrace	-69	
10/10/2015 1:15:04	14	Downstream Station #2	-78	
10/10/2015 1:15:05	14	Downstream Station #2	-76	
10/10/2015 1:15:08	14	Downstream Station #2	-78	
10/10/2015 1:15:10	14	Downstream Station #2	-72	
10/10/2015 1:15:11	14	Downstream Station #2	-71	
10/10/2015 1:15:12	14	Downstream Station #2	-75	
10/10/2015 1:17:50	15	Downstream Station #3	116	
10/10/2015 1:17:59	15	Downstream Station #3	130	
10/10/2015 1:18:08	15	Downstream Station #3	123	
10/10/2015 1:18:17	15	Downstream Station #3	142	
10/10/2015 1:18:27	15	Downstream Station #3	135	
10/10/2015 1:18:35	15	Downstream Station #3	134	
10/10/2015 1:18:44	15	Downstream Station #3	124	
10/10/2015 1:20:05	16	Downstream Station #4	136	
10/10/2015 1:20:16	16	Downstream Station #4	125	
10/10/2015 1:26:24	16	Downstream Station #4	185	Successful Passage
10/10/2015 1:26:33	16	Downstream Station #4	127	
10/10/2015 1:26:41	16	Downstream Station #4	201	

TABLE C30. PASSAGE SUMMARY FOR EEL 149.480 205

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/10/2015 0:54:41	1	Graham Lake Approach	-85	Released 10/8/2015 18:56
10/10/2015 0:54:42	1	Graham Lake Approach	-86	
10/10/2015 0:54:43	1	Graham Lake Approach	-87	
10/10/2015 0:54:44	1	Graham Lake Approach	-88	
10/10/2015 3:03:13	5	Downstream #1	-89	Passage – Unknown Route
10/10/2015 3:03:14	5	Downstream #1	-86	
10/10/2015 3:03:15	5	Downstream #1	-86	
10/10/2015 3:03:17	5	Downstream #1	-85	
10/10/2015 4:04:02	6	Ellsworth Approach	-75	
10/10/2015 4:04:03	6	Ellsworth Approach	-71	
10/10/2015 4:04:05	6	Ellsworth Approach	-70	
10/10/2015 4:04:06	6	Ellsworth Approach	-74	
10/10/2015 4:04:07	6	Ellsworth Approach	-70	
10/10/2015 4:12:43	10	Ellsworth Unit 2	-74	Ellsworth Dam Passage
10/10/2015 4:12:46	10	Ellsworth Unit 2	-58	
10/10/2015 4:12:47	10	Ellsworth Unit 2	-56	
10/10/2015 4:13:13	13	Ellsworth Tailrace	-66	
10/10/2015 4:13:14	13	Ellsworth Tailrace	-65	
10/10/2015 4:13:16	13	Ellsworth Tailrace	-71	
10/10/2015 4:13:18	13	Ellsworth Tailrace	-70	
10/10/2015 4:15:46	14	Downstream #2	-71	
10/10/2015 4:15:47	14	Downstream #2	-71	
10/10/2015 4:15:50	14	Downstream #2	-72	
10/10/2015 4:15:51	14	Downstream #2	-79	
10/10/2015 4:18:41	15	Downstream #3	118	
10/10/2015 4:18:50	15	Downstream #3	139	
10/10/2015 4:19:08	15	Downstream #3	156	
10/10/2015 4:19:17	15	Downstream #3	126	
10/10/2015 4:22:29	16	Downstream #4	157	
10/10/2015 4:22:37	16	Downstream #4	164	
10/10/2015 4:22:48	16	Downstream #4	202	
10/10/2015 4:22:56	16	Downstream #4	255	
10/10/2015 4:23:06	16	Downstream #4	250	
10/16/2015		Marina – manual tracking		Mortality

TABLE C31. PASSAGE SUMMARY FOR EEL 149.480 212

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/8/2015 22:00:19	1	Graham Lake Approach	-76	Released 10/8/2015 18:56
10/8/2015 22:00:20	1	Graham Lake Approach	-75	
10/8/2015 22:00:21	1	Graham Lake Approach	-76	
10/8/2015 22:00:22	1	Graham Lake Approach	-77	
10/8/2015 22:00:23	1	Graham Lake Approach	-77	
10/9/2015 0:15:17	5	Downstream #1	-87	Passage – Unknown Route
10/9/2015 0:15:18	5	Downstream #1	-86	
10/9/2015 0:15:19	5	Downstream #1	-85	
10/9/2015 0:15:20	5	Downstream #1	-86	
10/9/2015 2:12:44	6	Ellsworth Approach	-88	
10/9/2015 2:12:45	6	Ellsworth Approach	-88	
10/9/2015 2:12:46	6	Ellsworth Approach	-88	
10/9/2015 2:12:47	6	Ellsworth Approach	-88	
10/9/2015 2:12:48	6	Ellsworth Approach	-87	
10/9/2015 2:27:00	11	Ellsworth Unit 3	-70	Ellsworth Dam Passage
10/9/2015 2:27:02	11	Ellsworth Unit 3	-57	
10/9/2015 2:27:03	11	Ellsworth Unit 3	-57	
10/9/2015 2:27:04	11	Ellsworth Unit 3	-63	
10/9/2015 2:27:44	13	Ellsworth Tailrace	-67	
10/9/2015 2:27:45	13	Ellsworth Tailrace	-62	
10/9/2015 2:27:47	13	Ellsworth Tailrace	-62	
10/9/2015 2:27:48	13	Ellsworth Tailrace	-64	
10/9/2015 2:27:49	13	Ellsworth Tailrace	-64	
10/9/2015 2:30:18	14	Downstream #2	-80	
10/9/2015 2:30:19	14	Downstream #2	-69	
10/9/2015 2:30:20	14	Downstream #2	-68	
10/9/2015 2:30:23	14	Downstream #2	-75	
10/9/2015 2:46:33	15	Downstream #3	165	
10/9/2015 2:46:42	15	Downstream #3	154	
10/9/2015 2:46:50	15	Downstream #3	167	
10/9/2015 2:46:58	15	Downstream #3	176	
10/9/2015 2:47:08	15	Downstream #3	131	
10/9/2015 2:47:21	16	Downstream #4	88	
10/9/2015 2:52:28	16	Downstream #4	203	
10/9/2015 2:52:35	16	Downstream #4	175	Successful Passage
10/9/2015 2:52:44	16	Downstream #4	105	
10/9/2015 2:52:45	16	Downstream #4	255	

TABLE C32. PASSAGE SUMMARY FOR EEL 149.480 207

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/10/2015 7:34:14	1	Graham Lake Approach	-93	Released 10/8/2015 18:56
10/10/2015 7:34:24	1	Graham Lake Approach	-101	
10/10/2015 7:34:34	1	Graham Lake Approach	-94	
10/10/2015 7:34:44	1	Graham Lake Approach	-94	
10/10/2015 7:49:31	2	Graham Lake Fishway Weir	-58	Graham Lake Passage
10/10/2015 7:49:32	2	Graham Lake Fishway Weir	-59	
10/10/2015 7:49:33	2	Graham Lake Fishway Weir	-57	
10/11/2015 20:57:18	5	Downstream #1	-89	
10/11/2015 20:57:19	5	Downstream #1	-91	
10/11/2015 20:57:21	5	Downstream #1	-85	
10/11/2015 20:57:22	5	Downstream #1	-90	
10/16/2015 19:28:52	6	Ellsworth Approach	-87	
10/16/2015 19:28:53	6	Ellsworth Approach	-92	
10/16/2015 19:28:54	6	Ellsworth Approach	-78	
10/16/2015 19:28:55	6	Ellsworth Approach	-92	
10/16/2015 19:28:56	6	Ellsworth Approach	-91	
10/18/2015 22:22:17	11	Ellsworth Unit 3	-69	Ellsworth Dam Passage
10/18/2015 22:22:19	11	Ellsworth Unit 3	-58	
10/18/2015 22:22:20	11	Ellsworth Unit 3	-57	
10/18/2015 22:22:21	11	Ellsworth Unit 3	-58	
10/18/2015 22:25:53	14	Downstream #2	-75	
10/18/2015 22:25:54	14	Downstream #2	-69	
10/18/2015 22:25:55	14	Downstream #2	-71	
10/18/2015 22:25:58	14	Downstream #2	-72	
10/18/2015 22:25:59	14	Downstream #2	-71	
10/19/2015 2:58:12	15	Downstream #3	162	
10/19/2015 2:58:22	15	Downstream #3	166	
10/19/2015 2:58:29	15	Downstream #3	160	
10/19/2015 2:58:39	15	Downstream #3	188	
10/19/2015 2:58:47	15	Downstream #3	171	
10/19/2015 3:04:15	16	Downstream #4	139	
10/19/2015 3:04:33	16	Downstream #4	157	
10/19/2015 3:04:41	16	Downstream #4	254	Successful Passage
10/19/2015 3:04:51	16	Downstream #4	204	
10/19/2015 3:04:59	16	Downstream #4	253	
10/19/2015 3:05:10	16	Downstream #4	255	

TABLE C33. PASSAGE SUMMARY FOR EEL 149.320 92

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/17/2015 19:43:39	1	Graham Lake Approach	-87	Released 10/15/2015 18:17
10/17/2015 19:43:40	1	Graham Lake Approach	-86	
10/17/2015 19:43:42	1	Graham Lake Approach	-91	
10/17/2015 19:43:43	1	Graham Lake Approach	-90	
10/17/2015 19:43:44	1	Graham Lake Approach	-85	
10/17/2015 19:56:51	3	Graham Lake Gate 3	-71	Graham Lake Passage
10/17/2015 19:57:13	3	Graham Lake Gate 3	-74	
10/17/2015 22:29:28	5	Downstream #1	-83	
10/17/2015 22:29:29	5	Downstream #1	-83	
10/17/2015 22:29:30	5	Downstream #1	-83	
10/17/2015 22:29:31	5	Downstream #1	-82	
10/17/2015 22:29:32	5	Downstream #1	-81	
10/18/2015 3:43:14	6	Ellsworth Approach	-88	
10/18/2015 3:43:15	6	Ellsworth Approach	-88	
10/18/2015 3:43:16	6	Ellsworth Approach	-82	
10/18/2015 3:43:17	6	Ellsworth Approach	-89	
10/18/2015 3:43:18	6	Ellsworth Approach	-87	
10/18/2015 4:09:14	10	Ellsworth Unit 2	-57	Ellsworth Dam Passage
10/18/2015 4:09:35	13	Ellsworth Tailrace	-75	
10/18/2015 4:09:37	13	Ellsworth Tailrace	-65	
10/18/2015 4:09:39	13	Ellsworth Tailrace	-66	
10/18/2015 4:09:42	13	Ellsworth Tailrace	-68	
10/18/2015 4:09:44	13	Ellsworth Tailrace	-67	
10/18/2015 4:11:47	14	Downstream #2	-80	
10/18/2015 4:11:52	14	Downstream #2	-71	
10/18/2015 4:11:54	14	Downstream #2	-74	
10/18/2015 4:11:55	14	Downstream #2	-70	
10/18/2015 4:12:00	14	Downstream #2	-78	
10/18/2015 4:45:43	15	Downstream #3	181	
10/18/2015 4:45:44	15	Downstream #3	165	
10/18/2015 4:45:52	15	Downstream #3	177	
10/18/2015 4:46:01	15	Downstream #3	135	
10/18/2015 4:46:10	15	Downstream #3	172	
10/18/2015 5:00:53	16	Downstream #4	243	
10/18/2015 5:01:03	16	Downstream #4	254	Successful Passage
10/18/2015 5:01:11	16	Downstream #4	138	
10/18/2015 5:01:28	16	Downstream #4	231	

TABLE C34. PASSAGE SUMMARY FOR EEL 149.320 102

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/15/2015 21:32:34	1	Graham Lake Approach	-64	Released 10/15/2015 18:17
10/15/2015 21:32:35	1	Graham Lake Approach	-63	
10/15/2015 21:32:36	1	Graham Lake Approach	-63	
10/15/2015 21:32:37	1	Graham Lake Approach	-67	
10/15/2015 21:32:38	1	Graham Lake Approach	-64	
10/15/2015 21:38:26	3	Graham Lake Gate 3	-72	Graham Lake Passage
10/15/2015 21:38:30	3	Graham Lake Gate 3	-75	
10/15/2015 21:39:20	3	Graham Lake Gate 3	-75	
10/16/2015 21:55:04	5	Downstream #1	-86	
10/16/2015 21:55:05	5	Downstream #1	-86	
10/16/2015 21:55:06	5	Downstream #1	-85	
10/16/2015 21:55:07	5	Downstream #1	-86	
10/16/2015 21:55:08	5	Downstream #1	-89	
10/17/2015 0:02:12	6	Ellsworth Approach	-97	
10/17/2015 0:02:13	6	Ellsworth Approach	-96	
10/17/2015 0:02:14	6	Ellsworth Approach	-96	
10/17/2015 0:02:15	6	Ellsworth Approach	-94	
10/17/2015 0:02:16	6	Ellsworth Approach	-93	
10/17/2015 0:16:01	13	Ellsworth Tailrace	-65	Passage – Unknown Route
10/17/2015 0:16:03	13	Ellsworth Tailrace	-67	
10/17/2015 0:16:04	13	Ellsworth Tailrace	-71	
10/17/2015 0:16:05	13	Ellsworth Tailrace	-70	
10/17/2015 0:43:46	14	Downstream #2	-75	
10/17/2015 0:43:47	14	Downstream #2	-76	
10/17/2015 0:43:48	14	Downstream #2	-74	
10/17/2015 0:43:49	14	Downstream #2	-78	
10/17/2015 0:43:50	14	Downstream #2	-76	
10/17/2015 20:50:42	15	Downstream #3	120	
10/17/2015 20:50:50	15	Downstream #3	130	
10/17/2015 20:51:08	15	Downstream #3	131	
10/17/2015 20:51:17	15	Downstream #3	129	
10/17/2015 20:51:19	15	Downstream #3	122	
10/20/2015 15:11:48	16	Downstream #4	193	
10/20/2015 15:11:58	16	Downstream #4	207	
10/20/2015 15:12:06	16	Downstream #4	225	
10/20/2015 15:12:15	16	Downstream #4	207	
11/2/2015		Between Marina and tailrace – manual survey		Mortality

TABLE C35. PASSAGE SUMMARY FOR EEL 149.320 203

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/15/2015 19:59:04	1	Graham Lake Approach	-68	Released 10/15/2015 18:17
10/15/2015 19:59:05	1	Graham Lake Approach	-67	
10/15/2015 19:59:06	1	Graham Lake Approach	-68	
10/15/2015 19:59:07	1	Graham Lake Approach	-73	
10/15/2015 19:59:08	1	Graham Lake Approach	-73	
10/15/2015 20:02:34	2	Graham Lake Fishway Weir	-57	Graham Lake Passage
10/15/2015 20:02:35	2	Graham Lake Fishway Weir	-57	
10/15/2015 20:02:36	2	Graham Lake Fishway Weir	-57	
10/15/2015 20:02:37	2	Graham Lake Fishway Weir	-59	
10/21/2015 18:00:47	5	Downstream #1	-80	
10/21/2015 18:00:48	5	Downstream #1	-77	
10/21/2015 18:00:49	5	Downstream #1	-79	
10/21/2015 18:00:50	5	Downstream #1	-80	
10/21/2015 18:00:51	5	Downstream #1	-81	
10/21/2015 18:00:54	5	Downstream #1	-78	
10/25/2015 19:57:10	6	Ellsworth Approach	-88	
10/25/2015 19:57:11	6	Ellsworth Approach	-87	
10/25/2015 19:57:12	6	Ellsworth Approach	-84	
10/25/2015 19:57:13	6	Ellsworth Approach	-83	
10/25/2015 19:57:14	6	Ellsworth Approach	-83	
10/25/2015 20:07:08	11	Ellsworth Unit 3	-58	Ellsworth Dam Passage
10/25/2015 20:07:09	11	Ellsworth Unit 3	-57	
10/25/2015 20:07:10	11	Ellsworth Unit 3	-60	
10/25/2015 20:07:46	13	Ellsworth Tailrace	-69	
10/25/2015 20:07:47	13	Ellsworth Tailrace	-70	
10/25/2015 20:07:48	13	Ellsworth Tailrace	-70	
10/25/2015 20:07:49	13	Ellsworth Tailrace	-69	
10/25/2015 20:07:50	13	Ellsworth Tailrace	-70	
10/28/2015 11:56:46		Manual Tracking Near Tailrace	255	
10/28/2015 11:56:47		Manual Tracking Near Tailrace	255	In tailrace at end of study, 1 sec burst rate
10/28/2015 11:56:48		Manual Tracking Near Tailrace	211	

TABLE C36. PASSAGE SUMMARY FOR EEL 149.340 62

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/16/2015 3:03:34	1	Graham Lake Approach	-82	Released 10/15/2015 18:17
10/16/2015 3:03:35	1	Graham Lake Approach	-93	
10/16/2015 3:03:38	1	Graham Lake Approach	-87	
10/16/2015 3:03:39	1	Graham Lake Approach	-85	
10/16/2015 3:03:40	1	Graham Lake Approach	-85	
10/16/2015 15:37:27	3	Graham Lake Gate 3	-60	Graham Lake Passage
10/16/2015 15:37:28	3	Graham Lake Gate 3	-68	
10/16/2015 15:37:29	3	Graham Lake Gate 3	-58	
10/16/2015 20:06:30	5	Downstream #1	-83	
10/16/2015 20:06:31	5	Downstream #1	-83	
10/16/2015 20:06:32	5	Downstream #1	-81	
10/16/2015 20:06:33	5	Downstream #1	-80	
10/16/2015 20:06:34	5	Downstream #1	-79	
10/16/2015 20:06:35	5	Downstream #1	-80	
10/16/2015 22:16:07	6	Ellsworth Approach	-88	
10/16/2015 22:16:08	6	Ellsworth Approach	-89	
10/16/2015 22:16:09	6	Ellsworth Approach	-90	
10/16/2015 22:16:10	6	Ellsworth Approach	-89	
10/16/2015 22:16:12	6	Ellsworth Approach	-91	
10/16/2015 22:23:09	11	Ellsworth Unit 3	-57	Ellsworth Dam Passage
10/16/2015 22:23:10	11	Ellsworth Unit 3	-59	
10/16/2015 22:23:11	11	Ellsworth Unit 3	-57	
10/16/2015 22:25:14	14	Downstream #2	-76	
10/16/2015 22:25:16	14	Downstream #2	-73	
10/16/2015 22:25:20	14	Downstream #2	-73	
10/16/2015 22:25:31	14	Downstream #2	-79	
10/16/2015 22:27:12	15	Downstream #3	127	
10/16/2015 22:27:38	15	Downstream #3	140	
10/16/2015 22:27:47	15	Downstream #3	139	
10/16/2015 22:27:55	15	Downstream #3	127	
10/16/2015 22:28:06	15	Downstream #3	125	
10/16/2015 22:30:42	16	Downstream #4	128	
10/16/2015 22:30:43	16	Downstream #4	131	
10/16/2015 22:30:53	16	Downstream #4	221	Successful Passage
10/16/2015 22:31:11	16	Downstream #4	206	
10/16/2015 22:31:19	16	Downstream #4	242	

TABLE C37. PASSAGE SUMMARY FOR EEL 149.340 72

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/15/2015 19:10:19	1	Graham Lake Approach	-80	Released 10/15/2015 18:17
10/15/2015 19:10:20	1	Graham Lake Approach	-81	
10/15/2015 19:10:21	1	Graham Lake Approach	-81	
10/15/2015 19:10:22	1	Graham Lake Approach	-79	
10/15/2015 19:10:23	1	Graham Lake Approach	-80	
10/15/2015 19:15:13	3	Graham Lake Gate 3	-71	Graham Lake Passage
10/15/2015 19:15:30	3	Graham Lake Gate 3	-71	
10/15/2015 21:31:05	5	Downstream #1	-85	
10/15/2015 21:31:06	5	Downstream #1	-84	
10/15/2015 21:31:07	5	Downstream #1	-84	
10/15/2015 21:31:08	5	Downstream #1	-87	
10/15/2015 21:31:09	5	Downstream #1	-85	
10/15/2015 23:29:04	6	Ellsworth Approach	-90	
10/15/2015 23:29:05	6	Ellsworth Approach	-86	
10/15/2015 23:29:06	6	Ellsworth Approach	-87	
10/15/2015 23:29:07	6	Ellsworth Approach	-89	
10/15/2015 23:29:08	6	Ellsworth Approach	-95	
10/15/2015 23:44:16	10	Ellsworth Unit 2	-64	Ellsworth Dam Passage
10/15/2015 23:44:18	10	Ellsworth Unit 2	-58	
10/15/2015 23:44:19	10	Ellsworth Unit 2	-67	
10/15/2015 23:44:36	13	Ellsworth Tailrace	-67	
10/15/2015 23:44:39	13	Ellsworth Tailrace	-60	
10/15/2015 23:44:41	13	Ellsworth Tailrace	-65	
10/15/2015 23:44:47	13	Ellsworth Tailrace	-64	
10/15/2015 23:44:50	13	Ellsworth Tailrace	-71	
10/16/2015 19:16:19	14	Downstream #2	-69	
10/16/2015 19:16:20	14	Downstream #2	-67	
10/16/2015 19:16:22	14	Downstream #2	-67	
10/16/2015 19:16:23	14	Downstream #2	-75	
10/16/2015 19:16:24	14	Downstream #2	-74	
11/12/2015 12:18:14		Manual Tracking Near Downstream #3	125	
11/12/2015 12:18:24		Manual Tracking Near Downstream #3	112	Mortality
11/12/2015 12:18:34		Manual Tracking Near Downstream #3	108	

TABLE C38. PASSAGE SUMMARY FOR EEL 149.340 123

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/16/2015 1:59:01	1	Graham Lake Approach	-78	Released 10/15/2015 18:17
10/16/2015 1:59:02	1	Graham Lake Approach	-76	
10/16/2015 1:59:03	1	Graham Lake Approach	-75	
10/16/2015 1:59:04	1	Graham Lake Approach	-76	
10/16/2015 1:59:05	1	Graham Lake Approach	-75	
10/16/2015 1:59:06	1	Graham Lake Approach	-76	
10/16/2015 4:35:03	5	Downstream #1	-78	Passage – Unknown Route
10/16/2015 4:35:04	5	Downstream #1	-76	
10/16/2015 4:35:06	5	Downstream #1	-76	
10/16/2015 4:35:07	5	Downstream #1	-74	
10/16/2015 4:35:08	5	Downstream #1	-77	
10/16/2015 4:35:09	5	Downstream #1	-82	
10/16/2015 5:26:52	6	Ellsworth Approach	-77	
10/16/2015 5:26:53	6	Ellsworth Approach	-76	
10/16/2015 5:26:54	6	Ellsworth Approach	-75	
10/16/2015 5:26:55	6	Ellsworth Approach	-76	
10/16/2015 5:26:57	6	Ellsworth Approach	-76	
10/16/2015 5:26:58	6	Ellsworth Approach	-79	
10/16/2015 21:55:39	11	Ellsworth Unit 3	-57	Ellsworth Dam Passage
10/16/2015 21:55:40	11	Ellsworth Unit 3	-57	
10/16/2015 21:55:41	11	Ellsworth Unit 3	-58	
10/16/2015 21:55:42	11	Ellsworth Unit 3	-57	
10/16/2015 21:55:44	11	Ellsworth Unit 3	-66	
11/12/2015 11:41:27		Manual Tracking Near Tailrace	130	
11/12/2015 11:41:37		Manual Tracking Near Tailrace	95	Mortality
11/12/2015 11:41:47		Manual Tracking Near Tailrace	110	
11/12/2015 11:41:57		Manual Tracking Near Tailrace	158	

TABLE C39. PASSAGE SUMMARY FOR EEL 149.400 97

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/16/2015 19:02:01	1	Graham Lake Approach	-87	Released 10/15/2015 18:17
10/16/2015 19:02:02	1	Graham Lake Approach	-87	
10/16/2015 19:02:03	1	Graham Lake Approach	-87	
10/16/2015 19:02:04	1	Graham Lake Approach	-92	
10/16/2015 19:02:05	1	Graham Lake Approach	-88	
10/16/2015 21:13:07	5	Downstream #1	-88	Passage – Unknown Route
10/16/2015 21:13:09	5	Downstream #1	-88	
10/16/2015 21:13:10	5	Downstream #1	-89	
10/16/2015 21:13:11	5	Downstream #1	-87	
10/16/2015 21:13:12	5	Downstream #1	-85	
10/16/2015 21:13:14	5	Downstream #1	-89	
10/17/2015 1:14:28	6	Ellsworth Approach	-98	
10/17/2015 1:14:29	6	Ellsworth Approach	-87	
10/17/2015 1:14:30	6	Ellsworth Approach	-86	
10/17/2015 1:14:31	6	Ellsworth Approach	-90	
10/17/2015 1:14:48	6	Ellsworth Approach	-94	
10/17/2015 1:37:16	13	Ellsworth Tailrace	-77	Passage – Unknown Route
10/17/2015 1:37:17	13	Ellsworth Tailrace	-76	
10/17/2015 1:37:18	13	Ellsworth Tailrace	-78	
10/17/2015 1:37:19	13	Ellsworth Tailrace	-78	
10/17/2015 10:33:19	14	Downstream #2	-79	
10/17/2015 10:33:21	14	Downstream #2	-73	
10/17/2015 10:33:22	14	Downstream #2	-70	
10/17/2015 10:33:25	14	Downstream #2	-76	
10/17/2015 10:35:56	15	Downstream #3	131	
10/17/2015 10:36:06	15	Downstream #3	124	
10/17/2015 10:36:14	15	Downstream #3	127	
10/17/2015 10:36:42	15	Downstream #3	123	
10/17/2015 10:36:50	15	Downstream #3	121	
10/17/2015 10:38:56	16	Downstream #4	218	
10/17/2015 10:39:03	16	Downstream #4	106	
10/17/2015 10:39:04	16	Downstream #4	117	Successful Passage
10/17/2015 10:39:14	16	Downstream #4	196	
10/17/2015 10:39:22	16	Downstream #4	252	

TABLE C40. PASSAGE SUMMARY FOR EEL 149.400 118

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/16/2015 7:22:15	1	Graham Lake Approach	-77	Released 10/15/2015 18:17
10/16/2015 7:22:16	1	Graham Lake Approach	-77	
10/16/2015 7:22:18	1	Graham Lake Approach	-77	
10/16/2015 7:22:19	1	Graham Lake Approach	-78	
10/16/2015 7:22:20	1	Graham Lake Approach	-77	
10/16/2015 8:17:43	3	Graham Lake Gate 3	-73	
10/16/2015 8:17:52	3	Graham Lake Gate 3	-68	Graham Lake Passage
10/16/2015 8:17:54	3	Graham Lake Gate 3	-66	
10/16/2015 8:17:59	3	Graham Lake 3	-73	
10/16/2015 19:44:37	5	Downstream #1	-93	
10/16/2015 19:44:38	5	Downstream #1	-91	
10/16/2015 19:44:39	5	Downstream #1	-94	
10/16/2015 19:44:40	5	Downstream #1	-94	
10/16/2015 19:44:41	5	Downstream #1	-93	
10/16/2015 20:53:04	6	Ellsworth Approach	-70	
10/16/2015 20:53:06	6	Ellsworth Approach	-78	
10/16/2015 20:53:08	6	Ellsworth Approach	-78	
10/16/2015 20:53:09	6	Ellsworth Approach	-78	
10/16/2015 20:53:10	6	Ellsworth Approach	-79	
10/16/2015 21:03:24	11	Ellsworth Unit 3	-57	Ellsworth Dam Passage
10/16/2015 21:03:25	11	Ellsworth Unit 3	-57	
10/16/2015 21:03:27	11	Ellsworth Unit 3	-60	
10/16/2015 21:03:49	13	Ellsworth Tailrace	-61	
10/16/2015 21:03:51	13	Ellsworth Tailrace	-70	
10/16/2015 21:03:53	13	Ellsworth Tailrace	-66	
10/16/2015 21:03:56	13	Ellsworth Tailrace	-69	
10/16/2015 21:03:57	13	Ellsworth Tailrace	-65	
10/16/2015 21:20:26	15	Downstream #3	143	
10/16/2015 21:20:34	15	Downstream #3	140	
10/16/2015 21:20:43	15	Downstream #3	163	
10/16/2015 21:20:51	15	Downstream #3	173	
10/16/2015 23:05:48	16	Downstream #4	122	
10/16/2015 23:06:06	16	Downstream #4	159	
10/16/2015 23:06:14	16	Downstream #4	172	Successful Passage
10/16/2015 23:06:31	16	Downstream #4	220	
10/16/2015 23:06:32	16	Downstream #4	254	

TABLE C41. PASSAGE SUMMARY FOR EEL 149.400 113

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/19/2015 11:52:33	1	Graham Lake Approach	-73	Released 10/15/2015 18:17
10/19/2015 11:52:34	1	Graham Lake Approach	-67	
10/19/2015 11:52:35	1	Graham Lake Approach	-68	
10/19/2015 11:52:36	1	Graham Lake Approach	-69	
10/19/2015 11:52:37	1	Graham Lake Approach	-67	
10/19/2015 11:52:39	1	Graham Lake Approach	-71	
10/19/2015 12:02:12	3	Graham Lake Gate 3	-70	Graham Lake Passage
10/19/2015 12:03:20	3	Graham Lake Gate 3	-69	
10/19/2015 12:05:52	3	Graham Lake Gate 3	-75	
10/19/2015 19:50:57	5	Downstream #1	-92	
10/19/2015 19:50:58	5	Downstream #1	-91	
10/19/2015 19:50:59	5	Downstream #1	-88	
10/19/2015 19:51:00	5	Downstream #1	-91	
10/19/2015 19:51:01	5	Downstream #1	-92	
10/19/2015 20:59:33	6	Ellsworth Approach	-78	
10/19/2015 20:59:34	6	Ellsworth Approach	-79	
10/19/2015 20:59:35	6	Ellsworth Approach	-79	
10/19/2015 20:59:36	6	Ellsworth Approach	-91	
10/19/2015 20:59:38	6	Ellsworth Approach	-89	
10/20/2015 2:25:13	13	Ellsworth Tailrace	-80	Ellsworth Dam Passage Not Detected
10/20/2015 2:25:20	13	Ellsworth Tailrace	-80	
10/20/2015 2:25:22	13	Ellsworth Tailrace	-78	
10/20/2015 2:28:25	13	Ellsworth Tailrace	-78	
10/20/2015 2:31:30	13	Ellsworth Tailrace	-79	
11/12/2015 11:25:42		Manual Tracking Near Tailrace	227	
11/12/2015 11:25:43		Manual Tracking Near Tailrace	255	
11/12/2015 11:25:44		Manual Tracking Near Tailrace	230	
11/12/2015 11:25:45		Manual Tracking Near Tailrace	253	
11/12/2015 11:25:46		Manual Tracking Near Tailrace	255	
11/12/2015 11:25:48		Manual Tracking Near Tailrace	247	In tailrace at end of study, 1 sec burst rate

TABLE C42. PASSAGE SUMMARY FOR EEL 149.460 133

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/16/2015 23:26:05	1	Graham Lake Approach	-89	Released 10/15/2015 18:17
10/16/2015 23:26:06	1	Graham Lake Approach	-88	
10/16/2015 23:26:07	1	Graham Lake Approach	-90	
10/16/2015 23:26:08	1	Graham Lake Approach	-88	
10/16/2015 23:26:09	1	Graham Lake Approach	-91	
10/16/2015 23:29:23	2	Graham Lake Fishway Weir	-63	Graham Lake Passage
10/16/2015 23:29:25	2	Graham Lake Fishway Weir	-63	
10/16/2015 23:29:27	2	Graham Lake Fishway Weir	-62	
10/16/2015 23:29:40	2	Graham Lake Fishway Weir	-65	
10/17/2015 1:54:42	5	Downstream #1	-95	
10/17/2015 1:54:43	5	Downstream #1	-95	
10/17/2015 1:54:44	5	Downstream #1	-95	
10/17/2015 1:54:46	5	Downstream #1	-95	
10/17/2015 1:54:47	5	Downstream #1	-92	
10/17/2015 1:54:48	5	Downstream #1	-93	
10/17/2015 14:42:42	6	Ellsworth Approach	-76	
10/17/2015 14:42:44	6	Ellsworth Approach	-67	
10/17/2015 14:42:45	6	Ellsworth Approach	-74	
10/17/2015 14:42:46	6	Ellsworth Approach	-70	
10/17/2015 14:42:47	6	Ellsworth Approach	-72	
10/17/2015 16:00:11	10	Ellsworth Unit 2	-68	Ellsworth Dam Passage
10/17/2015 16:00:13	10	Ellsworth Unit 2	-58	
10/17/2015 16:00:14	10	Ellsworth Unit 2	-58	
10/17/2015 16:00:42	13	Ellsworth Tailrace	-66	
10/17/2015 16:00:45	13	Ellsworth Tailrace	-72	
10/17/2015 16:00:47	13	Ellsworth Tailrace	-80	
10/17/2015 16:00:48	13	Ellsworth Tailrace	-79	
10/17/2015 16:00:49	13	Ellsworth Tailrace	-75	
10/20/2015		Recovered In Tailrace		Mortality

TABLE C43. PASSAGE SUMMARY FOR EEL 149.460 157

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/16/2015 0:41:46	1	Graham Lake Approach	-86	Released 10/15/2015 18:17
10/16/2015 0:41:47	1	Graham Lake Approach	-85	
10/16/2015 0:41:48	1	Graham Lake Approach	-86	
10/16/2015 0:41:49	1	Graham Lake Approach	-85	
10/16/2015 0:41:50	1	Graham Lake Approach	-87	
10/16/2015 0:48:23	4	Graham Lake Gate 2	-67	Passage – Route Unknown
10/16/2015 0:51:27	3	Graham Lake Gate 3	-74	
10/16/2015 0:51:40	3	Graham Lake Gate 3	-64	
10/16/2015 3:04:18	5	Downstream #1	-85	
10/16/2015 3:04:19	5	Downstream #1	-84	
10/16/2015 3:04:20	5	Downstream #1	-83	
10/16/2015 3:04:21	5	Downstream #1	-83	
10/16/2015 3:04:22	5	Downstream #1	-85	
10/16/2015 19:27:38	6	Ellsworth Approach	-82	
10/16/2015 19:27:39	6	Ellsworth Approach	-87	
10/16/2015 19:27:40	6	Ellsworth Approach	-83	
10/16/2015 19:27:41	6	Ellsworth Approach	-85	
10/16/2015 19:27:42	6	Ellsworth Approach	-86	
10/16/2015 19:53:13	11	Ellsworth Unit 3	-66	Ellsworth Dam Passage
10/16/2015 19:53:16	11	Ellsworth Unit 3	-57	
10/16/2015 19:53:17	11	Ellsworth Unit 3	-57	
10/16/2015 19:53:18	11	Ellsworth Unit 3	-57	
10/16/2015 20:00:01	13	Ellsworth Tailrace	-63	
10/16/2015 20:00:02	13	Ellsworth Tailrace	-67	
10/16/2015 20:00:04	13	Ellsworth Tailrace	-70	
10/16/2015 20:00:06	13	Ellsworth Tailrace	-64	
10/30/2015 13:39:50		Manual Tracking Near Tailrace	131	
10/30/2015 13:39:51		Manual Tracking Near Tailrace	127	Mortality
10/30/2015 13:39:52		Manual Tracking Near Tailrace	114	
10/30/2015 13:39:54		Manual Tracking Near Tailrace	106	

TABLE C44. PASSAGE SUMMARY FOR EEL 149.460 163

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/16/2015 2:45:39	1	Graham Lake Approach	-76	Released 10/15/2015 18:17
10/16/2015 2:45:40	1	Graham Lake Approach	-76	
10/16/2015 2:45:41	1	Graham Lake Approach	-79	
10/16/2015 2:45:42	1	Graham Lake Approach	-83	
10/16/2015 19:10:09	2	Graham Lake Fishway Weir	-58	Graham Lake Passage
10/16/2015 19:10:10	2	Graham Lake Fishway Weir	-57	
10/16/2015 19:10:11	2	Graham Lake Fishway Weir	-59	
10/16/2015 23:23:29	5	Downstream #1	-90	
10/16/2015 23:23:30	5	Downstream #1	-94	
10/16/2015 23:23:32	5	Downstream #1	-89	
10/16/2015 23:23:33	5	Downstream #1	-92	
10/17/2015 1:03:08	6	Ellsworth Approach	-85	
10/17/2015 1:03:09	6	Ellsworth Approach	-85	
10/17/2015 1:03:10	6	Ellsworth Approach	-93	
10/17/2015 1:03:11	6	Ellsworth Approach	-96	
10/17/2015 1:03:12	6	Ellsworth Approach	-96	
10/17/2015 1:34:54	11	Ellsworth Unit 3	-57	Ellsworth Dam Passage
10/17/2015 1:34:55	11	Ellsworth Unit 3	-58	
10/17/2015 1:34:56	11	Ellsworth Unit 3	-57	
10/17/2015 1:35:21	13	Ellsworth Tailrace	-69	
10/17/2015 1:35:22	13	Ellsworth Tailrace	-70	
10/17/2015 1:35:32	13	Ellsworth Tailrace	-77	
10/17/2015 1:35:33	13	Ellsworth Tailrace	-78	
10/17/2015 1:35:38	13	Ellsworth Tailrace	-77	
10/17/2015 1:47:26	14	Downstream #2	-78	
10/17/2015 1:47:27	14	Downstream #2	-77	
10/17/2015 1:47:29	14	Downstream #2	-70	
10/17/2015 1:47:30	14	Downstream #2	-64	
10/17/2015 1:47:31	14	Downstream #2	-70	
10/17/2015 3:20:30	15	Downstream #3	157	
10/17/2015 3:20:38	15	Downstream #3	141	
10/17/2015 3:20:49	15	Downstream #3	130	
10/17/2015 3:20:57	15	Downstream #3	126	
10/17/2015 3:59:47	16	Downstream #4	145	
10/17/2015 3:59:57	16	Downstream #4	186	
10/17/2015 4:00:05	16	Downstream #4	249	
10/17/2015 4:00:15	16	Downstream #4	255	
10/17/2015 4:00:22	16	Downstream #4	252	
10/21/2015		Marina – manual tracking		Mortality

TABLE C45. PASSAGE SUMMARY FOR EEL 149.480 178

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/31/2015 4:11:03	1	Graham Lake Approach	-83	Released 10/15/2015 18:17
10/31/2015 4:11:04	1	Graham Lake Approach	-89	
10/31/2015 4:11:05	1	Graham Lake Approach	-84	
10/31/2015 4:11:06	1	Graham Lake Approach	-90	
10/31/2015 4:11:07	1	Graham Lake Approach	-92	
10/31/2015 4:14:38	2	Graham Lake Fishway Weir	-60	Graham Lake Passage
10/31/2015 4:14:40	2	Graham Lake Fishway Weir	-57	
10/31/2015 4:14:41	2	Graham Lake Fishway Weir	-57	
10/31/2015 6:39:06	5	Downstream #1	-94	
10/31/2015 6:39:07	5	Downstream #1	-90	
10/31/2015 6:39:08	5	Downstream #1	-86	
10/31/2015 6:39:09	5	Downstream #1	-88	
10/31/2015 6:39:11	5	Downstream #1	-95	
10/31/2015 8:37:06	6	Ellsworth Approach	-81	
10/31/2015 8:37:07	6	Ellsworth Approach	-85	
10/31/2015 8:37:09	6	Ellsworth Approach	-87	
10/31/2015 8:37:10	6	Ellsworth Approach	-85	
10/31/2015 8:37:11	6	Ellsworth Approach	-91	
10/31/2015 9:16:10	12	Ellsworth Unit 4	-79	Ellsworth Dam Passage
10/31/2015 9:16:15	12	Ellsworth Unit 4	-58	
10/31/2015 9:16:16	12	Ellsworth Unit 4	-60	
10/31/2015 9:16:18	12	Ellsworth Unit 4	-70	
10/31/2015 9:17:14	13	Ellsworth Tailrace	-61	
10/31/2015 9:17:15	13	Ellsworth Tailrace	-58	
10/31/2015 9:17:17	13	Ellsworth Tailrace	-62	
10/31/2015 9:17:18	13	Ellsworth Tailrace	-64	
10/31/2015 9:17:20	13	Ellsworth Tailrace	-69	
10/31/2015 9:27:25	14	Downstream #2	-77	
10/31/2015 9:27:26	14	Downstream #2	-70	
10/31/2015 9:27:27	14	Downstream #2	-68	
10/31/2015 9:27:33	14	Downstream #2	-70	
10/31/2015 9:27:35	14	Downstream #2	-72	
10/31/2015 18:22:26	16	Downstream #4	149	
10/31/2015 18:22:44	16	Downstream #4	245	
10/31/2015 18:22:51	16	Downstream #4	250	Successful Passage
10/31/2015 18:22:52	16	Downstream #4	255	
10/31/2015 18:23:01	16	Downstream #4	255	

TABLE C46. PASSAGE SUMMARY FOR EEL 149.480 167

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/17/2015 1:40:15	1	Graham Lake Approach	-70	Released 10/15/2015 18:17
10/17/2015 1:40:16	1	Graham Lake Approach	-68	
10/17/2015 1:40:17	1	Graham Lake Approach	-69	
10/17/2015 1:40:19	1	Graham Lake Approach	-69	
10/17/2015 1:40:20	1	Graham Lake Approach	-69	
10/17/2015 1:48:11	3	Graham Lake Gate 3	-70	Graham Lake Passage
10/17/2015 4:31:24	5	Downstream #1	-85	
10/17/2015 4:31:25	5	Downstream #1	-84	
10/17/2015 4:31:26	5	Downstream #1	-86	
10/17/2015 4:31:28	5	Downstream #1	-86	
10/17/2015 4:31:29	5	Downstream #1	-88	
10/17/2015 20:35:49	6	Ellsworth Approach	-75	
10/17/2015 20:35:50	6	Ellsworth Approach	-87	
10/17/2015 20:35:51	6	Ellsworth Approach	-84	
10/17/2015 20:35:52	6	Ellsworth Approach	-84	
10/17/2015 20:35:54	6	Ellsworth Approach	-84	
10/17/2015 20:45:17	10	Ellsworth Unit 2	-61	Ellsworth Dam Passage
10/17/2015 20:45:18	10	Ellsworth Unit 2	-57	
10/17/2015 20:45:19	10	Ellsworth Unit 2	-57	
10/17/2015 20:45:20	10	Ellsworth Unit 2	-72	
10/17/2015 20:45:38	13	Ellsworth Tailrace	-64	
10/17/2015 20:45:39	13	Ellsworth Tailrace	-68	
10/17/2015 20:45:41	13	Ellsworth Tailrace	-65	
10/17/2015 20:45:48	13	Ellsworth Tailrace	-66	
10/20/2015 7:01:39	14	Downstream #2	-80	
10/20/2015 7:01:40	14	Downstream #2	-80	
10/20/2015 7:01:41	14	Downstream #2	-80	
10/20/2015 7:01:42	14	Downstream #2	-80	
10/23/2015 11:25:18		Manual Tracking Near Downstream #2	208	
10/23/2015 11:25:28		Manual Tracking Near Downstream #2	255	Mortality
10/23/2015 11:25:38		Manual Tracking Near Downstream #2	255	
10/23/2015 11:25:48		Manual Tracking Near Downstream #2	255	

TABLE C47. PASSAGE SUMMARY FOR EEL 149.480 184

DATE AND TIME	SITE #	SITE NAME	POWER	NOTES
10/17/2015 18:57:12	1	Graham Lake Approach	-87	Released 10/15/2015 18:17
10/17/2015 18:57:13	1	Graham Lake Approach	-87	
10/17/2015 18:57:15	1	Graham Lake Approach	-77	
10/17/2015 18:57:17	1	Graham Lake Approach	-79	
10/17/2015 18:57:18	1	Graham Lake Approach	-83	
10/17/2015 19:06:25	3	Graham Lake Gate 3	-72	
10/17/2015 19:06:26	3	Graham Lake Gate 3	-69	Graham Lake Passage
10/17/2015 19:07:00	3	Graham Lake Gate 3	-69	
10/17/2015 19:07:38	3	Graham Lake Gate 3	-65	
10/17/2015 19:07:54	3	Graham Lake Gate 3	-59	
10/17/2015 21:17:21	5	Downstream Station #1	-90	
10/17/2015 21:17:22	5	Downstream Station #1	-88	
10/17/2015 21:17:23	5	Downstream Station #1	-89	
10/17/2015 21:17:24	5	Downstream Station #1	-86	
10/17/2015 21:17:25	5	Downstream Station #1	-89	
10/17/2015 21:17:26	5	Downstream Station #1	-87	
10/17/2015 22:16:23	6	Ellsworth Approach	-97	
10/17/2015 22:16:24	6	Ellsworth Approach	-96	
10/17/2015 22:16:25	6	Ellsworth Approach	-96	
10/17/2015 22:16:26	6	Ellsworth Approach	-82	
10/17/2015 22:16:27	6	Ellsworth Approach	-83	
10/17/2015 22:16:28	6	Ellsworth Approach	-81	
10/17/2015 22:16:30	6	Ellsworth Approach	-96	
10/18/2015 0:10:01	11	Ellsworth Unit 3	-73	
10/18/2015 0:10:02	11	Ellsworth Unit 3	-74	Ellsworth Dam Passage
10/18/2015 0:10:04	11	Ellsworth Unit 3	-64	
10/18/2015 0:10:05	11	Ellsworth Unit 3	-57	
10/18/2015 0:10:06	11	Ellsworth Unit 3	-58	
10/18/2015 0:10:09	11	Ellsworth Unit 3	-60	
10/18/2015 0:10:43	13	Ellsworth Tailrace	-70	
10/18/2015 0:10:44	13	Ellsworth Tailrace	-66	
10/18/2015 0:10:45	13	Ellsworth Tailrace	-60	
10/18/2015 0:10:48	13	Ellsworth Tailrace	-60	
10/18/2015 0:10:49	13	Ellsworth Tailrace	-61	
10/18/2015 0:10:50	13	Ellsworth Tailrace	-62	
10/18/2015 0:14:42	14	Downstream Station #2	-77	
10/18/2015 0:14:43	14	Downstream Station #2	-76	
10/18/2015 0:14:54	14	Downstream Station #2	-78	
10/18/2015 0:14:55	14	Downstream Station #2	-80	
10/18/2015 0:14:56	14	Downstream Station #2	-75	
10/18/2015 0:18:02	15	Downstream Station #3	138	
10/18/2015 0:18:11	15	Downstream Station #3	145	
10/18/2015 0:18:38	15	Downstream Station #3	155	
10/18/2015 0:18:39	15	Downstream Station #3	162	
10/18/2015 0:18:47	15	Downstream Station #3	147	
10/18/2015 0:21:00	16	Downstream Station #4	112	
10/18/2015 0:21:10	16	Downstream Station #4	151	Successful Passage
10/18/2015 0:21:19	16	Downstream Station #4	112	
10/18/2015 0:21:27	16	Downstream Station #4	217	

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APPENDIX E-9
RECREATION FACILITIES MANAGEMENT PLAN

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

RECREATION FACILITIES MANAGEMENT PLAN

BLACK BEAR HYDRO PARTNERS, LLC

December 2015

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

RECREATION FACILITIES MANAGEMENT PLAN

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ELLSWORTH PROJECT

FERC NO. 2727

RECREATION FACILITIES MANAGEMENT PLAN

1.0 INTRODUCTION AND BACKGROUND

The Ellsworth Hydroelectric Project (Project) is licensed by the Federal Energy Regulatory Commission (FERC) as Project No. 2727. The Project is licensed to Black Bear Hydro Partners, LLC (“Black Bear” or “Licensee”).

This Recreation Facilities Management Plan (Plan) describes the existing available public recreation facilities that provide access to Project lands and waters. This Plan also identifies proposed measures for enhancing public access to Project lands and waters that collectively, will maintain the existing recreation opportunities provided at the Ellsworth Project over the term of the new license.

2.0 CONSULTATION

The results of the Recreation Site/Facilities Inventory, conducted during the relicensing studies, are described in the Initial Study Report (ISR), which was provided to FERC and participating agencies, tribes, non-governmental organizations (NGOs), local governments, and the public for comment. A draft of this Recreation Facilities Management Plan was included in the Draft License Application. No comments regarding the recreation sites/facilities were received except that the Commission requested a map of the proposed canoe portage trail location.

3.0 PROJECT DESCRIPTION

The Project is located on the lower reach of the Union River in the City of Ellsworth, the towns of Waltham and Mariaville, and the township of Fletchers Landing in Hancock County, Maine. The Project consists of two developments, the Ellsworth Development and the Graham Lake Development. The Ellsworth Development consists of the Ellsworth Dam, which forms the 90-acre Lake Leonard, and the associated generating facilities having an authorized installed nameplate capacity of 8.9 MW. The Graham Lake Development consists of a dam with an approximately 10,000-acre storage reservoir (Graham Lake). There are no generating facilities at the Graham Lake Development.

In total, the Project boundary encompasses approximately 3,350 acres of land, and 10,099 acres of open water. Waters within the Project boundary include Lake Leonard (90 acres), Graham Lake (approximately 10,000 acres) and an intervening three mile riverine segment of the Union River. Black Bear owns or has rights to all lands within the Project boundary. The majority of lands surrounding the Project boundary are privately owned.

4.0 PROJECT-RELATED RECREATION AREAS AND FACILITIES

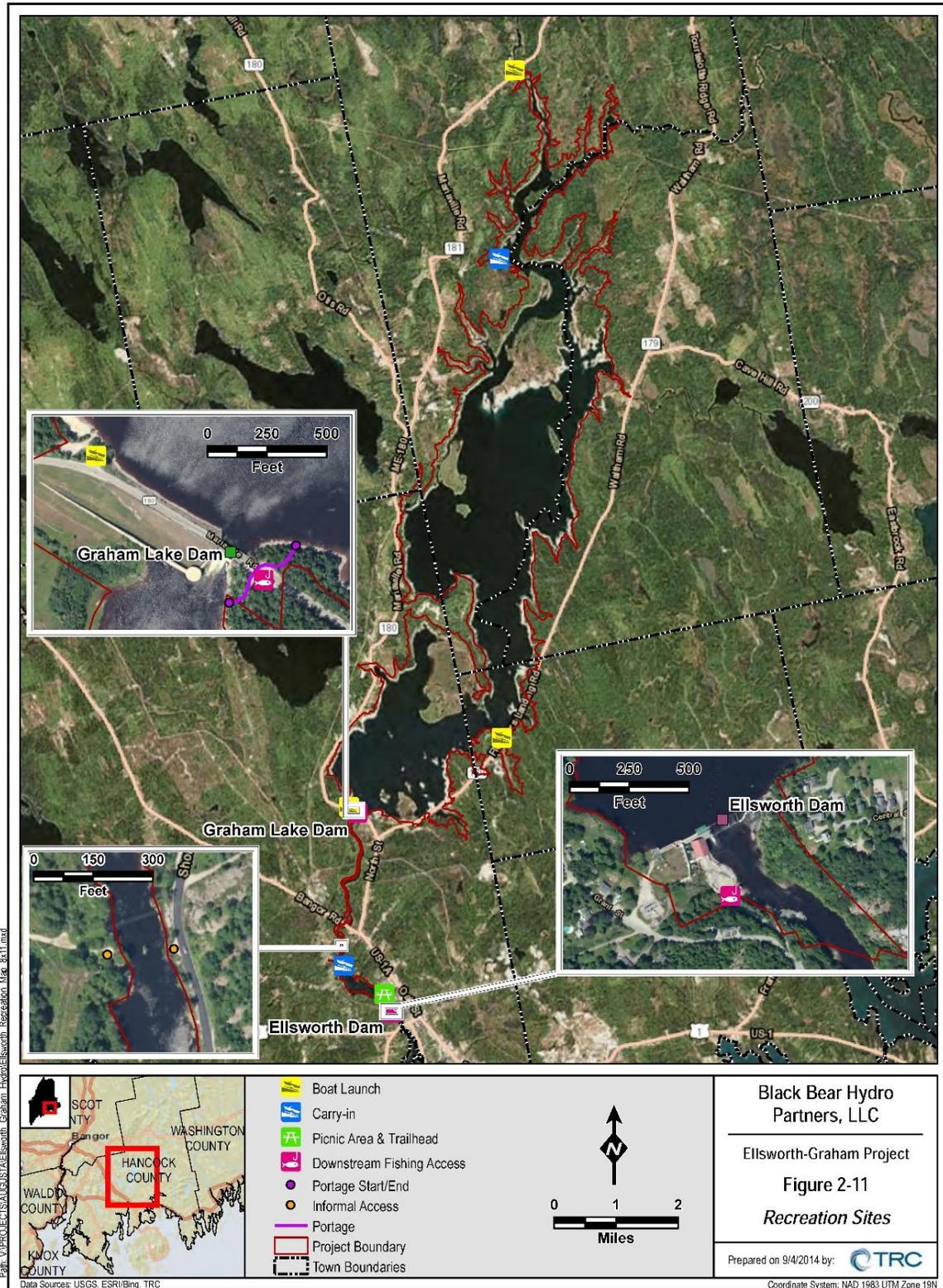
4.1 Existing Project Recreation Sites and Facilities

The Ellsworth Project has three existing public Project Recreation Sites that are maintained by Black Bear. These include a carry-in boat launch on Lake Leonard, a boat launch on Graham Lake, and a canoe portage/angler access trail around Graham Lake Dam (this trail will be limited to angler access only in the future and a new portage trail will be developed at the existing boat launch at the west end of the dam). Table 4-1 provides an overview of these sites and associated facilities. Detailed descriptions of each site follow.

Table 4-1: Commission Approved Recreation Facilities at Ellsworth Hydroelectric Project (FERC No. 2727)

Recreation Site Name	Recreation Facilities
Lake Leonard carry-in boat launch	a small gravel parking area and a six-foot wide hard surface carry-in ramp; additional parking occurs along the edge of the access road
Graham Lake boat launch	a 12-foot wide concrete plank boat ramp and gravel parking area that will accommodate approximately eight trailer rigs; the site is level with a gentle slope to the shoreline
Canoe portage and downstream angler access trail around Graham Lake	the downstream section of the trail is a well-worn footpath to the access points on the shore; parking areas are available on both sides of Patriot Road where the trail crosses; the northerly area will accommodate nine vehicles and the southerly area ten vehicles

Figure 4-1: Recreation Facilities Location Map



Ellsworth Development

Site Name: Lake Leonard Carry-in Boat Launch

Location: The Lake Leonard carry-in boat launch is located in Ellsworth, on the Shore Road on the east side of Lake Leonard.

Description of Facilities and Primary Recreational Activities¹: The carry-in boat launch and associated parking area is located at the northern end of Lake Leonard and is accessed via the Shore Road which runs along the eastern shore of the lake. Black Bear owns and manages the boat launch.

Site Regulations: The multi-use parking area is intended for day use, and signage clearly indicated that overnight camping or parking are strictly prohibited.

Site Inventory: An inventory of site amenities for the carry-in boat launch is provided in Table 4-2.



Photo 4-1: Lake Leonard carry-in boat launch

¹ Primary recreational activities generally correspond to the types of facilities available.



Photo 4-2: Lake Leonard carry-in boat launch parking area



Photo 4-3: Lake Leonard carry-in boat launch ramp



Photo 4-4: Lake Leonard carry-in boat launch sign

Graham Lake Development

Site Name: Graham Lake Boat Launch

Location: The Graham Lake boat launch is located at the southern end of Graham Lake just west of Graham Lake Dam in Ellsworth. The site can be accessed via Eagle Road (formerly Route 180).

Description of Facilities and Primary Recreational Activities: The site occupies approximately 1 acre, including approximately 60 feet of shoreline frontage. The boat ramp is comprised of 12-foot wide concrete planks and the gravel parking area can accommodate eight vehicles with trailers.

The Graham Lake boat launch is used primarily for launching (or retrieving) trailered watercraft on the reservoir. Launching of personal and non-motorized watercraft also occurs. The boat launch and nearby shoreline areas are occasionally used by anglers. Black Bear owns and manages the Graham Lake boat launch site.

Site Regulations: The Graham Lake boat launch is intended for day use, and site signage clearly states the overnight camping or parking is prohibited.

Site Inventory: An inventory of site amenities for the Graham Lake boat launch is provided in Table 4-2. Photos of the site follow.



Photo 4-5: Graham Lake boat launch facility sign



Photo 4-6: Graham Lake boat launch ramp



Photo 4-7: Graham Lake boat launch parking area

Graham Lake Development

Site Name: Canoe Portage and Downstream Angler Access Trail

Location: The current Graham Lake canoe portage and downstream angler access trail is located on the east side of Graham Lake Dam in Ellsworth. The portal trail take-out is located on the south shore of Graham Lake near the easterly anchor point for the upstream boat barrier. The trail extends approximately 200 feet to the parking area on the north side of Patriot Road (former Route 180). The trail crosses the now dead end Patriot Road and the parking area on the south side of the road, and extends down the bank to the shoreline downstream of the dam. The trail forks and extends to two access points approximately 100 and 160 feet below the dam.

Description of Facilities and Primary Recreational Activities: Boaters traveling down Graham Lake in personal watercraft (i.e. kayaks or canoes) can take-out at the south end of the reservoir, portage their boats around the dam, and enter the Union River below the dam. The take-out is marked with a sign (posted on a tree at the water's edge) stating "canoe portage" and showing a portage symbol. Anglers can also use the trail for access to the Union River for shore fishing below the dam.

Based on observations made during recreation studies performed in 2013 - 2014 (i.e. site visit observations, and recreation use data), the canoe portage trail appears to be seldom used for full portage from the impoundment to the tailwater. The put-in is occasionally used for launching personal, non-motorized watercraft on the Project tailwater; however, the put-in location appears to be used most frequently by anglers to access the tailwater for fishing. The canoe portage trail was observed to be steep, with uneven footing in spots and also had areas of minor erosion.

Black Bear owns and manages the canoe portage trail.

Site Regulations: The canoe portage trail is intended for day use, however, no site regulations are posted.

Site Inventory: An inventory of site amenities for the canoe portage trail is provided in Table 4-4.



Photo 4-9: Graham Lake downstream canoe portage/angler access trail



Photo 4-10: Graham Lake upstream canoe portage trail



Photo 4-11: Graham Lake canoe portage/angler access trail parking area (south side)



Photo 4-12: Graham Lake canoe portage/angler access trail parking area (north side)

4.2 Proposed Project-Related Recreation Sites and Facilities

Black Bear is proposing to continue to operate and maintain the Project under the existing licensed regime. Black Bear proposes to continue to operate and maintain the Lake Leonard carry-in boat launch, and the Graham Lake boat launch and their associated facilities and amenities.

In order to enhance boater (personal watercraft) access to the Union River below Graham Lake Dam, and also to address safety concerns, Black Bear is proposing to relocate the east-side Graham Lake Dam canoe portage trail to the west side of the dam. The proposed canoe portage route is shown on Figure 4-2. The current canoe portage trail take-out location is in very close proximity to the Graham Lake Dam gate structure and the east end anchor point for the boat barrier floats. In addition, due to the difficulty in carrying personal watercraft down the steep and uneven woods/ledge trail down to the put-in locations below the dam, Black Bear determined that relocating the portage trail to the west side of the dam would be a significant improvement. The new portage trail take-out area will be co-located with the Graham Lake boat launch, though it would be designed to avoid interference with use of the trailered boat launch ramp. The new put-in location will be downstream of the Graham Lake flood control structure, an area that is currently used by some boaters as an informal put-in site. The existing east-side angler's access trail will continue to be used, and will be improved and maintained. Black Bear will also provide Part 8 and directional and safety signage at each Project recreational area.

Figure 4-2: Proposed Canoe Portage Route

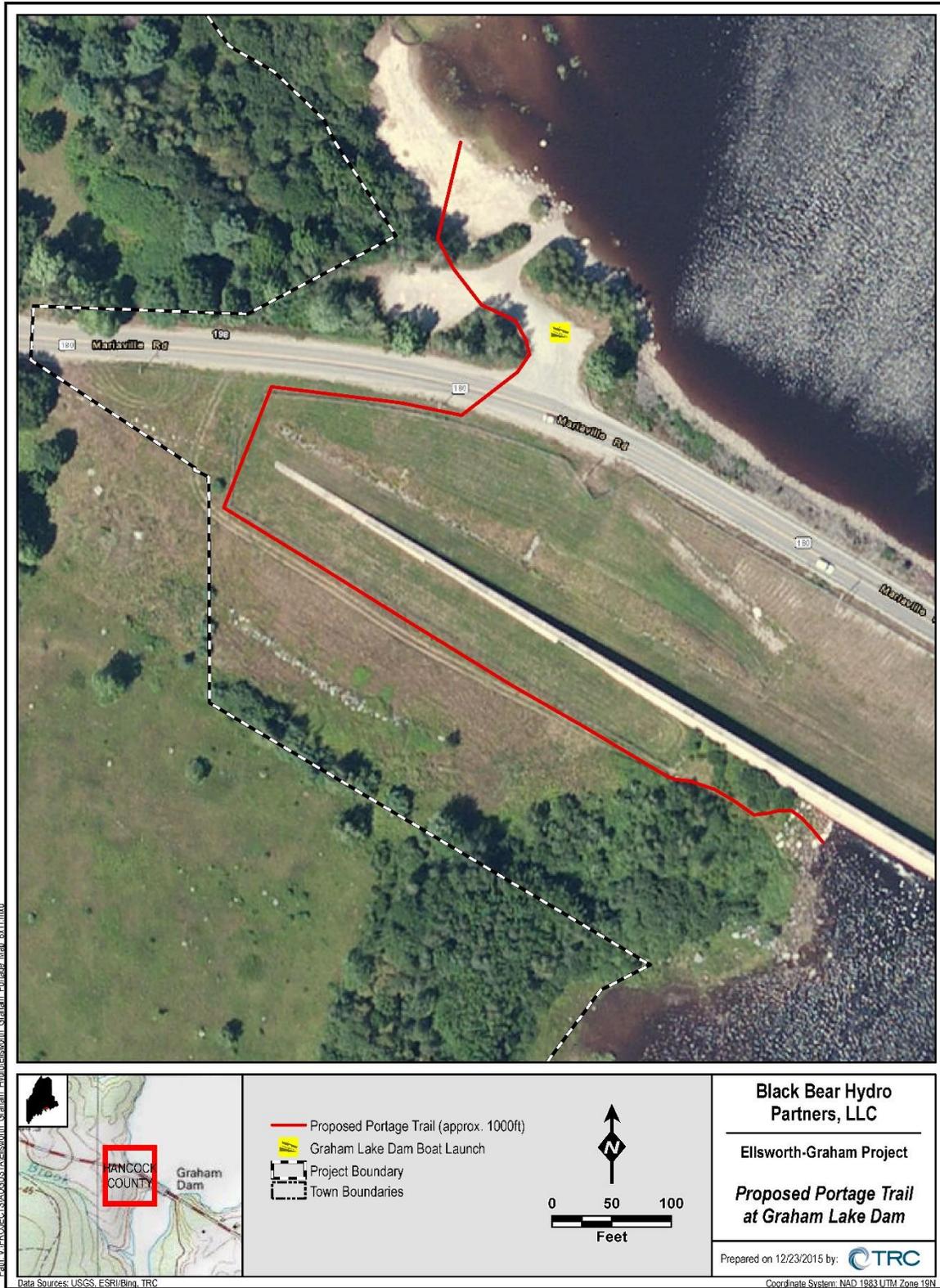


Table 4-2: Approved Recreation Amenities for the Ellsworth Hydroelectric Project FERC No. 2727

Project No.	Development Name	Recreation Amenity Name	Recreation Amenity Type	Amenity Status	Latitude*	Longitude*	FERC Citation & Date	Notes
P-2727	Lake Leonard	Lake Leonard boat launch	Carry-in boat launch	constructed	44.555049	-68.444943	68 FERC ¶62,240 09/14/1994	a six-foot wide hard surface carry-in ramp
P-2727	Graham Lake	Graham Lake Boat Launch	Boat Launch	constructed	44.592155	-68.442680		single lane, concrete planked ramp, approximately 12 feet wide
P-2727	Graham Lake	Downstream access trail	Downstream access trail	constructed	44.590857	-68.440227		forked path to two access points approximately 120 and 200 feet below the dam; the path is steep in spots with areas of erosion and irregular footing

*North American Datum (NAD) 1983 State Plane Coordinate System, Maine West, Feet

5.0 OTHER PUBLIC ACCESS

In addition to the Black Bear-owned and maintained facilities, there are several other public access sites associated with the Project. These sites are described below.

Ellsworth Elementary/Middle School Day Use Area:

The Ellsworth Elementary/Middle School day use area is located on the east shore of Lake Leonard in Ellsworth. The site is accessible by boat, foot, or by vehicle from the Shore Road. This site is owned and managed by the City of Ellsworth. Site improvements include three small open-sided shelters and informal trails to the shoreline. Vehicle parking for the site is provided at the school parking lot directly across the Shore Road. There is a footpath from Shore Road to the shelters. This site and facilities are outside the Project boundary, but the informal trails provide access to Project waters.



Photo 4-13: Day-use area shelters and path

Mariaville Carry-In Boat Launch:

The Mariaville carry-in is located on the west shore of Graham Lake off the Morrison Farm Road in Mariaville. The site is accessible by boat or by vehicle. The site has limited roadside parking for approximately six vehicles. The entrance road, parking areas and carry-in are compacted gravel on a gentle slope. The site is signed as a carry-in launch, although there is evidence that the site is used for trailered boat launching as well. The site is owned and managed by the Town of Mariaville and is outside the Project boundary, but provides access to Project waters.



Photo 4-14: Mariaville carry-in boat launch

Fletchers Landing:

Fletchers Landing is located on the east side of Graham Lake in Fletchers Landing Township (T8 SD). Access to the site is directly off Route 179. The site consists of a compacted gravel and grass parking area that will accommodate approximately ten trailer rigs. The boat launch area is approximately 15 feet wide and at one time had an asphalt surface. The asphalt ramp surface has degraded in some areas and has been repaired with gravel, stone, and concrete block. Local users appear to store boats on-site, both in the parking area and tied up to the shoreline. The site is owned by the State of Maine and outside the Project boundary, but provides access to Project waters.



Photo 4-15: Fletchers Landing boat launch and parking area

West Branch access site:

The West Branch Union River access site is located on the River Road in Mariaville. The site is accessible by boat and by vehicle from Route 181. A level gravel and grass parking area accommodates approximately seven vehicles and hand-carry watercraft can be launched into the West Branch via a short, steep, natural soil ramp. The site is privately-owned and outside the Project boundary, but provides access to Project waters. A dry hydrant for use of the local fire department is located on site.



Photo 4-16: West Branch Union River access site

Infant Street East Access

The Infant Street site is located off Shore Road on the east side of the Union River in Ellsworth. This is a discontinued City road that once crossed the Union River; the bridge has been removed. The site consists of a small (two vehicle) parking area (former road right-of-way) and a narrow informal footpath over the steep bank to the river. This site is owned by the City of Ellsworth and is outside the Project boundary, but provides access to Project waters.



Photo 4-17: Infant Street east access

Infant Street West Access

This site is located on the westerly side on Union River off Christian Ridge Road on the discontinued Infant Street in Ellsworth. The site consists of the discontinued road bed, which is accessible by vehicle, informal parking areas, and informal trails to the river. A trail leads to a large ledge outcrop on river's edge that is used for fishing, picnicking and other day use activities. The site is owned by the City and is located outside the Project boundary, but provides access to Project waters.



Photo 4-18: View upstream from ledge area of Infant Street west

6.0 MANAGEMENT MEASURES

6.1 Project Recreation Site Management and Maintenance

Black Bear will manage the proposed Project Recreation Sites, including the Leonard Lake carry-in boat access site, the Graham Lake boat launch, the fisherman access trail and parking area, and the canoe portage trail to provide safe and appropriate recreation access to the Project. Black Bear will ensure that the sites and facilities remain usable over the term of the new license.

Typical routine maintenance activities will include periodic mowing, litter clean-up, removal of fallen trees that hinder facility use, trimming overgrowth along the canoe portage trail, and checking that portage trail signage is in-place and readable. Black Bear will also conduct other improvements or repairs on an observed, as-needed basis.

Black Bear will complete the periodic FERC Form 80 process, as required by FERC.

6.2 Determining the Need for Additional Measures or Expansion of Existing Sites

In the event that the next FERC Form 80 process finds that an existing site has reached capacity, the need for additional access or improvements to existing sites will be further evaluated.

7.0 COST

Black Bear estimates the annual cost of inspecting and maintaining the existing recreation sites and facilities to be approximately \$26,000 per year (2015 dollars), excluding capital replacements and improvements.

Black Bear estimates the cost of proposed improvements to the Graham Lake boat launch to be approximately \$35,000.

Black Bear estimates the cost of proposed improvements to the fisherman access trail to be approximately \$25,000.

Black Bear estimates the cost of developing a portage trail on the west side of Graham Lake Dam to be approximately \$45,000.

Black Bear estimates the cost of developing Part 8, and directional and safety signage to be approximately \$20,000.

8.0 SCHEDULE

Black Bear will conduct inspection and maintenance of the all the recreational sites and facilities described herein on an as-needed basis.

Development of the new Graham Lake canoe portage trail, improvements to the fisherman's downstream access trail at Graham Lake, improvements to the Graham Lake boat launch, and

placement of the Part 8, and directional and safety signs will all be completed during the first full calendar year following issuance of a new license.

9.0 MODIFICATIONS TO PLAN

Any proposed modification to this Plan will be submitted to appropriate agencies for review and comment prior to submittal to FERC.

Prior to constructing any new structures or implementing major improvements to existing recreation facilities, design drawings will be submitted to FERC for approval. Any plans that may be developed for future recreational facilities will be provided to FERC for approval prior to construction. Any such plans will be provided along with drawings of facilities, documentation of consultation, cost estimates and schedule. The Maine Historic Preservation Commission will be included in the consultation process regarding the construction of new facilities or modifications to existing facilities that involve ground-disturbing activities.

10.0 REFERENCES

Black Bear Hydro Partners, LLC. 2014. Initial Study Report for the Ellsworth Hydroelectric Project (FERC No. 2727), filed with the Federal Energy Regulatory Commission on September 4, 2014.

APPENDIX E-10

**PHASE II ARCHAEOLOGICAL INVESTIGATIONS
AND
DRAFT HISTORIC PROPERTIES MANAGEMENT PLAN
(FILED SEPARATELY AS PRIVILEGED)**

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APPENDIX E-11
DRAFT OPERATIONS MONITORING PLAN

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Appendix E-11 - Operations Monitoring Plan

On December 20, 2012 the Black Bear Hydro Partners, LLC (BBHP or Licensee) formally initiated the relicensing process for the Ellsworth Hydroelectric Project (FERC No. 2727) with the filing of a Notice of Intent (NOI) and Pre-Application Document (PAD). In consultation with agencies, interested parties, and the Federal Energy Regulatory Commission (FERC or Commission), the Licensee conducted a number of resource studies, the results of which are incorporated in the Final License Application (FLA) for the Ellsworth Project. As a part of the FLA, the Licensee is filing a draft Project Operations Monitoring Plan. The plan will be finalized upon review by the FERC, and implemented in accordance with the issuance of a new license for the Project.

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**DRAFT
OPERATIONS MONITORING PLAN**

BLACK BEAR HYDRO PARTNERS, LLC

December 2015

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DRAFT
OPERATIONS MONITORING PLAN
ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)

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**DRAFT
OPERATIONS MONITORING PLAN**

**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

1.0 BACKGROUND

The Ellsworth Hydroelectric Project (Project) is an existing hydroelectric project located on the lower reach of the Union River, in the City of Ellsworth, the towns of Waltham and Mariaville, and the Township of Fletchers Landing (an unincorporated township), in Hancock County, Maine. The Project is owned and operated by Black Bear Hydro Partners, LLC (Black Bear or Licensee). The Project consists of two developments, the Ellsworth Development and the Graham Lake Development.

The Federal Energy Regulatory Commission (FERC) issued a new license for the Project by Order dated [xxx] (xx_FERC ¶xx,xxx). Article xxx of the new license requires that Licensee develop and implement a Project Operations Monitoring Plan (Plan). The purpose of this Plan is to document how the licensee will monitor, record compliance with, and report deviations from the requisite minimum flow and impoundment level maintenance requirements described below.

2.0 PROJECT DESCRIPTION

The Ellsworth Project is located in Downeast Maine on the Union River, approximately 3 miles upstream of the Union River Bay, which flows into the Atlantic Ocean. The Project includes Graham Lake, Graham Lake Dam, a 3-mile stretch of the Union River, Lake Leonard, and Ellsworth Dam and powerhouse.

2.1 Project Works

Ellsworth Development

The Ellsworth Dam is an Ambursen-style dam that was filled in part with concrete in the early 1990s. The Ellsworth Dam is 65-feet high and 377-feet long including a 275-foot spillway. The overflow spillway and non-overflow section are comprised of a reinforced concrete buttress dam

with 22 bays. The overflow spillway has a flashboard crest elevation of 66.7-feet. The non-overflow section includes a gatehouse; turbine-generator Unit No. 1 is served by a 10-foot diameter vertical penstock contained in the gatehouse. The non-overflow section is connected to an intake structure containing three additional penstocks: two 8-foot diameter penstocks serving turbine-generator Units No. 2 and 3, and one 12-foot diameter penstock serving turbine-generator Unit No. 4. The four units contained in the Ellsworth powerhouse have a total FERC-authorized nameplate capacity of 8.9 megawatts (MW).

An upstream fish passage facility consisting of a vertical slot fishway and trap is operated at the Ellsworth Dam providing for upstream fish passage and the commercial harvest of river herring by the City of Ellsworth under a cooperative management agreement with the Maine Department of Marine Resources. Downstream fish passage at each development is provide by dedicated surface weirs.

Graham Lake Development

Graham Lake Dam is a non-generating development located about four miles upstream from the Ellsworth Dam. The Graham Lake Dam is 30-feet high and consists of 670-foot long earth dike and an 80-foot long concrete gate structure plus abutments. The concrete gate structure contains three 20-foot wide radial gates and an 8-foot wide sluice that is used for downstream fish passage. There is a concrete flood control structure associated with the Graham Lake Dam. The flood control structure consists of a concrete flood wall approximately 720-feet long, a 65-foot diameter steel cell (formerly part of the construction coffer dam) and a 71-foot long wing wall extension that connects to the gate structure and serves as an emergency overflow spillway. No powerhouse is associated with the Graham Lake Dam and reservoir.

2.2 Impoundments

Ellsworth Development

The Ellsworth Project has a drainage area of approximately 547 square miles at the Ellsworth Dam. The lake impounded by the Ellsworth Dam, Lake Leonard, has a surface area of 90 acres at its normal maximum elevation of 66.7' and a length of one mile. Normal water levels in Lake Leonard are maintained between elevation 65.7' and 66.7'.

Graham Lake Development

The upper reservoir, Graham Lake, has a normal maximum surface area of approximately 10,000 acres and a maximum length of approximately 10 miles. Annual water levels in Graham Lake are managed between elevations 93.4' and 104.2'. Drawdown of Graham Lake in the summer/fall and more extensively at the beginning of the year provides significant downstream flood control benefits.

2.3 License Requirements

Articles xxx and xxx of the new license for the Ellsworth Project read as follows:

Article xxx – Minimum Flows

Except as temporarily modified by (1) approved maintenance activities, (2) extreme hydrologic conditions, as defined below, (3) emergency electrical system conditions, as defined below, or (4) agreement between the Licensee, the MDEP, and appropriate state and/or federal fisheries management agencies, the Licensee shall release a continuous minimum flow of 105 cubic feet per second (cfs) from the Graham Lake Development and the Ellsworth Development from July 1 through April 30, and a continuous minimum flow of 250 cfs from May 1 through June 30, for the protection of fishery resources.

Article xxx – Impoundment Levels

Except as temporarily modified by (1) approved maintenance activities, (2) extreme hydrologic conditions, as defined below, (3) emergency electrical system conditions, as defined below, or (4) agreement between the Licensee, the MDEP, and appropriate state and/or federal fisheries management agencies, the Licensee shall operate the project so that water levels in Lake Leonard are maintained between the elevations of 65.7' and 66.7' (flashboard crest) during normal operation, and water levels in Graham Lake are maintained between 104.2' and 93.4'.

"Extreme Hydrologic Conditions" means the occurrence of events beyond the Licensee's control such as, but not limited to, abnormal precipitation, extreme runoff, flood conditions, ice conditions or other hydrologic conditions such that the operational restrictions and requirements contained herein are impossible to achieve or are inconsistent with the safe operation of the Project.

"Emergency Electrical System Conditions" means operating emergencies beyond the Licensee's control which require changes in flow regimes to eliminate such

emergencies which may in some circumstances include, but are not limited to, equipment failure or other temporary abnormal operating conditions, generating unit operation or third-party mandated interruptions under power supply emergencies, and orders from local, state, or federal law enforcement or public safety authorities.

In addition to the above station operating requirements the fish passage facilities (the planned upstream eel passage facility, the downstream fishway, and upstream fish passage facility) at the Ellsworth dam each require operating flows. The operating flows for these facilities are established through adaptive management practices and in consultation with the fishery resource agencies but are initially based on a percentage of station capacity (approximately 2,640 cfs), generally 2% to 4%. Estimated operating flows are:

- Flows for upstream eel passage; approximately 5 gpm,
- Flows for downstream anadromous fish passage; approximately 60 cfs, and
- Flows for upstream anadromous fish passage; approximately 50 to 100 cfs.

3.0 OPERATIONS MANAGEMENT

3.1 Typical Operations

The Ellsworth Dam operates in a run-of-river mode automatically via pond level control while the Graham Lake Dam provides storage and has no power facilities. Timed releases at Graham Lake are used at Ellsworth Dam for power production. Black Bear releases a continuous minimum flow of 105 cfs from the Graham Lake Development and the Ellsworth Development from July 1 through April 30 and 250 cfs from May 1 through June 30. The ability to store and release water at Graham Lake allows the Ellsworth plant to operate in a peaking mode during periods of high electric demand.

3.2 High Water Operations

The Ellsworth Project is normally operated as a peaking plant, with water being released from the Graham Lake reservoir and then used to generate electricity at the downstream Ellsworth powerhouse. In a potential flood situation, Black Bear dam operators work to manage water levels along the Union River in order to minimize risk and flood damage; the Project gates,

spillways and generating units are operated based upon the High Water Guidelines which are incorporated into the Emergency Action Plan filed periodically with FERC.

3.3 Low Water Operations

The Ellsworth Project releases a continuous minimum flow of 105 cfs from July 1 through April 30 and 250 cfs from May 1 through June 30. Drawdown of Graham Lake provides important flow augmentation during dry inflow periods so that minimum flows can be maintained in the Union River below Graham Lake Dam.

3.4 Routine Maintenance Operations

The Ellsworth Project is remotely operated using a SCADA link to Brookfield Renewable Energy Group's North American System Control Center (NASCC) in Marlborough, Massachusetts.¹ A local operating crew is also available during weekdays and weekends as necessary to perform routine maintenance and operations of the facility. The dams are inspected routinely by Black Bear Engineering and Operations staff.

3.5 Scheduled Maintenance

3.5.1 Project Works

Periodic turbine-generator unit shutdowns will occur as necessary to perform maintenance activities. Under these circumstances the Licensee will maintain minimum downstream flow of 105 cfs from the Graham Lake Development and Ellsworth Lake Development from July 1 through April 30 and 250 cfs from May 1 through June 30 through the remaining turbines or spillways as necessary.

In addition to planned unit maintenance activities, there will be times when an operator has to clear accumulated debris (leaves, trees, branches, etc.) from the intake. This may require backing off the units to flush the debris away from the intake. The Licensee will maintain the required minimum flows as necessary during this activity.

¹ Black Bear Hydro Partners LLC is a member of the Brookfield Renewable Energy Group.

During planned maintenance activities where changes to the required minimum flows are necessary, Licensee will consult with Maine Department of Environmental Protection (MDEP), Maine Department of Inland Fisheries and Wildlife (MDIFW), U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) on temporary minimum flow limits.

3.5.2 Impoundments

Drawdown of the impoundments will be required from time to time to perform major maintenance on Project structures or to accommodate requests or orders from Federal or state agencies and entities concerned with public safety, construction/maintenance of downstream public works projects, and other similar activities. During sustained Project drawdowns within the normal operating parameters of the license, minimum flows will be maintained through the units or through the spillways as applicable. During planned drawdowns exceeding the normal operating parameters of the license, Licensee will consult with MDEP, MDIFW, USFWS and NMFS on minimum flows and impoundment level limits and refill.

3.5.3 Fish Passage Operations

The project fishways are operated, and records maintained, according to the Fish Passage Operations and Maintenance Plan that has been developed for the Project.

3.6 Unscheduled Operations

Project Works

The individual generating units, or the station, may occasionally trip off-line unexpectedly (i.e. line fault, equipment failure, etc.). Under these circumstances, the Licensee will maintain the required minimum flows from the Ellsworth Development through the remaining units or over the spillway. In the event that one unit is on line and trips, the NASCC will remotely start (or restart) a unit to meet the minimum flow. In the event that multiple units are on line and a unit trips, the NASCC will adjust the remaining unit flow to maintain the requisite minimum flow. NASCC can generally start a unit within 10 to 15 minutes of receiving an alarm of a unit or station trip. In the event that a unit or the station cannot be remotely restarted for any reason, a local operator will be dispatched to check the station and restart a unit if appropriate. The Ellsworth headpond is generally operated close to full pond elevation such that, during any

extended outage, the pond will start to spill in a relatively short time and pass the inflow. If the Licensee is unable to restore or transition the minimum flow to a unit or to the spillway within 15 minutes, the Licensee will notify MDEP, MDIFW, USFWS and NMFS of the minimum flow excursion within 24 hours (see Section 5.0, Reporting).

Impoundments

There may be occasions where the Licensee will need to initiate an unplanned drawdown to respond to emergencies beyond its control such as dam safety, public safety, or impending electrical system blackout emergencies. The Licensee will notify the MDEP, MDIFW, USFWS and NMFS within 24 hours of such emergencies and include the date, time, and the reason for the emergency drawdown (see Section 5.0, Reporting).

4.0 OPERATIONS MONITORING

The Licensee will monitor generation at the Project continuously via SCADA, outflow is calculated from the generation readings using a conversion factor based on kw/cfs passed through the unit(s).² [The curves or calculations used to convert kw to cfs, and gate settings to cfs, will be included in the final plan.] Pressure-sensitive headwater sensors (transducer) are in place at both the Graham Lake Dam and the Ellsworth dam and provide real time impoundment levels.

Project generation/outflow, and impoundment levels, will be recorded electronically by the automated operations system every 15 minutes and archived for Licensee's record of compliance with the requirements of the new license. These records can be retrieved and be made available to verify compliance.

The Licensee will provide copies of monitoring data (i.e., flow and impoundment level conditions) to the FERC, MDEP, MDIFW, USFWS and the NMFS, upon written request.

² Flow statistics for the Project area are calculated from generation data for Ellsworth Dam collected at the facility, as there is no USGS Gage associated with the Project area.

5.0 REPORTING

The Licensee will notify the MDEP, MDIFW, USFWS and the NMFS within 24 hours of any deviation from minimum flow requirements (of greater than 15 minutes) or headpond elevations, as explained above. The agency notification will include a brief summary of the deviation and any observed adverse environmental or public safety impacts resulting from the incident. The minimum flow or headpond elevations may also be interrupted for short periods after consultation with the MDEP and appropriate fisheries management agencies.

The Licensee will notify the FERC within ten days of any deviation from minimum flow requirements (of greater than 15 minutes) or headpond elevations. The notification will contain, to the extent possible, the cause, severity and duration of the incident, and any observed or reported adverse environmental impacts resulting from the incident. The report will also provide pertinent Project data and a description of corrective measures and documentation of consultation with the agencies. A copy of the report will be provided to the resource agencies.

APPENDIX E-12

**DRAFT BIOLOGICAL ASSESSMENT FOR ATLANTIC SALMON,
ATLANTIC STURGEON, AND SHORTNOSE STURGEON**

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ELLSWORTH HYDROELECTRIC PROJECT
FERC NO. 2727

DRAFT BIOLOGICAL ASSESSMENT
FOR
ATLANTIC SALMON, ATLANTIC STURGEON,
AND SHORTNOSE STURGEON

Black Bear Hydro Partners LLC
Lewiston, Maine



December 2015

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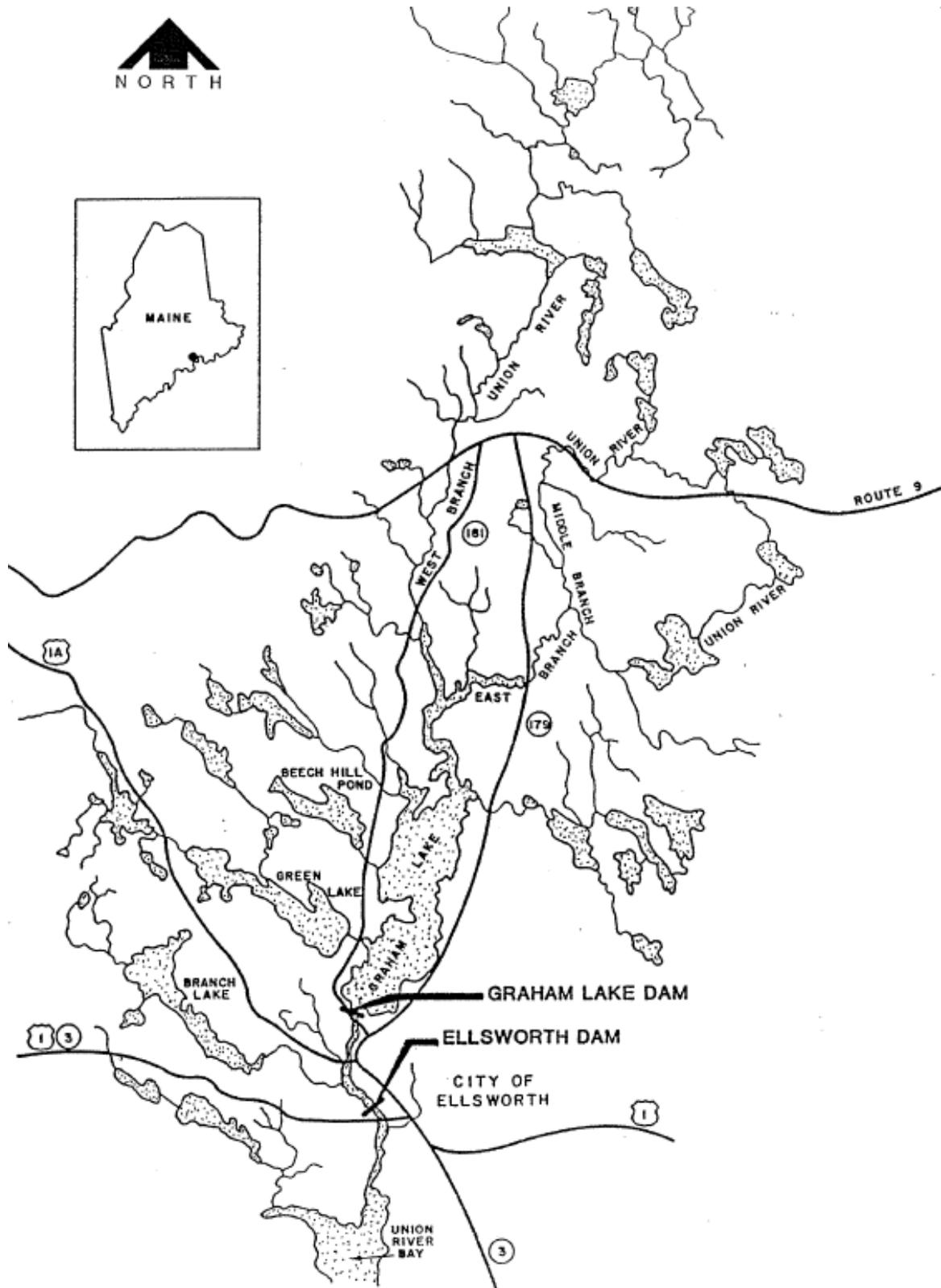
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1.0 Background

Black Bear Hydro Partners LLC (Black Bear) is in the process of relicensing the Ellsworth Project (FERC No. 2727), an 8.9 megawatt (MW) hydroelectric facility located on the Union River in the City of Ellsworth, Hancock County, Maine. The existing license for the Ellsworth Project expires in 2017; Black Bear will submit an application for a new license to the Federal Energy Regulatory Commission (FERC) by December 31, 2015. FERC's issuance of a new license for the Ellsworth Project is a federal action and, therefore, requires consultation under Section 7 of the Endangered Species Act (ESA) to assess the potential effects of the action on federally protected species and determine whether incidental take is expected to occur. A federal agency may designate a non-federal representative to conduct informal consultation or prepare a biological assessment to assess the effects of a proposed federal action on listed species. On September 14, 2011, FERC designated Black Bear as its non-federal representative for ESA consultation for the licensing of the Ellsworth Project.

Consistent with its designation as FERC's non-federal representative for ESA consultation for the relicensing of the Ellsworth Project, Black Bear has developed this draft Biological Assessment (BA) for the federally endangered Gulf of Maine (GOM) Distinct Population Segment (DPS) of Atlantic salmon, Atlantic sturgeon, and shortnose sturgeon at the Ellsworth Project. The Ellsworth Project consists of the Ellsworth Development, the Graham Lake Development, and appurtenant facilities. The Ellsworth Dam has an integral intake structure and powerhouse. Graham Lake Dam is located on the Union River upstream of Ellsworth Dam, creating the water storage reservoir known as Graham Lake (Figure 1).

FIGURE 1
PROJECT LOCATION MAP



1.1 ESA Listing of Atlantic Salmon

The GOM DPS of Atlantic salmon was first listed as endangered by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) (the Services) on November 17, 2000 (USFWS and NMFS 2000). The GOM DPS designation in 2000 included all naturally reproducing Atlantic salmon populations occurring in an area from the Kennebec River downstream of the former Edwards Dam site extending north to the international border between Canada and the United States at the mouth of the St. Croix River. This range includes the Union River. The listing in 2000 identified nine watersheds likely to contain naturally reproducing Atlantic salmon populations, including the Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap, and Sheepscot Rivers, Cove Brook and Kenduskeag Stream. The GOM DPS also included river-specific hatchery fish that were being propagated at the Craig Brook Hatchery for release into the wild. The November 2000 final rule listing the GOM DPS did not include fish that inhabit the mainstem and tributaries of the Penobscot River above the site of the former Bangor Dam, the upper Kennebec River, or the Androscoggin River (USFWS and NMFS 2000).

The 2006 Status Review for anadromous Atlantic salmon in the U.S. (Fay et al. 2006) assessed genetic and life history information and concluded that the GOM DPS, as defined in 2000, should be redefined to encompass the Penobscot, Kennebec, and Androscoggin Rivers. On June 19, 2009, the Services published a final rule determining that naturally spawned and conservation hatchery populations of anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, including those that were already listed in November 2000, constitute a DPS and hence a “species” for listing as endangered under the ESA (USFWS and NMFS 2009). This range includes the Union River.

1.2 Downeast Coastal Salmon Habitat Recovery Unit

The GOM DPS of Atlantic salmon is divided into three salmon habitat recovery units (SHRUs) within the range of the GOM DPS and include the following: the Downeast Coastal SHRU, the Penobscot Bay SHRU, and the Merrymeeting Bay SHRU. The three SHRUs were created to ensure that Atlantic salmon were widely distributed across the DPS such that recovery of the GOM DPS is not limited to one river or one geographic location, because widely distributed

species are less likely to become threatened or endangered by limited genetic variability and tend to be more stable over space and time (NOAA 2009).

The Downeast Coastal SHRU contains 61,395 units¹ of historically accessible spawning and rearing habitat for Atlantic salmon, of which 53,390 units are considered to be currently occupied, and 29,111 of these units are estimated to be functional units of spawning and rearing habitat (NMFS 2009a, NMFS 2009b). Within the Downeast Coastal SHRU, the Union River has about 12,000 units of historic spawning and rearing habitat, although NMFS concludes that dams reduce its equivalent functional habitat value to 4,062 units of habitat (NMFS 2009a). In addition to dams, a variety of issues and conditions affect Atlantic salmon recovery in the Union River, including agriculture, forestry, changing land use, hatcheries and stocking, roads and road crossings, mining, dredging, aquaculture, and introductions of non-native species such as smallmouth bass (NMFS 2009a).

1.3 Critical Habitat Designation

As a result of the June 19, 2009 endangered species listing, NMFS was required to evaluate historical occupancy of the watershed for the process of designating critical habitat for the GOM DPS. Section 3 of the ESA defines critical habitat as the following:

1. Specific areas within the geographical area occupied by the species at the time of listing, in which are found those physical or biological features that are essential to the conservation of the listed species and that may require special management considerations or protection; and
2. Specific areas outside the geographical area occupied by the species at the time of listing that are essential for the conservation of a listed species.

As part of the critical habitat designation, NMFS described the known primary constituent elements (PCEs) that are deemed essential to the conservation of the GOM DPS, including (1) sites for spawning and rearing and (2) sites for migration (excluding marine migration²). The

¹ One unit of habitat is 100m² (NMFS 2009a)

² NMFS was not able to identify the essential features of marine migration and feeding habitat or the specific locations of marine habitats at the time critical habitat was designated (NMFS 2009a).

physical and biological features of the two PCEs for Atlantic salmon critical habitat are as follows:

Physical and Biological Features of the Spawning and Rearing PCE

- A1. Deep, oxygenated pools and cover (e.g., boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.
- A2. Freshwater spawning sites that contain clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support spawning activity, egg incubation, and larval development.
- A3. Freshwater spawning and rearing sites with clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support emergence, territorial development and feeding activities of Atlantic salmon fry.
- A4. Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.
- A5. Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parr's ability to occupy many niches and maximize parr production.
- A6. Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.
- A7. Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.

Physical and Biological Features of the Migration PCE

- B1. Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations.
- B2. Freshwater and estuary migration sites with pool, lake, and instream habitat that provide cool, oxygenated water and cover items (e.g., boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon.
- B3. Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.
- B4. Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.
- B5. Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration.
- B6. Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

On June 19, 2009, NMFS designated as critical habitat 45 specific areas occupied by GOM DPS Atlantic salmon at the time of listing. Critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line (33 C.F.R. 329.11). Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater. Critical habitat is designated to include all perennial rivers, streams, and estuaries and lakes connected to the marine environment within the range of the GOM DPS, except for those particular areas within the range which are specifically excluded (NMFS 2009a).

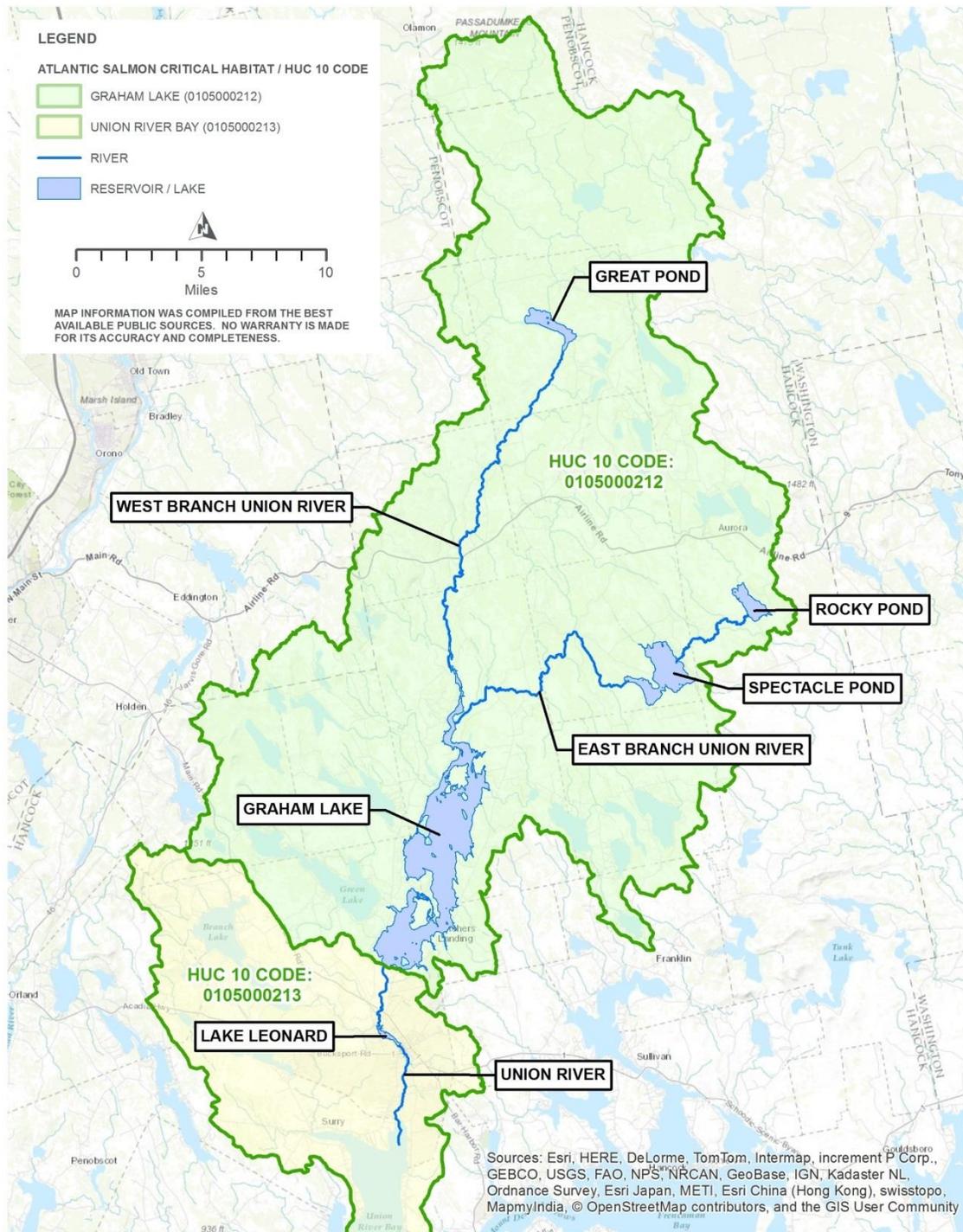
The Ellsworth Project falls within the designated critical habitat of the Downeast Coastal SHRU for Atlantic salmon. Critical Habitat is further delineated into HUC 10 watersheds. The Union River includes two HUC 10 watersheds listed as critical habitat, including the Graham Lake HUC 10 (code 0105000212) and the Union River Bay HUC 10 (code 0105000213). The entire Project area is within Atlantic salmon critical habitat as shown in Figure 2.

1.4 Other ESA Listed Species - Atlantic and Shortnose Sturgeon

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and shortnose sturgeon (*Acipenser brevirostrum*) have the potential to occur in the Union River downstream of the Ellsworth Project. On February 6, 2012, NOAA published notice in the Federal Register listing the Atlantic sturgeon as "endangered" in the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs, and as "threatened" in the Gulf of Maine DPS (77 FR 5880 and 77 FR 5914). The Ellsworth Project falls within the Gulf of Maine DPS.

Shortnose sturgeon were listed as endangered on March 11, 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Although shortnose sturgeon are listed as endangered range-wide, in the final recovery plan NMFS recognized 19 separate populations occurring throughout the range of the species. These populations are in New Brunswick Canada; Maine; Massachusetts; Connecticut; New York; New Jersey/Delaware; Maryland and Virginia; North Carolina; South Carolina; Georgia; and Florida. Critical habitat has not been designated for Atlantic or shortnose sturgeon.

FIGURE 2
CRITICAL HABITAT, UNION RIVER WATERSHED



2.0 Overview of the Draft Biological Assessment and Agency Consultation

2.1 Purpose and Description of Draft Biological Assessment

The FERC license for the Ellsworth Project expires in 2017. Black Bear initiated the relicensing process for the Project in 2012 and submitted an application for new license to FERC in December of 2015. As part of the relicensing process, Black Bear is addressing the potential for continued operation of the Project to affect ESA listed species. Black Bear had previously requested to be designated FERC's non-federal representative for the purpose of conducting informal consultation with the Services pursuant to Section 7 of the ESA. FERC designated Black Bear as its non-federal representative in a letter dated September 14, 2011.

The Services have indicated that activities related to the listing of the GOM DPS Atlantic salmon in Maine will be jointly managed and administered; however, NMFS will have the lead on issues pertaining to hydroelectric operations and their effects on Atlantic salmon and their critical habitat. Section 9 of the ESA prohibits the take of endangered species, including the GOM DPS Atlantic salmon, unless the take is authorized under specific provisions of the ESA. "Take" is defined by the ESA as "to harass, harm, pursue, ban, shoot, wound, kill, trap, capture, or collect," or to attempt to engage in any such conduct.

Exemptions to the prohibitions of take under Section 9 of the ESA can be provided by the Services through Section 10 or Section 7 of the ESA. Under ESA Section 10(a)(1)(B), permits may be issued for taking that is incidental to the purposes of an otherwise lawful activity (incidental take permits). Under ESA Section 7(a)(2), incidental take statements may be issued to exempt from the prohibitions any take anticipated as an incidental result of an activity conducted, permitted, or funded by a federal agency provided this take would not be likely to result in jeopardy to the species or destruction of its critical habitat. Section 7 of the ESA mandates that all federal agencies consult with the Secretaries of Commerce (through NMFS) and Interior (through the USFWS) to determine whether a proposed action is likely to be categorized, with respect to listed species and designated critical habitat, as follows:

1. **No Effect:** No effects to the species and its critical habitat from the proposed action, either positive or negative, are expected.

2. ***May Affect, Not Likely to Adversely Affect:*** All effects of the proposed action to the species and its critical habitat are beneficial, insignificant, or discountable. Beneficial effects have positive effects to the species or its critical habitat. Insignificant effects relate to the size of the impact and should not reach the scale where incidental or unintentional take (harming or killing) occurs. Discountable effects are those that are extremely unlikely to occur. Determinations of “not likely to adversely affect” due to beneficial, insignificant, or discountable effects require written concurrence from the USFWS or NMFS.
3. ***May Affect, Likely to Adversely Affect:*** The action would have an adverse effect on the species or its critical habitat. Any action that may result in take of an endangered species is considered an adverse effect. A combination of beneficial and adverse effects is still considered “likely to adversely affect” even if the net effect is neutral or positive. Adverse effects are not considered discountable because they are expected to occur. This determination requires formal consultation with the USFWS or NMFS.

2.2 Consultation

Both prior to and after the June 19, 2009 ESA listing of GOM DPS Atlantic salmon, Black Bear held discussions with the Services to develop measures to protect the GOM DPS Atlantic salmon. Between 2009 and 2011, Black Bear had numerous discussions with the Services to develop a draft BA and a Draft Species Protection Plan (SPP) for the Ellsworth Project as part of the prospective documents also covering Black Bear’s Penobscot River hydroelectric projects (Orono, Stillwater, Milford, West Enfield, and Medway projects). The SPP identified measures to avoid and minimize potential adverse effects on listed Atlantic salmon and designated critical habitat. In September 2011, NMFS requested that Black Bear remove the Ellsworth Project from the Penobscot draft BA and instead, develop a separate draft BA for the Ellsworth Project. This was done, and a draft BA for the Ellsworth Project was sent to the Services for their review on August 16, 2012. Black Bear held a meeting with NMFS to discuss development of the draft BA and SPP on November 13, 2012. NMFS provided comments on the draft BA on December 7, 2012. With the initiation of relicensing activities in late 2012, development of the draft BA has been coordinated with the schedule for developing the FERC license application. Based on further consultation with NMFS regarding potential protection measures and the lack of adequate

information to inform the determination of suitable measures, an SPP has not yet been developed for the Ellsworth Project. Black Bear will continue to consult with NMFS regarding ongoing salmon passage studies to identify appropriate protection measures. Further, NMFS, Maine Department of Marine Resources (Maine DMR), and USFWS are currently developing a stock rebuilding and management plan for the Union River as part of the Atlantic salmon recovery objectives (NMFS 2015).

3.0 Project Description

3.1 Project Facilities

The Ellsworth Project consists of the Ellsworth Development, the Graham Lake Development, and appurtenant facilities. The Ellsworth Dam has an integral intake structure and powerhouse, and creates the impoundment, Lake Leonard. Graham Lake Dam is located on the Union River about 4 miles upstream of Ellsworth Dam, creating the water storage reservoir known as Graham Lake (Figure 1).

Construction of the Ellsworth Dam was completed in 1907. Ellsworth Dam is approximately 377 feet long and 65 feet high with 1.7-foot-high flashboards on the spillway. Lake Leonard extends approximately 1 mile above Ellsworth Dam and has a surface area of 90 acres at a normal full pond water surface elevation of 66.7' U.S. Geological Survey (USGS) datum. The powerhouse is a reinforced concrete and concrete block masonry powerhouse containing four turbine-generator units, which have a total FERC authorized nameplate capacity of 8,900 kW (Table 1) and a total combined maximum flow capacity of approximately 2,460 cfs.

The Graham Lake Dam is an earthfill dam with concrete core walls, about 750 feet long and 30 feet high and includes a gated concrete spillway. The Graham Lake reservoir is approximately 10 miles long with a surface area of approximately 10,000 acres at normal full pond water surface elevation of 104.2' (Table 1). There are no generating facilities at the Graham Lake Development.

TABLE 1
CHARACTERISTICS OF THE ELLSWORTH PROJECT

Facility Characteristics	Ellsworth Dam	Graham Lake Dam
Reservoir Length	1 mile	10 miles
Reservoir Surface Area	90 acres	Approximately 10,000 acres
Reservoir Normal Full Pond Elevation	66.7' (includes 1.7-foot flashboards)	104.2'
Length of Dam	377 feet	750 feet
Height of Dam	65 feet	30 feet
Turbine Rated Capacity*	<ul style="list-style-type: none"> • Unit 1 – 3,800 hp (2,850 kW) (vertical shaft propeller) • Unit 2 – 2,900 hp (2,175 kW) (Kaplan) • Unit 3 – 2,900 hp (2,175 kW) (Kaplan) • Unit 4 – 3,800 hp unit (2,850 kW) (vertical shaft propeller) 	NA
Generator Rated Capacity**	<ul style="list-style-type: none"> • Unit 1 – 3,125 kVA @ power factor 0.8; 2,500 kW • Unit 2 – 2,500 kVA @ power factor 0.8; 2,000 kW • Unit 3 – 2,500 kVA @ power factor 0.8; 2,000 kW • Unit 4 – 3,000 kVA @ power factor 0.8; 2,400 kW 	
Trash Rack Spacing	Variable – Typical configuration based on normal pond elevation: Top 6-8 feet is concrete Unit 1 – 2.44 in. Units 2-4 – 1.00 in.(top)/2.37 in. (bottom)	NA

*The total combined maximum hydraulic capacity of the turbines is estimated to be 2,460 cfs.

**The total FERC authorized capacity of the facility, based on the limiting unit components, is 8.9 MW.

The Ellsworth Dam trap and transport facility is equipped with a four-baffle vertical slot upstream fishway leading to a trap fitted with a hopper and hoisting structure to facilitate fish transport in circular transport tanks (Figure 3). The fishway entrance is immediately adjacent to the powerhouse tailrace with a pumped attraction flow of up to 50 cfs. The upstream fishway and fish trapping facility were constructed at the Ellsworth Dam (Lake Leonard) in 1974, originally to provide a supplemental source of Atlantic salmon broodstock for use in the restoration of populations to the Penobscot and other rivers (Baum 1982). Since Atlantic salmon broodstock collection has been discontinued, the upstream fishway is now used primarily during the river herring migration, but also to collect any salmon that might use the facility for potential

upriver transport (depending on origin of fish) in the Union River. Adult Atlantic salmon that are captured in the fishway are examined to determine origin, and the Maine DMR determines whether Atlantic salmon caught in the fishway are released downstream of the Ellsworth Dam, upstream of the Graham Lake Dam, or, if an aquaculture escapee, removed by Maine DMR. Graham Lake Dam does not have an upstream fishway because fish are transported from the Ellsworth trap and transport facility to locations above the Graham Lake Dam.

Black Bear operates downstream passage facilities at both Ellsworth Dam (Figures 4 and 5) and Graham Lake Dam (Figure 6). Downstream measures at the Ellsworth Dam consist of two stop-log controlled surface weirs above Units 2 through 4 and a transport pipe leading to a plunge pool immediately downstream of the dam, as well as a third surface weir adjacent to the Unit 1 intake that discharges directly to the same plunge pool. In addition, a permanent stainless steel inlet screen was installed over the intake of the cooling water system at the Ellsworth Dam on May 26, 2015 as a downstream passage protection measure, following review and consultation with the resources agencies, including guidance provided by the USFWS and NMFS.

In addition to the activities associated with operation and maintenance of the fish passage facilities at the Ellsworth Dam, Black Bear operates a surface weir to provide downstream passage of out-migrating Atlantic salmon and river herring on the west end of the Graham Lake Dam gate structure. The development of this passage route was completed in 2003, coinciding with increased upstream stocking of alewives. The weir (Figure 6) is very similar to the downstream passage system at the Ellsworth Dam in that it is a surface weir that contains stoplogs, which enable Black Bear to adjust the opening as necessary. The opening empties into a downstream plunge pool and provides migrants with another route of passage in addition to the existing Tainter gates, which are operated to pass minimum flows and flows used for generation purposes at the Ellsworth Dam. The downstream fishways are operated from April 1 to December 31 annually, as river conditions allow.

FIGURE 3
VIEW OF FISHWAY LIFT IN OPERATION USED FOR TRANSFERRING FISH TO
THE HOLDING TANK AT THE ELLSWORTH DAM



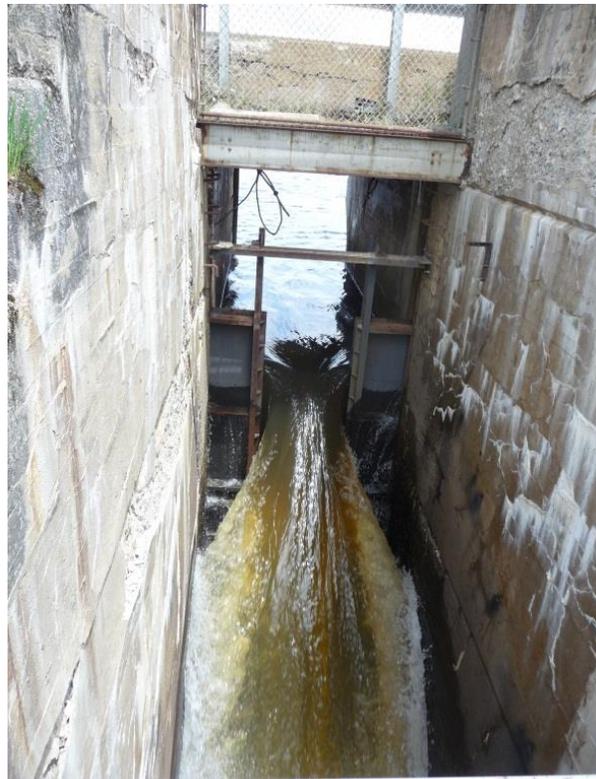
FIGURE 4
VIEW OF COLLECTION CHAMBER AND ENTRANCE TO DOWNSTREAM FISH
PASSAGE PIPE AT THE ELLSWORTH DAM



FIGURE 5
VIEW OF DISCHARGE FROM DOWNSTREAM FISH PASSAGE PIPE AND
SURFACE WEIR AT THE ELLSWORTH DAM



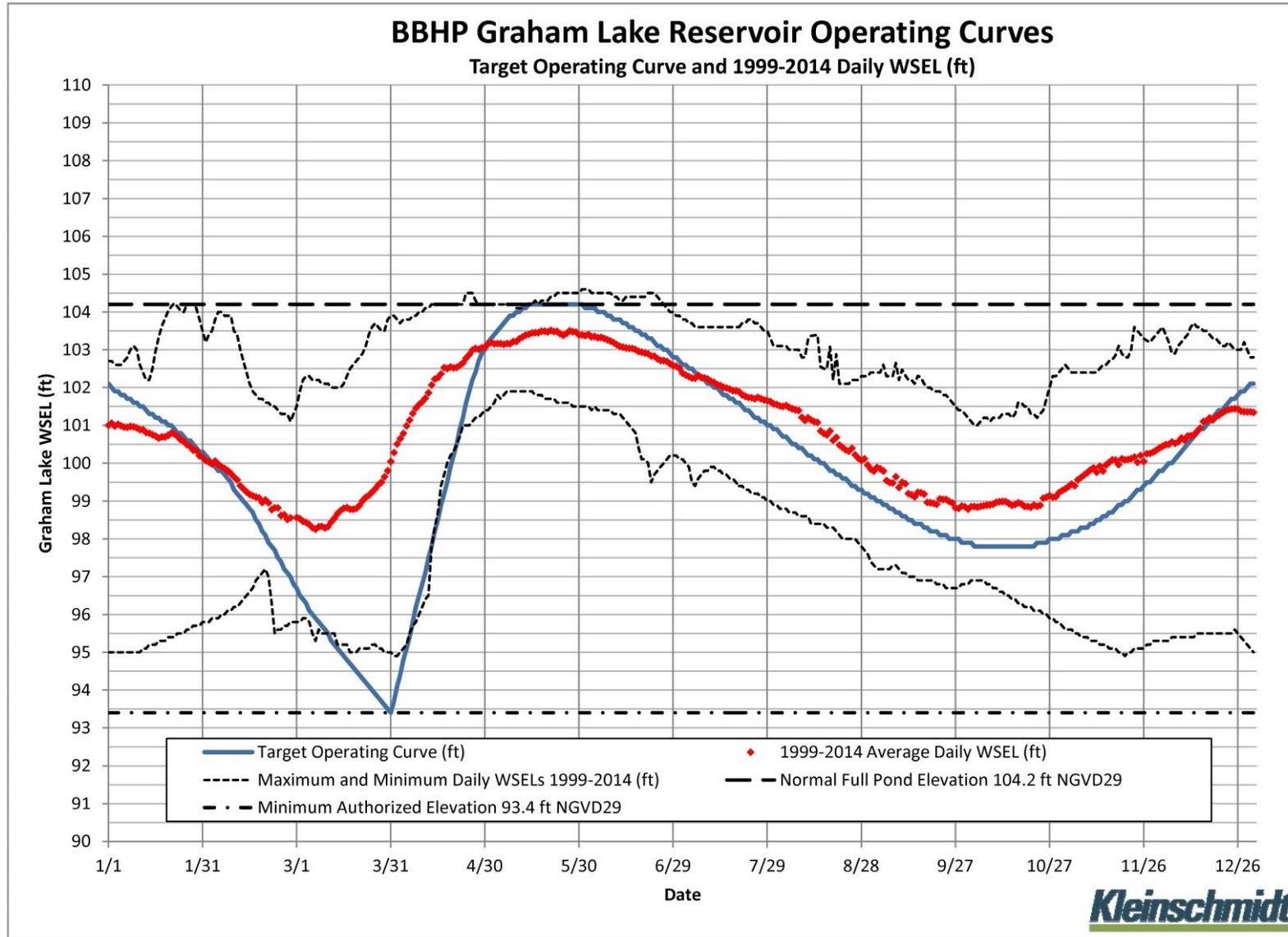
FIGURE 6
GRAHAM LAKE DAM FISH PASSAGE WEIR



3.2 Project Operations

The Ellsworth Project operates as both a water storage facility and as a peaking generation facility, depending on available inflows, while maintaining minimum flows. Timed releases at Graham Lake are used at Ellsworth Dam for power production. The releases may result in minor (approximately 1 foot) surface elevation variations in Lake Leonard. During high flow conditions, primarily in the spring and fall, the Project may operate at full load up to 24 hours a day. Graham Lake generally follows an operating curve that can result in fluctuations approaching 11 feet over the course of a year (Figure 7). As per Articles 401 and 402 of the 1987 Order Issuing New License, minimum flows and water levels are required and maintained by Black Bear. Article 401 specifies a continuous minimum flow release of 105 cfs from the Graham Lake Dam and Ellsworth Dam from July 1 through April 30 and a continuous minimum flow release of 250 cfs from May 1 through June 30 for the protection of fishery resources. Article 402 of the FERC license specifies that the licensee operates the Ellsworth Project so that the following water levels are maintained: Lake Leonard 1-foot fluctuation (65.7' to 66.7' msl) and Graham Lake 10.8-foot fluctuation (93.4' to 104.2' msl). Black Bear has proposed in the December 2015 application for new license to continue these fundamental operating parameters for the Ellsworth Project.

FIGURE 7
GRAHAM LAKE HISTORIC OPERATING CURVES



The Project's fish passage facilities are managed in consultation with the agencies³ through the *Comprehensive Fishery Management Plan for the Union River Drainage 2000-2005*, which is updated every five years. The current plan covers the three year period of 2015-2017 due to the expiration of the Project license in December 2017 (URFCC 2015). In 2014, the upstream fishway was operated for river herring (alewife; blueback herring) stocking and harvesting beginning in early May through mid-June, and then Black Bear continued to operate the fishway through November 4 for Atlantic salmon (URFCC 2015). In 2015, Black Bear conducted an upstream Atlantic salmon passage evaluation and operated the fishway from May 1 through October 31⁴. The downstream fishways are operated from April 1 to December 31 annually, as river conditions allow. Also in 2015, Black Bear developed a site specific operation and maintenance plan for the fishways. The plan, which is consistent with the original design criteria for the fishways, includes a daily checklist that was instituted at the beginning of the 2015 season, and will be employed in future seasons to ensure that the upstream and downstream fishways are operating properly. The plan also includes both a list of spare parts critical to fishway operation and a checklist of proper fishway operating characteristics. In 2015, Black Bear hired dedicated staff to operate the project fish passage facilities; these staff were dedicated to fishway operations, oversight, fish trap tending, and transporting the fish upriver. These dedicated fishway staff completed the daily checklists and prepared weekly reports on fishway operations, which were provided to the fisheries management agencies throughout the fishway operational season.

3.3 Water Quality in the Project Area

The Union River watershed encompasses approximately 500 square miles in Hancock and Penobscot Counties and is Maine's 19th largest river (Baum 1982). The headwaters of the Union River are located in three principal tributaries, East, West and Middle Branches (see Figure 1). Of the three, the West Branch is the largest (175 mi²) followed by the East (150 mi²) and Middle

³ Includes NMFS, USFWS, and Maine DMR

⁴ Consistent with Maine DMR protocols, the fishway is not operated when temperatures exceed 23°C (73°F), which occurred sporadically in July and September and the majority of August. However, observations of the fishway entrance and tailwater areas were conducted routinely.

(45 mi²) Branches. In total, there are approximately 484 miles of streams and 81 lakes and ponds within the watershed.

Maine statute 38 MRSA (§464-470) establishes the basis for the State's classification system of surface waters. The State has one water quality standard for lakes and great ponds (GPA) which includes inland bodies of water artificially formed or increased that have a surface area greater than 30 acres. Graham Lake is included in this classification. The Maine Department of Environmental Protection (Maine DEP) currently interprets the water quality statutes to classify Lake Leonard as a GPA water (K. Howatt, Maine DEP personal communication, June 16, 2015). There are four standards for the classification of fresh surface waters which are not classified as great ponds: Class AA, A, B, and C waters. The Union River from the outlet of Graham Lake to tidewater, excluding the impounded portion of Lake Leonard, is classified as Class B (38 M.R.S.A. §467.18.A (1)).

4.0 Listed Species Life History

4.1 Atlantic Salmon

Anadromous Atlantic salmon have a complex life history that includes spawning and rearing in freshwater rivers and streams, as well as extensive feeding migrations and sexual maturation in the marine environment (Fay et al. 2006). The freshwater juvenile stage of the life cycle can last from one to three years, after which juveniles undergo a physiological transformation (called smoltification) and migrate downstream to spend one to three years at sea, before returning to freshwater to spawn in their natal rivers. Unlike Pacific salmon, Atlantic salmon do not die after spawning, and can return to sea to repeat the migratory cycle.

Although spawning by Atlantic salmon does not occur until late October or November, most adult Atlantic salmon ascend rivers beginning in the spring. In the GOM rivers, the peak upstream migration occurs in June, but may persist until the fall (Fay et al. 2006). After fish enter the freshwater environment, they cease feeding and darken in coloration. Salmon that return early in the spring spend nearly five months in the river before spawning, seeking cool water refuges (e.g., deep pools, springs, and mouths of small cold-water tributaries) during the summer months (Fay et al. 2006). Following spawning, adults (referred to as "kelts") may move downstream in either the fall or the following spring, eventually reaching the estuary and ocean.

Once in the marine environment, these salmon resume feeding and a very small percentage may return as repeat spawners one to two years later.

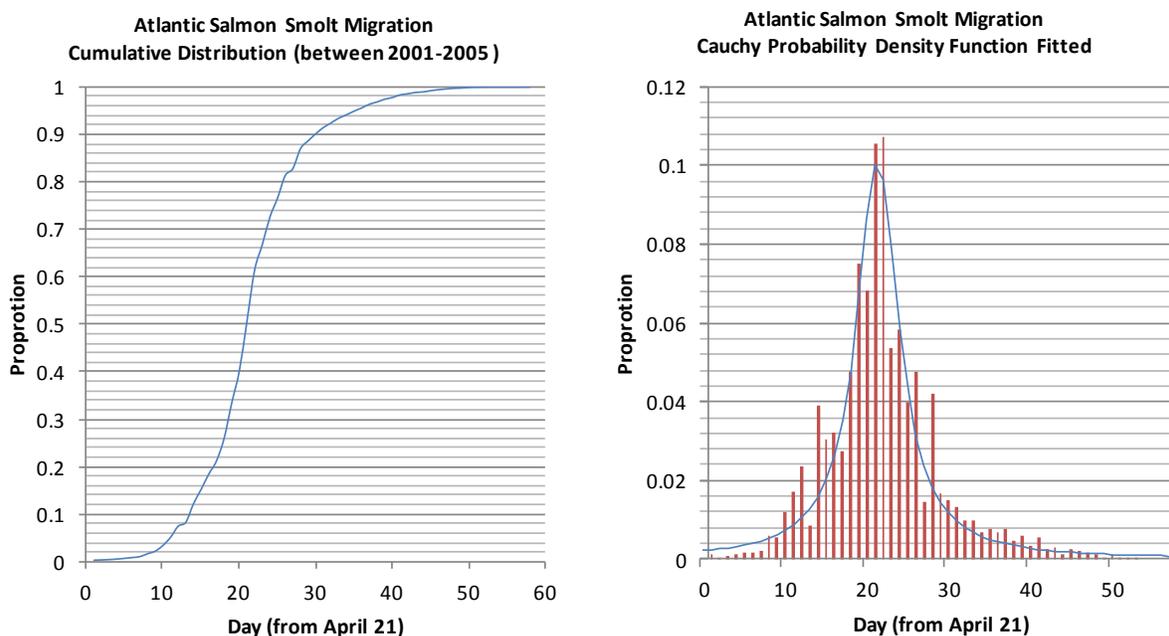
Preferred spawning habitat consists of gravel substrate with adequate water circulation to keep buried eggs well oxygenated. Water depth at spawning sites is typically 30 cm to 61 cm, and water velocity averages 60 cm per second (Fay et al. 2006). Spawning occurs from late October through November when water temperatures are roughly between 7.2°C to 10.0°C. The female uses its tail to scour or dig a series of nests in the gravel where the eggs are deposited; this series of nests is called a redd. One or more males fertilize the eggs as they are deposited in the redd. The female then continues digging upstream of the last deposition site, burying the fertilized eggs with clean gravel. A female salmon returning to spawn after spending two years at sea will produce approximately 7,500 eggs (Fay et al. 2006).

The eggs hatch in late March or April. At this stage, the young salmon are referred to as alevin or sac fry. Alevins remain in the redd for about six more weeks and are nourished by their yolk sac. Alevins emerge from the gravel in mid-May, and begin active feeding, at which time they are called fry (Fay et al. 2006). Within days, the salmon fry enter the parr stage, indicated by vertical bars (parr marks) visible on their sides. Parr prefer areas with adequate cover, water depths ranging from approximately 10 cm to 60 cm, water velocities between 30 cm and 92 cm per second, and water temperature near 16°C (Fay et al. 2006). Juvenile salmon are territorial and feed on a variety of aquatic invertebrates, including larvae of mayflies, stoneflies, chironomids, and caddis flies; aquatic annelids; mollusks; and numerous terrestrial invertebrate species that fall into the river (Fay et al. 2006). In fall as flows increase, and as temperature and day length decrease, parr often shelter in the substrate. Movement may be quite limited in the winter, but can occur, particularly if the formation of ice reduces available habitat (Fay et al. 2006).

After remaining in freshwater habitat for one to three years (typically two years in Maine), parr undergo a series of physiological, morphological and behavioral changes in a process called “smoltification.” This transformation occurs in the spring and prepares the salmon “smolt” for its dramatic change in osmoregulatory needs that come with movement from a freshwater to marine environment (Fay et al. 2006). The smolt emigration period is rather short and lasts only two to three weeks for each individual (NMFS 2008). While not specifically assessed in the

Union River, naturally reared and wild smolts in Maine typically enter the sea during May to begin their ocean migration (Fay et al. 2006). In the Penobscot River, smolts migrate between late April and early June with a peak migration in early May (Fay et al. 2006). The majority of smolts migrate in a short period of time, as demonstrated by NMFS' Penobscot River smolt trapping studies conducted between 2000 and 2005. These data show that 74% of the downstream run occurs in 15 days in mid-May (Figure 8) and that the majority of the smolt migration appears to take place after water temperatures rise to 10°C (USFWS unpublished *cited in Black Bear 2012*). The USFWS conducted a review of literature regarding diurnal migration timing and found that a median of 80.7% of smolts migrated at night (USFWS unpublished *cited in Black Bear 2012*).

FIGURE 8
SMOLT MIGRATION TIMING IN THE PENOBSCOT RIVER, BASED ON NMFS
SMOLT TRAPPING STUDIES BETWEEN 2001 AND 2005



Source: Review of NMFS' Penobscot River smolt trapping studies conducted between 2000 and 2005 - USFWS unpublished *cited in Black Bear 2012*.

Smolts have been documented to move through the Narraguagus River estuary (located in Downeast Maine) to the middle portion of the bay at 0.7 kilometers per hour (km/h) and 1.0 km/h in the outer Narraguagus Bay (Kocik et al. 2009). Overall, this study documented low survival between the estuary and open marine environment from 36% to 47% (Kocik et al. 2009).

Once in the ocean, Atlantic salmon become highly migratory, and undertake long migrations from their natal rivers (Fay et al. 2006). Major feeding areas in the ocean include the Davis Strait between Labrador and Greenland (USFWS and NMFS 2009). During their time at sea, Atlantic salmon undergo a period of rapid growth until they reach maturity and return to their natal river to complete the life cycle. Although the Gulf of Maine DPS yields the highest adult returns, millions of salmon are stocked annually, and these data indicate that freshwater and marine survival rates are extremely low (USFWS and NMFS 2009).

4.1.1 Recovery Plan Overview

Efforts aimed at restoring Atlantic salmon and their habitats in Maine have been underway for well over one hundred years. These efforts are supported by a number of federal, state, and local government agencies, as well as many non-governmental organizations. Major threats to Atlantic salmon “... continue to be impediments to fish passage; poor marine survival; water withdrawals; habitat degradation; poor water quality; recreational fishing mortality; disease and aquaculture impacts; and predation and competition” (Fay et al. 2006). The 2005 *Final Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon* for the originally listed GOM DPS (NMFS and USFWS 2005) presented a strategy for recovering Atlantic salmon and much of this strategy is carried over in the updated draft recovery plan (NMFS and USFWS 2015). This plan focused on reducing the most severe threats to the species and immediately halting the decline of the species to prevent extinction. The 2005 recovery program included the following elements:

- Protect and restore freshwater and estuarine habitats;
- Minimize potential for take in freshwater, estuarine, and marine fisheries;
- Reduce predation and competition for all life-stages of Atlantic salmon;
- Reduce risks from commercial aquaculture operations;
- Supplement wild populations with hatchery-reared DPS salmon;
- Conserve the genetic integrity of the DPS;
- Assess stock status of key life stages;
- Promote salmon recovery through increased public and government awareness; and
- Assess effectiveness of recovery actions and revise as appropriate (NMFS and USFWS 2005).

A wide variety of activities have focused on protecting and restoring GOM DPS Atlantic salmon. These activities include, but are not limited to:

- Hatchery supplementation;
- Removing unused dams or providing fish passage;
- Improving road crossings that block passage or degrade stream habitat;
- Protecting riparian corridors along rivers;
- Reducing the impact of irrigation water withdrawals;
- Limiting effects of recreational and commercial fishing;
- Reducing the effects of finfish aquaculture;
- Outreach and education activities; and
- Research focused on better understanding the threats to Atlantic salmon and developing effective restoration strategies (Trust 2008).

The interim recovery criteria from the critical habitat designation sets a minimum target of 500 wild adult returns and documented positive population growth (benchmark of threatened status) in each of the three SHRUs, which includes the utilization of critical habitat designated within Merymeeting Bay, Penobscot Bay, and Downeast watersheds (NMFS 2009a). The longer-term recovery target is 2,000 wild adult salmon returns in each SHRU (NMFS 2009a). In light of the 2009 GOM DPS listing and designation of critical habitat, the Services have developed an updated recovery plan for the expanded GOM DPS of Atlantic salmon. The main objective of the draft 2011 *Atlantic Salmon Recovery Framework: Implementation Plan* is to increase the abundance and preserve genetic diversity of wild Atlantic salmon populations that demonstrate persistent growth in all three SHRUs (NMFS et al. 2011). The following Action Teams have been initiated to implement defined actions and assessments related to specific objectives of the draft recovery plan:

1. Marine and Estuary Action Team,
2. Connectivity Action Team,
3. Genetic Diversity Action Team,
4. Conservation Hatchery Action Team,
5. Freshwater Action Team,

6. Outreach and Education Action Team, and
7. Stock Assessment Action Team (NMFS et al. 2011).

The Stock Assessment Action Team was established to provide scientific review of action team actions and results. These teams were also carried forward under the new draft Recovery Plan (NMFS and USFWS 2015).

4.1.2 Union River Comprehensive Fisheries Management Plan

In 1997 a group of agencies and interested parties (Union River Stakeholders Group, including the USFWS and Maine DMR) signed an agreement for the purposes of addressing interim and long-term fisheries management in the Union River drainage, including the provision of fish passage at the Ellsworth Hydroelectric Project. The Stakeholders adopted the following Mission Statement:

It is the goal of the Union River Stakeholders Group to achieve timely and effective restoration and/or management of populations of resident and self-sustaining diadromous fish in the Union River watershed, consistent with a comprehensive fishery management plan, and in a manner that balances the interests of the public, regulatory agencies, and the licensee of the Ellsworth Hydroelectric Project.

The Stakeholders agreed that they would develop a comprehensive, biologically-based plan, in order to support decisions on fishery management in the Union River.

The Union River Fisheries Coordinating Committee (URFCC), consisting of state and federal natural resource agencies and non-governmental conservation organizations⁵; as well as the City of Ellsworth; Black Bear; and interested members of the public, developed a comprehensive fishery management plan for the Union River. The plan consists of multi-year assessment cycles, beginning with 2000-2005. The most recent update to the plan (*Comprehensive Fishery Management Plan for the Union River Drainage, 2015-2017*, URFCC 2015) covers the period 2015-2017, due to the expiration of the Ellsworth Project license in December 2017. The current

⁵ The URFCC includes the USFWS, Maine DMR (former Maine Atlantic Salmon Commission), Maine Department of Inland Fisheries and Wildlife (Maine DIFW), City of Ellsworth, Union River Watershed Coalition, Union Salmon Association, the Maine Council of the Atlantic Salmon Federation, Black Bear, and interested members of the public.

plan identifies agency goals and objectives for diadromous and resident fish populations in the Union River drainage, and describes the various tasks and responsibilities related to the restoration and management of those resources, including stocking, habitat assessment, population monitoring, and fish passage.

4.2 Atlantic Sturgeon

The Atlantic sturgeon is a long-lived, late maturing, estuarine dependent, anadromous species. Information in the following subsections is taken from the 2007 Atlantic sturgeon status review (Atlantic Sturgeon Status Review Team 2007), unless otherwise noted. The species' historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida. Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in the spring/early summer; February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems. In some southern rivers, a fall spawning migration may also occur. A fall migration of ripening adults upriver in the Saint John River, New Brunswick is also observed; however, this fall migration is not considered a spawning run as adults do not spawn until the spring. Atlantic sturgeon spawning is believed to occur in flowing water between the salt front and fall line of large rivers, where optimal flows are 46-76 cm/s and depths of 11-27 meters. Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (e.g., cobble). Hatching occurs approximately 94-140 hours after egg deposition at temperatures of 20° and 18°C, respectively, and larvae assume a demersal existence. The yolk sac larval stage is completed in about 8-12 days, during which time the larvae move downstream to rearing grounds over a 6-12 day period. During the first half of their migration downstream, movement is limited to night. During the day, larvae use benthic structure (e.g., gravel matrix) as refugia. During the latter half of migration when larvae are more fully developed, movement to rearing grounds occurs both day and night. Juvenile sturgeon continue to move further downstream into brackish waters, and eventually become residents in estuarine waters for months or years.

Upon reaching a size of approximately 76-92 cm, the subadults may move to coastal waters where populations may undertake long-range migrations. Tagging and genetic data indicate that subadult and adult Atlantic sturgeon may travel widely once they emigrate from rivers. Subadult

Atlantic sturgeon transit between coastal and estuarine habitats, undergoing rapid growth. These migratory subadults, as well as adult sturgeon, are normally found in shallow (10-50 meters) near shore areas dominated by gravel and sand substrate. Coastal features or shorelines where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, Delaware, Delaware Bay, Chesapeake Bay, and North Carolina, which presumably provide better foraging opportunities. Despite extensive mixing in coastal waters, Atlantic sturgeon return to their natal river to spawn as indicated from tagging records and the relatively low rates of gene flow reported in population genetic studies. Males usually begin their spawning migration early and leave after the spawning season, while females make rapid spawning migrations upstream and quickly depart following spawning.

Atlantic sturgeon have been aged to 60 years, however, this should be taken as an approximation as the only age validation study conducted to date shows variations of ± 5 years. Vital parameters of sturgeon populations show clinal variation with faster growth and earlier age at maturation in more southern systems, though not all data sets conform to this trend. For example, Atlantic sturgeon mature in South Carolina at 5-19 years, in the Hudson River at 11-21 years and in the Saint Lawrence River at 22-34 years. Atlantic sturgeon likely do not spawn every year. Multiple studies have shown that spawning intervals range from 1-5 years for males and 2-5 for females. Fecundity of Atlantic sturgeon has been correlated with age and body size (ranging from 400,000 - 8 million eggs). The average age at which 50% of maximum lifetime egg production is achieved is estimated to be 29 years, approximately 3-10 times longer than for other bony fish species examined (NOAA 2012a).

The GOM DPS includes all Atlantic sturgeon that are spawned in the watersheds from the Maine/Canadian border and extending southward to include all associated watersheds draining into the Gulf of Maine as far south as Chatham, Massachusetts (NOAA 2012a). Tagging and tracking data indicate that there is mixing of sturgeon from different DPSs throughout their marine range, and consequently, NMFS determined that the marine ranges for the five DPSs are the same: all marine waters, including coastal bays and estuaries, from Labrador Inlet, Labrador, Canada to Cape Canaveral, Florida (NOAA 2012a, 2012b).

4.3 Shortnose Sturgeon

The shortnose sturgeon is an endangered fish species that occurs in large coastal rivers of eastern North America. In the northern part of its range, the species is considered to be “freshwater amphidromous,” meaning it spawns in freshwater, but regularly enters seawater during various stages of its life (NMFS 1998). Shortnose sturgeon are occasionally found near the mouths of rivers, and coastal migrations between the lower Penobscot River and the Androscoggin/Kennebec estuary (i.e., Merrymeeting Bay) have been documented (Zydlewski 2009, Fernandes et al. 2010). Juveniles typically move upstream in rivers in spring and summer, and downstream in fall and winter, but inhabit reaches above the freshwater - saltwater interface. Adults may move into higher salinity areas on a more regular basis (NMFS 1998).

Shortnose sturgeon are a long-lived species. The maximum documented age is 67 years for females, while males seldom exceed 30 years of age (NMFS 1987). In the northern part of their range, females do not spawn until about 18 years of age, while males spawn at about 12 years of age (NMFS 1987). Shortnose sturgeon females typically spawn every three to five years, while males may spawn as often as every one to three years (NMFS 1998). Spawning typically takes place in mid- to late spring when water temperatures reach 8-9°C; spawning ends when the water temperature reaches 12-15°C. Spawning may occur over a period of days to a few weeks. Overall spawning success can be negatively impacted if flows are unusually high during the spawning period (NMFS 1998).

Shortnose sturgeon typically seek the most accessible upstream areas for spawning, and may use a variety of micro-habitats. Channels appear to be important for spawning, which takes place over a variety of substrates (often gravel, rubble or boulders), in shallow to relatively deep water, and in moderate velocities (NMFS 1998).

Eggs are demersal and adhesive and remain near the spawning site. After eggs hatch, larval shortnose sturgeon are poor swimmers, and react negatively to light, instead seeking refuge among crevices and other cover on the bottom near the spawning site (NMFS 1998). After 9-12 days, the yolk sac is absorbed and the young sturgeon actively migrate downstream to locate suitable habitat. Young of year sturgeon typically inhabit deeper freshwater areas, and assume a more migratory behavior in the second summer of life (NMFS 1998).

Juvenile shortnose sturgeon (3 to 10 years old) typically inhabit the saltwater/freshwater interface in the lower reaches of rivers, foraging over fine-grained sand/silt/mud substrates. Juvenile and adult sturgeon can often use the same micro-habitats (NMFS 1998).

Adult shortnose sturgeon often inhabit short reaches of rivers, or concentration areas in summer and winter, where depth, velocity and substrate conditions combine to create favorable habitat for freshwater mussels, a preferred food item. Shortnose sturgeon will also forage in backwaters and in tidal channels under various levels of salinity (NMFS 1998).

Shortnose sturgeon are considered to be omnivorous. Juvenile sturgeon feed on a variety of benthic aquatic invertebrates (crustaceans, insects, worms, mollusks); adults show a preference for mollusks (NMFS 1998).

5.0 Presence of Listed Species in the Project Area

5.1 Atlantic Salmon

Runs of Atlantic salmon and other anadromous fish were once common in the Union River (Havey 1961), but disappeared in the late 1700s and early 1800s with the construction of dams in the lower portion of the river. Dams at outlets of many of the lakes and ponds in the drainage prevent full access of migratory fish to historical habitat (URFCC 2010).

Annual releases of hatchery-reared Atlantic salmon smolts (one- and two-year old fish) began in the Union River in 1971, and were continued until 1991, when stocking was suspended due to funding reductions and a redirected focus on wild salmon rivers and the Penobscot River (USASAC 1992). In the last 10 years of the broodstock program of that period, an average of approximately 36,000 smolts were stocked annually. Since 1993, there has been sporadic stocking of salmon fry and parr by the USFWS in the Union River in an effort to continue the restoration effort (Table 2).

In 2011, 19,000 fry and 282 excess brood stock (pre-spawn) were stocked in the West Branch Union River in Amherst (URFCC 2015). Spawning activity was assessed through redd counts near the release location, and over 200 redds were well distributed through the area (Figure 9). Fry stocking did not occur the next two years because of this natural reproduction. The Union

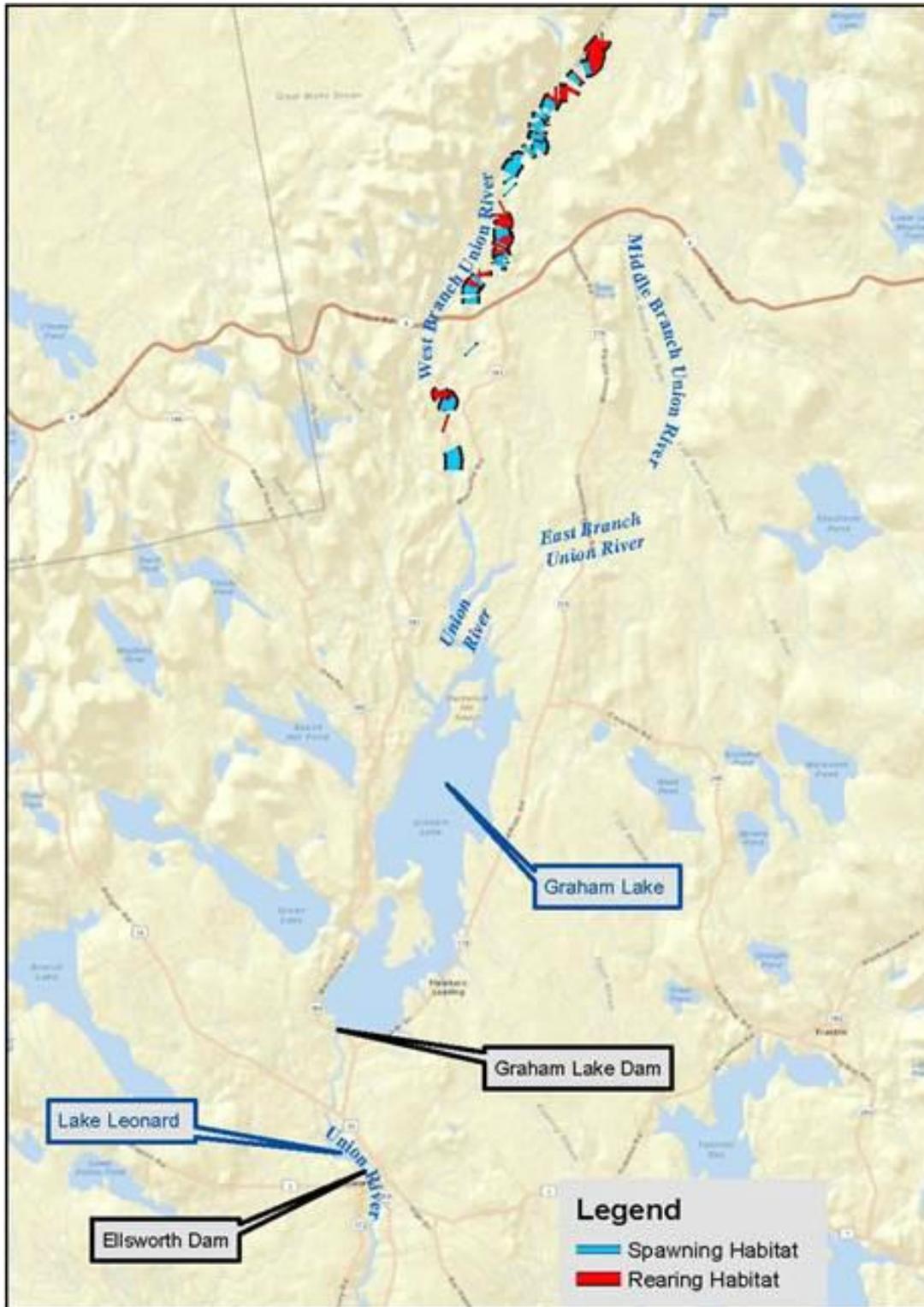
River Salmon Association resumed fry stocking in 2014, which will continue until at least 2017 (URFCC 2015).

TABLE 2
NUMBER OF ATLANTIC SALMON STOCKED
BY LIFE STAGE IN THE UNION RIVER

Year	Fry	0 Parr	1 Parr	2 Parr	1 Smolt	2 Smolt	Adult
1971-2001	425,000	371,400	0	0	379,700	251,000	0
2002	5,000	0	0	0	0	0	0
2003	3,000	0	0	0	0	0	0
2004	3,000	0	0	0	0	0	0
2005	2,000	0	0	0	0	0	0
2006	2,000	0	0	0	0	0	0
2007	22,000	0	0	0	0	0	0
2008	23,000	0	0	0	0	0	0
2009	28,000	0	0	0	0	0	0
2010	19,000	0	0	0	0	0	0
2011	19,000	0	0	0	0	0	282
2012	Natural recruitment from 282 adult spawners stocked in September, 2011 – no fry stocking						
2013	Natural recruitment from 282 adult spawners stocked in September, 2011 – no fry stocking						
2014	23,000	0	0	0	0	0	0

Source: URFCC 2015.

FIGURE 9
MAP SHOWING LOCATION OF SALMON REDDS
OBSERVED IN THE UNION RIVER IN 2011



Note: Red circles indicate location of redds, numbers to the right of circles indicate the number of redds at that location. Not all numbers are visible due to map scale. Source: URFCC 2012.

Completion of the fish trap at the Ellsworth Dam in 1974 aided in the collection of returning adult salmon; however, the effectiveness of the facility had initially been hampered by inadequate attraction flow and other operational problems, all of which have been improved in recent years (URFCC 2015). Adult Atlantic salmon returns to the Union River are shown in Table 3. Prior to aquaculture development in nearby marine areas, salmon origin was determined by fin condition and general appearance; however, this does not conclusively discriminate between aquaculture escapees and hatchery origin salmon. Large numbers of apparent aquaculture escapees were caught in 1996, but not verified with scale analyses.

Since 1999, the resource agencies have examined scale samples from each adult salmon returning to the Union River to determine origin. The assessments of salmon origin show that returns to the Union River since 1993 (i.e., following cessation of the broodstock program) consist of a few hatchery origin strays and a few wild or fry stocked salmon. The latter include salmon that originated from fry stocking, natural reproduction, or wild/fry stocked strays from other rivers. A few strays into the Union River that originated from the Penobscot River, or from the other eastern Maine rivers, is consistent with the homing and straying behavior of Atlantic salmon and the typical rate of straying described in the Status Review (i.e., 2% (Fay et al. 2006). The limited amount of stocking and natural spawning for a number of years has resulted in a near absence of sea-run salmon returns since 2003 (URFCC 2015). Between 2006 and 2011, no salmon returned to the Union River. Since then, three aquaculture escapees (non-GOM DPS salmon) were captured in 2012, one salmon (wild) returned in 2013, and two (one wild and one hatchery⁶) in 2014 (Table 3) (URFCC 2015). The 2014 suspected hatchery stray was released downstream of the Project. In 2015, the upstream fishway was operated four times per day for an extended period from May 1 to October 31; no Atlantic salmon were observed.

⁶ Wild and hatchery Atlantic salmon returning to the Union River are considered part of the GOM DPS.

TABLE 3
UNION RIVER SALMON RETURNS BY ORIGIN

Year	Aquaculture*	Hatchery	Wild	Total
1973 - 1986	0	1,892	4	1,896
1987	undetermined	63	0	63
1988	undetermined	45	2	47
1989	undetermined	30	0	30
1990	undetermined	21	0	21
1991	undetermined	2	6	8
1992	undetermined	4	0	4
1993	undetermined	0	0	0
1994	undetermined	0	0	0
1995	undetermined	0	0	0
1996	undetermined	68	1	69
1997	undetermined	8	0	8
1998	undetermined	13	0	13
1999	63	6	3	72
2000	3	2	0	5
2001	2	0	0	2
2002	6	5	0	11
2003	0	1	0	1
2004	0	1	1	2
2005	4	0	0	4
2006	0	0	0	0
2007	0	0	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	3	0	0	3
2013	0	0	1	1
2014	0	1	1	2
2015	0	0	0	0
TOTAL 1995 - 2015	81	105	7	193

Source: URFCC 2015 and Maine DMR 2015

Note: Salmon returns before 2000 included rod and trap captures..

The Union River has about 12,000 units of historic spawning and rearing habitat, of which 4,062 units are considered occupied and functional spawning and rearing habitat (NMFS 2009a). Most (67%) of the potential Atlantic salmon habitat is located in the West Branch of the Union River, based on surveys that were conducted in the late 1950s (Havey 1961; Baum 1982)⁷. The main stem of the river and tributaries (above Ellsworth Dam) account for 16% of the salmon habitat, with the balance occurring in the East Branch (13%) and Middle Branch (3%) of the system. Using an assumed production of 3.0 smolts/100 square yards of stream bottom, and a marine survival of 1-3%, the habitat in the Union River above Ellsworth could generate a self-sustaining run of about 250-750 salmon (Baum 1997). Additional production of adult salmon could result from fish spawning in three minor tributaries below the Ellsworth Dam (Meadow Stream, Patten Stream, and Card Brook).

5.2 Atlantic Sturgeon and Shortnose Sturgeon

Atlantic sturgeon have been observed in the Union River below Ellsworth Dam, according to state fishery personnel. The status of the population of Atlantic sturgeon and shortnose sturgeon, which may also occur in the river, is unknown at this time (URFCC 2010). In the Status Review of Atlantic sturgeon, it was noted that, “The geomorphology of most small coastal rivers in Maine is not sufficient to support Atlantic sturgeon spawning populations, except for the Penobscot and the estuarial complex of the Kennebec, Androscoggin, and Sheepscot Rivers”, though subadults may use the estuaries of smaller coastal drainages during the summer months (Atlantic Sturgeon Status Review Team 2007). Zydlewski et al. (2011) found that shortnose sturgeon use small coastal rivers as they migrate between the Kennebec and Penobscot Rivers. However, only one shortnose sturgeon and no Atlantic sturgeon tagged at other locations have been detected by the acoustic receivers deployed in the lower Union River (Pers. Comm., G. Zydlewski, UMaine, July 9, 2014 and August 20, 2015). From review of the limited bathymetry data of the original river channel that has been inundated by Lake Leonard, there may be steep gradient reaches that would have historically kept Atlantic and shortnose sturgeon from accessing the Union River above the site of the Ellsworth Dam.

⁷ As noted, in 2011, 19,000 fry and 282 excess brood stock (pre-spawn) were stocked in the West Branch Union River in Amherst (URFCC 2015). Spawning activity was assessed through redd counts near the release location, and over 200 redds were well distributed through the area (Figure 8).

6.0 Potential Effects on Listed Species

6.1 Atlantic Salmon

The following sections discuss the relevant life stages potentially affected by the Ellsworth Project and evaluate what the potential Project effects are on those life stages of Atlantic salmon. As discussed above, regular stocking of Atlantic salmon smolts in the Union River was suspended in 1991, and since then, there has been only limited stocking of salmon fry or parr in the Union River. Also, in 2011 adult salmon (excess broodstock) were stocked in the river. A total of three GOM DPS Atlantic salmon have returned to the Union River in the last ten years, all of which were in 2013 and 2014 (URFCC 2015, Maine DMR 2015).

The following sections examine Project effects related to connectivity (i.e., upstream and downstream passage of adult and juvenile salmon), tributary access, and habitat suitability. The effects of predation on juvenile and adult salmon are also discussed.

6.1.1 Life Stage Assessments of Project Interactions

Very few Atlantic salmon have returned to the Union River in the last ten years, and little information is available on how Atlantic salmon have historically used the Union River habitat. Ellsworth Dam is located at the upper limit of tidal influence of the Union River, and there is no documented salmon spawning and rearing habitat downstream of the Project. The Union River in the Project area serves as a migration corridor to suitable habitat upstream of the Project. Thus, the life stages of Atlantic salmon that could be affected by the Project include adults migrating upstream to spawn and downstream migrating smolts and kelts (Fay et al. 2006). Potential effects to salmon are lessened at the Ellsworth Project, because the Project provides upstream fish passage (vertical slot upstream fish passage and trapping facility) and downstream fish passage (downstream fish bypass facility integral at each dam). The fish passage facilities are managed in consultation with the agencies through the *Comprehensive Fishery Management Plan for the Union River Drainage 2015-2017*.

6.1.2 Upstream Passage

The fish passage facility at the Ellsworth Project is designed to trap Atlantic salmon and other

anadromous fish and to transport fish to suitable upstream habitat located above the Project dams. The fishway is managed in consultation with the agencies through the management plan, and historically, Maine DMR has annually directed Black Bear whether to transport any returning adult Atlantic salmon upstream of the Project. The vertical slot upstream fish passage and trapping facility at the Project has a positive effect on the Atlantic salmon GOM DPS, as it increases habitat connectivity in the event migrating adults seek to enter the Union River searching for access to suitable spawning habitats. Some potential negative effects from the trapping, trucking, and transporting of adult Atlantic salmon include migration delay/interruption, and handling and holding stress or injury. While specific empirical studies of the upstream passage effectiveness for adult Atlantic salmon at Ellsworth have not been conducted to date, primarily due to a lack of available study fish, an Upstream Atlantic Salmon Passage Study was conducted in 2015 to evaluate whether increased operations at the trapping facility may increase the capture of adult Atlantic salmon. The trap was operated from sunrise to sunset from May 1 to October 31 and checked at least four times a day. No Atlantic salmon were collected or observed.

Hydroelectric facilities may result in delays of upstream migration of Atlantic salmon. Several studies on the Penobscot River have evaluated upstream passage behavior, including the time needed for individual adult salmon to pass upstream of various dams once detected in the vicinity of a spillway or tailrace. These studies have documented certain migratory behaviors that may contribute to migration delays, including frequent upstream and downstream movement, periods of holding in fast water, seeking thermal refuge in tributaries, attraction to spillage at dams, reduced migratory behavior in late summer, and inhibited movement at temperature above 23°C (Power and McCleave 1980, Shepard 1995). However, upstream passage is site specific, and the findings from passage studies conducted in the Penobscot River or other rivers may not be applicable to the Ellsworth Project.

As part of the ongoing relicensing of the Project, Black Bear reviewed historic information relating to operations and environmental conditions during historic captures of Atlantic salmon to assist in evaluating the efficacy of the trap and truck facility and operations (Black Bear 2014). Recorded data on fishway operations when salmon were captured was available for years 2002 to 2005. There were no apparent trends in salmon captures and flow conditions, as salmon were collected over a wide range of river flows from summer flows as low as 48 cfs to the higher

June flow of 937 cfs. Salmon were also captured over a range in temperatures up to 74°F. The fish trap was not operated when water temperatures were at or exceeded 77°F as per direction from Atlantic Sea-Run Salmon Commission and Maine DMR protocol. Temperatures in the upper seventies are more typical of late summer when salmon are not expected to be entering the river, or would be expected to be holding in thermal refugia. The current Maine DMR protocol is to not handle Atlantic salmon at fish passage facilities when the river temperature exceeds 73°F. While there is a low probability of salmon captures when water temperature exceeds 73°F (few salmon have been collected in the Union River at or above this temperature historically), Black Bear plans to modify its operational and handling procedures in case such a situation occurs in the future.

Using an assumed production of 3.0 smolts/100 square yards of stream bottom, and a marine survival of 1 - 3 %, Baum (1997 *cited in* URFCC 2010) estimated the habitat in the Union River upstream of the Ellsworth Project could generate a self-sustaining run of about 250 - 750 Atlantic salmon. It should be noted however, current marine survival has been estimated to be lower, 0.09 to 1.02%, from 1995 to 2004 (ICES 2008 *cited in* USFWS and NMFS 2009), which would result in a run of approximately 250 or less fish, given that this survival range is on the lower end or less than Baum (1997) used.

Fisheries management agencies have expressed a concern for the safe, timely, and effective passage of Atlantic salmon, especially during river herring harvest operations, and the potential for migration delay due to fishway crowding or infrequent trap and transport operation. Under current operations, the trap and hopper are visually inspected for Atlantic salmon and if one is spotted, the hopper is left in the water and the salmon is dip-netted out and placed in a holding tank. The salmon is then measured, examined for fin clips, fin wear, or other markings, a scale sample is taken, and the magnified scale image and fish photo is digitally captured. This information is transmitted to the Maine DMR who then determines whether the Atlantic salmon caught in the fishway is to be released downstream of the Ellsworth Dam (hatchery or aquaculture escapees), moved via transport tank truck upstream (wild origin) and released in the West Branch of the Union River, approximately 17 miles upstream, or removed. Generally this process takes one to two hours, and in the case of wild Atlantic salmon, they arrive in upstream habitat more quickly than if they had passed volitionally and swam the entire distance.

The current trap and transport facilities and operating protocols at Ellsworth have provided for the handling of 190,000 to 1,200,000 river herring and 0 to 8 Atlantic salmon annually from 2000 to 2015. The Ellsworth trap and transport facility was originally designed and operated to pass Atlantic salmon. Historically, this facility has handled up to 263 adult Atlantic salmon broodstock in a year, including times concurrent with alewife harvesting. Black Bear examined the Ellsworth fishway hopper capacity for salmon with regard to the estimated maximum self sustained run size of 750 Atlantic salmon (Baum 1997 *cited in* URFCC 2010), and found that the Ellsworth lift hopper has more than four times the required capacity to pass a run of 750 Atlantic salmon (Black Bear 2014). Further, Black Bear conducted an Upstream Fish Passage Alternatives Analysis that evaluated the adequacy of the existing fishway facility to handle design populations of multiple species and potential fishway modifications and alternative designs (included as an appendix to the December 2015 License Application). Trap and transport systems have been used successfully to pass other species such as for the shad restoration on the Susquehanna River and the river herring restoration in the Sebasticook River. Sigourney et al. (2015) evaluated trap and transport of Atlantic salmon on the Penobscot River and found it was an effective means to increase migration success. Black Bear will continue to consult with fisheries management agencies on the need for and, if necessary, the design of upstream fish passage improvements based upon the results of the relicensing studies and future management plans to be published by the fisheries management agencies.

A concern was also expressed for peaking flow effects on aquatic habitat and upstream passage effectiveness downstream of the Ellsworth Dam. In regards to upstream passage effectiveness, the one consistent observation made throughout the upstream fish passage study (Black Bear 2014 and 2015) was that fish (river herring) occurrence and densities were higher in the afternoon and evening (prior to sunset) hours, and on incoming tides. A review of project operations/ river flow data did not suggest the fish migration or fishway numbers responded to changes in flow from the Project. Because river herring can access the river below Ellsworth Dam, it is expected that turbine discharge would not affect other diadromous fish from accessing Ellsworth Dam.

6.1.3 Downstream Passage - Smolts

The downstream fish passage facilities at each Ellsworth Project dam consist of stop-log controlled surface weirs, leading to a plunge pool immediately downstream of each dam. The downstream fish passage weirs have historically been operated from April 1 to December 31 each year, as river conditions allow.

The presence of dams can potentially result in downstream migration delays (discussed in a following section). Also, if salmon pass through the turbines, there is a risk of injury or mortality from blade strike or other factors. Because of the few salmon returns, the limited amount of juvenile stocking efforts, and the resulting low numbers of smolts that would be expected to occur in the river, no survival studies have yet been conducted in the Union River. In a 2014 relicensing study, Black Bear conducted a desktop fish entrainment and downstream passage assessment (referred to as the Downstream Fish Passage Study [Black Bear 2014]) to evaluate downstream passage at the Project for Atlantic salmon smolts and kelts (along with other species), including the potential for entrainment, turbine-induced mortality, migratory route selection, and whole station survival.

The results of the 2014 desktop entrainment study (Black Bear 2014) predicted that salmon smolts would not be excluded by, or impinged on, the trashracks, because their maximum reported sizes are smaller than the minimum estimated exclusion size; however, it is expected that the trashracks still provide some level of deterrence due to the presence of the structures (Fay et al. 2006; Alden 2012; Brown et al. 2009). Smolt burst speeds and average intake velocities at the trashracks at Ellsworth Dam were evaluated to predict the ability of smolts to avoid entrainment. Table 4 displays the calculated intake approach velocities in front of the trashracks for each unit at the Ellsworth Dam. Smolt burst speeds have been observed at around 6.0 feet per second (Peake et al. 1997), suggesting that smolts can easily avoid involuntary entrainment (Black Bear 2014). Sustained swim speeds of smolts have been observed at 1.6 feet per second (Booth et al. 1997).

TABLE 4
ELLSWORTH TRASHRACK SPACING AND CALCULATED INTAKE VELOCITIES

Parameter	Unit 1	Unit 2*	Unit 3	Unit 4
Trashrack Clear Spacing (in)	2.44	1.00 (top)/2.37(bottom)		
Approach Intake Velocity (feet/s)	1.16	2.97	2.97	2.79

* It is important to note that the Unit 2 and 3 trashracks start 7.8 feet below the normal full pond headwater elevation of 66.7 ft (first 7.8 feet is concrete), then has 1-in clear-space trashracks between 7.8 and 14.0 feet before the trashrack clear-spacing increases to 2.37 inches below 14.0 feet deep. The Unit 4 trashracks start 5.7 feet below the normal headwater elevation of 66.7 ft (first 5.7 feet is concrete), then has the same clear-spacing sizes at slightly different depths.

Black Bear collected field measurements in front of the trashracks at the Ellsworth Dam intakes to provide a more detailed understanding of intake velocities. Velocity measurements were also taken at the three entrances of the Ellsworth dam downstream fish bypass. Researchers took 240 water velocity measurements at 93 discrete positions in front of the trashracks at Units 2, 3, and 4 (Table 5). Measurements were not taken in front of the Unit 1 intake because it is only accessible by diving. Velocity measurements at Unit 4 are considered to be representative of the velocity in front of Unit 1 because of the similarity between the units. Average water velocity ranged from -0.13 to 2.43 feet per second (fps). All velocity values in the upper 14 feet (with 1-inch spacing) were below 2 fps and 87% of all intake velocity values were less than 2 fps. Most of the higher velocity values were at water depths of 15 feet or more, below where most surface oriented fish would pass. The measurements were fairly uniform across the face of the racks, demonstrating that the variation in trashrack spacing combined with flows through the downstream fish bypass entrances does not create abnormal flow vectors in the intake area which is sometimes identified as an important threshold for evaluating entrainment risk for some fish species.

TABLE 5
VELOCITIES MEASURED AT ELLSWORTH TRASHRACKS.

Unit Number	Unit 2	Unit 3	Unit 4	All Units
No. of positions on rack face	22	36	35	93
Minimum average velocity (fps)	0.10	-0.13	0.49	-0.13
Maximum average velocity (fps)	2.27	2.08	2.43	2.43

The field measurements of intake approach velocity were taken from the trash rake, which results in measurements at a position in front of the trash racks (approximately 3 feet in front of

racks), while the calculated approach velocity was estimated at the trash rack face. Since approach velocity decreases with increasing distance from the racks the difference between calculated and field measured velocity is reasonable and suggests consistency between methods. The lower than estimated velocities in front of the 1-inch racks in the upper 14 feet of the intake are consistent with the reduced clear space for water to flow through the racks and should result in reduced entrainment levels for surface oriented fish.

The Downstream Fish Passage Study also estimated entrainment risk through the evaluation of species presence in the basin, outmigration periodicity, and downstream fish passage operations at the Project. There are currently very few salmon (smolts and kelts) expected to occur at the Project that would be at risk for entrainment. However, if the salmon run size increases, then smolts are predicted to have a moderate risk of entrainment due to their smaller size and ability to pass through the trashracks. Blade strike survival rates were estimated as part of this study, which were 96.1% for smolts entrained through Units 1 and 4, and 93.3% for smolts entrained through Units 3 and 4 (Black Bear 2014).

Spillway survival, as well as bypass survival and effectiveness, were also estimated as part of the Downstream Fish Passage Study. This was done by evaluating empirical data available from other hydropower projects with similar characteristics to make predictions at the Graham Lake Dam and Ellsworth Dam. Smolts were predicted to have high survival through the Graham Lake Dam taintor gates (99.6%) and surface weir (100%). High smolt survival rates were also predicted at the Ellsworth spillway (97.1%) and surface weir (99.0%). Whole station bypass effectiveness at Ellsworth was estimated to be 34.0%. Whole station survival for smolts was estimated to be 95.1 to 95.6% for smolts passing Ellsworth Dam, and 94.7 to 95.2% for smolts passing both Project dams (Table 6).

TABLE 6
ATLANTIC SALMON WHOLE STATION SURVIVAL ESTIMATES
AT THE PROJECT

Target Species	Size Range (in)	Outmigration Months	Ellsworth Development Total Survival			Cumulative Total Project Survival ¹		
			Exceedance Flow (%) ²			Exceedance Flow (%) ²		
			75%	50%	25%	75%	50%	25%
Adult Salmon	25-32	April-May and October-November	99%	99.0%	99.0%	98.5%	98.5%	98.5%
Salmon Smolts	5-8	April-June	95.1%	95.1%	95.6%	94.7%	94.7%	95.2%

¹Cumulative survival includes survival through the Graham Lake Dam Taintor gates and Ellsworth Development.

² Varying inflows representing a dry, wet, and normal year were applied to this evaluation, which translated into using the 75%, 50%, and 25% monthly exceedance flows.

Indirect survival, or delayed mortality, has been evaluated at some west coast projects. Alden (2012) used results from these studies that averaged 93% for indirect survival, and based on professional judgment, suggested that indirect survival would be 95% for Atlantic salmon passing the Penobscot River hydroelectric projects in Maine, due to the low head relative to the west coast projects where the studies were performed. There is considerable uncertainty regarding how to assess indirect survival, given the difficulty in measuring it (NMFS and USFWS 2015). NMFS noted this in its Biological Opinion for evaluating project effects to Atlantic salmon for Black Bear hydroelectric projects on the Penobscot River (NMFS did not attempt to quantify delayed mortality) (NMFS 2012). The results of some more recent studies conducted on the Penobscot River system have attempted to quantify differences in survival for smolts migrating through free-flowing river reaches and impounded river reaches (Holbrook et al. 2011, Stich et al. 2015a) and decreased estuarine survival for smolts migrating past multiple dams (Stich et al. 2015b). However, challenges remain in regards to quantifying delayed or indirect mortality and therefore neither was included as part of this analysis, rather only direct survival was evaluated past Ellsworth Dam, in addition to passage through Graham Lake Dam (Black Bear 2014).

In order to examine the effectiveness of the downstream passage facilities at Ellsworth, and in accordance with the December 30, 2014 Determination on Requests for Study Modifications and New Studies for the Ellsworth Hydroelectric Project by FERC, Black Bear developed a study

plan in consultation with the agencies, to conduct a field study in 2016 to evaluate the effectiveness of downstream passage of Atlantic salmon smolts at the Ellsworth Project. The study plan was filed with FERC on March 31, 2015 and approved by Order from the FERC dated April 21, 2015. This study will monitor tagged salmon smolt passage through the Project area (from upstream of Graham Lake) using radio telemetry tags and monitoring gear, and passage survival at the Ellsworth Dam using acoustic tags and receivers maintained by NFMS downstream of the dam. The field study is planned for spring 2016, pending receipt of all required permits and approvals.

6.1.4 Downstream Passage - Kelts

No information on Atlantic salmon kelt presence is available for the Ellsworth Project, but based on evaluations on the Penobscot River, presented below, it is assumed that kelts at Ellsworth would pass over the spillways, through the downstream bypasses or, depending on trashrack spacing, through turbines during outmigrations. Kelt abundance at the Project is very low, given very few adult salmon have returned to the Union River in the last ten years, and only 288 adults (pre-spawn broodstock) have been stocked in the West Branch of the Union River, all in 2011.

Downstream passage success of kelts was assessed on the Penobscot River at Weldon Dam and several other sites in the lower Penobscot River (GNP 1989, Shepard 1989, Hall and Shepard 1990). The study fish were hatchery kelts that were tagged and released in the spring and the kelts tended to move downstream with high flows in early spring (mostly April through early May). Some of the adult salmon tagged at Weldon Dam during the fall upstream spawning migration returned downstream after spawning, and several of these pre-spawn tagged salmon returned downstream prior to spawning, indicating they may have been imprinted on other areas in the watershed and were trying to locate these areas (GNP 1989).

Kelt studies in the lower Penobscot River documented that most kelts passed the dams during high flow periods, typically over the spillways, but also through gates and sluices (Hall and Shepard 1990). The initial approach of kelts at the Veazie and Milford Dams reflected the distribution of flow, which means the proportion of kelts that approached spillways was highly correlated with spillway flow. Similarly, at the confluence of the Stillwater Branch and the main stem, kelts followed the routes in approximate proportion to flow in the two channels (Shepard 1989). Kelts that approached powerhouse intakes were deterred by trashracks and sought

alternative routes of passage, typically passing via spillage after hours to days at the site (GNP 1989, Hall and Shepard 1990) and there were no mortalities in the two years of study (Hall and Shepard 1990).

In 2010, eight fish that migrated downstream of Veazie Dam were recaptured 17 days after being released in the Piscataquis River, and “appeared in excellent condition and showed no adverse effects from passing downstream over multiple (seven) dams” (Spencer et al. 2010, 2011). It should be noted that in normal flow years the Ellsworth Project spills about 11% of the time in May, while it spills about 21% of the time in April. In addition, the fish passage weirs are each passing approximately 50 cfs continuously during this period.

From the 2014 desktop Downstream Fish Passage Study (Black Bear 2014), Atlantic salmon kelts are expected to be fully excluded by trashrack spacing at the Project (2.44 inch clear space at Unit 1, and 1.0 inch on the top half, and 2.37 inches on the bottom half on Units 2, 3, and 4). This finding is supported by a downstream passage assessment conducted by Alden (2012), which suggests 100% kelt exclusion at Maine hydroelectric projects with trashrack clear-spacing less than 2.4 inches. Kelts could experience impingement on trash racks if hydraulic conditions exceed the kelt’s swimming capabilities, however, according to observed burst swim speeds of adult salmon ranging from 16.5 to 19.7 feet per second (Wolter and Arlinghaus 2003), salmon kelts can easily avoid involuntary entrainment or impingement, and have no risk of entrainment due to their inability to pass through trashracks less than 2.4 inches (Alden 2012), and would likely have a 100% bypass effectiveness rate at the Project (via downstream bypass, or over the spillway if spill is occurring). Whole station survival estimates are presented above in Table 6.

6.1.5 Migration Delay

Smolt migration from freshwater to estuarine environments must be completed during a brief period of suitable environmental conditions—what researchers have termed a “smolt window”—or they may suffer irreversible effects that reduce their survival upon entering seawater (McCormick et al. 1999). Studies of Atlantic salmon smolt migration at other locations have documented certain migratory patterns, diel behaviors, responses to hydroelectric project structures, and effects of water temperature and river flow.

Smolt migration is primarily nocturnal in the early phases of the run (Ruggles 1980, Mudre and Saunders 1987, Shepard 1991). During the later phases of the smolt run, smolts exhibit movements throughout the day. During daylight, smolts generally cease migrating and hold station to avoid predators, most of which use vision to locate their prey. Daytime holding habitats tend to have characteristics similar to large parr habitats (i.e., moderate velocity, shallow depth and large substrates), when these habitats are available (BPHA 1994).

Barriers may affect the timing of the smolt migration. Migrating fish that do not reach the sea within the physiological smolt window may start reverting to the parr condition (Hoar 1988; Nielsen et al. 2001; Shrimpton et al. 2000). Thus, any significant delay of smolts may result in fish either becoming residents or reaching the estuary in sub-optimal physiological condition (McCormick et al. 1998; Shrimpton et al. 2000). Late migrants lose physiological smolt characteristics due to high water temperatures during spring migration (McCormick et al. 1999).

The onset of the smolt migration has often been linked to a thermal threshold of 10°C, although the rate of increase may be a more important environmental stimulus than the absolute temperature (Jonsson and Ruud-Hansen 1985). While not specifically assessed in the Union River, naturally-reared and wild smolts in Maine typically enter the sea during May to begin their ocean migration (Fay et al. 2006). In the Penobscot River, smolts migrate between late April and early June with a peak migration in early May (Fay et al. 2006). The peak of movement shifted from year to year in response to environmental conditions (Bakshtansky et al. 1976, Jonsson and Ruud-Hansen 1985). Smolt migratory movement is a combination of passive entrainment with flow, particularly in areas of high water velocity, and active swimming (Ruggles 1980). Active swimming speeds may exceed 1 meter per second for prolonged periods (Vanderpool 1992, Shepard 1993) and can include directed movement through very large lakes and reservoirs in the absence of rheotactic cues (Bourgeois and O'Connell 1986).

At the Ellsworth Project smolts may pass the project facilities through a combination of routes. At the Graham Lake dam smolts may pass either via the dedicated passage weir, or via the Tainter gates when they are open. At the Ellsworth dam smolts may pass via the three dedicated passage weirs, via spill depending on operations/river flow, or via the turbines. A Downstream Atlantic Salmon Smolt Passage Study will be conducted in the spring of 2016 to evaluate smolt passage through the project area and past the project facilities.

No information on Atlantic salmon kelt migration is available for the Ellsworth Project, but evaluations were conducted on the Penobscot River. Current Maine DMR research tracking tagged adult salmon (transported from Veazie Dam to spawning habitat in the Piscataquis River) has shown that adults can drop downstream quickly past many dams (Spencer et al. 2010, 2011). Researchers noted that “the presence of dams did not appear to impede downstream movement of motivated salmon and some fish passed seven dams in as many days.” In two years of kelt telemetry studies at Veazie and Milford Dams, 35 of 49 kelts were delayed less than 2.0 hours (minimum – 0.1 hour, maximum – 155 hours) before finding a safe route of passage in spilled water.

Upstream migrating adults are caught and passed at the Ellsworth Dam fish trap and truck facility. Any significant delay in migration that occurs may increase adult salmon exposure to predation, such as from seals. An Upstream Atlantic Salmon Passage Study was conducted in 2015 to evaluate whether increased effort at the trapping facility resulted in an increase in the capture, or rate of capture, of adult Atlantic salmon. The trap was operated from sunrise to sunset from May 1 to October 31 in 2015, and was checked at least four times a day. No Atlantic salmon were collected or observed.

6.1.6 Habitat in Project Area

Within the range of the GOM DPS, the Union River contains two main stem dams (the Ellsworth and Graham Lake Dams) and numerous tributary dams, primarily at the outlets of lakes and ponds. The Project’s upstream passage (trap and truck from the Ellsworth Dam) and downstream passage facilities (at both dams) allow access to spawning and rearing habitat, further reducing effects to salmon. While both the upstream and downstream facilities pass migrating fish, specific studies for the effectiveness of passing Atlantic salmon have not been conducted. In addition, very few salmon have returned to the river in the last ten years, and low level stocking has occurred in the Union River, consequently very few salmon smolts would be expected to be out-migrating. Black Bear will be conducting an Atlantic salmon downstream passage survival study at the Project in the spring of 2016 to collect empirical data.

In general, dam impoundments increase water depth, increase the water retention time (flushing rate) within a given river reach, and dampen daily fluctuations in water temperatures (FERC 1997). Large reservoirs with deep water that thermally stratify in summer may release water that

is warmer or colder than ambient inflows, depending on the depth of withdrawal in relation to the depth of the thermocline, whereas run-of-the-river impoundments are typically shallow and have little effect on temperature (EPA modeling conducted on the Columbia River; Public Utility District No. 1 of Chelan County 2005). Impoundment conditions that result in reduced flow cues can result in migratory delay and result in habitat changes that are preferred by warmwater species that prey on juvenile Atlantic salmon such as largemouth and smallmouth bass and pike species (NMFS and USFWS 2015).

Project Impoundments

The Ellsworth Project results in up to approximately 11 miles of the Union River being impounded. Graham Lake is about 10 miles long with a surface area of approximately 10,000 acres; Graham Lake is relatively shallow, with an average depth of approximately 17 feet, and showed only weak short-term stratification during water quality studies conducted in 2013. The temperature in Graham Lake was fairly uniform through the water column on each of the summer sampling dates. Lake Leonard is about one mile long with a surface area of 90 acres; it averages 25 feet deep and is approximately 55 feet deep at its deepest point. Lake Leonard showed some stratification during the 2013 studies. Article 402 of the 1987 FERC license specifies that the licensee operates the Ellsworth Project so that the following normal water levels are maintained: Lake Leonard 1-foot fluctuation (65.7' to 66.7') and Graham Lake 10.8-foot fluctuation (93.4' to 104.2').

Graham Lake provides a majority of the spawning and rearing habitat for river herring in the Union River watershed, and Black Bear's trap and transport efforts have allowed for development of one of the largest alewife runs in the country. NMFS has suggested that increased river herring populations may provide some predation buffer to Atlantic salmon (NOAA 2009). Atlantic salmon adults collected in the upstream fish trap are transported upstream of Graham Lake where they have access to suitable spawning habitat in the West Branch of the Union River and other tributaries.

Riverine Sections

The Ellsworth Project operates in a peaking mode while maintaining minimum flows and modest generation at all times. The Project license requires that Black Bear release a continuous

minimum flow of 105 cfs from the Graham Lake Dam and the Ellsworth Dam from July 1 through April 30 and a continuous minimum flow of 250 cfs from May 1 through June 30 to protect fishery resources. Because the Ellsworth Project starts at the head of tide, there are no Project flow effects on juvenile salmon habitat below the dam. Observations below the Ellsworth dam indicate the river bed remains watered under minimum flow conditions with no evidence of areas of potential stranding.

Minimum flow releases from the project dams have protected and maintained the area fisheries. This was demonstrated in the relicensing study (Instream Flow and Union River Tributary Access Study [Black Bear 2014]) conducted in 2014. Flows analyzed included two low flows (150 and 300 cfs), a mid-range flow (1,230 cfs) and a high level (2,460 cfs) generating capacity flow. The study found aquatic habitat criteria for Atlantic salmon is sufficient at all flows analyzed. In addition, a zone of passage is provided throughout the Union River during the observed low flows.

Pursuant to Article 404 of the current FERC license, the Bangor Hydro-Electric Company (licensee prior to Black Bear) developed a minimum flow study plan in consultation with the USFWS, NMFS, Maine DMR, and Maine DEP to study the effectiveness of the 250 cfs minimum flow downstream of the project to determine if it was adequate to provide sufficient dissolved oxygen (DO) during the river herring migration. Study results, filed with FERC on September 4, 1990, indicated that DO concentrations were not significantly reduced under the operational conditions of the study. The agencies asserted that the study was not conducted during the worst case scenario and recommended that the licensee repeat the study when annual alewife runs were high to determine potential effects. The licensee repeated the study and found in a 2006 report that the required minimum flow provides sufficient dissolved oxygen and is protective of water quality for upstream migrant alewife, as well as other aquatic life. Resource agencies concurred with the conclusion and agreed that the current minimum flow should be maintained and that no additional DO sampling was needed (FERC Order dated October 13, 2006 Modifying Minimum Flow Study Plan Under Article 404).

Tributaries

As demonstrated in the 2014 Union River Tributary Access Study (Black Bear 2014), tributaries to the Union River between Graham Lake and Lake Leonard (Greys, Shackford, Moore, and

Gilpatrick brooks) maintained adequate connectivity for Atlantic salmon and other aquatic species during the flows observed. The study was conducted in September 2014 during managed low flow conditions. All tributary confluences had adequate depths (> 6 inches) during the observed low flows that would allow Atlantic salmon access. In addition, the tributary confluences had low velocities that would not preclude access by Atlantic salmon. Therefore, the confluence at each of the tributaries provide a zone of passage into the tributaries for Atlantic salmon to access any suitable spawning habitat that may be present upstream in these tributaries. Natural low flows within the tributaries themselves were observed during the study, suggesting that low flows within the tributaries could potentially be a limiting factor for migratory fish accessibility further up in the tributaries.

It should be noted that migratory species typically migrate upstream into tributaries during instances of high runoff following rain events, rather than during the low flow period observed in this study. This further suggests that accessibility to these tributaries is available during the Atlantic salmon migratory season.

Gilpatrick Brook likely has the most preferable salmon habitat at the confluence to the Union River than the other tributaries observed, as the lower portion of this stream contained adequate depth (>1.25 ft), flow (approximately 2 ft/s), substrate (cobble and gravel), and cover (large woody debris, shoreline vegetation, boulders) suitable for various life stages of Atlantic salmon (Fay et al. 2006) (Black Bear 2014).

Stakeholder comments on the USR suggested that the evaluation of accessibility to tributaries should be based upon more detailed criteria. To further address stakeholder comments on the USR, and in accord with FERC's December 8, 2015 Determination on Requested Study Modifications, Black Bear will consult with agencies and collect additional zone of passage information in 2016 for select tributaries to the Union River between Graham Lake and Lake Leonard. Black Bear will file the results of this study with FERC by December 31, 2016 as additional information to the FLA.

Juvenile Atlantic salmon, specifically parr, seek riffle habitat associated with diverse rough gravel substrate, as typically found in tributaries (Kircheis and Liebich 2007). Parr can also move great distances into or out of tributaries and main-stems to seek out habitat that is more conducive to growth and survival, such as areas of thermal refuge, resistance to dewatering, or

increased prey abundance (McCormick et al. 1998). Atlantic salmon spawning and rearing areas have been identified in the West Branch of the Union River upstream of Graham Lake (USFWS 2011) (Figure 9).

6.1.7 Maintenance Activities

Maintenance activities affecting Atlantic salmon primarily pertain to periodic maintenance to the fishways. Black Bear has developed a site specific operation and maintenance plan for the fishways at this Project to ensure that the upstream and downstream fishways are operating properly. The plan also includes both a list of spare parts critical to fishway operation and a checklist of proper fishway operating characteristics. In 2015, Black Bear hired dedicated staff to operate the project fish passage facilities; these staff were dedicated to fishway operations, oversight, fish trap tending, and transporting the fish upriver. These dedicated fishway staff completed the daily checklists and prepared weekly reports on fishway operations, which were provided to the fisheries management agencies throughout the fishway operational season. The activities performed for upstream and downstream fishway maintenance have a positive effect on Atlantic salmon, as these activities ensure the fishways remain effective.

6.1.8 Predation

Atlantic salmon smolts face predation risk during their migration from freshwater to estuarine and marine environments. Anthropogenic factors may contribute to conditions that support known predators of Atlantic salmon, such as chain pickerel, smallmouth bass, and double crested cormorants (Fay et al., 2006). Dams may increase predation risk due to smolt disorientation, injuries, congregating behavior, and decreased abundance of other diadromous fishes that historically acted as a prey buffer by providing a robust alternative food source for predators (Northeast Salmon Team 2011). Dam passage may also affect predator detection and avoidance by salmonids (Raymond 1979, Mesa 1994).

The Union River drainage supports a variety of resident and migratory fish species. Principal resident sportfish include landlocked Atlantic salmon, brook trout, lake trout, brown trout, splake, landlocked arctic char, smallmouth bass, largemouth bass, chain pickerel, and white perch. Populations of resident fish are maintained through natural reproduction and stocking.

The Union River also contains migratory fish such as striped bass and American eel (URFCC 2010).

Fish species such as brook trout and American eel are native to all major drainages in Maine and likely feed on salmon eggs and small salmon. Introductions of top predator fish (e.g., smallmouth bass, chain pickerel, and brown trout are non-native fish species that occur in the Union River watershed) negatively affect resident fish communities by disrupting normal feeding behavior (Bystrom et al. 2007), decreasing prey abundance (He and Kitchell 1990, Findlay et al. 2005), and through extirpation of native species (Findlay et al. 2005, Bystrom et al. 2007). Striped bass are also known predators of Atlantic salmon smolts (Blackwell and Juanes 1998); however, their abundance in Maine is variable each year, indicating that predation by striped bass doesn't have an appreciable effect on Atlantic salmon populations (Beland et al. 2001).

Smallmouth bass are a warm-water species whose range now extends through north-central Maine and well into New Brunswick (Jackson 2002). Smallmouth bass are numerous in Graham Lake. Smallmouth bass likely feed on salmon fry and parr, though little quantitative information exists regarding the extent of bass predation. Smallmouth bass are predators of smolts in main stem habitats, and bioenergetics modeling indicates that bass predation is insignificant at 5°C, but increases with increasing water temperature during the smolt migration (Van den Ende 1993). Largemouth bass, another top predator species, were introduced illegally into Graham Lake about five years ago, and are expanding rapidly (pers. comm. Greg Burr, Maine Department of Inland Fisheries and Wildlife [Maine DIFW] July 3, 2014).

Chain pickerel, which are also common in Graham Lake, are known to feed upon salmon smolts within the range of the GOM DPS and certainly feed upon fry and parr, as well as smolts, given their piscivorous feeding habits (Van den Ende 1993). Chain pickerel feed actively in temperatures below 10°C (Van den Ende 1993, Maine DIFW 2002). Smolts were, by far, the most common item in the diet of chain pickerel observed by Barr (1962) and Van den Ende (1993). However, Van den Ende (1993) concluded that, “daily consumption was consistently lower for chain pickerel than that of smallmouth bass,” apparently due to the much lower abundance of chain pickerel.

Birds known to prey upon Atlantic salmon throughout their life cycle include species such as mergansers, belted kingfisher, bald eagles, ospreys, double-crested cormorants, gulls, and gannets (Fay et al. 2006). The USFWS has concluded that avian predation poses a high-level threat to the survival and recovery of GOM DPS Atlantic salmon (NMFS and USFWS 2005). Blackwell et al. (1997) reported that salmon smolts were the most frequently occurring food items in cormorants sampled at main stem dam foraging sites. In a study in the Penobscot River, cormorants were present during the spring smolt migration as migrants, stopping to feed before resuming northward migrations, and as resident nesting birds using Penobscot Bay nesting islands (Blackwell 1996, Blackwell and Krohn 1997). Another study found Atlantic salmon comprised 26% of cormorant's diet during the smolt run (Hatch and Weseloh 1999). Meister and Gramlich (1967) studied salmon predation by cormorants in the Machias River estuary. The results of this study documented that cormorants consumed an estimated 8,000 tagged hatchery smolts during the period 1966-1967 in the Machias River. Predation rates on migrating hatchery-reared salmon smolts were found to be as high as 13.4% in the Machias River (Meister and Gramlich 1967).

Breeding pairs of double-crested cormorants in Maine have increased significantly since the late 1970s, and smolts are a frequent prey item (Northeast Salmon Team 2011). The abundance of alternative prey resources such as upstream migrating alewife, helps reduce the impacts of cormorant predation on GOM DPS Atlantic salmon (Northeast Salmon Team 2011). Common mergansers and belted kingfishers are likely the most important predators of Atlantic salmon fry and parr in freshwater environments, as well as seals that also predate upon adult salmon (Fay et al. 2006). Studies conducted in Canada found mergansers consumed more juvenile Atlantic salmon than cormorants (NMFS and USFWS 2005). These birds are common in Maine, including the Union River watershed (Cornell Lab of Ornithology 2012).

A restored run of river herring in the Union River drainage is expected to be beneficial to Atlantic salmon restoration efforts, because river herring provide a predation buffer, by providing predators with alternative, and potentially more abundant prey.

6.2 Atlantic Sturgeon and Shortnose Sturgeon

Because sturgeon only rarely occur in the Project tailwaters, normal Project operations should have minimal effect on shortnose and Atlantic sturgeon, or their habitat. There is a potential that sturgeon could be encountered during maintenance activities, for example, during planned dewatering of the draft tubes for turbine inspection or maintenance activities. There is also a possibility that sturgeon could be captured in the fish trap and handled during the sorting process. Black Bear has developed and will implement a sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fish lift operations, and in the event of stranding during periodic dewatering of the draft tubes.

6.3 Potential for Cumulative Effects

Cumulative effects are those effects of future state and private activities, not involving federal activities, that are reasonably certain to occur within the action area (50 C.F.R. § 402.02). Cumulative effects do not include future federal or federally authorized action, which would be subject to future ESA section 7(a)(2) consultations. Activities that occur now and are expected to continue in the future include recreational fishing and boating, which are regulated by the state of Maine.

Impacts to GOM DPS Atlantic salmon from non-federal activities are largely unknown in the Union River. It is possible that occasional recreational fishing could result in incidental takes of GOM DPS Atlantic salmon. There is no information to suggest that the effects of future activities in the action area will be any different from effects of activities that have occurred in the past. The cumulative effects from forestry and agricultural practices will continue to occur in the watershed area, potentially affecting water quality and spawning and rearing habitat.

While not directly linked to Atlantic salmon, the Ellsworth Development will continue to have positive cumulative environmental effects by providing renewable energy, thus decreasing the nation's dependence on fossil fuels, and minimizing the substantial adverse cumulative effects that fossil fuels have on the environment. In addition, the Project's upstream and downstream fish passage facilities provide benefits to Atlantic salmon, specifically during periods of migration; however, the current Project effect to GOM DPS Atlantic salmon is negligible due to the lack of salmon in the river (e.g., only sporadic stocking over the years, very few returning

adults during the last ten years, very few smolts expected to be out-migrating). Cumulative effects in the Union River watershed may occur from the need to pass numerous non-licensed small dams, if located within critical habitat.

7.0 Proposed Measures and Studies

This section describes measures proposed by Black Bear to evaluate existing salmon protection measures and to provide additional enhancements to Atlantic salmon. Table 7 provides an overview summary, and proposed measures are discussed further below.

**TABLE 7
OVERVIEW OF PROPOSED PROTECTION MEASURES**

2015	2016-2017
<ul style="list-style-type: none"> • Black Bear implemented site specific operations and management plan for fishways • Black Bear submitted Draft License Application in July • Black Bear conducted upstream passage study/observations for extended period (May 1 to October 31) • Black Bear conducted field measurements of intake velocities at the Ellsworth trashracks • Black Bear develops Draft BA • Black Bear meets with the Services to discuss Draft BA • Black Bear submits Final License Application and Draft BA in December 	<ul style="list-style-type: none"> • FERC issues BA • NMFS issues Biological Opinion and Incidental Take Statement covering term of new license • Black Bear conducts downstream smolt passage study during 2016 Black Bear will work with the Services to develop appropriate protection measures based on results of the pending studies • FERC issues a new or annual license before December 31, 2017

7.1 Upstream Passage

In 2015, Black Bear conducted an upstream Atlantic salmon passage monitoring study. The goal of the study was to provide information about how the fishway operations influence the numbers of adult Atlantic salmon that are collected. Black Bear began operating and monitoring the trap and haul facility to provide passage for salmon on May 1, 2015 and operated the trap and haul facility daily from sunrise to sunset until October 31, 2015. Black Bear recorded information on water temperature, tidal stage, river flow, and the number of units generating each time the trap was checked. The trap was checked/lift operated at least four times daily. No Atlantic salmon were collected or observed in 2015.

If enhancement measures are appropriate to further protect GOM DPS Atlantic salmon, based on these study results and consultation with the agencies, Black Bear will work with the agencies to develop an SPP that incorporates the measures, as appropriate.

7.2 Downstream Passage

Black Bear will evaluate downstream smolt passage at the Project to determine the effectiveness of the downstream fishway and to evaluate survival for downstream migrating Atlantic salmon smolts. A detailed study plan was developed in consultation with NMFS, USFWS, and Maine DMR, and filed with FERC on March 31, 2015. FERC approved the study plan in a letter dated April 21, 2015. Proposed study methods involve use of radio and acoustic telemetry tagging of hatchery smolts to evaluate the effectiveness of the existing downstream fish passage facility at the Project. The study will evaluate migration routes and passage survival of tagged smolts within the Project area, including the Graham Lake and Ellsworth Dams and associated impoundments. As specified in the study plan, multiple release groups will be used, and the evaluation will occur during the peak smolt migration season in May. The study will be conducted in 2016.

If enhancement measures are appropriate to further protect GOM DPS Atlantic salmon, based on these study results and consultation with the agencies, Black Bear will work with the agencies to develop an SPP that incorporates the measures, as appropriate.

7.3 Fish Passage Facility Management

Black Bear has developed a site specific operation and maintenance plan for the fishways for the Ellsworth Project. The plan includes a daily check list that was employed throughout the 2015 season and will be continued in future seasons to ensure that the upstream and downstream fishways are operating properly. The site specific operation and maintenance plan for the fishways includes both a list of spare parts critical to fishway operation and a checklist of proper fishway operating characteristics. Black Bear is providing dedicated staff to implement the site specific operation and maintenance plan for the fishways each year. These staff are dedicated to fishway operations, oversight, fish trap tending, and trucking of fish upriver at the Project. Black Bear maintains a spare recovery pump, which provides 50 cfs of attraction flow into the two

downstream bypass weirs in the main powerhouse intakes, to serve as a backup in the event of a pump failure.

7.4 Sturgeon Handling Plan

Black Bear has developed, and will implement, a sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fish lift operations, and in the event of stranding during periodic dewatering of the draft tubes (Attachment A).

8.0 Determination of Effect

Based on the analyses contained in this draft BA, the Determination of Effect of the Project for Atlantic salmon (and its designated critical habitat), shortnose sturgeon, and Atlantic sturgeon are provided below:

8.1 Atlantic Salmon

Based on the existence of the Project, and on information regarding the likely presence of GOM DPS Atlantic salmon, their biology and habitat requirements, this draft BA concludes that the action is likely to adversely affect (LAA) a small number of GOM DPS Atlantic salmon at the Project.

The LAA determination for the Ellsworth Project is based on the likelihood that despite efforts by Black Bear to implement fish passage measures and to provide mitigation measures, injury or mortality could occur to a small number of downstream migrating GOM DPS Atlantic salmon smolts. Black Bear will continue to manage the Project to avoid or minimize this effect through the continued implementation of fish protection and enhancement measures outlined in this document and will work with NMFS to develop an SPP.

Black Bear foresees no overall destruction or adverse modification of critical habitat, though there will be continued effects to the migratory primary constituent elements (PCEs) of the critical habitat designated for Atlantic salmon (see discussion in Section 1.3). The measures to promote restoration of GOM DPS Atlantic salmon in the Union River, as reflected in this document, have resulted in improvements to upstream and downstream fish passage facilities at

the Project over the years. Continued consultation and refinements made from the results of future studies described in this document will lead to improvement of migratory PCEs for GOM DPS Atlantic salmon. In turn, PCEs for migrating adults and smolts will also be improved as a direct result of the relicensing of the Ellsworth Project.

The Proposed Action developed herein, including development of an SPP, is expected to minimize adverse effects to Atlantic salmon and its critical habitat.

8.2 Shortnose Sturgeon and Atlantic Sturgeon

Due to the uncommon occurrence of the species at the Project, normal operations would have minimal or no effect on shortnose sturgeon or Atlantic sturgeon. There is a possibility that sturgeon could be captured in the fish trap and handled during the sorting process, or during planned dewatering of the draft tubes for turbine inspection or maintenance activities. If this occurs, Black Bear staff would take the steps specified in the sturgeon handling plan (Attachment A) to return the sturgeon to the river downstream of the Project. Implementation of the sturgeon handling plan will provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fish lift operations or maintenance activities. The Proposed Action is not likely to adversely affect (NLAA) sturgeon at the Projects.

9.0 Literature Cited

Alden Research Laboratory (Alden). 2012. Atlantic salmon survival estimates at mainstem hydroelectric projects on the Penobscot River. Holden, Massachusetts.

Atlantic Sturgeon Status Review Team. 2007. Status review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). National Marine Fisheries Service. February 23, 2007. 188 pp.

Bakshantansky, E.L., I.A. Barybina, and V.D. Nesterov. 1976. Changes in the intensity of downstream migration of Atlantic salmon smolts according to abiotic conditions. ICES Anadromous and Catadromous Fish Committee C.M.1976/M:4.

Bangor Pacific Hydro Associates (BPHA). 1994. 1994 Evaluation of Downstream Fish Passage Facilities at the West Enfield Hydroelectric Project. FERC #2600-029. Bangor-Pacific Hydro Associates. Bangor, ME. 18 pp. and appendices.

- Barr, L.M. 1962. A life history of the chain pickerel, *Esox niger Lesueur*, in Beddington Lake, Maine. M.S. Thesis University of Maine, Orono, ME: 88 pp.
- Baum, E.T. 1997. Maine Atlantic Salmon: A National Treasure. Atlantic Salmon Unlimited. Hermon, ME. 224 pp.
- _____. 1982. The Union River: An Atlantic salmon management plan. Atlantic Sea Run Salmon Commission. Bangor, Maine. 27 p.
- Beland, K.F., J.F. Kocik, J. VandeSande, and T.F. Sheehan. 2001. Striped Bass Predation Upon Atlantic Salmon Smolts in Maine. *Northeastern Naturalist* 8(3):267-274.
- Black Bear Hydro Partners, LLC. (Black Bear). 2014. Initial Study Report (ISR), Ellsworth Hydroelectric Project, FERC No. 2727. Submitted by Black Bear Hydro Partners, LLC. September.
- Black Bear Hydro Partners LLC (Black Bear). 2012. Draft Biological Assessment for Atlantic salmon, shortnose sturgeon, and Atlantic Sturgeon. Black Bear Hydro Projects - Orono Project, FERC No. 2710, Stillwater Project, FERC No. 2712, Milford Project, FERC No. 2534, West Enfield Project, FERC No. 2600, and Medway Project, FERC No. 2666. Prepared - March 2012.
- Blackwell, B.F. 1996. Ecology of double-crested cormorants using the Penobscot River and Bay Maine. Doctoral dissertation, University of Maine.
- Blackwell, B.F. and F. Juanes. 1998. Predation on Atlantic salmon smolts by striped bass after dam passage. *North American Journal of Fisheries Management* 18: 936-939.
- Blackwell, B.F. and W.B. Krohn. 1997. Spring foraging distribution and habitat selection by double-crested cormorants on the Penobscot River, Maine, USA. *Colonial Waterbirds* 20(1): 66-76.
- Blackwell, B.F., W.B. Krohn, N.R. Dube, and A.J. Godin. 1997. Spring prey use by double-crested cormorants on the Penobscot River, Maine, USA. *Colonial Waterbirds* 20(1): 77-86.

- Booth, R.K., E.B. Bombardier, R.S. McKinley, D.A. Scruton, and R.F. Goosney. 1997. Swimming Performance of Post Spawning Adult (Kelts) and Juvenile (Smolts) Atlantic Salmon, *Salma salar*. Can. Manusc. Rep. Fish. Aquat. Sci. No. 2406: V + 18 p.
- Bourgeois, C.E. and M.F. O'Connell. 1986. Observations on the seaward migration of Atlantic salmon (*Salmo salar L.*) smolts through a large lake as determined by radio telemetry and Carlin tagging. Canadian Journal of Zoology 66: 685-691.
- Brown L.S., Haro A. and Castro-Santos T., 2009. Three-dimensional movements of silver-phase American eels in the forebay of a small hydroelectric facility. *In: Casselman J.M. and Cairns D.K. (eds.), Eels at the edge: science, status and conservation concerns, American Fisheries Society Symposium, 58, Bethesda, 277–291.*
- Bystrom P., J. Karlsson, P. Nilsson, T. Van Kooten, J. Ask, and F. Olofsson. 2007. Substitution of top predators: effects of pike invasion in a subarctic lake. *Freshwater Biology 52(7): 1271-1280. Cited in Maine DMR and Maine DIFW 2009.*
- Cornell. 2012. Cornell Lab of Ornithology. All About Birds. Double-crested cormorant. Online [URL]: <http://www.allaboutbirds.org/guide/search.aspx>. (Accessed July 2012).
- Fay C., M. Bartron, S. Craig, A. Hecht, J. Pruden, R. Saunders, T. Sheehan and J. Trial. 2006. Status review for anadromous Atlantic salmon (*Salmo salar*) in the United States. Report to the National Marine Fisheries Service and U.S. Fish and Wildlife Service. 294 pages.
- Federal Energy Regulatory Commission (FERC). 1997. Final Environmental Impact Statement - Lower Penobscot River Basin, Maine (Basin Mills, Stillwater, and Milford Hydroelectric Projects - FERC Nos. 10981, 2712, and 2534, respectively). FERC, Washington, D.C.
- Fernandes, S.J., G.B. Zydlewski, J.D. Zydlewski, G.S. Wippelhauser, and M.T. Kinnison. 2010. Seasonal distribution and movements of shortnose sturgeon and Atlantic sturgeon in the Penobscot River Estuary, Maine. *Transactions of the American Fisheries Society 139: 1436-1449.*
- Findlay, D.L., M.J. Vanni, M. Patterson, K.H. Mills, S.E.M. Kasian, W.J. Findlay, and A.G

- Salki. 2005. Dynamics of a boreal lake ecosystem during a long-term manipulation of top predators. *Ecosystems* (8):603-618. *Cited in* Maine DMR and Maine DIFW 2009.
- Great Northern Paper Company (GNP). 1989. 1989 report on downstream passage of Atlantic salmon smolts and kelts at Weldon Dam. Great Northern Paper, Millinocket, Maine. 94 pages plus appendices.
- Hall, S.D. and S.L. Shepard. 1990. 1989 Progress report of Atlantic salmon kelt radio telemetry investigations on the lower Penobscot River. Bangor Hydro-Electric Company. Bangor, Maine. 30 pages.
- Hatch, J.J. and D.V. Weseloh. 1999. Double-crested Cormorant (*Phalacrocorax auritus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online [URL]: <http://bna.birds.cornell.edu/bna/species/441>. Accessed April 2011.
- Havey, K.A. 1961. Union River fish management and restoration. Maine Dept. of Inland Fish and Wildlife. Machias, Maine. 42 p.
- He, X. and J.F. Kitchell. 1990. Direct and Indirect Effects of Predation on a Fish Community: A Whole-Lake Experiment. *Transactions of the American Fisheries Society* 119(5): 825-835. *Cited in* Maine DMR and Maine DIFW 2009.
- Hoar, W.S. 1988. The physiology of smolting salmonids. In *Fish physiology* Vol. XIB (Hoar, W. S. & D. J., Randall eds.). London: Academic Press. *Cited in* Svendsen 2008.
- Holbrook, C.M., M.T. Kinnison, and J. Zydlewski. 2011. Survival of migrating Atlantic salmon smolts through the Penobscot River, Maine: a preresoration assessment. *Trans. Am. Fish. Soc.* 140:1255-1268.
- Jackson, D.A. 2002. Ecological Effects of Micropterus Introductions: The Dark Side of Black Bass. In *Black Bass: Ecology, Conservation, and Management*. American Fisheries Society Symposium No. 31:221-232.

- Jonsson, B. and J. Ruud-Hansen. 1985. Water temperature as the primary influence on timing of seaward migrations of Atlantic salmon (*Salmo salar*) smolts. Canadian Journal of Fisheries and Aquatic Sciences 42:593-595.
- Kircheis, D., and T. Liebich. 2007. Draft habitat requirements and management considerations for Atlantic salmon (*Salmo salar*) in the Gulf of Maine Distinct Population Segment (GOM DPS). November 2007.
- Kocik, J.F., J.P. Hawkes, T.F. Sheehan, P.A. Music, K.F. Beland. 2009. Assessing Estuarine and Coastal Migration and Survival of Wild Atlantic Salmon Smolts from the Narraguagus River, Maine Using Ultrasonic Telemetry. American Fisheries Society Symposium 69:293-310.
- Maine Department of Inland Fisheries and Wildlife (Maine DIFW). 2002. Fishes of Maine. Augusta, ME. 38 pp.
- Maine Department of Marine Resources (Maine DMR). 2015. Trap Count Statistics. [Online] URL: <http://www.maine.gov/dmr/searunfish/trapcounts.shtml>.
- Maine Department of Marine Resources (Maine DMR) and Maine Department of Inland Fisheries and Wildlife (Maine DIFW). 2009. Operational Plan for the Restoration of Diadromous Fishes to the Penobscot River. Prepared for the Atlantic Salmon Commission. April 10, 2009 draft. 293 pp.
- McCormick, S.D., L.P. Hansen, T.P. Quinn, and R.L. Saunders. 1998. Movement, migration, and smolting of Atlantic salmon (*Salmo salar*). Canadian Journal of Fisheries and Aquatic Sciences 55, 77-92. Cited in Svendsen 2008 and Kircheis and Liebich 2007.
- McCormick, S.D., R.A. Cunjack, B. Dempson, M.F. O'Dea and J.B. Carey. 1999. Temperature-related loss of smolt characteristics in Atlantic salmon (*Salmo salar*) in the wild. Canadian Journal of Fisheries and Aquatic Sciences 56:1649-1658.
- Meister, A.L. and F. J. Gramlich. 1967. Cormorant predation on tagged Atlantic salmon smolts. Final report of the 1966-67 Cormorant - Salmon Smolt Study. Atlantic Sea Run Salmon Commission, Orono, Maine.

- Mesa, M.G. 1994. Effects of multiple acute stressors on the predator avoidance ability and physiology of juvenile chinook salmon. *Transactions of the American Fisheries Society* 123(5): 786-793. *Cited in* USFWS and NMFS 2009.
- Mudre, J.M. and W.P. Saunders. 1987. Radio telemetric investigation of downstream passage of Atlantic salmon smolts at Bellows Falls station. Prepared for New England Power and Northeast Utilities; 21 pages w/appn.
- NMFS. 1987. (Draft) Status Review of shortnose sturgeon (*Acipenser brevirostrum* LeSueur 1818) Listed under the Endangered Species Act of 1973.
- _____. 1998. Recovery plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland 104 pp.
- _____. 2008. Endangered Species Act Section 7 formal consultation regarding proposed funding of fisheries sampling in the Penobscot River, Maine, to be funded by NMFS. Gloucester, MA. Biological Opinion, September 4.
- _____. 2009a. Endangered and Threatened Species. Designation of critical habitat for Atlantic salmon (*Salmo salar*) Gulf of Maine Distinct Population Segment. Final rule. Federal Register, Vol. 74, No. 117. June 19, 2009.
- _____. 2009b. Biological evaluation of Atlantic salmon habitat within the Gulf of Maine Distinct Population Segment.
- _____. 2012. Dam Impact Assessment Model. Lab Reference Document. Northeast Fisheries Science Center, Woods Hole, MA.
- National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (Maine DMR), U.S. Fish and Wildlife Service (USFWS), and Penobscot Indian Nation (PIN). 2011. Atlantic Salmon Recovery Framework: Implementation Plan. March 2011.
- National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2005. Final Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (*Salmo salar*). NMFS, Silver Spring, MD; USFWS, Hadley, MA. 325 pp.

- _____. 2015. Atlantic Salmon Recover Plan (Draft). Online [URL]: <http://atlanticsalmonrestoration.org/resources/documents/atlantic-salmon-recovery-plan-2015/atlantic-salmon-recovery-plan>. Accessed December 8, 2015.
- National Oceanic and Atmospheric Administration (NOAA). 2009. Draft Gulf of Maine Distinct Population Segment Management Guidance for Recovery.
- _____. 2012a. Endangered and Threatened wildlife and plants; threatened and endangered status for distinct population segments of Atlantic Sturgeon in the Northeast Region. Final rule. Federal Register, Vol. 77 No. 24 February 6, 2012.
- _____. 2012b. Endangered and Threatened wildlife and plants; Final listing determination for two distinct population segments of Atlantic Sturgeon in the Southeast Region. Final rule. Federal Register, Vol. 77 No. 24 February 6, 2012.
- Nielsen, C., G. Holdensgaard, H.C. Petersen, B.T. Björnsson and S.S. Madsen. 2001. Genetic differences in physiology, growth hormone levels and migratory behavior of Atlantic salmon smolts. *Journal of Fish Biology* 59, 28-44. *Cited in Svendsen 2008.*
- Northeast Salmon Team. 2011. Managing the Impacts of Cormorant Predation on Smolts. NMFS. [Online] URL: <http://www.nefsc.noaa.gov/salmon/Finalcormorantfactsheet.html>. Accessed July 2011.
- Penobscot River Restoration Trust (Trust). 2008. Applications to surrender licenses for the Veazie (FERC No. 2304), Great Works (FERC No. 2312), and Howland (FERC No. 2721) hydroelectric projects. Filed with the Federal Energy Regulatory Commission, Washington, D.C., November 2008.
- Peake, S.J., McKinley, R.S. and Scruton, D.A. 1997. Swimming performance of various freshwater Newfoundland salmonids relative to habitat selection and fishway design. *Journal of Fish Biology* 51: 710-723.
- Power, J.H. and J.D. McCleave. 1980. Riverine movements of hatchery reared Atlantic salmon (*Salmo salar*) upon return as adults. *Environmental Biology of Fishes* 5(1):3-13.

- Raymond, H.L. 1979. Effects of dams and impoundments on migrations of juvenile chinook salmon and steelhead from the Snake River, 1966 to 1975. *Transactions of the American Fisheries Society* 108(6): 505-529. *Cited in* USFWS and NMFS 2009.
- Ruggles, C.P. 1980. A review of downstream migration of Atlantic salmon. Canadian Technical Report of Fisheries and Aquatic Sciences No. 952. Freshwater and Anadromous Division.
- Shepard, S.L. 1989. 1988 Progress Report of Atlantic Salmon Kelt Radio Telemetry Investigations in the Lower Penobscot River. Bangor Hydro-Electric Company. 30 pp.
- _____. 1991. A radio telemetry investigation of Atlantic salmon smolt migration in the Penobscot River of Maine. Proceedings of the Atlantic salmon workshop, Rockport, Maine March 6-7, 1991. U.S. Fish and Wildlife Service. Pages 101-118.
- _____. 1993. Survival and Timing of Atlantic Salmon Smolts Passing the West Enfield Hydroelectric Project. Bangor-Pacific Hydro Associates. 27 pp.
- _____. 1995. Atlantic salmon spawning migrations in the Penobscot River, Maine: fishways, flows and high temperatures. MS Thesis. Univ. Maine. Orono, ME. 111 pp.
- Shrimpton, J.M., B.T. Björnsson, and S.D. McCormick. 2000. Can Atlantic salmon smolt twice? Endocrine and biochemical changes during smolting. *Canadian Journal of Fisheries and Aquatic Sciences* 57, 1969 - 1976. *Cited in* Svendsen 2008.
- Sigourney, D.B., and J.D. Zydlewski, E. Hughes, and O. Cox. 2015. Transport, dam passage, and size selection of adult Atlantic salmon in the Penobscot River, Maine. *N. Am. J. Fish. Mgmt.* 35:1164-1176.
- Smith, C. L. 1985. The inland fishes of New York State. The New York State Department of Environmental Conservation, Albany, New York.
- Spencer, R., K. Gallant, and D. Buckley. 2010. Migratory behavior and spawning activity of adult sea-run Atlantic salmon translocated to novel upriver habitat within the Penobscot Basin, Maine. A Progress Report to the West Enfield Fisheries Fund Committee. March

- 1, 2010.
- _____. 2011. 2010 Progress Report. Migratory behavior and spawning activity of adult sea-run Atlantic salmon translocated to novel upriver habitat within the Penobscot Basin, Maine. A Report for the West Enfield Fisheries Fund Committee. April 25, 2011.
- U.S. Atlantic Salmon Assessment Committee (USASAC). 1992. Annual Report of the U.S. Atlantic Salmon Assessment Committee. Report No. 4 – 1991 Activities.
- U.S. Fish and Wildlife Service (USFWS). 2011. USFWS Gulf of Maine Coastal Program (GOMP), GIS data: (USFWS MEASHS) Maine Atlantic Salmon Habitat Surveys. Publication_Date: 20110621. Title: ashab3. Geospatial Data Presentation Form: vector digital data. Available at <http://www.maine.gov/megis/catalog/>.
- U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 2000. Endangered and Threatened Species. Gulf of Maine Distinct Population Segment of Atlantic salmon. Listing as endangered. Final rule. Federal Register, Vol. 65, No. 223. November 17, 2000.
- U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 2009. Endangered and Threatened Species. Determination of endangered status for the Gulf of Maine Distinct Population Segment of Atlantic salmon. Final rule. Federal Register, Vol. 74, No. 117. June 19, 2009.
- Union River Fisheries Coordinating Committee (URFCC). 2015. Comprehensive Fishery Management Plan for the Union River Drainage, 2015-2017. February 2010.
- _____. 2012. 2011 Annual Report, Union River Fisheries Coordinating Committee. Prepared by Black Bear Hydro partners, LLC on behalf of URFCC. February 2012.
- _____. 2010. Comprehensive Fishery Management Plan for the Union River Drainage 2011-2014. 29 pp.
- Van den Ende, O. 1993. Predation on Atlantic salmon smolts (*Salmo salar*) by smallmouth bass (*Micropterus dolomeiu*) and chain pickerel (*Esox niger*) in the Penobscot River, Maine. M.S. Thesis. University of Maine. Orono, ME. 95 pp.

- Vanderpool, A.M. 1992. Migratory Patterns and Behavior of Atlantic Salmon Smolts in the Penobscot River, Maine. Thesis. University of Maine, Orono. 61pp.
- Wolter and Arlinghaus. 2003. Navigation impacts on freshwater fish assemblages: the ecological relevance of swimming performance. *Reviews in Fish Biology & Fisheries* 13: 63-89.
- Zydlewski, G. 2009. Cianbro Constructors, LLC Penobscot River Operations, Brewer, Maine Shortnose Sturgeon monitoring, July 2008 – October 2008. University of Maine. School of Marine Sciences.
- Zydlewski, G. B., M. T. Kinnison, P. E. Dionne¹, J. Zydlewski and G. S. Wippelhauser. 2011. Shortnose sturgeon use small coastal rivers: the importance of habitat connectivity. *J. Appl. Ichthyol.* 27 (Suppl. 2) (2011), 41–44 © 2011 Blackwell Verlag, Berlin. ISSN 0175–8659.

ATTACHMENT A
STURGEON HANDLING PLAN

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Sturgeon Handling Plan for the Ellsworth Development

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and shortnose sturgeon (*Acipenser brevirostrum*) have the potential to occur in the Union River downstream of the Project. Black Bear will implement the following sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during operations of the fish trap or during maintenance of the project facilities.

Fish Trap Operations

If sturgeon are found in the Project's fish trap, the following procedures will be implemented:

- For each sturgeon detected, Black Bear shall record the weight, length, and condition of the fish. Fish should also be scanned for PIT tags. River flow, spillage, and water temperature will be recorded. All relevant information will be recorded on the reporting sheet (Sturgeon Reporting Sheet for the Ellsworth Project, a copy of which is attached).
- Black Bear shall follow the contact procedure outlined below that was developed in coordination with the National Oceanic and Atmospheric Administration (NOAA) to obtain a contact with the appropriate Endangered Species Act (ESA) representative for handling sturgeon.
- If alive and uninjured, the sturgeon will be immediately returned downstream. A long handled net outfitted with non-abrasive knotless mesh will be used to place the sturgeon back into the river downstream of the dam. The fish should be properly supported during transport in the net to ensure that it is not injured.
- If any injured sturgeon are found, Black Bear shall report immediately to NOAA (see contact information below). Injured fish must be photographed and measured, if possible, and the reporting sheet must be submitted to NOAA within 24 hours. If the fish is badly injured, the fish should be retained by Black Bear, if possible, until obtained by a NOAA recommended facility for potential rehabilitation.

- If any dead sturgeon are found, Black Bear must report immediately to NOAA (see contact information below). Any dead specimens or body parts should be photographed, measured, scanned for tags and all relevant information should be recorded on the Salvage Form included below. Specimens should be stored in a refrigerator or freezer by Black Bear until they can be obtained by NOAA for analysis.

Unit Inspection and Maintenance

On occasion, the Ellsworth Development units are dewatered for inspection or for maintenance activities. Prior to dewatering, the headgate and tailwater gates are closed, and then water is pumped from the unit. Black Bear will follow the protocols outlined here:

- Designated Black Bear employees will conduct a visual check for the presence of any sturgeon in the draft tube area as soon as possible once the water levels allow. If sturgeon are observed in the draft tube, Black Bear will refill the draft tube as necessary and remove the sturgeon. The process of dewatering would be repeated, and a visual check would be conducted to see if any sturgeon remain in the draft tube as it is dewatered.
- If sturgeon are observed in the draft tubes, they will be removed by dip net or other appropriate equipment, and place in the river downstream of the powerhouse.
- Unit dewatering for annual inspections will not be scheduled during April and May unless there is an emergency, in which case consultation with the appropriate resources agencies will take place.
- For each fish removed, Black Bear will record the weight, length, and condition. Fish would also be scanned for PIT tags. All relevant information will be recorded on the reporting sheet (attached Sturgeon Reporting Sheet for the Ellsworth Development).
- If any injured sturgeon are found, Black Bear will report it immediately to NOAA (see contact information below). Injured fish must be photographed and measured, if possible, and the reporting sheet will be submitted to NOAA within 24 hours. If the fish is badly injured, the fish shall be retained by Black Bear, if possible, until obtained by a NOAA recommended facility for potential rehabilitation.

- Black Bear shall report any dead fish immediately to NOAA (see contact information below). Any dead specimens or body parts should be photographed, measured, scanned for tags and all relevant information shall be recorded on the Salvage Form included below. Specimens should be stored in a refrigerator or freezer by Black Bear until they can be obtained by NOAA for analysis.

Contact Information

Points of contact will be developed with the appropriate resource agencies, and their names and contact information will be shared and updated on an as-needed basis. Black Bear anticipates that points of contact will be identified at Black Bear, Maine DMR, USFWS, and NOAA. Copies of all reporting sheets will be developed and submitted to USFWS/NOAA at the end of the season.

Contact information:

- If any sturgeon are detected – Bob Richter (207-242-5001) or the Operator (207-461-3619).
- If unavailable, contact – Gail Wippelhauser, Maine Department of Marine Resources (207-624-6349).
- Within 24 hours of any contact with an injured or dead sturgeon, contact NOAA Fisheries Northeast Regional Office –Protected Resources Division Main Number (978-282-9328) or Julie Crocker (978-282-8480) and fax any reporting sheets to 978-281-9394.

Reports at End of Season

- At the end of the season, copies of all reporting sheets will be send to:

Jeff Murphy
NOAA Fisheries
17 Godfrey Drive, Suite 1
Orono, ME 04976

Sturgeon Reporting Sheet for the Ellsworth Development

Date: _____ Time: _____

Physical conditions:

Is spill being released over the dam? YES NO

What is the approximate gaged river flow? _____ (in cfs)

Water temperature (°C): _____

Is the fishway operating? YES NO

Is project generating? YES NO

If yes, what units are currently being operating?

Location from where species was recovered (circle): FISH TRAP / DRAFT TUBES

OTHER _____

If fish trap, estimate condition of trap: EMPTY / FEW FISH / MODERATE FULL / VERY FULL

Species information:

Total length: _____ Fork length: _____ Weight: _____

Condition of fish: _____

Does the sturgeon have visible injuries or abrasions: YES NO

If Yes, circle and code area of abrasions on sturgeon diagram on back side of sheet.

Comments/other: _____

Name of watch observer: _____

Observer's Signature: _____

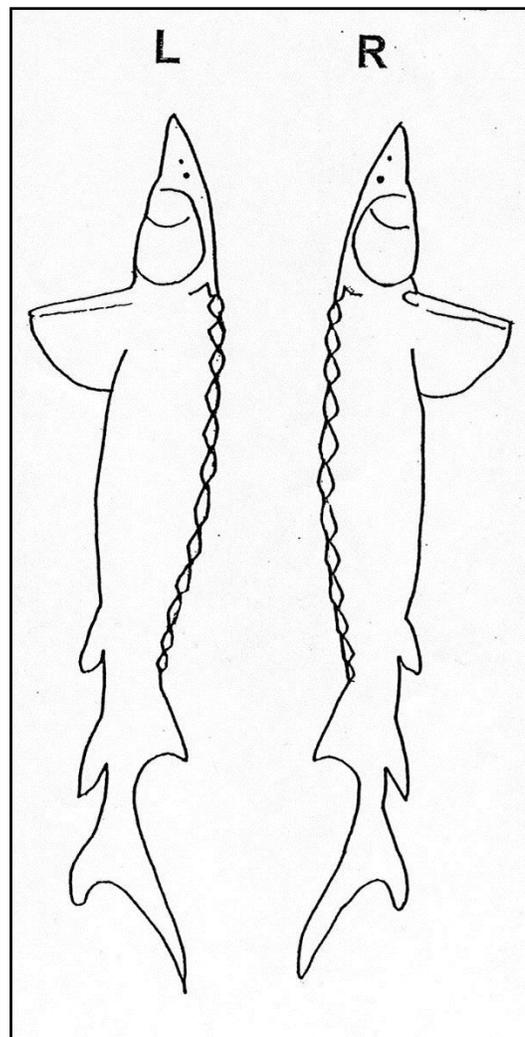
Abrasion Codes

None

Light Whitening or smoothed scutes,
Early sign of skin abrasion.

Moderate Early sign of redness on skin, scutes or fins, Erosion of skin over bony structures,
Loss of skin pigment

Heavy Large portion of skin red, scutes excessively worn,
Damaged, or missing; patches of skin missing,
Boney structures exposed; flaccid musculature.



For use in documenting dead sturgeon in the wild under ESA permit no. 1814 (version 07-20-2009)

INVESTIGATORS'S CONTACT INFORMATION Name: First _____ Last _____ Agency Affiliation _____ Email _____ Address _____ Area code/Phone number _____	UNIQUE IDENTIFIER (Assigned by NMFS) DATE REPORTED: Month <input type="text"/> <input type="text"/> Day <input type="text"/> <input type="text"/> Year 20 <input type="text"/> <input type="text"/> DATE EXAMINED: Month <input type="text"/> <input type="text"/> Day <input type="text"/> <input type="text"/> Year 20 <input type="text"/> <input type="text"/>
---	---

SPECIES: (check one) <input type="checkbox"/> shortnose sturgeon <input type="checkbox"/> Atlantic sturgeon <input type="checkbox"/> Unidentified <i>Acipenser</i> species Check "Unidentified" if uncertain. See reverse side of this form for aid in identification.	LOCATION FOUND: <input type="checkbox"/> Offshore (Atlantic or Gulf beach) <input type="checkbox"/> Inshore (bay, river, sound, inlet, etc) River/Body of Water _____ City _____ State _____ Descriptive location (be specific) _____ _____ Latitude _____ N (Dec. Degrees) Longitude _____ W (Dec. Degrees)
--	---

CARCASS CONDITION at time examined: (check one) <input type="checkbox"/> 1 = Fresh dead <input type="checkbox"/> 2 = Moderately decomposed <input type="checkbox"/> 3 = Severely decomposed <input type="checkbox"/> 4 = Dried carcass <input type="checkbox"/> 5 = Skeletal, scutes & cartilage	SEX: <input type="checkbox"/> Undetermined <input type="checkbox"/> Female <input type="checkbox"/> Male How was sex determined? <input type="checkbox"/> Necropsy <input type="checkbox"/> Eggs/milt present when pressed <input type="checkbox"/> Borescope	MEASUREMENTS: Circle unit Fork length _____ cm / in Total length _____ cm / in Length <input type="checkbox"/> actual <input type="checkbox"/> estimate Mouth width (inside lips, see reverse side) _____ cm / in Interorbital width (see reverse side) _____ cm / in Weight <input type="checkbox"/> actual <input type="checkbox"/> estimate _____ kg / lb
--	--	--

TAGS PRESENT? Examined for external tags including fin clips? Yes No Scanned for PIT tags? Yes No

Tag #	Tag Type	Location of tag on carcass
_____	_____	_____
_____	_____	_____

CARCASS DISPOSITION: (check one or more) <input type="checkbox"/> 1 = Left where found <input type="checkbox"/> 2 = Buried <input type="checkbox"/> 3 = Collected for necropsy/salvage <input type="checkbox"/> 4 = Frozen for later examination <input type="checkbox"/> 5 = Other (describe) _____	Carcass Necropsied? <input type="checkbox"/> Yes <input type="checkbox"/> No Date Necropsied: _____ Necropsy Lead: _____	PHOTODOCUMENTATION: Photos/video taken? <input type="checkbox"/> Yes <input type="checkbox"/> No Disposition of Photos/Video: _____ _____
--	--	---

SAMPLES COLLECTED? Yes No

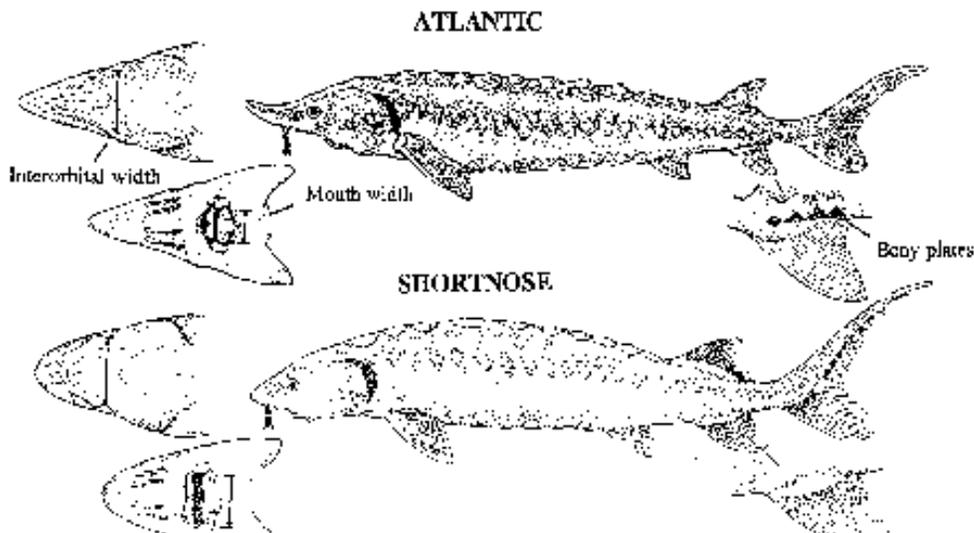
Sample	How preserved	Disposition (person, affiliation, use)
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Comments:

Distinguishing Characteristics of Atlantic and Shortnose Sturgeon (version 07-20-2009)

Characteristic	Atlantic Sturgeon, <i>Acipenser oxyrinchus</i>	Shortnose Sturgeon, <i>Acipenser brevirostrum</i>
Maximum length	> 9 feet/ 274 cm	4 feet/ 122 cm
Mouth	Football shaped and small. Width inside lips < 55% of bony interorbital width	Wide and oval in shape. Width inside lips > 62% of bony interorbital width
*Pre-anal plates	Paired plates posterior to the rectum & anterior to the anal fin.	1-3 pre-anal plates almost always occurring as median structures (occurring singly)
Plates along the anal fin	Rhombic, bony plates found along the lateral base of the anal fin (see diagram below)	No plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations

* From Vecsei and Peterson, 2004



Describe any wounds / abnormalities (note tar or oil, gear or debris entanglement, propeller damage, etc.). Please note if no wounds / abnormalities are found.

Data Access Policy: Upon written request, information submitted to National Marine Fisheries Service (NOAA Fisheries) on this form will be released to the requestor provided that the requestor credit the collector of the information and NOAA Fisheries. NOAA Fisheries will notify the collector that these data have been requested and the intent of their use.

Submit completed forms (within 30 days of date of investigation) to: Jessica Pruden, Shortnose Sturgeon Recovery Coordinator, NOAA Fisheries Northeast Region, 55 Great Republic Drive, Gloucester, MA 01930
 Phone: 978-282-8482; Fax: 978-281-9394; E-Mail Jessica.Pruden@noaa.gov

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EXHIBIT F
GENERAL DESIGN DRAWINGS
AND SUPPORTING DESIGN REPORT

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT F
GENERAL DESIGN DRAWINGS AND SUPPORTING DESIGN REPORT**

The design drawings showing plan, elevations, and sections of the principal Project works are included as follows:

<u>Sheet No.</u>	<u>Title</u>
Sheet 1	Ellsworth Powerhouse and Dam Plan and Section
Sheet 2	Ellsworth Powerhouse Plan
Sheet 3	Ellsworth Powerhouse and Intake Section
Sheet 4	Ellsworth Powerhouse and Dam Sections
Sheet 5	Graham Lake Dam Site Plan and Section
Sheet 6	Graham Lake Dam Plan, Sections and Details

In accordance with Federal Energy Regulatory Commission (FERC or Commission) regulations, certain sensitive information related to this relicensing proceeding is being filed under separate cover with the Commission only. Special handling of this material is required to protect the security of critical energy infrastructure.

In order to protect critical energy infrastructure, the Commission has enacted regulations to govern public access to certain information. The Exhibit F drawings and Supporting Design Report referenced herein contain sensitive and detailed engineering information that, if used improperly, may compromise the safety of the Project and those responsible for its operation. Therefore, the Exhibit F drawings and Supporting Design Report have been labeled "Contains Critical Energy Infrastructure Information - Do Not Release." The drawings and Supporting Design Report have been submitted to FERC under separate cover. Agencies may file a CEII request under 18 CFR § 388.113 or a Freedom of Information Act (FOIA) request under 18 CFR § 388.108 to obtain the Exhibit F drawings.

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EXHIBIT G
PROJECT MAPS

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT G
PROJECT MAPS**

The following maps show the location of the Ellsworth Hydroelectric Project, principal features, and Project boundary:

<u>Sheet No.</u>	<u>Title</u>
Sheet 1	Project Detail Map
Sheet 2	Project Detail Map
Sheet 3	Project Detail Map

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Reference Point #1
 Northing: 320496
 Easting: 993822

Reference Point #2
 Northing: 333311
 Easting: 997964

Matchline

Sheet 1
 Sheet 2

ELLSWORTH DEVELOPMENT

INSET A

Powerhouse
 Fishway
 Ellsworth Dam
 Transmission Line (See Note)
 Traverse "A"
 Traverse "B"

Traverse "A"			
FROM STA.	TO STA.	DIST.	BEARING
1	2	79.5	N 82° 10' W
2	3	80	N 05° 25' W
3	4	50	N 82° 10' W
4	5	99	N 05° 25' W
5	6	148.5	N 38° 05' W
6	7	282.9	S 86° 04' W
7	8	38	N 25° 01' 50" W
8	9	23.7	N 11° 09' 40" W
9	10	49.4	N 11° 30' 10" W
10	11	39.8	N 12° 49' 40" W
11	12	34.4	N 25° 10' 50" W
12	13	15.9	N 51° 46' 00" W
13	14	24.8	S 77° 53' 50" E
14	15	144.3	N 55° 24' 50" W
15	16	8.3	N 26° 23' 50" W
16	1		By Shore

Traverse "B"			
FROM STA.	TO STA.	DIST.	BEARING
A	B	50	N 44° 22' E
B	C	130	S 51° 40' E
C	D	585	N 23° 14' W
D	E	231	N 16° 23' W
E	F	75	N 44° 22' E
F	G	83	N 07° 48' W
G	H	172.3	N 84° 00' E
H	I	To Shore	S 06° 50' W
I			By Shore

LAKE LEONARD
 Project Boundary
 El. 66.67'

Project Boundary
 El. 66.67'

Project Boundary
 El. 66.67'

SEE INSET A
 THIS SHEET

Commission Approved Recreation Amenity Table

#	Name	Northing	Easting
A	Carry-in Boat Launch	16186521	1785054
B	Boat Launch	16200057	1785508
C	Downstream Fishing Access	16199533	1786210

Reference Point Table
 NAD83 State Plane Maine West Zone U.S. Feet

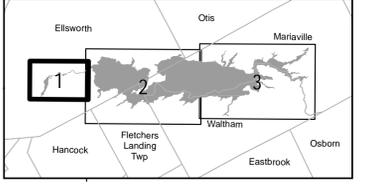
Sheet #	Reference Point #	Northing	Easting
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1	2	333311.0	997964.0
1	3	325298.0	1002791.0
2	4	348299.0	1000410.0
2	5	335732.0	1014127.0
2	6	356720.0	1017132.0
3	7	382421.0	1011112.0
3	8	368961.0	1021908.0
3	9	393752.0	1027245.0

Legend

- Recreation Amenity
- ⊕ Reference Point (NAD83 State Plane, Maine East Zone, U.S. Survey Feet)
- Traverse Point
- Project Boundary
- Road
- ~ Stream

NOTES:
 EASEMENTS FOR, AND ACCESS RIGHTS-OF-WAY TO NON-PROJECT FACILITIES ARE EXCLUDED FROM THE PROJECT. ALL TRANSMISSION AND DISTRIBUTION LINES SHOWN WITHIN PROJECT BOUNDARY ARE EXCLUDED FROM THE PROJECT

Reference Point #3
 Northing: 325298
 Easting: 1002791



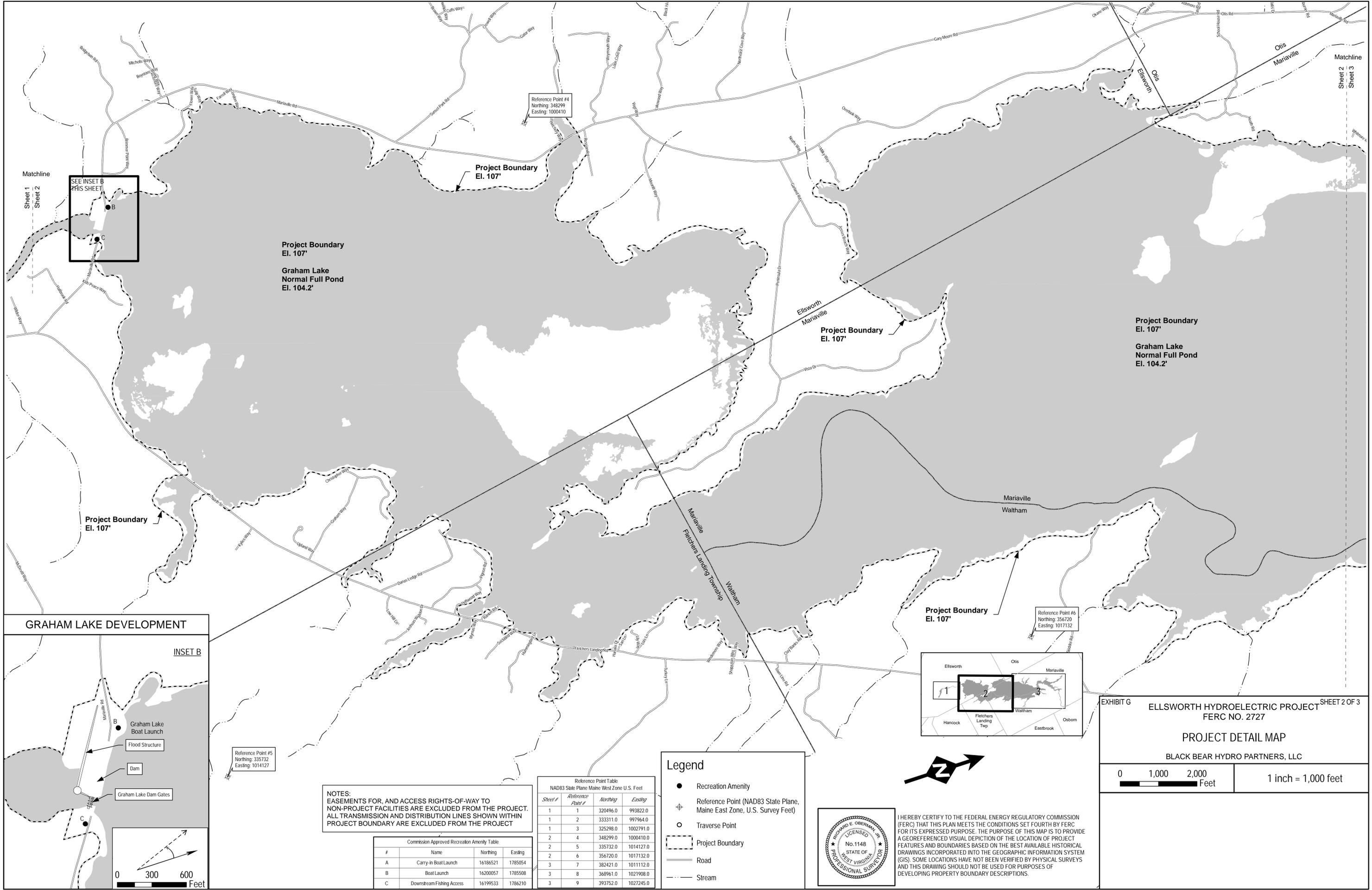
I HEREBY CERTIFY TO THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) THAT THIS PLAN MEETS THE CONDITIONS SET FORTH BY FERC FOR ITS EXPRESSED PURPOSE. THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS INCORPORATED INTO THE GEOGRAPHIC INFORMATION SYSTEM (GIS). SOME LOCATIONS HAVE NOT BEEN VERIFIED BY PHYSICAL SURVEYS AND THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY DESCRIPTIONS.

EXHIBIT G SHEET 1 OF 3
ELLSWORTH HYDROELECTRIC PROJECT
 FERC NO. 2727

PROJECT DETAIL MAP

BLACK BEAR HYDRO PARTNERS, LLC

0 500 1,000 Feet
 1 inch = 500 feet



Reference Point #4
 Northing: 348299
 Easting: 1000410

Reference Point #6
 Northing: 356720
 Easting: 1017132

Reference Point #5
 Northing: 335732
 Easting: 1014127

NOTES:
 EASEMENTS FOR, AND ACCESS RIGHTS-OF-WAY TO
 NON-PROJECT FACILITIES ARE EXCLUDED FROM THE PROJECT.
 ALL TRANSMISSION AND DISTRIBUTION LINES SHOWN WITHIN
 PROJECT BOUNDARY ARE EXCLUDED FROM THE PROJECT

#	Name	Northing	Easting
A	Carry-in Boat Launch	16186521	1785054
B	Boat Launch	16200057	1785508
C	Downstream Fishing Access	16199533	1786210

Sheet #	Reference Point #	Northing	Easting
1	1	320496.0	993822.0
1	2	333311.0	997964.0
1	3	325298.0	1002791.0
2	4	348299.0	1000410.0
2	5	335732.0	1014127.0
2	6	356720.0	1017132.0
3	7	382421.0	1011112.0
3	8	368961.0	1021908.0
3	9	393752.0	1027245.0

Legend

- Recreation Amenity
- ⊕ Reference Point (NAD83 State Plane, Maine East Zone, U.S. Survey Feet)
- Traverse Point
- - - Project Boundary
- Road
- ~ Stream



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GRAHAM LAKE DEVELOPMENT

INSET B

Graham Lake Boat Launch
 Flood Structure
 Dam
 Graham Lake Dam Gates

0 300 600 Feet

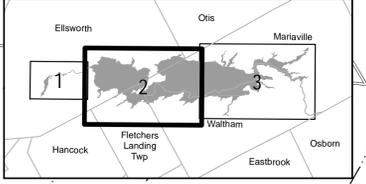
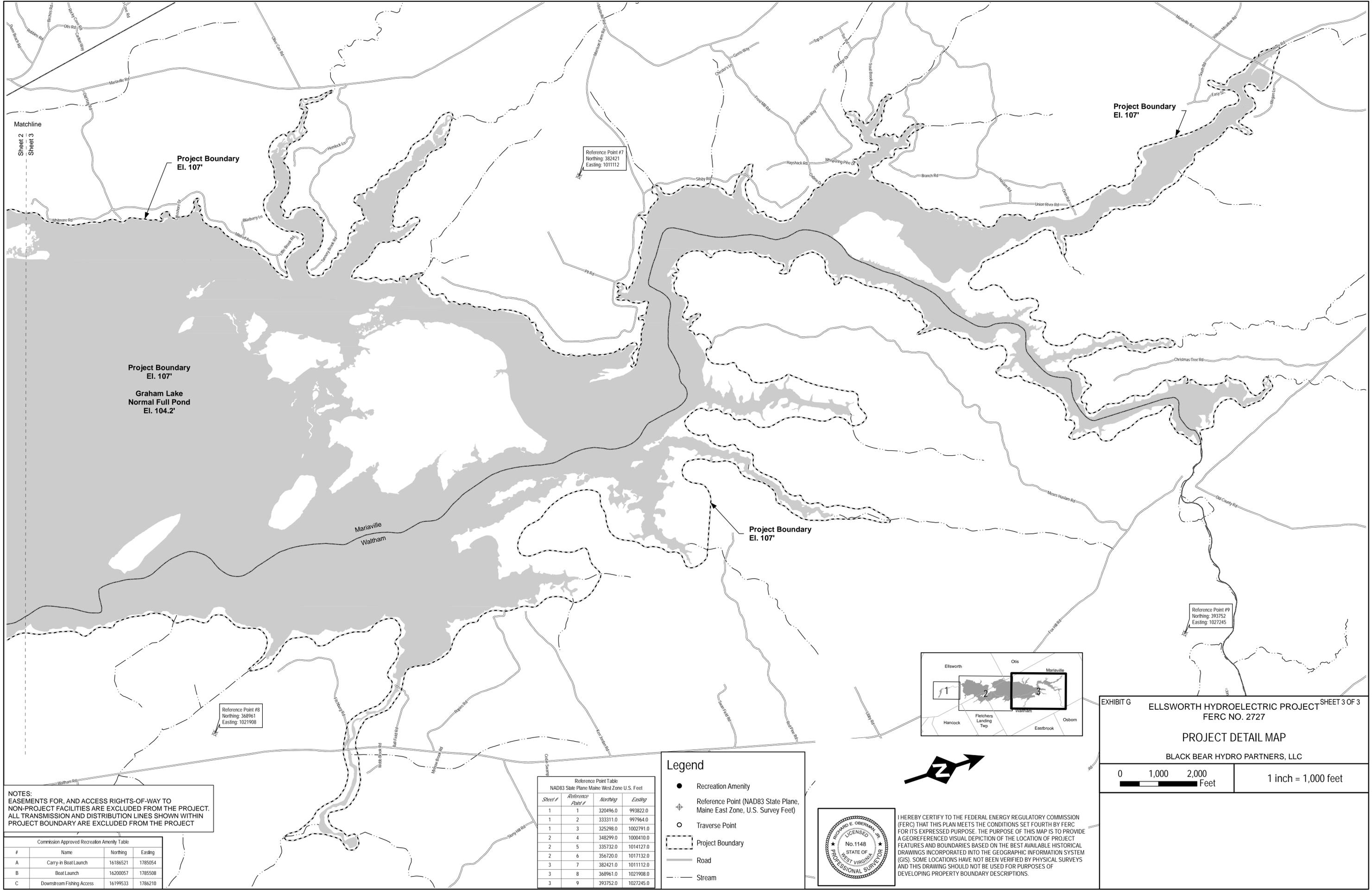


EXHIBIT G ELLSWORTH HYDROELECTRIC PROJECT SHEET 2 OF 3
 FERC NO. 2727

PROJECT DETAIL MAP

BLACK BEAR HYDRO PARTNERS, LLC

0 1,000 2,000 Feet
 1 inch = 1,000 feet



Matchline
Sheet 2
Sheet 3

Project Boundary
El. 107'

Reference Point #7
Northing: 382421
Easting: 1011112

Project Boundary
El. 107'

Project Boundary
El. 107'
Graham Lake
Normal Full Pond
El. 104.2'

Mariaville
Waltham

Project Boundary
El. 107'

Reference Point #9
Northing: 393752
Easting: 1027245

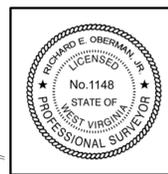
Reference Point #8
Northing: 368961
Easting: 1021908

NOTES:
EASEMENTS FOR, AND ACCESS RIGHTS-OF-WAY TO
NON-PROJECT FACILITIES ARE EXCLUDED FROM THE PROJECT.
ALL TRANSMISSION AND DISTRIBUTION LINES SHOWN WITHIN
PROJECT BOUNDARY ARE EXCLUDED FROM THE PROJECT

Commission Approved Recreation Amenity Table			
#	Name	Northing	Easting
A	Carry-in Boat Launch	16186521	1785054
B	Boat Launch	16200057	1785508
C	Downstream Fishing Access	16199533	1786210

Reference Point Table NAD83 State Plane Maine West Zone U.S. Feet			
Sheet #	Reference Point #	Northing	Easting
1	1	320496.0	993822.0
1	2	333311.0	997964.0
1	3	325298.0	1002791.0
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2	5	335732.0	1014127.0
2	6	356720.0	1017132.0
3	7	382421.0	1011112.0
3	8	368961.0	1021908.0
3	9	393752.0	1027245.0

- Legend**
- Recreation Amenity
 - ⊕ Reference Point (NAD83 State Plane, Maine East Zone, U.S. Survey Feet)
 - Traverse Point
 - - - Project Boundary
 - Road
 - ~ Stream



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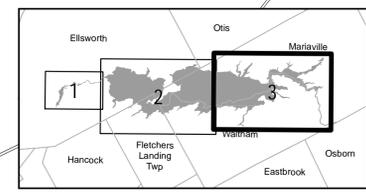


EXHIBIT G ELLSWORTH HYDROELECTRIC PROJECT SHEET 3 OF 3
FERC NO. 2727

PROJECT DETAIL MAP

BLACK BEAR HYDRO PARTNERS, LLC

0 1,000 2,000 Feet

1 inch = 1,000 feet

EXHIBIT H

**DESCRIPTION OF PROJECT MANAGEMENT
AND NEED FOR PROJECT POWER**

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)**

**APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM**

**EXHIBIT H
DESCRIPTION OF PROJECT MANAGEMENT
AND NEED FOR PROJECT POWER**

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**ELLSWORTH HYDROELECTRIC PROJECT
(FERC NO. 2727)****APPLICATION FOR NEW LICENSE
FOR MAJOR PROJECT – EXISTING DAM****EXHIBIT H
DESCRIPTION OF PROJECT MANAGEMENT
AND NEED FOR PROJECT POWER****1.0 INTRODUCTION**

The Ellsworth Project (Project) is an existing hydroelectric project owned by, and licensed to, Black Bear Hydro Partners, LLC (Black Bear). Black Bear is an independent power producer and, as such, does not provide electric service to any particular group or class of customers. The Project generates renewable power that is currently sold into the New England wholesale market administered by the non-profit Independent System Operator (ISO) for New England (ISO New England). ISO New England administers all significant aspects of the New England Power Pool (NEPOOL) power market including: (i) the NEPOOL Open Access Transmission Tariff; (ii) the dispatch, billing and settlement system for interchange power in NEPOOL; (iii) NEPOOL energy and automatic generation control markets; and (iv) the NEPOOL installed capability market.

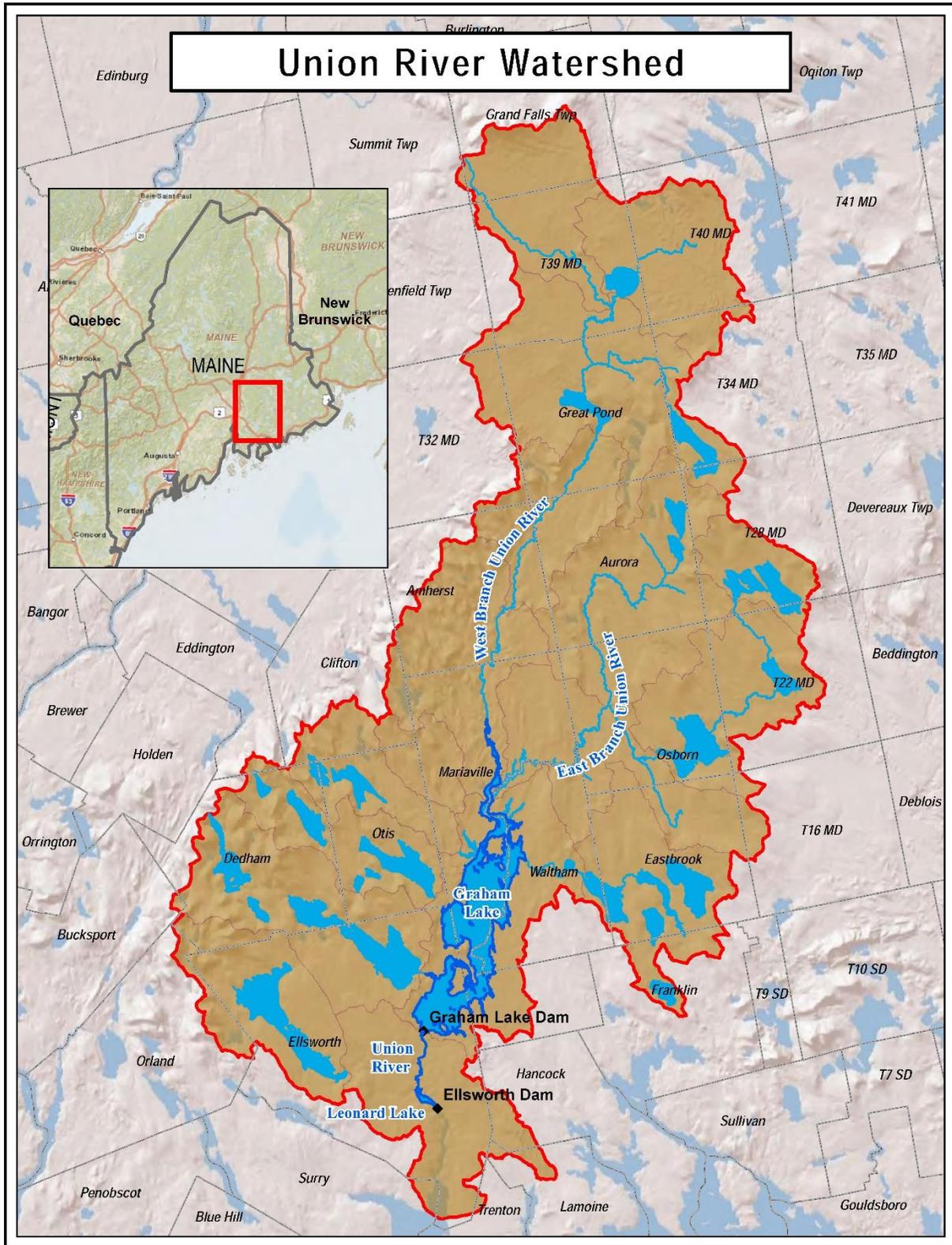
2.0 INFORMATION TO BE SUPPLIED BY ALL APPLICANTS**2.1 Plans and Ability of Owners of Ellsworth Dam to Operate and Maintain the Project****2.1.1 Plans to Increase Capacity or Generation**

Black Bear has no current plans to increase the capacity or generation of the Project.

2.1.2 Plans to Coordinate the Operation of the Project with Other Water Resource Projects

The Project, owned by Black Bear is the only facility located on the Union River. The facility consists of two developments; Graham Lake development and Ellsworth development and their respective reservoirs typically operated for water storage and power generation. Operationally, the Project is typically run as a peaking plant, with water being released from the Graham Lake reservoir used to generate electricity at the downstream Ellsworth powerhouse to follow the electrical load of customers in the NEPOOL market.

Figure H-1: Union River Watershed



2.1.3 Plans to Coordinate the Operation of the Project with Other Electrical Systems

Black Bear is an independent power producer and member of NEPOOL that currently sells power from the Project wholesale to ISO New England. NEPOOL is a voluntary association whose members include not only traditional vertically integrated electric utilities, but independent power producers such as Black Bear that are participating in the competitive wholesale electricity marketplace. ISO New England serves as the independent system operator to operate the regional bulk power system and to administer the wholesale marketplace. ISO New England's primary responsibilities are to coordinate, monitor, and direct the operations of the major generating and transmission facilities in the region. The objective of ISO New England is to promote a competitive wholesale electricity marketplace while maintaining the electrical system's integrity and reliability. ISO New England seeks to assure both maximum reliability and economy of the bulk power supply for New England.

To this end, the electric facilities of NEPOOL member companies are operated as if they comprised a single power system. ISO New England accomplishes this by central dispatching of available power resources, and using the lowest cost generation and transmission equipment available at any given time consistent with meeting reliability requirements. As a result of this economic dispatch, utilities and their customers realize significant savings annually. NEPOOL participants also have strengthened the reliability of the bulk power system through shared operating reserves and coordinated maintenance scheduling.

The ISO New England staff constantly monitors and directs the operation of more than 300 generators and more than 7,600 miles of transmission lines in New England. ISO New England also is responsible for forecasting the various levels of daily electricity demand that will occur throughout the region and scheduling resources to meet the demand.

2.2 Need for the Electricity Generated by the Project

2.2.1 The Reasonable Costs and Availability of Alternative Sources of Power

The Project generates renewable power. The electrical output from the Project is sold wholesale into the ISO New England administered market.

The replacement of energy and capacity provided by the Project would be met through other sources, likely to be fossil-fired generating units, whose fuel and other variable costs would be significantly higher than those of the Project. As the lowest variable cost resource among power supply alternatives, hydroelectric assets such as the Project can bid energy into the ISO New England market at lower prices than alternative resources. Thus, loss of a low-variable cost resource such as the Project would result in upward pressure on the clearing prices in the NEPOOL market and ultimately paid by electric consumers in New England.

The Project provides renewable power, without the emissions of air pollutants or greenhouse gases that the marginal fossil fuel plants produce. This is an increasingly important fact in New England where all six New England states have enacted legislation to reduce the dependence on fossil fired generation through the introduction of Renewable Portfolio Standards (RPS), or similar legislation, that encourages and requires the use of renewable power sources in the state's total resource output. Many of these RPS programs include an annual escalating supply requirement to further encourage reliance on renewable power sources. Legislation that has been enacted is designed to increase the amount of renewable power supply in the region's mix of generation resources or, alternatively, reduce the amount of fossil fired generation as a percentage of the total resource output. The following are examples of actions in New England.

- In 1998, the Maine legislature enacted P.L. 1997, Chapter 31, “*An Act to Restructure the State's Electric Industry*”. This Act requires that: as a condition of licensing pursuant to Section 3203, each competitive [retail] electricity provider in this State must demonstrate in a manner satisfactory to the Commission that no less than 30 percent of its portfolio of supply sources for retail electricity sales in this State is accounted for by renewable resources. 35-A M.R.S.A §3210(3).
- In Connecticut the General Assembly stated (*Act Concerning Electric Restructuring, Public Act 98-28*) that as a licensing condition effective in 2000, an electric supplier must demonstrate that: not less than one-half of one percent of its total electricity output shall be generated from Class I renewable energy sources and an additional 5.5 percent of the total output shall be from Class I or Class II renewable energy sources. These minimum requirements increased annually until 2009, at which time the minimum percentage for “Class I” renewable sources became 6 percent and the minimum total percentage for Class I and Class II renewables became seven percent. Class II renewables include hydroelectric facilities with a current or pending license.

As these statutes and rules are implemented or adopted in New England, “clean” hydroelectric generation becomes an even more important and valuable part of the fuel mix for electric suppliers in the region.

2.2.2 Increase in Costs if the Licensee is not Granted a License

If Black Bear is not granted a license, this Project would cease to provide affordable and clean electricity to the New England Power Pool from its generation. An unquantified increase in costs would likely occur to the New England electric consumer if a license for continued operation of the Project was not granted. In addition, providing regulated, relatively stable downstream flows for downstream flood control benefits and flow augmentation during dry periods would not occur.

2.2.3 Effects of Alternative Sources of Power

Effects on Licensee's Customers

This section is not applicable to Black Bear, since Black Bear is a wholesale supplier.

Effect on Licensee's Operating and Load Characteristics

Black Bear is an independent power producer and, as such, does not maintain a separate transmission system which could be affected by replacement or alternative power sources.

Effect on Communities Served by the Project

Because Black Bear provides wholesale electricity to the regional system, the Project does not serve specific communities. It provides low cost, reliable capacity and energy for the regional electric customers. If ISO New England must replace the power benefits generated at the Project, the cost would be significantly more than the projected cost of operating the Project under the new license.

Because Black Bear cannot predict with any certainty the actual type or location of a potential alternative facility providing replacement power, it cannot specifically discuss potential effects on any particular community.

2.3 Need, Reasonable Cost, and Availability of Alternative Sources of Power

Black Bear is an independent power producer and, as such, does not have an obligation or need to prepare load and capability forecasts in reference to any particular group or class of customers. For the region, those obligations and tasks remain within the scope of services provided by ISO New England and NEPOOL.

2.4 Effect of Power on Licensee's Industrial Facility

This section is not applicable to Black Bear, which does not own industrial facilities.

2.5 Need of Indian Tribe Licensee for Electricity Generated by the Project

This section is not applicable to the Ellsworth Project.

2.6 Impacts on the Operations and Planning of Licensee's Transmission System

Because Black Bear is an independent power producer and does not own the local transmission system, this section is not applicable to Black Bear. Power generated by the Project is transmitted to the local utility transmission/distribution system.

2.7 Statement of Need for Modifications

Black Bear is not proposing any fundamental capacity changes to the Project facilities or operation. Black Bear conducted a standard redevelopment study of the Project in accordance with 18 CFR §5.18 (c)(1)(A)(1) to assess the feasibility of increasing power production including additional generation capacity, efficiency upgrades and increasing the impoundment level by up to one foot. The Project Redevelopment Study was conducted to evaluate potential generation and operations modifications, so that any feasible alternatives to increase or improve project generation, as well as any potential effects on natural resources, could be evaluated as part of the relicensing process. One part of the study assessed the potential for up to a 1 foot increase in the Graham Lake normal full pool reservoir elevation. The second part of the study examined the potential for adding additional generation capability. In addition, the potential for installing a unit to utilize available flows at Graham Lake was evaluated. Of the options evaluated, raising the normal maximum headpond level would present structural and project land issue considerations that would likely be cost prohibitive at this time. Based on those issues, a detailed, further, in-depth evaluation is not recommended. Therefore, Black Bear has no plans to add a generation unit at Graham Lake Dam at this time.

A review of system head losses and unit efficiencies at the Ellsworth Dam were investigated. In comparing calculated potential station capacity to actual historical generation, there may be some opportunity to increase Project generating capacity through efficiency upgrades (e.g., upgrade generators that limit turbine output). However, there is a factor of diminishing returns to consider given the potential equipment cost to achieve higher generation levels.

2.8 Consistency with Comprehensive Plans

Relicensing and continued operation of the Project will continue to be compatible with the comprehensive development and utilization of the waterway, and conform to the various comprehensive natural resource plans developed by resource management agencies, and approved by FERC, as discussed below.

Section 10(a)(2) of the Federal Power Act (FPA) requires the Federal Energy Regulatory Commission (FERC or Commission) to consider the extent to which a project is consistent with federal and state comprehensive plans for improving, developing, and conserving waterways affected by the project. In accordance with Section 10(a) (1) of the FPA, the list of Commission approved federal and state comprehensive plans was reviewed to determine applicability to the Ellsworth Project. The federal resource agencies, as well as the State of Maine, have prepared a number of comprehensive plans, which provide a general assessment of a variety of environmental conditions in Maine. In addition, the State of Maine's plans include policies related to ensuring that the State's energy needs are met and supporting hydropower, a renewable and indigenous source, as a valuable portion of the energy mix. These plans also address water

quality, water pollution control, wetlands, recreation, and land management issues. The Ellsworth Project's consistency with pertinent state and federal comprehensive plans is discussed below.

2.8.1 FERC-Approved State of Maine Comprehensive Plans

In 1987, the State of Maine submitted to FERC a three-volume Comprehensive Rivers Management Plan. Volumes 1 and 2 of the plan were approved by FERC in October 1982. Volume 3 of the plan was included in the updated submittal in 1987 and contained hydro-related core laws, executive orders, and other plans. Subsequently, the State of Maine produced Volumes 4 and 5 of the Comprehensive Rivers Management Plan in 1992 and 1993, respectively (see separate discussion below). These volumes have also been approved by FERC.

State of Maine Comprehensive Rivers Management Plan, May 1987 – Volume 1

Volume 1 contains the Comprehensive Hydropower Plan issued by the Maine Office of Energy Resources (MOER) in October 1982¹. The Comprehensive Hydropower Plan consists of three parts: Maine Rivers Policy, The Projected Contribution of Hydroelectric Generation to Meeting Maine's Electricity Needs in 1990 and 2000, and the Statewide Fisheries Plan, Summary.

“Maine Rivers Policy,” Executive Order No. 1, FY 82/83

On July 6, 1982, Governor Joseph E. Brennan issued the above-captioned Executive Order designating certain river stretches as meriting special protection. The Governor ordered that no new dams shall be constructed on these stretches and that additional development or redevelopment of existing dams on these stretches be designed and executed in a manner that either enhances significant resources values or does not diminish them. This policy was adopted legislatively as part of the Maine Rivers Act.

The section of the Union River on which the Project is located is not one of the listed river segments meriting special protection. Therefore, the order is not applicable to the Project.

¹ The Office of Energy Resources has since been disbanded. The State Planning Office was responsible for oversight and development of Maine's comprehensive plans until it was disbanded in July 2012, although the Department of Agriculture, Conservation, and Forestry does provide municipal level assistance in municipal level comprehensive planning.

The Projected Contribution of Hydroelectric Generation to Meeting Maine’s Electricity Needs in 1990 and 2000 (Maine Office of Energy Resources, October 1982)

Executive Order No. 1, FY82/83 directed MOER to prepare an estimate of the contribution that hydropower could make to meet the State’s electricity needs in the years 1990 and 2000. The report was prepared in 1982; therefore, much of the information in the MOER report is outdated. However, the report does stress that Maine’s energy policy “call for increased reliance on indigenous and renewable resources, such as hydro, in preference to imported and nonrenewable resources, such as oil.”

The Project currently conforms with this portion of the Plan in that it contributes hydroelectric generation (an indigenous and renewable resource) in meeting Maine’s electricity needs. The new license for the Project is projected to be issued in 2017 and the Project will continue to conform with this portion of the Plan.

Statewide Fisheries Plan, Summary (Maine Department of Inland Fisheries and Wildlife, June 1982)

The Statewide Fisheries Plan evaluates, by river basin, whether new or improved fish passage facilities may be needed at hydro development sites. It also specifies the fishery agencies’ management goals, as they existed in 1982. This Plan represents the policies of the three author agencies (Maine Department of Inland Fisheries and Wildlife [MDIFW], Department of Marine Resources [DMR], and Atlantic Sea-Run Salmon Commission – now under the auspices of the Division of Sea-run Fisheries and Habitat within the Maine DMR) regarding conservation, management, and enhancement of river fishery resources in Maine. The Plan also identifies and evaluates significant river fisheries based upon several criteria. The Plan states that at the Ellsworth Project, “No fish passage is required at this time”. Subsequent to adoption of the plan, fish passage measures have been provided at the Project.

State of Maine Comprehensive Rivers Management Plan, May 1987 – Volume 2

Volume 2 of the State of Maine Comprehensive Rivers Management Plan consists of the 1982 Maine Rivers Study. The Maine Rivers Study defines a list of unique and natural recreation rivers and classifies the rivers as A, B, C, or D. This study, prepared by the Maine Department of Conservation and National Park Service, identifies the main stem of the Union River from its outlet in Union Bay to Graham Lake, as Class C waters.

The reach of the Union River in the Project vicinity is identified as containing the following unique or significant resource values: Critical Ecologic, Undeveloped, and Anadromous Fishery.

Black Bear’s proposals to continue operation of the Project essentially as it is operated now will help maintain or enhance the anadromous fishery in Graham Lake. The continued operation of the Project is consistent with the Plan.

State of Maine Comprehensive Rivers Management Plan, May 1987 – Volume 3

Volume 3 of the State of Maine Comprehensive Rivers Management Plan contains two parts. Part I is a compilation of laws which affect the construction, operation, maintenance, and licensing of hydro projects in Maine. Part II is a compilation of Executive Department Orders and other plans. (Note: A discussion of revised laws and Executive Department Orders implemented after the submittal of Volume 3 to the FERC in 1987 is contained in Volume 4 of the State of Maine Comprehensive Rivers Management Plan submitted to FERC in 1992, see discussion below.)

Volume 3, Part I – Core Laws

The applicability of these Core Laws to the Ellsworth Project are discussed below.

Maine Rivers Act

In the Maine Rivers Act 12 M.R.S.A. §401 et. seq., the Legislature expressly found:

.....the state’s rivers comprise one of its most important natural resources, historically vital to the state’s commerce and industry; that the value of the state’s rivers and streams has increased due to the growth in demand for hydropower; that the rivers and streams afford Maine people with major opportunities for economic expansion through the development of hydropower; and that “the best interests of the state’s people are served by a policy which recognizes the importance that their rivers and streams have for meeting portions of several public needs, provides guidance for striking a balance among the various uses which affords the public the maximum benefit and seeks harmony rather than conflict among these uses.” 38 M.R.S.A. §402(6).

Black Bear has consulted with and actively worked to resolve issues as they were raised by appropriate federal and state agencies, tribes, local governments, and non-governmental organizations (NGOs) during the relicensing process. This process has identified the importance of continued operation of the Project while identifying the relative importance of the river and its resources for various uses in providing public benefits. Where Black Bear has worked with the various interests to develop a proposal that balances the applicable needs, the Project conforms with these Core Laws.

Maine Waterway Development and Conservation Act (MWDCA) 38 M.R.S.A. §630 et. seq.

The MWDCA replaced several earlier laws and requires the developer to obtain one permit from the Maine Department of Environmental Protection (MDEP) or the Land Use Planning Commission (LUPC). The legislature emphasized the importance of hydropower to the State of Maine when it enacted the MWDCA.

The legislature finds and declares that the surface waters of the State constitute a valuable indigenous and renewable energy resource; and that hydropower development utilizing these waters is unique in its benefits and impacts to the natural environment, and makes a significant contribution to the general welfare of the citizens of the State for the following reasons:

- Hydropower is the State's only economically feasible, large-scale energy resource which does not rely on combustion of a fuel, thereby avoiding air pollution, solid waste disposal problems and hazards to human health from emissions, wastes and by-products. Hydropower can be developed at many sites with minimal environmental impacts, especially at sites with existing dams or where current type turbines can be used.
- Like all energy generating facilities, hydropower projects can have adverse effects; in contrast with other energy sources, they may also have positive environmental effects. For example, hydropower dams can control floods and augment downstream flow to improve fish and wildlife habitats, water quality and recreation opportunities.
- Hydropower is presently the State's most significant indigenous resource that can be used to free our citizens from their extreme dependence on foreign oil for peaking power.

Black Bear is proposing to continue to operate the Project to provide a source of renewable energy available to the people of Maine. Therefore, the continued operation of the Project is consistent with the policies expressed by the Maine legislature. By continuing to operate the Project as proposed, the energy-related benefits noted above will continue, as will the benefits to fish and wildlife habitat, water quality and recreation opportunities.

Black Bear is proposing the construction of recreational and environmental enhancements at the Project over the term of the new license; i.e. improve the boat launch, relocate the canoe portage, improve the fisherman access trail, and provide an upstream eel passage facility. Licensee will obtain MWDCA permits if necessary for the construction of these facilities.

An Act Concerning Fishways in Dams and Other Artificial Obstructions in Inland Waterways – 12 M.R.S.A. §7701-A

This act was enacted with the intent of conserving, developing, or restoring anadromous or migratory fish resources by requiring the construction or repair of fishways. The decision to require a fishway at a dam must, under the Act, be based on the restoration of one or more fish species of anadromous or migratory fish to the area upstream of the obstruction. In addition, the decision to require a fishway may be justified by the protection or enhancement of any rare, threatened, or endangered fish species.

The Project area contains both riverine and impoundment fisheries habitats. Fish passage facilities are in place in the tailwater area below the Ellsworth Dam. The facilities include a fishway with an integral trapping facility that captures river herring and Atlantic salmon. The fish are transported to the appropriate stocking areas upstream. Downstream passage at Graham Lake Dam consists of a surface weir. The Ellsworth Dam has a surface weir/collection box system with a flume. Black Bear proposes to continue the operation of fish passage facilities and fish trucking activities. Therefore, the Project conforms to this Act.

An Act Concerning Fishways in Dams and Other Artificial Obstructions in Coastal Waters – 12 M.R.S.A. §6121

This act states that the Commissioner of Inland Fisheries and Wildlife shall annually examine all dams and other artificial obstructions to fish passage within the coastal waters in order to determine whether fishways are necessary, sufficient or suitable for the passage of anadromous fish.

The Project area contains both riverine and impoundment fisheries habitats. Fish passage facilities are in place in the tailwater area below the Ellsworth Dam. The facilities include a fishway with an integral trapping facility that captures river herring and Atlantic salmon. They are transported to the appropriate stocking areas upstream. Downstream passage at Graham Lake Dam consists of a surface weir. The Ellsworth Dam has a surface weir/collection box system with a flume. Black Bear proposes to continue the operation of fish passage facilities and fish trucking activities. Therefore, the Project conforms to this Act.

The facility provides for upstream fish passage and is also used for the commercial harvest of river herring by the City of Ellsworth under a cooperative management agreement with the Maine Department of Marine Resources.

The Maine Dam Inspection, Registration, and Abandonment Act – 38 M.R.S.A. §815 et. seq.²

This law allows MDEP to establish water level regimes and minimum flow requirements for impoundments not within the jurisdiction of FERC.

This statute is not applicable to the Project since it is a FERC-licensed Project and is not subject to Maine DEP jurisdiction regarding establishment of water levels.

An Act to Amend the Classification System for Maine Waters and Change the Classification of Certain Waters – 38 M.R.S.A. §464 et. seq.

This Act was enacted to restore and maintain the chemical, physical, and biological integrity of the State's waters and to preserve certain pristine state waters. Water quality standards for fresh surface waters established by the Act that are pertinent to the Ellsworth Project consist of Class B, and Class GPA waters. The operation of the Project and its consistency with these standards is discussed in Exhibit E, Section 4.4.2.

Alteration of Rivers, Streams and Brooks – 38 M.R.S.A. §425 et. seq.

This article prohibited the alteration of a river, stream, or brook or areas adjacent to rivers, streams, or brooks due to dredging, filling, or construction such that any dredged spoil, fill or structure may fall or be washed into these waters without first obtaining a permit from the Commissioner. This act was replaced with the Natural Resources Protection Act (NRPA), 38 M.R.S.A. §480-A et. seq. which regulates similar activities along the State's waters. However, projects that are reviewed under the MWDCa are not subject to review under the Natural Resources Protection Act (NRPA).

The Licensee is not proposing any construction or redevelopment of the Project that would require an NRPA permit. If any construction is proposed in the future, the appropriate permits will be obtained.

Mandatory Shoreland Zoning and Subdivision Control – 38 M.R.S.A. §435 et. seq.

This article requires that lands within 250 feet of the normal high water mark of certain waters or wetlands be subjected to municipal zoning and subdivision control.

² Legislative actions in recent years have changed the scope of this act.

The City of Ellsworth, Town of Mariaville, Town of Waltham, and the Maine Land Use Planning Commission (which covers Fletchers Landing Township) currently have zoning requirements for those lands located within 250 feet of the normal high water mark of the Project impoundments. The Licensee is proposing the construction of several recreational and environmental enhancements at the Project over the term of the new license; Black Bear will obtain any required shoreland zoning permits prior to construction of any of the new facilities.

Land Subdivision – 30-A M.R.S.A. §4401-4407

This article grants special protection from land subdivisions to particular river reaches identified in the article. This article does not include any Project area lands. Black Bear is not proposing any construction that would be considered a subdivision. The Project conforms with this article.

Land Use Regulations – 12 M.R.S.A. §681 et. seq

This article requires the sound planning, zoning, and subdivision control of the unorganized and organized townships of the State.

The City of Ellsworth, Town of Mariaville, and Town of Waltham are located in an organized portion of the state that is subject to the jurisdiction of the Maine Department of Environmental Protection and local municipalities. Fletchers Landing Township is subject to LUPC regulations for the lands abutting the Project boundary include the Great Pond Protection Subdistrict. The purpose of this subdistrict is to regulate residential and recreational development on Great Ponds to protect water quality, recreation potential, fishery habitat, and scenic character. This subdistrict applies to areas within 250 feet of the normal high water mark of those bodies of standing water 10 acres or greater in size. Allowed uses without a permit include temporary docks, forest management activities, except for timber harvesting, primitive recreational uses and wildlife and fishery management practices (LURC, 2011). The Project conforms to this article for Fletchers Landing Township.

Special River Protection Zoning Map. Legend List (Maine Land Use Regulation Commission, 1987)

This map identifies river segments that have been designated by the Land Use Regulatory Commission³ for “Special River Protection Zoning.”

³ The Land Use Regulatory Commission (LURC) is now the Land Use Planning Commission (LUPC).

The Project is mainly located in an organized portion of the state that is subject to the jurisdiction of the Maine Department of Environmental Protection and local municipalities. A small portion of the Project is located in Fletchers Landing Township, which is subject to LUPC regulations, this section of the Union River is not identified in the Special River Protection Zoning map.

Maine Rivers Access and Easement Plan (Joseph Handy, 1985)

Black Bear has consulted with stakeholders on access and other recreation issues in the Project area, and proposed recreation enhancements as detailed in Exhibit E, Section 4.4.7. The Project is in conformance with the strategies outlined in this Plan.

Designating the State Agencies Responsible for Water Quality Certification, Executive Order No. 5, FY85/86 Note: Updated Order No. 3, 96/97

This executive order identifies the state agencies responsible for reviewing and authorizing water quality certifications for hydropower projects. Maine DEP has jurisdiction for water quality certification for the licensing of the Ellsworth Project.

Black Bear will apply for water quality certification from Maine DEP in accordance with FERC's regulations. Project water quality and its consistency with these standards are discussed in Exhibit E, Section 4.4.2.

State of Maine Comprehensive River Management Plan – December 1992 – Volume 4

Volume 4 of the State of Maine Comprehensive River Management Plan consists of three sections. Part I is a summary of the revised Core Hydro Laws subsequent to those contained in Volume 3 which were approved in 1987. Part II is a compilation of Executive Orders and other plans including Maine resource agency policy regarding hydropower. Part III contains reports and studies regarding hydropower and relicensing.

Volume 4, Part I – Revised Core Hydro Laws

The revisions to the Core Hydro Laws contained in Volume 4 of the Plan are not all pertinent to the Ellsworth Project. The revised Core Hydro Laws that are pertinent to the Project are discussed below.

Special Protection for Outstanding Rivers

This law identifies river segments that are protected from further hydroelectric development in the State of Maine.

The Project is not located on an Outstanding River segment, and is therefore compliant with this law.

Hydropower Relicensing Standards

These standards require that existing hydropower impoundments be managed to protect habitat and aquatic life criteria commensurate with the appropriate water quality classifications. The Ellsworth area is subject to Class GPA water quality standards. Maine statute 38 M.R.S.A. subsection 464(9) clarifies that hydropower projects with impoundments must satisfy the aquatic life criteria contained in 38 M.R.S.A. subsection 464(4)(a) (i.e., Class C), which states that the receiving waters shall be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community. The operation of the Project and its consistency with these standards is discussed in Exhibit E, Section 4.4.2.

Volume 4, Part II – Compilation of Executive Orders and Other Plans

Part II of Volume 4, Implementing Plans and Orders, contains State resource agency plans and policies regarding hydropower. The following plans and orders are discussed:

State of Maine Statewide River Fisheries Management Plan, June 1982

This plan is discussed previously under State of Maine Comprehensive Rivers Management Plan, May 1987 – Volume 1.

Addendum to the State of Maine Statewide Fisheries Management Plan, June 1982

This addendum includes a number of particular projects in the plan's target for anadromous fish restoration. The addendum includes the Union River, which it lists as having the potential for two million alewives.

Maine Comprehensive Hydropower Plan, July 1992

This plan assessed the then current and future demand for hydropower in the State of Maine. Hydropower is recognized as a significant resource available for use in meeting current and future energy needs. The plan also considers the potential for storage facilities to be developed as generating hydro facilities. Operation of the Ellsworth Project is consistent with this plan as it will continue to produce reliable, efficient indigenous energy from hydropower to meet the State of Maine energy needs.

Maine State Agency Hydropower Policy Statements

These policy statements provide the basis for agency comments on hydro-project license applications. These statements are not directly applicable to the Ellsworth Project as they set out the policy for State agencies to follow in commenting on hydro projects in general. Agency comments on the Project are addressed in the appropriate sections of Exhibit E.

Executive Order Designating the State Agencies Responsible for Water Quality Certification

This order identifies Maine DEP as the agency responsible for reviewing and providing water quality certification. Black Bear will apply for water quality certification from Maine DEP in accordance with FERC regulations. Project water quality and its consistency with these standards is discussed in Exhibit E, Section 4.4.2.

Feasibility Study of Maine’s Small Hydropower Potential

This study was performed for the Maine Office of Energy Resources and examined the potential for development/expansion of hydropower development of Maine’s low head dams.

This plan is not applicable to the Ellsworth Project.

Maine Hydropower Licensing and Relicensing Status Report 1989-91

These reports update hydropower licensing and relicensing activities in the State of Maine for 1989 through 1991. The Project relicensing began after this report was written and is not included in this summary of licensing activities.

Volume 4, Part III – Hydropower and Relicensing Reports and Studies

This section of Volume 4 of the State of Maine Comprehensive River Management Plan describes the current regulations for hydropower relicensing and reports the status of Maine projects with regard to the federal relicensing process.

The studies and reports contained in Part III of the State of Maine Comprehensive River Management Plan are not pertinent to the Ellsworth Project.

State of Maine Statewide River Fisheries Management Plan – June 1982 Maine Department of Inland Fisheries and Wildlife, Maine Department of Marine Resources, and Atlantic Sea-Run Salmon Commission

This plan is discussed previously under State of Maine Comprehensive Rivers Management Plan, May 1987 – Volume 1.

Management of Atlantic Salmon in the State of Maine: A Strategic Plan – July 1984, Maine Atlantic Sea-Run Salmon Commission

This plan lists as its objectives the maintenance of Atlantic salmon populations in rivers where they currently exist, and the restoration of Atlantic salmon populations in historical salmon rivers. The plan also identifies specific strategies to achieve the stated objectives, including fishway installation or improvement, increased hatchery capacity, and diversion of hatchery stocks once natural reproduction increases in stocked rivers.

The Ellsworth Project is not targeted by these restoration plans.

Maine State Comprehensive Outdoor Recreation Plan (SCORP) 2003-2008, Maine Department of Conservation, Bureau of Parks and Lands

This plan serves as the State’s official policy document for statewide outdoor recreation planning and for acquisition and development of public outdoor recreation areas and facilities. The plan identifies outdoor recreation issues of Statewide importance based upon, but not limited to, input from the public participation program and also provides information about the demand for and supply of outdoor recreation resources and facilities in the state. The SCORP satisfies the requirements of the Land and Water Conservation Fund (LWCF) Act (P.I. 88-578) which dictates that each state have an approved SCORP available on file with the National Park Service in order to participate in the LWCF program. The SCORP contains an implementation program that identifies the State’s strategies, priorities, and actions for the obligation of its LWCF apportionment. The SCORP also includes a wetlands priority component with Section 303 of the Emergency Wetlands Resources Act of 1986. This wetland component provides information on state wetland conservation planning efforts as reflected in the Maine State Wetlands Conservation Plan published in 2001.

The SCORP does not contain any recommendations or assessments that are specific to the Ellsworth Project area. Black Bear has consulted with stakeholders on access and other recreation issues in the Project area throughout the relicensing process. Black Bear is in compliance with the strategies outlined in this plan.

2.8.2 FERC-Approved Federal Comprehensive Plans

Atlantic Salmon Restoration in New England, Final Environmental Impact Statement 1989-2021. U.S. Fish and Wildlife Service, 1989

This document discusses the stated aim of the USFWS relative to Atlantic salmon (i.e., the restoration of self-sustaining populations of Atlantic salmon by the year 2021 to 11 rivers in Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island. The Union River is not included.).

The Union River Fisheries Coordinating Committee (URFCC), consisting of state and federal natural resource agencies and non-governmental conservation organizations; as well as the City of Ellsworth; Black Bear Hydro Partners, LLC; and interested members of the public, developed a Comprehensive Fishery Management Plan (CFMP) for the Union River. The management plan consists of multi-year assessment cycles, beginning with 2000-2005. The most recent CFMP covers the period 2015-2017. With respect to Atlantic salmon, only three suspected aquaculture strays (2012) and two wild salmon (one in 2013 and one in 2014), and 1 hatchery (2014) have returned to the Ellsworth Project in the past nine years.

The state and federal natural resource agencies are signatories to the Comprehensive Fishery Management Plan, which is consistent with the objectives described in this document.

Fisheries USA: The Recreational Fisheries Policy of the U.S. Fish and Wildlife Service

This policy, under the auspices of the 1988 National Recreational Fisheries Policy (National Policy), encompasses the guiding principles, goals, and objectives set forth by the National Policy. The Policy, in short, defines the USFWS's stewardship role in management of the Nation's recreational fishery resources, which include not only angling, but fish watching and photographing. With the Fisheries USA, USFWS committed to accomplish three goals:

- Usability – to optimize the opportunities for people to enjoy the Nation's recreational fisheries.
- Sustainability – to ensure the future of quality and quantity of the Nation's recreational fisheries; and
- Action – to work in partnership with other Federal governmental agencies, states, tribes, conservation organizations, and the public to effectively manage the Nation's recreational fisheries.

Black Bear has consulted with USFWS and other applicable resource agencies and organizations on the topics of protection of fish resources and provisions of recreational fishing opportunities within the Project study area. Sections 4.4.3 and 4.4.7 of Exhibit E describe the existing fish resource and recreational opportunities the Project provides. The Project is in conformance with this policy.

Nationwide Rivers Inventory. National Park Service, January 1982, updated 1995

The Nationwide Rivers Inventory (NRI), completed in 1981 for the New England Region, is a survey of the nation's rivers conducted to identify segments meeting the minimum criteria for further study and/or potential inclusion into the National Wild and Scenic Rivers System (NWSRS). Once included on the NRI, a river is protected to the extent that pursuant to Section f(d) of the Wild and Scenic Rivers Act, and in accordance with a Presidential Directive and guidance in the form of "Procedures for Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory," issued by the Council on Environmental Quality:

"Each federal agency shall, as part of its normal planning and environmental review process, take care to avoid or mitigate adverse effects on Rivers identified in the Nationwide Inventory." [Presidential Directive, August 2, 1979.]

This directive gives guidance to federal agencies on protecting the resources that cause the river to qualify for listing on the NRI.

According to the NRI, the West Branch of the Union River from the Route 181 bridge to Great Pond is listed for Fish. This segment of the river is a historic Atlantic Salmon Fishery (NPS, 2012). The Project boundary includes a small portion of this river segment. Black Bear has maintained the National Park Service on all distributions throughout the relicensing process and is not proposing any changes to the operation of the Project. The Project is in conformance with this directive.

North American Waterfowl Management Plan – 1986 U.S. Fish and Wildlife Service and Canadian Wildlife Service

This plan identifies waterfowl population goals and outlines the requirements of a waterfowl management and conservation program that would attain these goals. The plan addresses 37 species of the family *Anatidae*, (i.e., ducks, geese and swans) which occur in both the United States and Canada. The plan also discusses groups of similar species in terms of their ecological niche, distribution, abundance, breeding, population status and outlook, and causes of population declines or increases. The plan outlines a variety of initiatives and recommendations which will protect and enhance waterfowl resources, including: financial incentives for landowners for habitat maintenance; outright purchase of significant habitat; protective zoning; private land conservation promotion; financial participation of private conservation organizations; prioritization of public land management to enhance waterfowl resources; public works planning which considers and mitigates waterfowl resource impacts; and encouragement of joint ventures between private and public groups to enhance and preserve waterfowl habitat. Specific recommendations identify areas to be preserved, bag limits, and other hunting limitations for certain species and survey activities.

The majority of initiatives and recommendations contained in this plan are beyond the scope of Black Bear's operation of the Ellsworth Project. The most pertinent initiative of this Plan involves habitat protection and maintenance. The Project provides habitat for a number of the species discussed in this plan. The Project is located within the North Atlantic Flyway, and Project waters thus attract a variety of transient and migrating waterfowl species such as Canada goose, black duck, common merganser, and mallard duck. Continued operation of the Ellsworth Project, as proposed, will have no new effects to Project wildlife or their habitats, but will continue to provide waterfowl habitat for both nesting and migratory species. The Project is in conformance with the plan.

Final Amendment #11 to the Northeast Multi-species Fishery Management Plan; Amendment #1 to the Atlantic Salmon FMP; and Components of the Proposed Atlantic Herring FMP for Essential Fish Habitat. Volume 1. (USFWS, 1998)

In 1996 the U.S. Congress recognized the increasing pressure on marine resources in the country and addressed these problems in its reauthorization of the Magnuson Fishery Conservation and

Management Act, now known as the Magnuson-Stevens Act. This Act required the eight Regional Fishery Management Councils, in collaboration with National Oceanic and Atmospheric Administration (NOAA) Fisheries, to give heightened consideration to Essential Fish Habitat (EFH) in resource management decisions. Congress defined EFH as “those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity.” The designation and conservation of EFH seeks to minimize adverse effects on habitat caused by fishing and non-fishing activities.

The EFH designation for Atlantic represents all waters currently or historically accessible to Atlantic salmon within the streams, rivers, lakes, ponds, wetlands, and other water bodies in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut. Other species of fish incorporated under the NMFS amendments are not applicable to the Project.

Before a Federal agency proceeds with an activity that may adversely affect a designated EFH (e.g., relicensing of a hydro project), the agency must: 1) consult with NOAA Fisheries and, if requested, the appropriate Council for the recommended measures to conserve EFH and 2) reply within thirty days of receiving EFH recommendations. The agency response must include proposed measures to avoid or minimize adverse impacts on the habitat, or alternatively an explanation if the agency cannot adhere to the recommendation from NOAA Fisheries.

FERC will initiate consultation with NMFS regarding EFH for Atlantic salmon in the Project area following receipt of this application.

As mentioned previously, the CFMP addresses the need for fish passage facilities at the Project in a comprehensive fashion. The state and federal natural resource agencies are signatories to the CFMP, which is consistent with the objectives described in this document.

Final Recovery Plan for the Shortnose Sturgeon – 1998 National Marine Fisheries Service.

Congress passed the Endangered Species Act of 1973 (16 USC 1531 et seq., amended 1978, 1982, 1986, 1988) (ESA) to protect species of plants and animals endangered or threatened with extinction. NMFS and USFWS share responsibility for the administration of the Endangered Species Act. NMFS is responsible for most marine and anadromous species including the shortnose sturgeon. Section 4(f) of the ESA directs the responsible federal agency to develop and implement a recovery plan, unless such a plan would not promote the conservation of a species. NMFS determined that a recovery plan would promote conservation and recovery of shortnose sturgeon.

The NMFS recovery plan for shortnose sturgeon primarily addresses recovery of extant (i.e., existing) shortnose population segments. The plan does not specify the Union River in the

NMFS implementation schedule for recovery. Therefore, the plan is not applicable to the Project.

Fishery Management Report No. 24 of the Atlantic States Marine Fisheries Commission: Interstate Fisheries Management for Atlantic striped bass – 1995 National Marine Fisheries Service.

The Atlantic States Marine Fisheries Commission prepared a Fishery Management Plan for the striped bass fishery in order to protect and restore this popular recreational and commercial species. The goal of this amendment is to: perpetuate, through cooperative interstate fishery management, migratory stocks of Atlantic striped bass so as to allow a commercial and recreational harvest consistent with the long-term maintenance of self-sustaining spawning stocks and to provide for the restoration and maintenance of their critical habitat. .

The document describes the goals and objectives for the species, its current status, the ecological challenges affecting the species, and management options and actions needed to reach and maintain management goals.

Striped bass use the Union River estuary for feeding during the spring, summer and fall and are attracted into the river by the presence of migrating river herring, American shad and eels. They are not known to spawn in the Union River, but originate from other coastal migratory populations at major spawning rivers outside of the Gulf of Maine, including the Hudson and Delaware Rivers, and the tributaries to Chesapeake Bay. Striped bass are a popular sportfish in the Union River and are currently protected through the use of regulated minimum sizes, creel limits and seasonal angling restrictions (URFCC, 2014).

As mentioned previously, the CFMP addresses the need for fish passage facilities at the Project in a comprehensive fashion. The state and federal natural resource agencies are signatories to the CFMP, which is consistent with the objectives described in this document.

Fishery Management Report No. 31 of the Atlantic States Marine Fisheries Commission. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Sturgeon – 1998 National Marine Fisheries Service.

The Atlantic States Marine Fisheries Commission is a compact of fifteen Atlantic Coast states (including Maine) created to promote better utilization of the fisheries (marine, shell, and anadromous) along the Atlantic seaboard. The goal of the Amendment is to restore Atlantic sturgeon spawning stocks to population levels which will provide for sustainable fisheries and ensure viable spawning populations. The Amendment describes the life history of the species, including spawning locations where known, hatching requirements for eggs, and juvenile nursery area requirements and migrations. The document details a management plan intended to return the stocks to sustainable levels.

According to Amendment 1 of the NMFS Fisheries Management Plan for Atlantic sturgeon, only the estuarine complex of the Kennebec, Androscoggin, and Sheepscot Rivers in Maine currently support a spawning population of Atlantic sturgeon in New England. Amendment 1 requires each state to implement identification and protection of Atlantic sturgeon habitat within its jurisdiction in order to ensure the sustainability of that portion of the spawning stock. States must notify NMFS in writing of the locations of habitats used by Atlantic sturgeon. The State of Maine did not identify the Union River as having Atlantic sturgeon habitat. Therefore, the plan and its amendment are not applicable to the Project.

Fishery Management Report No. 35 of the Atlantic States Marine Fisheries Commission: Shad and River Herring – Amendment 1 to the Interstate Fishery Management Plan for Shad and River Herring – 1999 National Marine Fisheries Service; Technical Addendum 1 to Amendment 1 of the Interstate Fisheries Management Plan for Shad and River Herring – 2000 NMFS.

The Atlantic States Marine Fisheries Commission prepared a Fishery Management Plan for the shad and river herring fishery in order to protect and restore the species. The goal of this amendment is to: protect, enhance, and restore East Coast migratory spawning stocks of American shad, hickory shad, and river herrings in order to achieve stock restoration and maintain sustainable levels of spawning stock biomass.

The document describes the goals and objectives for the species, its current status, the ecological challenges affecting the species, and management options and actions needed to reach and maintain management goals.

A trap and truck operation is run by Black Bear for the purposes of stocking river herring and Atlantic salmon. This operation was implemented in 1974; since 2000, the number of adults stocked upstream has exceeded 100,000 fish and returns have ranged from 9,260 to 1,219,927 fish. Despite annual stocking of hatchery-reared smolts from 1971-1990, sporadic stocking of salmon fry and parr from 1971-2011, and a one-time release of surplus broodstock in 2012, only three suspected aquaculture strays (2012), two wild (one in 2013 and one in 2014), and 1 hatchery (2014) Atlantic salmon have returned to the Ellsworth Project in the past nine years. The CFMP is consistent with the objectives described in this document and conforms with this plan.

Fishery Management Report No. 36 of the Atlantic States Marine Fisheries Commission: Interstate Fisheries Management for American Eel (*Anguilla rostrata*) – 2000 National Marine Fisheries Service.

The Atlantic States Marine Fisheries Commission prepared a Fisheries Management Plan for the American eel fishery in order to protect and restore the species. The Atlantic States Marine Fisheries Commission American Eel Fisheries Management Plan is a working document that

describes the goals and objectives for the species, its current status, the ecological challenges affecting the species, and management options and actions needed to reach and maintain management goals. The stated goals of the Fisheries Management Plan are to: (1) protect and enhance the abundance of American eel in inland and territorial waters of the Atlantic States and jurisdictions and contribute to the viability of the American eel spawning population, and (2) provide for sustainable commercial and recreational fisheries preventing the over harvest of any eel life stage.

Although the report does not identify the Union River as eel habitat, Project studies have found that American eel are present in the Union River and Project waters. Following consultation with the Maine DMR, an American Eel Upstream Passage Study was conducted. Black Bear is proposing to develop in consultation with the fisheries agencies upstream passage measures for eel at the Project. Downstream eel passage studies are scheduled at the project during the fall of 2015 and 2016.

Interstate Fishery Management Plan for Atlantic Sturgeon: Amendment 1 - 1998 Atlantic States Marine Fisheries Commission.

Amendment 1 was designed to result in stock recovery, with consequent ecological and economic benefits to coastal ecosystems and fishermen. Amendment 1 describes the life history of Atlantic sturgeon, including spawning, hatching requirements, juvenile nursery area requirements and migration, as well as stock assessment.

Interstate Fishery Management Plan for Shad and River Herring Technical Addendum 1 - 2000 Atlantic States Marine Fisheries Commission.

Technical Addendum #1 (February 2000) was adopted to correct and clarify the monitoring requirements in Amendment 1, Tables 2 and 3.

Interstate Fishery Management Plan for Shad and River Herring Amendment 2 - 2009. Atlantic States Marine Fisheries Commission.

Amendment 2 was developed based on the concern that river herring are in decline coast-wide. Amendment 2 prohibits interstate commercial and recreational fisheries beginning January 1, 2012, unless a sustainable management plan was submitted for approval by a state or jurisdiction by January 1, 2010. Amendment 2 also required fishery independent and dependent monitoring from member states to conserve, restore, and protect critical river herring habitat.

Interstate Fishery Management Plan for Shad and River Herring Amendment 3 - 2010. Atlantic States Marine Fisheries Commission.

Amendment 3 establishes a coast wide commercial and recreational moratorium, with exceptions for sustainable systems, for shad and river herring. To improve data collection of shad and river

herring, Amendment 3 implemented additional fisheries independent and dependent monitoring for some states or jurisdictions, such as, monitoring stocks, hatchery production, and commercial, recreational, and bycatch fisheries. Finally, Amendment 3 requires states and jurisdictions to submit a habitat plan regardless of whether their commercial fishery would remain open.

2.9 Financial and Personnel Resources

Black Bear has considerable experience operating not only the Ellsworth Project but several other licensed hydroelectric and water storage projects as well. Black Bear has operated the Project and multiple other hydroelectric and water storage projects since 2009. Black Bear has available a complete staff of engineers, biologists, operators, mechanics, and electricians that are trained and experienced in the operation of hydroelectric projects. In addition, Black Bear has available the administrative, licensing, and support personnel that are needed to maintain compliance with the terms of the license.

Information regarding the Project's expected annual costs and value are provided in Exhibit D of the License Application.

2.10 Notification of Affected Land Owners

Black Bear does not propose to expand the Project to encompass additional lands of others. Therefore, notification of adjacent landowners is not applicable.

2.11 Applicant's Electricity Consumption Efficiency Improvement Program

Because Black Bear is an independent power producer, this section is not applicable to the Project.

2.12 Identification of Indian Tribes Affected by the Project

There are no Indian tribes affected by the Project. The four federally-recognized Indian tribes having the potential to be interested in the relicensing are included on the distribution list for the Project.

3.0 INFORMATION TO BE PROVIDED BY AN APPLICANT WHO IS AN EXISTING LICENSEE

3.1 Measures Planned to Ensure Safe Management, Operation, and Maintenance of the Project

The Ellsworth Project is operated remotely from Brookfield Renewable Energy Group's North American System Control Center (NASCC) in Marlboro, MA⁴. An operator is available during weekdays and weekends as necessary to perform routine maintenance and operations at the Ellsworth Project. Daily logs of pond level, flow, and outages are maintained electronically for the Project.

The Project is subject to regular Part 12 Inspections by FERC. FERC's New York Regional Office conducts an environmental inspection every four to five years. Black Bear completes all necessary corrective actions to address comments and recommendations arising from FERC inspections in a timely manner.

The dam is inspected routinely by Black Bear's Engineering and Operations staff, as well as after local earthquakes of magnitude 3.0 or greater and floods in the Project vicinity. Black Bear conducts an annual field reconnaissance upstream and downstream of the Project to verify that no changes have occurred that would reasonably be expected to adversely affect public health, safety, or property in the event of a dam failure. Further, Black Bear maintains and annually verifies the accuracy of a contact list to be used in the event of a dam failure at the Project. An independent inspection by Black Bear's engineering staff is also conducted annually and routine repairs are performed as needed.

Black Bear has placed a copy of the Emergency Action Plan (EAP) at the Project and at its office in Lewiston, Maine. Local operations staff is on call 24 hours a day. Black Bear's staff reviews the EAP at least annually and there is an annual EAP training for Project personnel.

3.1.1 Existing and Planned Operation of the Project During Flood Conditions

The Ellsworth Project is operated as a peaking plant, with water being released from the Graham Lake reservoir and then used to generate electricity at the downstream Ellsworth powerhouse. During periods of high inflows, primarily in the spring and fall, the project may generate at full load up to 24 hours a day.

⁴ Licensee Black Bear Hydro Partners, LLC is member of Brookfield Renewable Energy Group.

The ability to store large volumes of inflow in the spring is also valuable given the location of downtown Ellsworth just below the Ellsworth Dam. In a potential flood situation, Black Bear dam operators work to manage water levels along the Union River in order to minimize risk and flood damage.

Black Bear is proposing to operate the Ellsworth Project essentially as it has been operated in the past with some resource enhancements. There would be no significant changes to the fundamental operation of the Project to support downstream flows or the flow regime in the Union River. As a result, the Project will continue to provide important benefits of regulated, relatively stable downstream flows.

3.1.2 Warning Devices Used to Ensure Downstream Public Safety

There are numerous safety signs at the Project and along the Union River advising the public of the Project and safety considerations. These signs are in addition to the signs attached to the upstream safety barriers (installed during the summer boating season upstream of the spillway gates and intake to protect boaters using the impoundments) and the recreational and information signs posted in the vicinity of the Project. Black Bear's Public Safety Plan for the Project was filed with the Commission on November 23, 2015. Black Bear's High Water Guidelines for the Project are appended to the Project's Emergency Action Plan, which was filed with the Commission on December 7, 2015.

3.1.3 Proposed Changes Affecting the Existing Emergency Action Plan

There are no proposed changes that would affect the existing EAP. As noted above, Black Bear conducts an annual field reconnaissance upstream and downstream of the Project to verify that no changes have occurred that would reasonably be expected to adversely affect public health, safety, or property in the event of a dam failure. Further, Black Bear maintains and annually verifies the accuracy of a contact list to be used in the event of a dam failure at the Project.

3.1.4 Existing and Planned Monitoring Devices

See Exhibit F – Supporting Design Report of this application for a complete description of existing monitoring devices at the Project.

3.1.5 Project’s Employee and Public Safety Record

Black Bear has an excellent record of operating in a work-safe environment. During the past 5 years⁵, there have been no employee deaths or recordable injuries at the Project.

There have been no project-related deaths or serious injuries to members of the public within the Project boundary during the past 5 years.

Black Bear is committed to maintaining and operating its facilities in a manner that allows the public to safely enjoy recreational activities. Upstream safety barriers are installed during the summer boating season upstream of the spillway gates and intake to protect boaters using the impoundments, and warning signs are posted at numerous locations around the Project and on the Union River.

3.2 Current Operation of the Project

A full description of the Project operation is contained in Exhibit B of this License Application.

3.3 Project History

A description of the Project history is contained in Exhibit C of this License Application.

3.4 Lost Generation Due to Unscheduled Outages

Table H -1 lists the record of unscheduled outages and related lost generation during the last five years.

⁵ Black Bear Hydro Partners, LLC became the Licensee for the Project by FERC Order Approving Transfer of License dated September 17, 2009 (128 FERC ¶ 62,212).

Table H-1: Ellsworth Project Unscheduled Outages and Lost Generation, 2010-2014

Unit	Date/Time Unavailable	Date/Time Available	Reason for Unit Unavailability	Estimated MW Hours Lost ¹
3	March 19, 2011	April 25, 2011	High vibration alarm	2
3	April 1, 2011	April 8, 2011	High vibration alarm	2
2	December 30 2011	March 19, 2011	Pilot exciter	2
4	September 3, 2013	October 4, 2013	Programmable component failure	0
4	May 14, 2014	May 19, 2014	Broken wicket gate link	0

3.5 Licensee's Record of Compliance

The Project has a good record of compliance with the terms and conditions of the existing license. The Licensee has received a single letter of violation. On January 27, 2015 the Commission notified Black Bear that, in relation to an October/November 2014 fisheries incident at the Project, it had failed to show due diligence in the operation of the downstream fish passage facilities as required by Article 406 of the license, which consequently resulted in a violation of Article 406. Licensee met with the Commission and responded to the various requests from the Commission regarding the incident, supplying information regarding the incident and measures undertaken to ensure safe and effective fish passage at the facility. By letter dated May 26, 2015, the Commission summarized its understanding of the incident and expressed its appreciation for Licensee's responses and for the measures that were being undertaken to improve fish passage. All of the measures proposed have been, or are currently being, implemented by Licensee.

3.6 Actions Affecting the Public

Operation of the Ellsworth Project provides regulated, relatively stable flow and water levels to the Union River from the Graham Lake Dam downstream through downtown Ellsworth.

Black Bear has always allowed public access to the Project impoundments and the surrounding Project lands. Recreation within the Project boundary is typically recreational fishing and boating. Other portions of the Union River offer opportunities for boating, picnicking, swimming, kayaking, and fishing. Black Bear provides public recreation access at several formal recreation sites that provide opportunities for bank fishing and motorized and non-motorized boating. A full description of these opportunities, associated recreational facilities

provided by the Black Bear, and the recreational enhancement proposed are contained in Exhibit E of this application. Black Bear is proposing to implement a Recreation Facilities Management Plan for the Project.

Black Bear's regard for public safety is demonstrated by its active program of installing warning signs and safety devices at the Project. These are described in the Public Safety Plan which was most recently filed with the Commission on November 23, 2015.

3.7 Ownership and Operating Expenses That Would Be Reduced if the License Were Transferred

Black Bear is applying for a long-term license to continue to maintain and operate the Project. Additionally, there is no competing application to take over the Project. Because there is no proposal to transfer the Project license, this section is not applicable to the Project.

3.8 Annual Fees for Use of Federal or Native American Lands

This section is not applicable to the Project since it uses no federal or Native American lands.

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**ATTACHMENT 6
ATLANTIC SALMON DRAFT
BIOLOGICAL ASSESSMENT &
SPECIES PROTECTION PLAN
SEPTEMBER 28, 2018**

September 28, 2018

VIA E-FILING

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

***Ellsworth Hydroelectric Project FERC No. 2727-086
Atlantic Salmon Draft Biological Assessment and Species Protection Plan***

Dear Secretary Bose:

Black Bear Hydro Partners, LLC (Black Bear), licensee for the Ellsworth Hydroelectric Project (Project), filed an Application for New License (Application) for the Project on December 30, 2015. The Application detailed the plan and timeline for conducting several continuing studies necessary to inform the Commission's license decision. Licensee had also planned to file a revised Draft Biological Assessment (BA) and proposed Species Protection Plan (SPP) for Atlantic salmon following review of the study results and further consultation with the agencies. Enclosed is the Licensee's Draft BA and proposed SPP for the Ellsworth Project.

The Draft BA considers the various studies and fish passage measures that have been undertaken by the Licensee since the Application was filed with FERC in 2015 (BA Section 5), and assesses the effects of those measures and the measures proposed in the SPP (BA Section 6). The proposed SPP is primarily focused on Atlantic salmon, but also considers the needs of other anadromous fish species in the Union River.

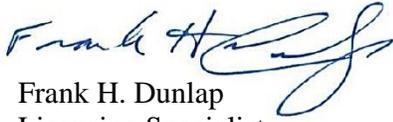
Development of the proposed SPP, and the measures included therein, was done in close consultation with the fisheries resource agencies, including both the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) through a series of meetings that were held between June 2017 and July 2018. The July 27, 2018 Draft BA and proposed SPP have been reviewed by the agencies; NMFS provided comments on the Draft BA and those comments have been addressed as appropriate in the attached.

The Licensee proposes to implement the SPP and the fish passage measures contained therein at the Ellsworth Project, and requests that the Commission consider the SPP and the SPP measures as a relicensing proposal for evaluation in the Environmental Assessment currently being prepared by Commission staff.

If you have any questions regarding this filing, please contact me by phone at (207) 755-5603 or by email at Frank.Dunlap@BrookfieldRenewable.com.

Ellsworth Project FERC No. 2727
Draft BA and Proposed SPP

Sincerely,

A handwritten signature in blue ink, appearing to read "Frank H. Dunlap". The signature is fluid and cursive, with a large, stylized flourish at the end.

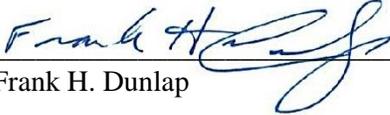
Frank H. Dunlap
Licensing Specialist
Brookfield Renewable

Encl.: Ellsworth Project Draft Biological Assessment and Proposed Species Protection Plan

cc: Distribution List
FERC: Nicolas Palso, Bill Connelly
Brookfield: S. Murphy, K. Maloney, R. Dill, K. Bernier

CERTIFICATE OF SERVICE
 Ellsworth Hydroelectric Project (FERC No. 2727)
 Atlantic Salmon Draft Biological Assessment and Species Protection Plan

I, Frank H. Dunlap, Licensing Specialist, Brookfield Renewable, hereby certify that a link to the foregoing document on the Commission website has been transmitted to the following parties on September 28, 2018.



 Frank H. Dunlap

One copy, via e-filing to:

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Ellsworth Project FERC No. 2727
Draft BA and Proposed SPP

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ELLSWORTH PROJECT

FERC NO. 2727

**DRAFT BIOLOGICAL ASSESSMENT
FOR
ATLANTIC SALMON, ATLANTIC STURGEON,
AND SHORTNOSE STURGEON**

**Black Bear Hydro Partners, LLC
Milford, Maine**



September 2018

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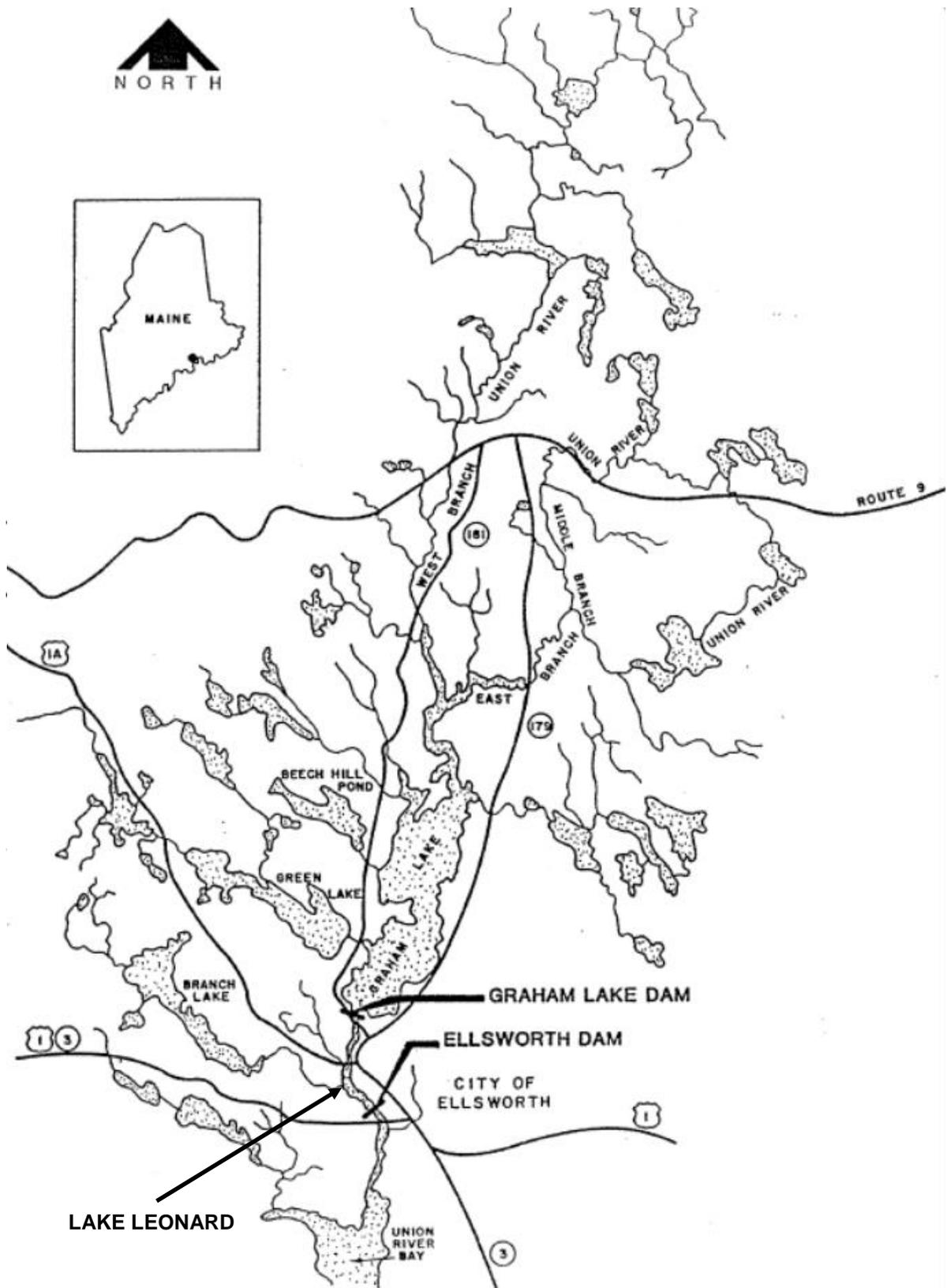
1.0 Background

Black Bear Hydro Partners, LLC (Black Bear) is in the process of relicensing the Ellsworth Project (FERC No. 2727), an 8.9 megawatt (MW) hydroelectric facility located on the Union River in the City of Ellsworth, Hancock County, Maine. Black Bear submitted an application for a new license to the Federal Energy Regulatory Commission (FERC) on December 30, 2015, and FERC is currently reviewing the application and developing an Environmental Assessment (EA). FERC's issuance of a new license for the Ellsworth Project is a federal action and, therefore, requires consultation under Section 7 of the Endangered Species Act (ESA) to assess the potential effects of the action on federally protected species and determine whether incidental take is expected to occur. A federal agency may designate a non-federal representative to conduct informal consultation or prepare a biological assessment to assess the effects of a proposed federal action on listed species. On September 14, 2011, FERC designated Black Bear as its non-federal representative for ESA consultation for the relicensing of the Ellsworth Project.

Consistent with its designation as FERC's non-federal representative for ESA consultation for the relicensing of the Ellsworth Project, Black Bear developed a draft Biological Assessment (BA) for the federally endangered Gulf of Maine (GOM) Distinct Population Segment (DPS) of Atlantic salmon, along with shortnose sturgeon and the federally threatened GOM DPS of Atlantic sturgeon, at the Ellsworth Project, and submitted it as Appendix E-12 in the license application filed on December 30, 2015. The Ellsworth Project consists of the Ellsworth Development, the Graham Lake Development, and appurtenant facilities. The Ellsworth Dam has an integral intake structure and powerhouse. Graham Lake Dam is located on the Union River upstream of Ellsworth Dam, creating the water storage reservoir known as Graham Lake (Figure 1).

In 2017 and 2018, Black Bear held six meetings with the agencies to identify measures to avoid and minimize potential adverse effects of Project operation on listed Atlantic salmon and designated critical habitat at the Ellsworth Project. Black Bear has developed a Species Protection Plan (SPP; Attachment A) to present the measures that were agreed to during these meetings. Black Bear is herein updating the 2015 Draft BA to analyze the effects of the proposed SPP measures, and to incorporate recently collected Project-specific information related to Atlantic salmon.

FIGURE 1
PROJECT LOCATION MAP



1.1 Overview of the Draft Biological Assessment, Species Protection Plan, and Agency Consultation

1.1.1 Purpose and Description of Draft Biological Assessment

Black Bear is updating the Draft BA, which was submitted with the December 30, 2015 license application, to analyze the effects of the proposed SPP measures and to incorporate recently collected Project-specific information related to Atlantic salmon (Attachment A).

The U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) (the Services) stated that activities related to the listing of the GOM DPS of Atlantic salmon in Maine will be jointly managed and administered; however, NMFS will have the lead on issues pertaining to hydroelectric operations and their effects on Atlantic salmon and their critical habitat (USFWS and NMFS 2016). Section 9 of the ESA prohibits the take of endangered species, including the GOM DPS of Atlantic salmon, unless the take is authorized under specific provisions of the ESA. “Take” is defined by the ESA as “to harass, harm, pursue, ban, shoot, wound, kill, trap, capture, or collect,” or to attempt to engage in any such conduct.

Exemptions to the prohibitions of take under Section 9 of the ESA can be provided by the Services through Section 10 or Section 7 of the ESA. Under ESA Section 10(a)(1)(B), permits may be issued for taking that is incidental to the purposes of an otherwise lawful activity (incidental take permits). Under ESA Section 7(a)(2), incidental take statements may be issued to exempt from the prohibitions any take anticipated as an incidental result of an activity conducted, permitted, or funded by a federal agency, provided this take would not be likely to result in jeopardy to the species or destruction of its critical habitat. Section 7 of the ESA mandates that all federal agencies consult with the Secretaries of Commerce (through NMFS) and Interior (through the USFWS) to determine whether a proposed action is likely to be categorized, with respect to listed species and designated critical habitat, as follows:

1. **No Effect:** No effects to the species and its critical habitat from the proposed action, either positive or negative, are expected.
2. **May Affect, Not Likely to Adversely Affect:** All effects of the proposed action to the species and its critical habitat are beneficial, insignificant, or discountable. Beneficial effects have positive effects to the species or its critical habitat. Insignificant effects relate

to the size of the impact and should not reach the scale where incidental or unintentional take (harming or killing) occurs. Discountable effects are those that are extremely unlikely to occur. Determinations of “not likely to adversely affect” due to beneficial, insignificant, or discountable effects require written concurrence from the USFWS or NMFS.

3. ***May Affect, Likely to Adversely Affect:*** The action would have an adverse effect on the species or its critical habitat. Any action that would result in take of an endangered species is considered an adverse effect. A combination of beneficial and adverse effects is still considered “likely to adversely affect” even if the net effect is neutral or positive. Adverse effects are not considered discountable because they are expected to occur. This determination requires formal consultation with the USFWS or NMFS.

This Draft BA is organized as follows:

- Section 1 provides the background and need for the Draft BA for the GOM DPS of Atlantic salmon, Atlantic sturgeon, and shortnose sturgeon.
- Section 2 provides the Project description of the existing facilities and existing operations.
- Section 3 describes the life histories for the GOM DPS of Atlantic salmon, Atlantic sturgeon, and shortnose sturgeon.
- Section 4 describes the presence of listed species in the Project Area.
- Section 5 evaluates the effects of the Project’s existing conditions on listed species.
- Section 6 describes the Project’s proposed SPP measures and actions to further protect listed species and evaluates the effects of these proposed measures and actions on listed species.
- Section 7 identifies the determination of the effects on listed species considering the proposed SPP measures and actions.
- The proposed SPP is attached to this Draft BA in Attachment A.

1.1.2 Purpose and Description of Proposed Species Protection Plan

In consultation with the agencies, Black Bear has developed a proposed SPP that identifies measures and actions to avoid and minimize potential adverse effects of Project operation on listed Atlantic salmon and designated critical habitat at the Ellsworth Project (Attachment A).

Provisions of the previous Draft BA submitted in 2015 required Black Bear to evaluate the effectiveness of the existing downstream fish passage facilities for passing Atlantic salmon for up to three years, as well as other protection measures and monitoring efforts, in order to inform the development of an appropriate SPP. Results of these efforts are summarized herein, and have been utilized by Black Bear in consultation with NMFS and other resource agencies to inform development of the SPP with agreed upon protection measures.

Assuming the protection measures are adequate to avoid jeopardizing the continued existence of the listed GOM DPS of Atlantic salmon and avoid destroying or adversely modifying designated critical habitat, NMFS will issue a Biological Opinion (BO) based on the BA and SPP with protective measures, which will include an Incidental Take Statement.

1.1.3 Consultation

Both prior to and after the June 19, 2009 ESA listing of the GOM DPS of Atlantic salmon, Black Bear held discussions with the Services to develop measures to protect the GOM DPS of Atlantic salmon. Between 2009 and 2011, Black Bear had numerous discussions with the Services to develop a Draft BA and SPP for the Ellsworth Project as part of the prospective documents also covering Black Bear's Penobscot River hydroelectric projects (Orono, Stillwater, Milford, West Enfield, and Medway projects). In September 2011, NMFS requested that Black Bear remove the Ellsworth Project from the Penobscot draft BA and, instead, develop a separate draft BA for the Ellsworth Project. This was done, and a draft BA for the Ellsworth Project was sent to the Services for their review on August 16, 2012. Black Bear held a meeting with NMFS to discuss development of the Draft BA and Draft SPP on November 13, 2012. NMFS provided comments on that Draft BA on December 7, 2012. With the initiation of relicensing activities in late 2012, development of the Draft BA had been coordinated with the schedule for developing the FERC license application in 2015. Based on further consultation with NMFS regarding potential protection measures and the lack of adequate information for determining suitable measures, a Draft SPP was not developed at that time for the Ellsworth Project.

As described above, Black Bear continued consultation with NMFS and resource agencies and decided to conduct an Atlantic salmon smolt downstream passage study at the Project. Based on the results of the study, additional enhancements were made to enhance downstream passage. A

second year of study was conducted to evaluate the effectiveness of the enhancements. Following the completion of two years of these studies (2016 and 2017), Black Bear and the resource agencies agreed a third year was not necessary to further inform protection measures. Several consultation meetings occurred in 2017 and 2018 between Black Bear, NMFS, and the other interested resources agencies to discuss updated Draft SPP measures, contained and evaluated herein. Black Bear provided an updated Draft BA and SPP to the agencies for their review and comment in August 2018. The NMFS provided comments on the draft documents, those comments have been addressed to a large degree in this revised Draft BA.

1.2 ESA Listing of Atlantic Salmon

The GOM DPS of Atlantic salmon was first listed as endangered by the Services on November 17, 2000 (USFWS and NMFS 2000). The GOM DPS designation in 2000 included all naturally reproducing Atlantic salmon populations occurring in an area from the Kennebec River downstream of the former Edwards Dam site extending north to the international border between Canada and the United States at the mouth of the St. Croix River. This range includes the Union River. The listing in 2000 identified nine watersheds likely to contain naturally reproducing Atlantic salmon populations, including the Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap, and Sheepscot Rivers, Cove Brook and Kenduskeag Stream. The GOM DPS also included river-specific hatchery fish that were being propagated at the Craig Brook Hatchery for release into the wild. The November 2000 final rule listing the GOM DPS did not include fish that inhabit the mainstem and tributaries of the Penobscot River above the site of the former Bangor Dam, the Kennebec River above the site of the former Edwards Dam, or the Androscoggin River (USFWS and NMFS 2000).

The 2006 Status Review for anadromous Atlantic salmon in the U.S. (Fay et al. 2006) assessed genetic and life history information and concluded that the GOM DPS, as defined in 2000, should be redefined to encompass the Penobscot, Kennebec, and Androscoggin Rivers. On June 19, 2009, the Services published a final rule determining that naturally spawned and conservation hatchery populations of anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, including those that were already listed in November 2000, constitute a DPS and hence a “species” for listing as endangered under the ESA (USFWS and NMFS 2009). This range includes the Union River.

1.2.1 Downeast Coastal Salmon Habitat Recovery Unit

The GOM DPS of Atlantic salmon is divided into three salmon habitat recovery units (SHRUs) within the range of the GOM DPS and includes the following: the Downeast Coastal SHRU, the Penobscot Bay SHRU, and the Merrymeeting Bay SHRU. The three SHRUs were created to ensure that Atlantic salmon were widely distributed across the DPS such that recovery of the GOM DPS is not limited to one river or one geographic location, because widely distributed species are less likely to become threatened or endangered by limited genetic variability and tend to be more stable over space and time (NOAA 2009).

The Downeast Coastal SHRU contains 61,395 units¹ of historically accessible spawning and rearing habitat for Atlantic salmon, of which 53,390 units are considered to be currently occupied, and 29,111 of these units are estimated to be functional units of spawning and rearing habitat (NMFS 2009a, NMFS 2009b). Within the Downeast Coastal SHRU, the Union River has about 12,000 units of historic spawning and rearing habitat, although NMFS concludes that dams reduce its equivalent functional habitat value to 4,062 units of habitat (NMFS 2009a). In addition to dams, a variety of issues and conditions affect Atlantic salmon recovery in the Union River, including agriculture, forestry, changing land use, hatcheries and stocking, roads and road crossings, mining, dredging, aquaculture, and introductions of non-native species such as smallmouth bass (NMFS 2009a).

1.2.2 Critical Habitat Designation

As a result of the June 19, 2009, endangered species listing, NMFS was required to evaluate historical occupancy of the watershed for the process of designating critical habitat for the GOM DPS. Section 3 of the ESA defines critical habitat as the following:

1. Specific areas within the geographical area occupied by the species at the time of listing, in which are found those physical or biological features that are essential to the conservation of the listed species and that may require special management considerations or protection; and
2. Specific areas outside the geographical area occupied by the species at the time of listing that are essential for the conservation of a listed species.

¹One unit of habitat is 100m² (NMFS 2009a).

As part of the critical habitat designation, NMFS described the known primary constituent elements (PCEs) that are deemed essential to the conservation of the GOM DPS, including (1) sites for spawning and rearing and (2) sites for migration (excluding marine migration). The physical and biological features of the two PCEs for Atlantic salmon critical habitat are as follows:

Physical and Biological Features of the Spawning and Rearing PCE

- A1. Deep, oxygenated pools and cover (e.g., boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.
- A2. Freshwater spawning sites that contain clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support spawning activity, egg incubation, and larval development.
- A3. Freshwater spawning and rearing sites with clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support emergence, territorial development and feeding activities of Atlantic salmon fry.
- A4. Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.
- A5. Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parr's ability to occupy many niches and maximize parr production.
- A6. Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.
- A7. Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.

Physical and Biological Features of the Migration PCE

- B1. Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations.
- B2. Freshwater and estuary migration sites with pool, lake, and instream habitat that provide cool, oxygenated water and cover items (e.g., boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon.
- B3. Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.
- B4. Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.
- B5. Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration.
- B6. Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

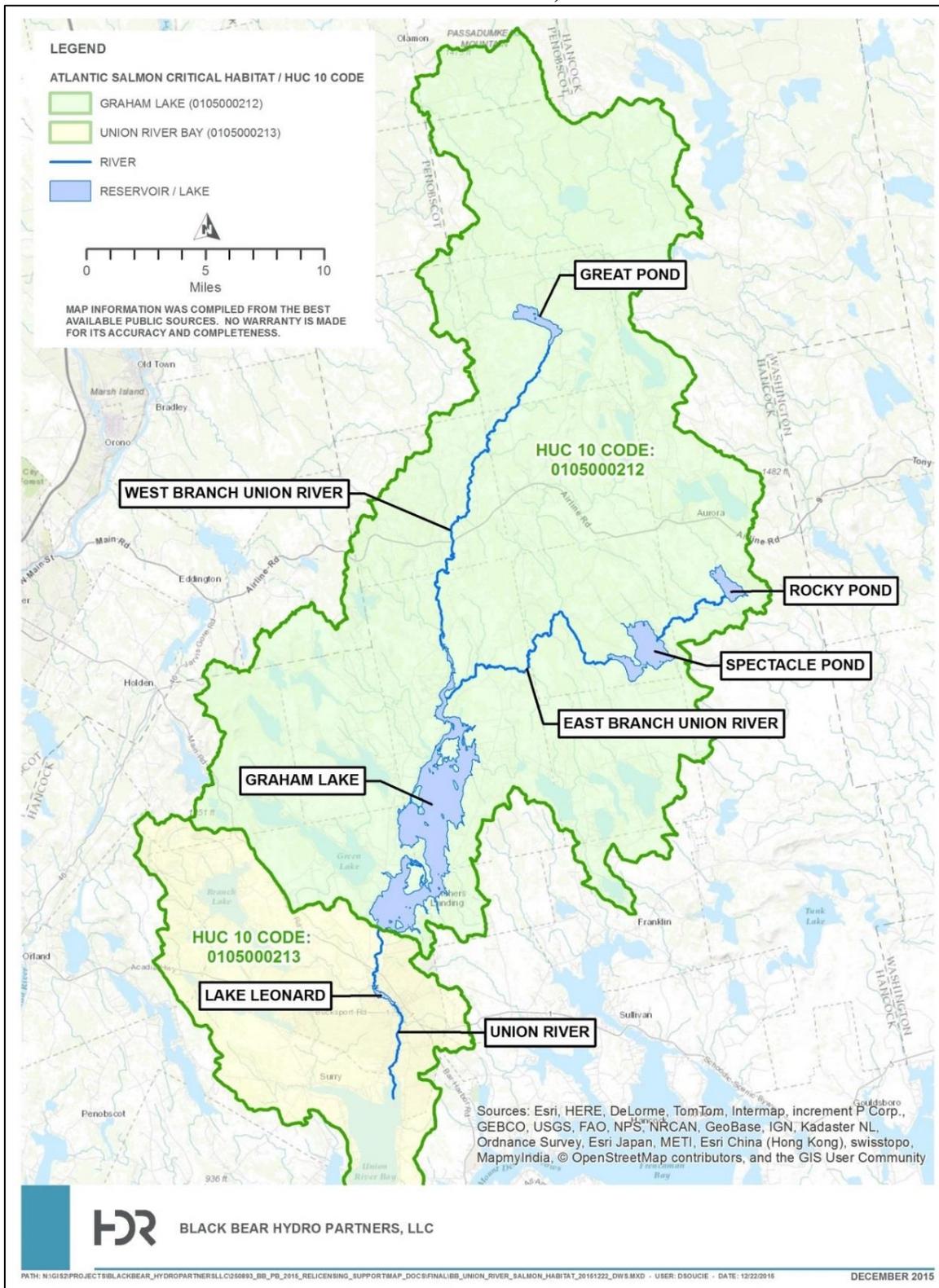
On June 19, 2009, NMFS designated as critical habitat 45 specific areas occupied by GOM DPS Atlantic salmon at the time of listing. Critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line (33 C.F.R. 329.11). Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater. Critical habitat is designated to include all perennial rivers, streams, and estuaries and lakes connected to the marine environment within the range of the GOM DPS of Atlantic salmon, except for those particular areas within the range which are specifically excluded (NMFS 2009a).

The Ellsworth Project falls within the designated critical habitat of the Downeast Coastal SHRU for Atlantic salmon. Critical habitat is further delineated into HUC 10 watersheds. The Union River includes two HUC 10 watersheds listed as critical habitat, including the Graham Lake HUC 10 (code 0105000212) and the Union River Bay HUC 10 (code 0105000213). The entire Project area is within GOM DPS Atlantic salmon critical habitat as shown in Figure 2.

1.2.3 Atlantic Salmon Recovery Plan Overview

Efforts aimed at protecting Atlantic salmon and their habitats in Maine have been underway for well over one hundred years. These efforts are supported by a number of federal, state, and local government agencies, as well as many private conservation organizations. The 2005 *Final Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon* for the originally-listed GOM DPS (NMFS and USFWS 2005) presented a strategy for recovering

FIGURE 2
ATLANTIC SALMON CRITICAL HABITAT, UNION RIVER WATERSHED



Atlantic salmon in the rivers listed as endangered under the ESA in 2000. An updated draft recovery plan was recently published for public comment, which addresses recovery within the expanded range of the GOM DPS of Atlantic salmon described in the 2009 listing rule (USFWS and NMFS 2016).

The 2016 *Draft Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon* (USFWS and NMFS 2016) reflects a new recovery planning approach (termed the Recovery Enhancement Vision, or REV) that focuses on the three statutory requirements in the ESA including: site-specific recovery actions; objective, measurable criteria for delisting; and time and cost estimates to achieve recovery and intermediate steps. The draft recovery plan is based on two premises: first, that recovery must focus on rivers and estuaries located in the GOM DPS until threats in the marine environment are better understood; and second, that survival of Atlantic salmon in the GOM DPS depends on conservation hatcheries through much of the recovery process (USFWS and NMFS 2016). The main objectives of the draft 2016 recovery plan is to maintain self-sustaining, wild populations with access to sufficient suitable habitat in each SHRU, and ensure that necessary management options for marine survival are in place. In addition, the plan seeks to reduce or eliminate all threats that either individually or in combination might endanger the DPS (USFWS and NMFS 2016).

The current recovery criteria for downgrading classification from endangered to threatened consist of:

1. The entire DPS has a total annual escapement of at least 1,500 naturally reared adults spawning in the wild, with at least two of the three SHRUs having at least 500 naturally reared adult returns;
2. The population in each of at least two of the three SHRUs must also have a population growth rate greater than 1.0 in the 10-year period preceding reclassification;
3. Adults originating from stocked eggs, fry, and parr are included when estimating population growth rates; and
4. Sufficient suitable spawning and rearing habitat for the offspring of the 1,500 naturally reared adults is accessible and distributed throughout designated Atlantic salmon critical habitat, with at least 7,500 accessible and suitable habitat units in each of at least two of the three SHRUs (USFWS and NMFS 2016).

The longer-term recovery target for the delisting of Atlantic salmon consists of:

1. The DPS has a self-sustaining annual escapement of at least 2,000 wild adult salmon returns in each of the three SHRUs for a DPS-wide total of at least 6,000 wild adults;
2. Each SHRU has a population growth rate of greater than 1.0 in the 10-year period preceding delisting, and at the time of delisting, the DPS demonstrates self-sustaining persistence; and
3. Sufficient suitable spawning and rearing habitat for the offspring of 6,000 wild adults is accessible and distributed throughout designated Atlantic salmon critical habitat, and with at least 30,000 accessible and suitable habitat units in each SHRU, located according to the known migratory patterns of returning wild adult salmon.

This recovery plan includes a table that generally identifies the priority, timing, and involved parties for the various actions, but it is important to recognize that annual decisions made about recovery priorities will be formulated in SHRU-level work plans (USFWS and NMFS 2015). SHRU-level work plans provide the basis for determining activities that should be implemented in the short term for each of the plan's recovery actions. The seven categories of recovery actions include:

- Habitat Connectivity, intended to enhance connectivity between the ocean and freshwater habitats important for salmon recovery;
- Genetic Diversity, intended to maintain the genetic diversity of Atlantic salmon populations over time;
- Conservation Hatchery, intended to increase adult spawners through the conservation hatchery program;
- Freshwater Conservation, intended to increase adult spawners through the freshwater production of smolts;
- Marine and Estuary, intended to increase survival in these habitats by increasing understanding of these salmon ecosystems and identifying the location and timing of constraints to the marine productivity of salmon in support of management actions to improve survival;
- Federal/Tribal Coordination, intended to facilitate consultation with all involved Tribes on a government-to-government basis; and

- Outreach, Education, and Engagement, intended to collaborate with partners and engage interested parties in recovery efforts for the GOM DPS (USFWS and NMFS 2016).

For geographically based recovery actions, the SHRU-level work plans (USFWS and NMFS 2015) describe threats and recovery activities with a high priority within a 5-year period. Threats listed for the overall Downeast Coastal SHRU consist of:

- Climate change and the adverse effect it may have on habitats most suitable for Atlantic salmon.
- Dams and culverts that block or impeded access to Atlantic salmon spawning and rearing habitat degrade habitat features for native riverine species.
- The stocking and introduction of non-native species, particularly smallmouth bass, compete with and prey on Atlantic salmon.
- Pollution attributed to land use and development practices in the Downeast Coastal SHRU can harm Atlantic salmon and degrade the productive capacity of freshwater and estuary habitats.
- Historic and current land uses have degraded the complexity and productivity of freshwater habitats that support Atlantic salmon (e.g., historic log drives, past and current agriculture and forestry practices, and residential development practices).
- The small population size and small number of remaining family groups within the Downeast Coastal SHRU compromises the overall fitness of the GOM DPS.
- Limited resources to assess all areas that could be occupied by Atlantic salmon.

Specific to the Ellsworth Project, the work plan described these threats to the Union River (USFWS and NMFS 2016):

- The Ellsworth Dam impairs upstream and downstream passage efficiency of adult salmon, smolts, and other diadromous fish, and decreases water quality above the dam. Graham Station does not have an upstream fishway, blocking all upstream migratory fish. Current operations block upstream migration of diadromous fish and may delay or block downstream migration of emigrating smolts and other diadromous fish.

Recovery actions are also outlined in the work plan (USFWS and NMFS 2015) to address these threats. Those actions potentially relevant to the Ellsworth Project include:

- Continue to provide fry to the Union River Salmon Association to support stock rebuilding efforts in the Union River.
- Ensure hydro operations at the Ellsworth Dam will minimize harm to Atlantic salmon and adverse effects to their critical habitat.
- Ensure operations at the Graham Lake Dam will minimize harm to Atlantic salmon and adverse effects to their critical habitat.
- Develop a stock rebuilding and management plan for the Union River.

1.3 Other ESA Listed Species - Atlantic and Shortnose Sturgeon

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and shortnose sturgeon (*Acipenser brevirostrum*) have the potential to occur in the Union River downstream of the Ellsworth Project. On February 6, 2012, NOAA published notice in the Federal Register listing the Atlantic sturgeon as "endangered" in the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs, and as "threatened" in the GOM DPS (77 FR 5880 and 77 FR 5914). The Ellsworth Project falls within the Atlantic sturgeon GOM DPS. On August 17, 2017, NOAA designated critical habitat for Atlantic sturgeon in the threatened GOM DPS (82 FR 39160). Critical habitat for Atlantic sturgeon was not designated within the Union River and is, therefore, not present within the Project area.

Shortnose sturgeon were listed as endangered on March 11, 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Although shortnose sturgeon are listed as endangered range-wide, in the final recovery plan NMFS recognized 19 separate populations occurring throughout the range of the species. These populations are in New Brunswick, Canada; Maine; Massachusetts; Connecticut; New York; New Jersey/Delaware; Maryland and Virginia; North Carolina; South Carolina; Georgia; and Florida. Critical habitat has not been designated for shortnose sturgeon.

2.0 Project Description

2.1 Project Facilities

The Ellsworth Project consists of the Ellsworth Development, the Graham Lake Development, and appurtenant facilities. The Ellsworth Dam has an integral intake structure and powerhouse, and creates the impoundment, Leonard Lake. Graham Lake Dam is located on the Union River about 4 miles upstream of Ellsworth Dam, creating the water storage reservoir known as Graham Lake (Figure 1).

Construction of the Ellsworth Dam was completed in 1907. Ellsworth Dam is approximately 377 feet long and 65 feet high with 1.7-foot-high flashboards on the spillway. Lake Leonard extends approximately 1 mile above Ellsworth Dam and has a surface area of 90 acres at a normal full pond water surface elevation of 66.7 feet U.S. Geological Survey (USGS) datum. The powerhouse is a reinforced-concrete and concrete block masonry powerhouse containing four turbine-generator units, which have a total FERC authorized capacity of 8,900 kilowatts (kW) (Table 1) and a total combined maximum flow capacity of approximately 2,460 cubic feet per second (cfs).

The Graham Lake Dam is an earthen dam with concrete core walls about 750 feet long and 30 feet high, and it includes a gated concrete spillway. The Graham Lake reservoir is approximately 10 miles long with a surface area of approximately 10,000 acres at normal full pond water surface elevation of 104.2 feet (Table 1). There are no generating facilities at the Graham Lake Development.

The Ellsworth Dam fish trap and transport facility is equipped with a four-baffle vertical slot upstream fishway leading to a trap fitted with a hopper and hoisting structure to facilitate fish transport in circular transport tanks (Figure 3). The fishway entrance is immediately adjacent to the powerhouse tailrace with a pumped attraction flow of up to 50 cfs. The upstream fishway and fish trapping facility were constructed at the Ellsworth Dam in 1974, originally to provide a supplemental source of Atlantic salmon broodstock for use in the restoration of populations to the Penobscot and other rivers (Baum 1982).

**TABLE 1
CHARACTERISTICS OF THE ELLSWORTH PROJECT**

Facility Characteristics	Ellsworth Dam	Graham Lake Dam
Reservoir Length	1 mile	10 miles
Reservoir Surface Area	90 acres	10,000 acres
Reservoir Normal Full Pond Elevation	66.7 feet mean sea level (msl) (includes 1.7-foot-high flashboards)	104.2 feet msl
Length of Dam	377 feet	750 feet
Height of Dam	65 feet	30 feet
Turbines Rated Capacity*	<ul style="list-style-type: none"> • Unit 1 – 3,800 horsepower (hp) (2,850 kW) (vertical shaft propeller) • Unit 2 – 2,900 hp (2,175 kW) (Kaplan) • Unit 3 – 2,900 hp (2,175 kW) (Kaplan) • Unit 4 – 3,800 hp unit (2,850 kW) (vertical shaft propeller) 	NA
Turbine Rotational Speeds (RPM)	<ul style="list-style-type: none"> • Unit 1 – 200 RPM • Unit 2 – 360 RPM • Unit 3 – 360 RPM • Unit 4 – 200 RPM 	NA
Generator Rated Capacity**	<ul style="list-style-type: none"> • Unit 1 – 3,125 kVA @ power factor 0.8; 2,500 kW • Unit 2 – 2,500 kVA @ power factor 0.8; 2,000 kW • Unit 3 – 2,500 kVA @ power factor 0.8; 2,000 kW • Unit 4 – 3,000 kVA @ power factor 0.8; 2,400 kW 	NA
Trashrack Spacing	Variable – Typical configuration based on normal pond elevation: Top 6-8 feet is concrete Unit 1 – 2.44 in. Units 2-4 – 1.00 in.(top)/2.37 in. (bottom)	NA

*The total combined maximum hydraulic capacity of the turbines is estimated to be 2,460 cfs.

**The total FERC-authorized capacity of the facility, based on the limiting unit components, is 8.9 MW.

The upstream passage facility was described as an interim measure until additional information became available from assessments incorporated in the Union River Fisheries Management Plan that would provide information needed to make decisions regarding permanent fish passage measures (URFCC 2000). Since Atlantic salmon broodstock collection has been discontinued, the upstream fishway is now used primarily during the river herring migration, but also to collect any salmon that might use the facility for potential upriver transport (depending on origin of fish) in

the Union River. Adult Atlantic salmon that are captured in the fishway are examined to determine origin, and the Maine Department of Marine Resources (MDMR) determines whether Atlantic salmon caught in the fishway are released downstream of the Ellsworth Dam, upstream of the Graham Lake Dam, or removed by MDMR. Graham Lake Dam does not have an upstream fishway, because fish are transported from the Ellsworth trap and transport facility to locations above Graham Lake Dam.

Black Bear operates downstream passage facilities at both Ellsworth Dam (Figures 4 and 5) and Graham Lake Dam (Figure 6). Downstream measures at the Ellsworth Dam consist of two stoplog-controlled surface weirs above Units 2 through 4 and a transport pipe that discharges to a downstream sluiceway located on the overflow section of the dam. A third surface weir is located adjacent to the Unit 1 intake that discharges directly to the same sluiceway leading to a plunge pool immediately downstream of the dam. The downstream face of the spillway was resurfaced in 2017 to limit fish injuries when passed over the dam section adjacent to the third surface weir. In addition, a permanent stainless steel inlet screen was installed over the intake of the cooling water system at the Ellsworth Dam on May 26, 2015 as a downstream passage protection measure, following review and consultation with the resources agencies, including guidance to prevent fish impingement provided by the USFWS and NMFS.

In addition to the activities associated with operation and maintenance of the fish passage facilities at the Ellsworth Dam, Black Bear operates a surface weir to provide downstream passage of out-migrating Atlantic salmon and river herring on the west end of the Graham Lake Dam gate structure. The development of this passage route was completed in 2003, coinciding with increased upstream stocking of alewives. The weir is very similar to the downstream passage system at the Ellsworth Dam in that it is a surface weir that contains stoplogs, which enable Black Bear to adjust the opening as necessary. However, these stoplogs have been removed from the surface weir year round. The opening empties into a downstream plunge pool and provides downstream migrants with another route of passage in addition to the existing Tainter gates, which are operated to pass minimum flows and flows used for generation purposes at the Ellsworth Dam. This weir at Graham Lake Dam was modified in 2017 by adding a sloped floor, two side panels, and a bell shaped entrance to create an Alden weir to improve approach velocities and fish attraction to the weir (Figure 6). The downstream fishways are operated from April 1 to December 31 annually, as river conditions allow.

FIGURE 3
VIEW OF FISHWAY LIFT IN OPERATION USED FOR TRANSFERRING FISH TO
THE HOLDING TANK AT THE ELLSWORTH DAM



FIGURE 4
VIEW OF COLLECTION CHAMBER AND ENTRANCE TO DOWNSTREAM FISH
PASSAGE PIPE AT THE ELLSWORTH DAM



FIGURE 5
VIEW OF DISCHARGE FROM DOWNSTREAM FISH PASSAGE PIPE AND
SURFACE WEIR AT THE ELLSWORTH DAM



FIGURE 6
GRAHAM LAKE DAM FISH PASSAGE WEIR



2.2 Project Operations

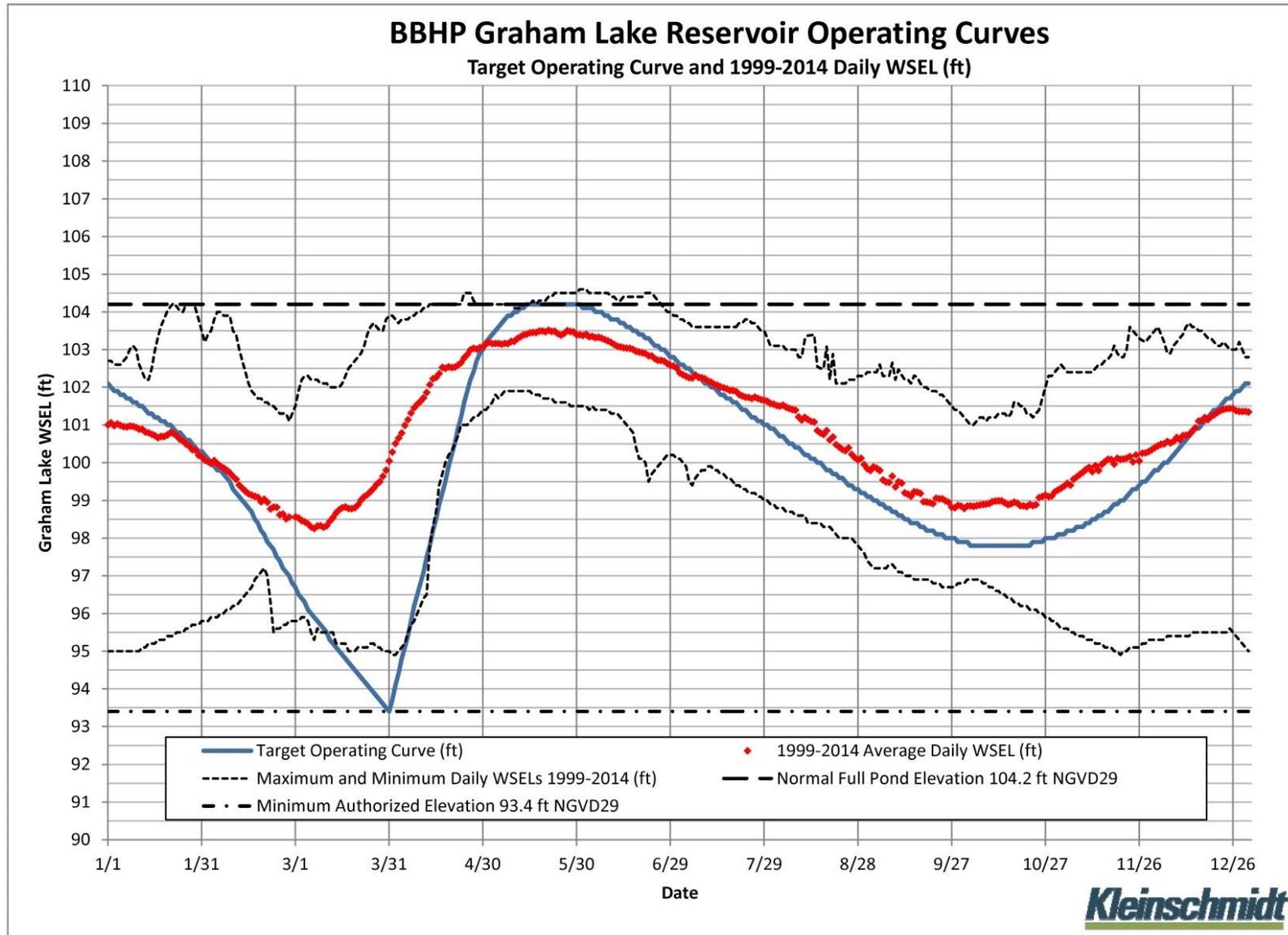
The Ellsworth Project operates as both a water storage facility and as a peaking generation facility, depending on available inflows, while maintaining minimum flows. Timed releases at Graham Lake are used at Ellsworth Dam for power production. The releases may result in minor (approximately 1 foot) surface elevation variations in Lake Leonard. During high flow conditions, primarily in the spring and fall, the Project may operate at full load up to 24 hours a day. Graham Lake generally follows an operating curve that can result in fluctuations approaching 11 feet over the course of a year (Figure 7). As per Articles 401 and 402 of the 1987 Order Issuing New License, minimum flows and water levels are required and maintained by Black Bear. Article 401 specifies a continuous minimum flow release of 105 cfs from the Graham Lake Dam and Ellsworth Dam from July 1 through April 30, and a continuous minimum flow release of 250 cfs from May 1 through June 30 for the protection of fishery resources. Article 402 of the FERC license specifies that the licensee operate the Ellsworth Project so that the following water levels are maintained: Lake Leonard 1-foot fluctuation (65.7 feet to 66.7 feet mean sea level [msl]) and Graham Lake 10.8-foot fluctuation (93.4 feet to 104.2 feet msl). Black Bear has proposed to continue these fundamental operating parameters for the Ellsworth Project in the December 2015 application for a new license.

The upstream fishway is typically operated for river herring (alewife; blueback herring) stocking and harvesting from early May through mid-June, and continuing through October 31 for Atlantic salmon (URFCC 2015). The downstream fishways are operated from April 1 to December 31 annually, as river conditions allow.

In 2014 and 2015, Black Bear implemented physical and operational measures to enhance fish passage at the Project, including development of a site-specific Fish Passage Operation and Maintenance (O&M) Plan for the fishways. The Fish Passage O&M Plan, which is consistent with the original design criteria for the fishways, includes a daily checklist that is used to ensure that the upstream and downstream fishways are operating properly. The plan also includes both a list of spare parts critical to fishway operation and a checklist of proper fishway operating characteristics. Since 2015, Black Bear has also hired staff dedicated to operate the Project fish passage facilities annually; these staff are dedicated to fishway operations, oversight, fish trap tending, and transporting the fish upriver. These dedicated fishway staff complete the daily

checklists and prepared weekly reports on fishway operations, which have been provided to the fisheries management agencies throughout the fishway operational seasons since 2015. Black Bear also repaired the Ellsworth downstream fishway recovery pump, installed a pump failure monitor, and purchased a spare pump as a backup in 2015. In addition, Black Bear installed a cover screen at the primary intake of the cooling water system to prevent fish entrainment into this system, and then modified the cooling water operations and re-plumbed this system to allow for auxiliary and secondary intakes to be used only as an emergency backup water source. This intake cover screen is inspected weekly via underwater video camera during the fish passage season. A 2017 change to improve downstream Atlantic salmon smolt passage included the installation of an Alden-type weir at the entrance to the downstream passage facility at Graham Lake Dam to improve flow characteristics and attraction to the weir.

**FIGURE 7
OPERATING CURVES, GRAHAM LAKE**



2.2.1 Union River Comprehensive Fisheries Management Plan

Through 2017, the Project's fish passage facilities were managed and operated in consultation with the relevant fisheries agencies through the *Comprehensive Fishery Management Plan (CFMP) for the Union River Drainage*, which was updated every five years. In 1997, a group of agencies and interested parties (including the USFWS and MDMR) signed an agreement for the purposes of addressing interim and long-term fisheries management in the Union River drainage, including the provision of fish passage at the Ellsworth Hydroelectric Project. The stakeholders agreed that they would develop a comprehensive, biologically-based plan in order to support decisions on fishery management in the Union River. The Union River Fisheries Coordinating Committee (URFCC), consisting of state and federal natural resource agencies and non-governmental conservation organizations²; as well as the City of Ellsworth; Black Bear; and interested members of the public, developed the CFMP (URFCC 2000, 2015). The URFCC adopted the following Mission Statement:

It is the goal of the Union River Stakeholders Group to achieve timely and effective restoration and/or management of populations of resident and self-sustaining diadromous fish in the Union River watershed, consistent with a comprehensive fishery management plan, and in a manner that balances the interests of the public, regulatory agencies, and the licensee of the Ellsworth Hydroelectric Project.

The CFMP (URFCC 2000, 2015) identified agency goals and objectives for diadromous and resident fish populations in the Union River drainage, and described the various tasks and responsibilities related to the restoration and management of those resources, including stocking, habitat assessment, population monitoring, and fish passage.

The most recent plan covered the three-year period of 2015-2017 due to the scheduled expiration of the Project license in December 2017 (URFCC 2015). Although the plan has expired, Black Bear has and will continue the operations of the upstream fish trap at the Ellsworth Project as described in the plan in order to continue annual transport of at least 315,000 river herring (if

² The URFCC included the USFWS, MDMR (formerly including the Maine Atlantic Salmon Commission), Maine Department of Inland Fisheries and Wildlife (MDIFW), City of Ellsworth, Union River Watershed Coalition, Union Salmon Association, the Maine Council of the Atlantic Salmon Federation, Black Bear, and interested members of the public.

available) upstream during the interim period before a new license is issued. Black Bear will also continue to operate the downstream fishway per the operational and physical modifications identified in 2014 and 2015, described above, while continuing to prioritize unit operations to favor Units 1 and 4 during downstream fish migration periods.

2.3 Water Quality in the Project Area

The Ellsworth Project area is located within the Union River watershed and encompasses portions of the Union River, Lake Leonard, and Graham Lake. The Union River watershed encompasses approximately 547 square miles in Hancock and Penobscot Counties in Maine (Maine DEP, MDIF&W, and MEGIS 2010) and includes 484 miles of streams and 81 miles of lakes and ponds (College of the Atlantic 2004). The Union River watershed is bordered by coastal rivers and by the Gulf of Maine to the south, the Penobscot River basin to the west and north, and the Narraguagus River basin to the east (FERC 1987).

The Project creates two impoundments on the Union River, Lake Leonard, which is a small impoundment upstream of the Ellsworth Dam, and Graham Lake, which is a larger storage reservoir upstream of Graham Lake Dam. Lake Leonard has a surface area of approximately 90 acres at its normal maximum elevation of 66.7 feet msl, a width of up to 0.3 miles, and a maximum length of approximately 1.0 mile. Lake Leonard has a volume of 751 acre-feet. Graham Lake has a surface area of approximately 10,000 acres at a normal full pond surface elevation of 104.2 feet msl; a maximum width of 2.75 miles; and a maximum length of approximately 10 miles. Graham Lake has a volume of approximately 124,000 acre-feet.

Maine statute 38 MRSA (§464-470) establishes the basis for the State's classification system of surface waters. The State has one water quality standard for lakes and great ponds (GPA) which includes inland bodies of water artificially formed or increased that have a surface area greater than 30 acres. Graham Lake is included in this classification. The Maine Department of Environmental Protection (MDEP) currently interprets the water quality statutes to classify Lake Leonard as a GPA water (K. Howatt, MDEP personal communication, June 16, 2015). There are four standards for the classification of fresh surface waters which are not classified as great ponds: Class AA, A, B, and C waters. The Union River from the outlet of Graham Lake to tidewater, excluding the impounded portion, Lake Leonard, is classified as Class B (38 M.R.S.A. §467.18.A (1)).

Impoundment water quality sampling was conducted in accordance with MDEP's Lake Trophic State Sampling Protocol for Hydropower Studies on a bi-weekly basis in Graham Lake from April 23 through October 24, 2013, and in Lake Leonard from June 13 through October 24, 2013, as part of the relicensing studies for the Project. Graham Lake weakly stratifies during the summer months, but due to the shallowness of the lake and long fetch from multiple directions, the stratification often breaks down during windy periods that prevail on the lake. Water quality in Lake Leonard is similar to Graham Lake, though slightly less turbid.

Riverine water quality sampling was also conducted as part of the relicensing of this Project in the Union River in the tailwater area of Graham Lake Dam in accordance with MDEP's River Sampling Protocol on a weekly basis from July 2 through September 12, 2013, in both the early morning (before 7:00 AM) and afternoon (after 1:00 PM) on each sampling day. Sampling was not conducted in the Ellsworth Dam tailwater, as the Union River is subject to tidal fluctuations at that point. Over the course of the 11-week sampling period, temperatures ranged from 19.1 – 26.6 degrees Celsius (°C) and dissolved oxygen (DO) levels ranged from 8.3 and 10.4 milligrams per liter (mg/l) (96 – 114% saturation). The impoundments and riverine reaches sampled during the 2013 relicensing studies met applicable water quality Class GPA (impoundments) and Class B (riverine) state standards.

3.0 Listed Species Life History

3.1 Atlantic Salmon

Anadromous Atlantic salmon have a complex life history that includes spawning and rearing in freshwater rivers and streams, as well as extensive feeding migrations and sexual maturation in the marine environment (Fay et al. 2006). The freshwater juvenile stage of the life cycle can last from one to three years, after which juveniles undergo a physiological transformation (called smoltification) and migrate downstream to spend one to three years at sea before returning to freshwater to spawn in their natal rivers. Unlike Pacific salmon, Atlantic salmon do not die after spawning, and can return to sea to repeat the migratory cycle.

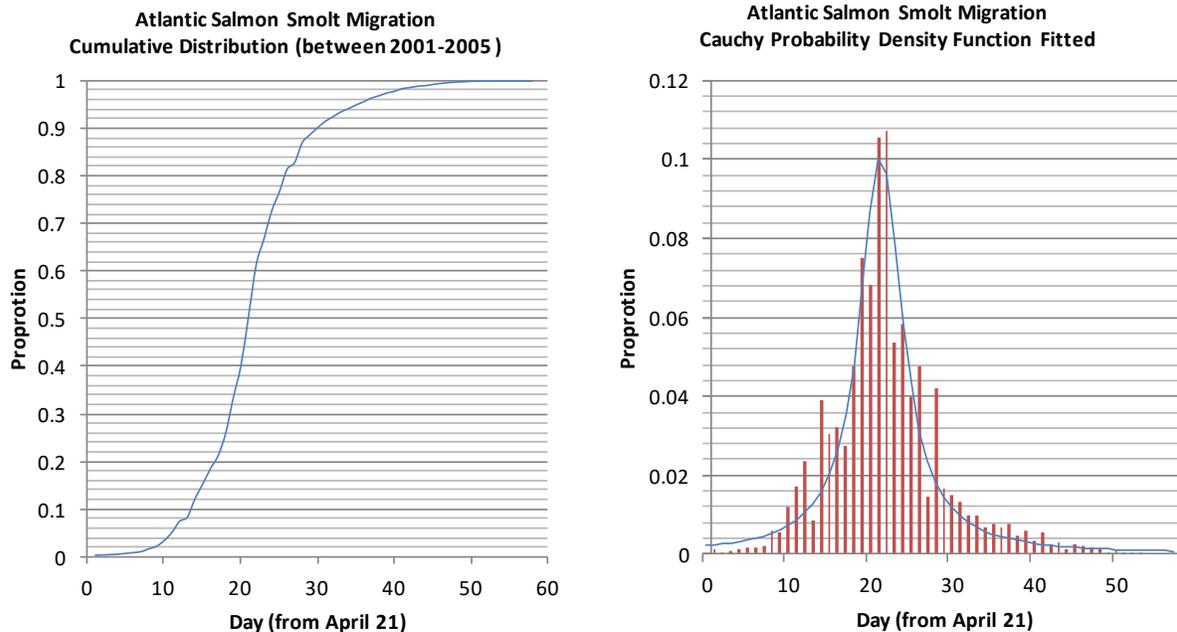
Although spawning by Atlantic salmon does not occur until late October or November, most adult Atlantic salmon ascend rivers beginning in the spring. In the GOM rivers, the peak upstream migration occurs in June, but may persist until the fall (Fay et al. 2006). After fish enter the freshwater environment, they cease feeding and darken in coloration. Salmon that return early in the spring spend nearly five months in the river before spawning, seeking cool water refuges (e.g., deep pools, springs, and mouths of small cold-water tributaries) during the summer months (Fay et al. 2006). Following spawning, adults (referred to as “kelts”) may move downstream in either the fall or the following spring, eventually reaching the estuary and ocean. Once in the marine environment, these salmon resume feeding and a very small percentage may return as repeat spawners one to two years later.

Preferred spawning habitat consists of gravel substrate with adequate water circulation to keep buried eggs well oxygenated. Water depth at spawning sites is typically 30 centimeters (cm) to 61 cm, and water velocity averages 60 cm per second (Fay et al. 2006). Spawning occurs from late October through November when water temperatures are roughly between 7.2 degrees Celsius (°C) to 10.0°C. The female uses its tail to scour or dig a series of nests in the gravel where the eggs are deposited; this series of nests is called a redd. One or more males fertilize the eggs as they are deposited in the redd. The female then continues digging upstream of the last deposition site, burying the fertilized eggs with clean gravel. A female salmon returning to spawn after spending two years at sea will produce approximately 7,500 eggs (Fay et al. 2006).

The eggs hatch in late March or April. At this stage, the young salmon are referred to as alevin or sac fry. Alevins remain in the redd for about six more weeks and are nourished by their yolk sac. Alevins emerge from the gravel in mid-May, and begin active feeding, at which time they are called fry (Fay et al. 2006). Within days, the salmon fry enter the parr stage, indicated by vertical bars (parr marks) visible on their sides. Parr prefer areas with adequate cover, water depths ranging from approximately 10 cm to 60 cm, water velocities between 30 cm and 92 cm per second, and water temperature near 16°C (Fay et al. 2006). Juvenile salmon are territorial and feed on a variety of aquatic invertebrates, including larvae of mayflies, stoneflies, chironomids, and caddis flies; aquatic annelids; mollusks; and numerous terrestrial invertebrate species that fall into the river (Fay et al. 2006). In fall as flows increase, and as temperature and day length decrease, parr often shelter in the substrate. Movement may be quite limited in the winter, but can occur, particularly if the formation of ice reduces available habitat (Fay et al. 2006).

After remaining in freshwater habitat for one to three years (typically two years in Maine), parr undergo a series of physiological, morphological, and behavioral changes in a process called “smoltification.” This transformation occurs in the spring and prepares the salmon “smolt” for its dramatic change in osmoregulatory needs that come with movement from a freshwater to marine environment (Fay et al. 2006). The smolt emigration period is rather short and lasts only two to three weeks for each individual (NMFS 2008). While not specifically assessed in the Union River, naturally reared and wild smolts in Maine typically enter the sea during May to begin their ocean migration (Fay et al. 2006). In the Penobscot River, smolts migrate between late April and early June with a peak migration in early May (Fay et al. 2006). The majority of smolts migrate in a short period of time, as demonstrated by NMFS’ Penobscot River smolt trapping studies conducted between 2000 and 2005. These data show that 74 percent of the downstream run occurs in 15 days in mid-May (Figure 8) and that the majority of the smolt migration appears to take place after water temperatures rise to 10°C (USFWS unpublished *cited in* Black Bear 2012). The USFWS conducted a review of literature regarding diurnal migration timing and found that a median of 80.7 percent of smolts migrated at night (USFWS unpublished *cited in* Black Bear 2012).

FIGURE 8
SMOLT MIGRATION TIMING IN THE PENOBSCOT RIVER BASED ON NMFS
SMOLT TRAPPING STUDIES BETWEEN 2001 AND 2005



Source: Review of NMFS' Penobscot River smolt trapping studies conducted between 2000 and 2005 - USFWS unpublished *cited in* Black Bear 2012.

Smolts have been documented to move through the Narraguagus River estuary (located in Downeast Maine) to the middle portion of the bay at 0.7 kilometers per hour (km/h) and 1.0 km/h in the outer Narraguagus Bay (Kocik et al. 2009). Higher survival rates were observed for smolts that exhibited a reversal migratory pattern through the bay, suggesting that smolts moving out to sea with the flooding and ebbing tides are more likely to survive than those that do not, likely falling prey to various predators. Overall, this study documented low survival between the estuary and open marine environment from 36 percent to 47 percent (Kocik et al. 2009).

Once in the ocean, Atlantic salmon become highly migratory and undertake long migrations from their natal rivers (Fay et al. 2006). Major feeding areas in the ocean include the Davis Strait between Labrador and Greenland (USFWS and NMFS 2009). During their time at sea, Atlantic salmon undergo a period of rapid growth until they reach maturity and return to their natal river to complete the life cycle. Although the GOM DPS yields the highest adult returns, millions of salmon are stocked annually, and these data indicate that freshwater and marine survival rates are extremely low (USFWS and NMFS 2009).

3.2 Atlantic Sturgeon

The Atlantic sturgeon is a long-lived, late maturing, estuarine dependent, anadromous species. Information in the following subsections is taken from the 2007 Atlantic sturgeon status review (Atlantic Sturgeon Status Review Team 2007), unless otherwise noted. The species' historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida. Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in the spring/early summer; February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems. In some southern rivers, a fall spawning migration may also occur. A fall migration of ripening adults upriver in the Saint John River, New Brunswick is also observed; however, this fall migration is not considered a spawning run as adults do not spawn until the spring. Atlantic sturgeon spawning is believed to occur in flowing water between the salt front and fall line of large rivers, where optimal flows are 46-76 cm/s and depths of 11-27 meters. Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (e.g., cobble). Hatching occurs approximately 94-140 hours after egg deposition at temperatures of 20° and 18°C, respectively, and larvae assume a demersal existence. The yolk-sac larval stage is completed in about 8-12 days, during which time the larvae move downstream to rearing grounds over a 6-12 day period. During the first half of their migration downstream, movement is limited to night. During the day, larvae use benthic structure (e.g., gravel matrix) as refugia. During the latter half of migration when larvae are more fully developed, movement to rearing grounds occurs both day and night. Juvenile sturgeon continue to move further downstream into brackish waters and eventually become residents in estuarine waters for months or years.

Upon reaching a size of approximately 76-92 cm, the subadults may move to coastal waters where populations may undertake long-range migrations. Tagging and genetic data indicate that subadult and adult Atlantic sturgeon may travel widely once they emigrate from rivers. Subadult Atlantic sturgeon transit between coastal and estuarine habitats, undergoing rapid growth. These migratory subadults, as well as adult sturgeon, are normally found in shallow (10-50 meters) near-shore areas dominated by gravel and sand substrate. Coastal features or shorelines where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, Delaware, Delaware Bay, Chesapeake Bay, and North Carolina, which presumably provide better foraging opportunities. Despite extensive mixing in coastal waters, Atlantic sturgeon return to their natal river to spawn as indicated from tagging records and the relatively low rates of gene

flow reported in population genetic studies. Males usually begin their spawning migration early and leave after the spawning season, while females make rapid spawning migrations upstream and quickly depart following spawning.

Atlantic sturgeon have been aged to 60 years; however, this should be taken as an approximation, as the only age validation study conducted to date shows variations of ± 5 years. Vital parameters of sturgeon populations show clinal variation with faster growth and earlier age at maturation in more southern systems, though not all data sets conform to this trend. For example, Atlantic sturgeon mature in South Carolina at 5-19 years, in the Hudson River at 11-21 years, and in the Saint Lawrence River at 22-34 years. Atlantic sturgeon likely do not spawn every year. Multiple studies have shown that spawning intervals range from 1-5 years for males and 2-5 for females. Fecundity of Atlantic sturgeon has been correlated with age and body size (ranging from 400,000 - 8 million eggs). The average age at which 50 percent of maximum lifetime egg production is achieved is estimated to be 29 years, approximately 3-10 times longer than for other bony fish species examined (NOAA 2012a).

The GOM DPS includes all Atlantic sturgeon that are spawned in the watersheds from the Maine/Canadian border and extending southward to include all associated watersheds draining into the Gulf of Maine as far south as Chatham, Massachusetts (NOAA 2012a). Tagging and tracking data indicate that there is mixing of sturgeon from different DPSs throughout their marine range, and, consequently, NMFS determined that the marine ranges for the five DPSs are the same: all marine waters, including coastal bays and estuaries, from Labrador Inlet, Labrador, Canada to Cape Canaveral, Florida (NOAA 2012a, 2012b).

3.3 Shortnose Sturgeon

The shortnose sturgeon is an endangered fish species that occurs in large coastal rivers of eastern North America. In the northern part of its range, the species is considered to be “freshwater amphidromous,” meaning it spawns in freshwater, but regularly enters seawater during various stages of its life (NMFS 1998). Shortnose sturgeon are occasionally found near the mouths of rivers, and coastal migrations between the lower Penobscot River and the Androscoggin/Kennebec estuary (i.e., Merrymeeting Bay) have been documented (Zydlewski 2009, Fernandes et al. 2010). Juveniles typically move upstream in rivers in spring and summer and downstream in fall and winter, but inhabit reaches above the freshwater - saltwater interface. Adults may move into higher salinity areas on a more regular basis (NMFS 1998).

Shortnose sturgeon are a long-lived species. The maximum documented age is 67 years for females, while males seldom exceed 30 years of age (NMFS 1987). In the northern part of their range, females do not spawn until about 18 years of age, while males spawn at about 12 years of age (NMFS 1987). Shortnose sturgeon females typically spawn every three to five years, while males may spawn as often as every one to three years (NMFS 1998). Spawning typically takes place in mid- to late spring when water temperatures reach 8-9°C; spawning ends when the water temperature reaches 12-15°C. Spawning may occur over a period of days to a few weeks. Overall spawning success can be negatively impacted if flows are unusually high during the spawning period (NMFS 1998).

Shortnose sturgeon typically seek the most accessible upstream areas for spawning, and may use a variety of micro-habitats. Channels appear to be important for spawning, which takes place over a variety of substrates (often gravel, rubble, or boulders), in shallow to relatively deep water and in moderate velocities (NMFS 1998).

Eggs are demersal and adhesive and remain near the spawning site. After eggs hatch, larval shortnose sturgeon are poor swimmers, and react negatively to light, instead seeking refuge among crevices and other cover on the bottom near the spawning site (NMFS 1998). After 9-12 days, the yolk sac is absorbed and the young sturgeon actively migrate downstream to locate suitable habitat. Young of year sturgeon typically inhabit deeper freshwater areas, and assume a more migratory behavior in the second summer of life (NMFS 1998).

Juvenile shortnose sturgeon (3 to 10 years old) typically inhabit the saltwater/freshwater interface in the lower reaches of rivers, foraging over fine-grained sand/silt/mud substrates. Juvenile and adult sturgeon can often use the same micro-habitats (NMFS 1998).

Adult shortnose sturgeon often inhabit short reaches of rivers, or concentration areas in summer and winter, where depth, velocity and substrate conditions combine to create favorable habitat for freshwater mussels, a preferred food item. Shortnose sturgeon will also forage in backwaters and in tidal channels under various levels of salinity (NMFS 1998).

Shortnose sturgeon are considered to be omnivorous. Juvenile sturgeon feed on a variety of benthic aquatic invertebrates (crustaceans, insects, worms, mollusks); adults show a preference for mollusks (NMFS 1998).

4.0 Presence of Listed Species in the Project Area

4.1 Atlantic Salmon

Runs of Atlantic salmon and other anadromous fish were once common in the Union River (Havey 1961), but disappeared in the late 1700s and early 1800s with the construction of dams in the lower portion of the river. Dams at outlets of many of the lakes and ponds in the drainage prevent full access of migratory fish to historical habitat (URFCC 2010).

Annual releases of hatchery-reared Atlantic salmon smolts (one- and two-year-old fish) began in the Union River in 1971, and were continued until 1991, when stocking was suspended due to funding reductions and a redirected focus on wild salmon rivers and the Penobscot River (USASAC 1992). In the last 10 years of the broodstock program of that period, an average of approximately 36,000 smolts were stocked annually. Since 1992, there has been sporadic stocking of salmon fry and parr by the USFWS in the Union River in an effort to continue the restoration effort (Table 2).

In 2011, 19,000 fry and 282 excess brood stock (pre-spawn) were stocked in the West Branch Union River in Amherst (URFCC 2015). Spawning activity was assessed through redd counts near the release location, and over 200 redds were well distributed through the area (Figure 9). Fry stocking did not occur the next two years because of this natural reproduction. The Union River Salmon Association resumed fry stocking in 2014, which has continued each year since. Smolts from radio telemetry studies associated with this Project have also been reported as stocked in the Union River in 2017 (USASAC 2018).

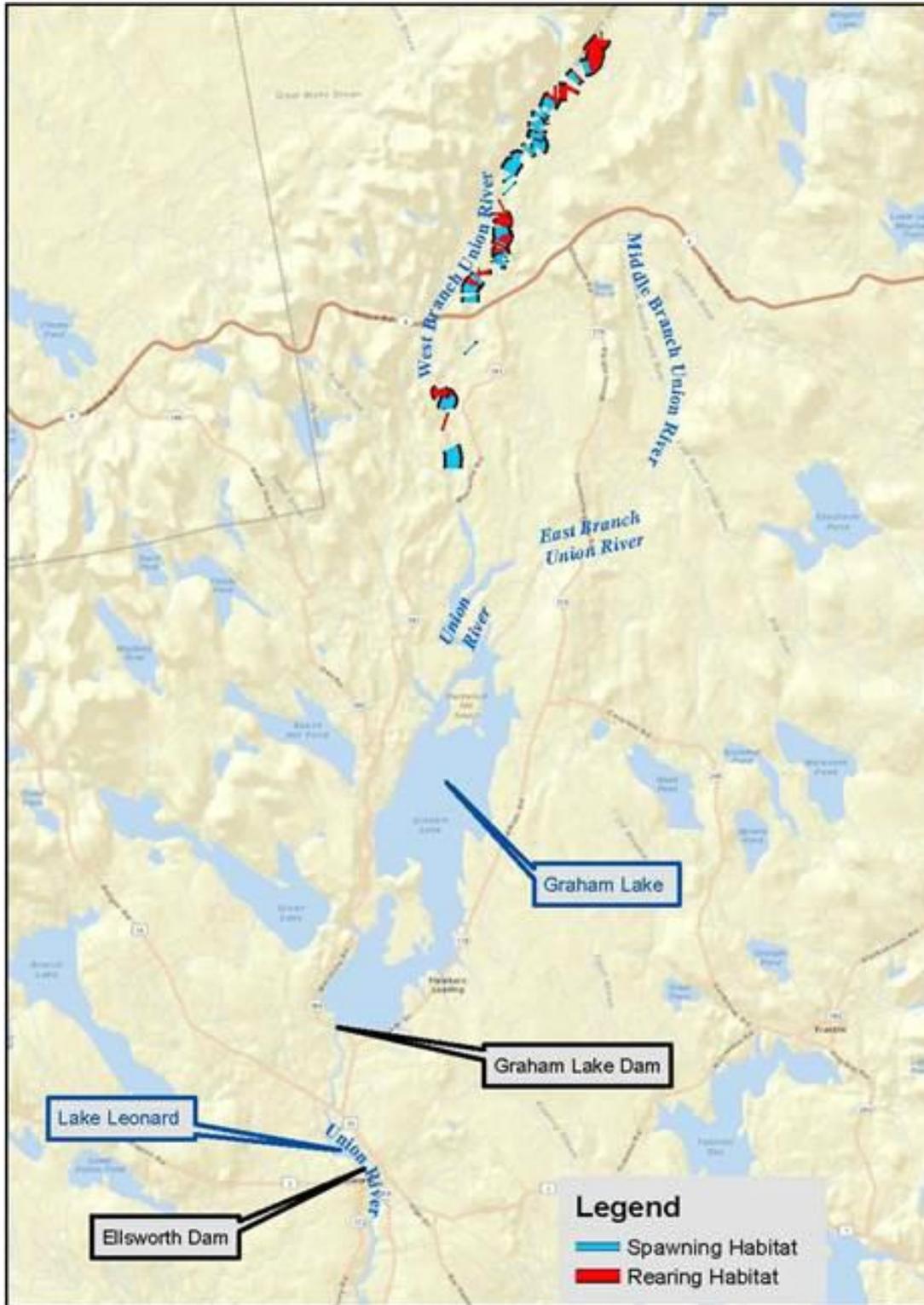
**TABLE 2
NUMBER OF ATLANTIC SALMON STOCKED
BY LIFE STAGE IN THE UNION RIVER**

Year	Fry	0 Parr	1 Parr	2 Parr	1 Smolt	2 Smolt	Adult
1971-2006	440,000	371,400	0	0	379,700	251,000	0
2007	22,000	0	0	0	0	0	0
2008	23,000	0	0	0	0	0	0
2009	28,000	0	0	0	0	0	0
2010	19,000	0	0	0	0	0	0
2011	19,000	0	0	0	0	0	282
2012	Natural recruitment from 282 adult spawners stocked in September, 2011 – no fry stocking						
2013	Natural recruitment from 282 adult spawners stocked in September, 2011 – no fry stocking						
2014	24,000	0	0	0	0	0	0
2015	25,000	0	0	0	0	0	0
2016*	26,000	0	0	0	294	0	0
2017*	25,000	0	0	0	383	0	0

Source: USASAC 2018, Normandeau 2016, 2017.

* Note: The smolts stocked in 2016 and 2017 were the smolts used for the studies conducted by the Licensee in 2016 and 2017.

FIGURE 9
MAP SHOWING LOCATION OF SALMON SPAWNING AND REARING HABITAT
UTILIZED BY ADULT HATCHERY BROODSTOCK RELEASED IN THE UNION
RIVER IN 2011



Source: URFCC 2012.

Completion of the fish trap at the Ellsworth Dam in 1974 has aided in the collection of returning adult salmon. According to Baum (1982), initially, the effectiveness of the facility was hampered by inadequate attraction flow and other operational problems. To improve attraction, water flow at the entrance of the fishway was manipulated by stoplogs, depending upon whether or not the powerhouse turbines were operating. The fishway was determined to be more effective in attracting salmon when turbines were not operating, resulting in reduced river flow. Further, salmon tended to hold in the pool below the trap where they were captured by hand or dip net when the fishway pump was turned off and water drained out of the fishway (Baum 1982). From 1975 to 1981, the fish trap was operated between two and six hours per day depending upon river flow, and one to two days per week generally from June to October. The infrequent schedule for fishway operation was due to the lack of personnel to operate it (the trap was operated by Atlantic Salmon Commission; Baum 1982). Since 2015, the upstream fishway operation has been expanded to seven days a week from May 1 through October 31 (subject to water temperature protocols), with the trap checked for Atlantic salmon multiple times a day from approximately 7 am to 6 pm. Brookfield maintains staff dedicated to monitoring and maintaining the fishway operation.

Adult Atlantic salmon returns to the Union River are shown in Table 3. Prior to aquaculture development in nearby marine areas, salmon origin was determined by fin condition and general appearance; however, this does not conclusively discriminate between aquaculture escapees and hatchery origin salmon. Large numbers of apparent aquaculture escapees were caught in 1996, but not verified with scale analyses.

Since 1999, the resource agencies have examined scale samples from each adult salmon returning to the Union River to determine origin. The assessments of salmon origin show that returns to the Union River since 1993 (i.e., following cessation of the broodstock program) consist of a few hatchery origin strays and a few wild or fry stocked salmon. The former are most likely strays from the Penobscot River. The latter include salmon that originated from fry stocking, natural reproduction, or wild/fry stocked strays from other rivers. A few strays into the Union River that originated from the Penobscot River, or from the other eastern Maine rivers, is consistent with the homing and straying behavior of Atlantic salmon and the typical rate of straying described in the Status Review (i.e., 2% [Fay et al. 2006]). Between 2006 and 2011, no salmon returned to the Union River. Since then, three aquaculture escapees (non-GOM DPS salmon) were captured in

2012, one salmon (wild) returned in 2013, and two (one wild and one hatchery³) in 2014. No adult salmon have been documented returning to the Union River since 2014 (Table 3) (URFCC 2018).

The Union River has about 12,000 units of historic spawning and rearing habitat, of which 4,062 units are considered occupied and functional spawning and rearing habitat (NMFS 2009a). Most (67%) of the potential Atlantic salmon habitat is located in the West Branch of the Union River based on surveys that were conducted in the late 1950s (Havey 1961; Baum 1982)⁴. The main stem of the river and tributaries (above Ellsworth Dam) account for 16 percent of the salmon habitat, with the balance occurring in the East Branch (13%) and Middle Branch (3%) of the system. Using an assumed production of 3.0 smolts/100 square yards of stream bottom, and a marine survival of 1-3 percent, the habitat in the Union River above Ellsworth could generate a self-sustaining run of about 250-750 salmon (Baum 1997). Additional production of adult salmon could result from fish spawning in three minor tributaries below the Ellsworth Dam (Meadow Stream, Patten Stream, and Card Brook).

TABLE 3
UNION RIVER SALMON RETURNS BY ORIGIN

Year	Aquaculture*	Hatchery	Wild	Total
1973 - 1986	0	1892	4	1896
1984	undetermined	40	0	40
1985	undetermined	82	0	82
1986	undetermined	67	0	67
1987	undetermined	63	0	63
1988	undetermined	45	2	47
1989	undetermined	30	0	30
1990	undetermined	21	0	21
1991	undetermined	2	6	8
1992	undetermined	4	0	4
1993	undetermined	0	0	0
1994	undetermined	0	0	0
1995	undetermined	0	0	0
1996	undetermined	68	1	69
1997	undetermined	8	0	8
1998	undetermined	13	0	13

³ Wild and hatchery Atlantic salmon returning to the Union River are considered part of the GOM DPS.

⁴ As noted, in 2011, 19,000 fry and 282 excess brood stock (pre-spawn) were stocked in the West Branch Union River in Amherst (URFCC 2015). Spawning activity was assessed through redd counts near the release location, and over 200 redds were well distributed through the area (Figure 9).

Year	Aquaculture*	Hatchery	Wild	Total
1999	63	6	3	72
2000	3	2	0	5
2001	2	0	0	2
2002	6	5	0	11
2003	0	1	0	1
2004	0	1	1	2
2005	4	0	0	4
2006	0	0	0	0
2007	0	0	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	3	0	0	3
2013	0	0	1	1
2014	0	1	1	2
2015	0	0	0	0
2016	0	0	0	0
2017	0	0	0	0

Source: URFCC 2018.

* Aquaculture fish are not considered GOM DPS Atlantic salmon.

Note: Salmon returns before 2000 included rod and trap captures.

4.2 Atlantic Sturgeon and Shortnose Sturgeon

Atlantic sturgeon have been observed in the Union River below Ellsworth Dam, according to state fishery personnel. The status of the populations of Atlantic sturgeon and shortnose sturgeon, which may also occur in the river, is unknown at this time (URFCC 2010). In the Status Review of Atlantic sturgeon, it was noted that, “The geomorphology of most small coastal rivers in Maine is not sufficient to support Atlantic sturgeon spawning populations, except for the Penobscot and the estuarial complex of the Kennebec, Androscoggin, and Sheepscot Rivers,” though subadults may use the estuaries of smaller coastal drainages during the summer months (Atlantic Sturgeon Status Review Team 2007). Zydlewski et al. (2011) found that shortnose sturgeon use small coastal rivers as they migrate between the Kennebec and Penobscot Rivers.

Historically, Atlantic and shortnose sturgeon had very limited access to the Union River. From review of the limited bathymetry data of the original river channel that has been inundated by

Leonard Lake, there may be steep gradient reaches that would have historically kept Atlantic and shortnose sturgeon from accessing the Union River above the site of the Ellsworth Dam. Specific to the Union River, NOAA-Fisheries deployed acoustic monitoring receivers in the Union River approximately 1.5 km downstream of the Ellsworth Dam between 2008 and 2016. During this time, two acoustic-tagged Atlantic sturgeon were detected in the vicinity, the first on June 20, 2011, and the second on June 23 and June 24, 2014 (Pers. Comm., G. Goulette, NOAA-Fisheries, March 30, 2018).

5.0 Potential Effects from Existing Conditions on Listed Species

5.1 Atlantic Salmon

The following section examines the effects of existing Project conditions and operations on various life stages of Atlantic salmon. Section 6 describes the additional measures and actions included in the proposed SPP and evaluates the effects of those measures and actions to improve Atlantic salmon protection at the Project.

5.1.1 Life Stage Assessments of Project Interactions

The Union River in the Project area serves as a migration corridor to suitable spawning habitat upstream of the Project. There is no documented salmon spawning and rearing habitat downstream of the Project. Thus, the life stages of Atlantic salmon affected by the Project include adults migrating upstream to spawn and downstream migrating smolts and kelts (Fay et al. 2006). Some of the effects of the existing Project on Atlantic salmon adults and smolts have been reduced through provision of upstream fish passage (vertical slot upstream fish passage and trapping facility) and downstream fish passage (downstream fish bypass facility integral at each dam). The additional measures included in the proposed SPP and described in Section 6 will provide further protection for these life stages of Atlantic salmon.

5.1.2 Upstream Passage

This section evaluates the effects of the existing Ellsworth Project and its operation on upstream passage of adult Atlantic salmon.

The upstream fish passage facility at the Ellsworth Project is designed to trap Atlantic salmon and other anadromous fish and to transport fish to suitable upstream habitat located above the Project dams. Trap and transport systems have been used successfully to pass other species, such as for shad restoration on the Susquehanna River and river herring restoration in the Sebasticook River. Sigourney et al. (2015) evaluated trap and transport of Atlantic salmon on the Penobscot River over four mainstem dams and found it increased arrival success, decreased transit time, and that fish transport did not strongly influence passage.

The existing Ellsworth Dam fishway trap and transport facility is managed in consultation with the agencies, and historically, MDMR has annually directed Black Bear whether to transport any returning adult Atlantic salmon upstream of the Project. The vertical slot upstream fish passage and trap and transport facility enhances habitat connectivity by providing migrating adults entering the Union River with access to suitable spawning habitats upstream. However, trapping, trucking, and transporting of adult Atlantic salmon can potentially have adverse effects from migration delay/interruption, and handling and holding stress or injury.

Empirical studies to evaluate the upstream passage effectiveness for adult Atlantic salmon at Ellsworth Dam have not been conducted to date, primarily due to a lack of available study fish. However, in 2015, Black Bear conducted an Upstream Atlantic Salmon Passage Study to evaluate whether increased operations at the trapping facility resulted in an increase in the capture, or rate of capture, of adult Atlantic salmon. The Ellsworth Dam fishway trap was operated from sunrise to sunset from May 1 to October 31 and checked at least four times a day. No Atlantic salmon were collected or observed in 2015, nor in any following years (through 2018) at the Ellsworth Project.

Hydroelectric facilities may also result in delays of upstream migration of Atlantic salmon. Several studies on the Penobscot River have evaluated upstream passage behavior, including the time needed for individual adult salmon to pass upstream (via fishway) of various dams once detected in the vicinity of a spillway or tailrace. These studies have documented certain migratory behaviors that may contribute to migration delays, including frequent upstream and downstream movement, periods of holding in fast water, seeking thermal refuge in tributaries, attraction to spillage at dams, reduced migratory behavior in late summer, and inhibited movement at temperature above 23°C (Power and McCleave 1980, Shepard 1995).

On the Union River, as part of the ongoing relicensing of the Project, Black Bear reviewed historic information relating to Ellsworth Project operations and environmental conditions during historic captures of Atlantic salmon to assist in evaluating the efficacy of the trap and truck facility and operations (Black Bear 2014). Recorded data on fishway operations when salmon were captured were available for years 2002 to 2005. There were no apparent trends in salmon captures and flow conditions, as salmon were collected over a wide range of river flows from summer flows as low as 48 cfs to the higher June flow of 937 cfs. Salmon were also captured over a range in temperatures

up to 74 degrees Fahrenheit (°F). The fish trap was not operated when water temperatures were at or exceeded 77°F, as per direction from Atlantic Sea-Run Salmon Commission and MDMR protocol. Temperatures in the upper seventies are more typical of late summer when salmon are not expected to be entering the river, or would be expected to be holding in thermal refugia. It was assumed that the fish trap at the Ellsworth Dam would be closed for up to a week or two each year when temperatures exceed 77°F. (Water quality studies in 2013 confirmed water temperatures in excess of 77°F in the river reach below Graham Lake.)

The MDMR protocol was revised in 2015 (MDMR 2015 draft), and the current MDMR protocol for the Union River is to minimize handling of Atlantic salmon when the river temperature exceeds 73.4°F; therefore, any Atlantic salmon collected in the trap are to be adipose punched and returned immediately to the river adjacent to the trap (MDMR 2018). Black Bear follows the current MDMR protocol.

Run size relative to fishway design and operation can also be a contributing factor to migration delay. Baum (1997 *cited in* URFCC 2010) used an assumed production of 3.0 smolts/100 square yards of stream bottom, and a marine survival of 1 - 3 percent, and estimated the habitat in the Union River upstream of the Ellsworth Project could generate a self-sustaining run of about 250 - 750 Atlantic salmon. More recently, marine survival has been estimated to be 0.09 to 1.02 percent, from 1995 to 2004 (ICES 2008 *cited in* USFWS and NMFS 2009); which would result in a run of approximately 250 or less fish based on the Baum assumptions.

Fisheries management agencies have expressed a concern for the safe, timely, and effective passage of Atlantic salmon adults at the Ellsworth Dam fishway, especially during river herring harvest operations, and the potential for migration delay due to fishway crowding or infrequent trap and transport operation. Under current operations, the trap and hopper are visually inspected for Atlantic salmon. If one is spotted, the hopper is left in the water and the salmon is dip-netted out and placed in a holding tank. The salmon is then measured, examined for fin clips, fin wear, or other markings; a scale sample is taken; and the magnified scale image and fish photo is digitally captured. This information is transmitted to the MDMR, which then determines whether the Atlantic salmon caught in the fishway are to be released downstream of the Ellsworth Dam (unknown origin, or lack of direction from MDMR); moved via transport tank truck upstream (GOM hatchery origin or wild fish) and released in the West Branch of the Union River,

approximately 17 miles upstream; or removed (aquaculture escapees). Generally, this process takes one to two hours.

The Ellsworth Dam fishway trap and transport facility was originally designed and operated to pass Atlantic salmon. Historically, the facility handled up to 263 adult Atlantic salmon broodstock in a year, including times concurrent with alewife harvesting. Between 2000 and 2015, trap and transport facilities and operating protocols at Ellsworth provided for the handling of 190,000 to 1,200,000 river herring and 0 to 8 Atlantic salmon, annually.

In 2014, Black Bear examined the Ellsworth fishway hopper capacity for salmon with regard to the estimated maximum self-sustained run size of 750 Atlantic salmon (Baum 1997 *cited in* URFCC 2010), and found that the Ellsworth lift hopper has more than four times the required capacity to pass a run of 750 Atlantic salmon (Black Bear 2014). Many river herring also use the trap, and there is concern that this could limit Atlantic salmon use during peak periods of the river herring run. Black Bear conducted an Upstream Fish Passage Alternatives Analysis as part of the Ellsworth Project relicensing process that evaluated the adequacy of the existing fishway facility to handle design populations of multiple species and potential fishway modifications and alternative designs (e.g., excluding river herring from the hopper; the Upstream Fish Passage Alternatives Analysis was included as an appendix to the December 2015 License Application).

The upstream fishway and trap and truck facility has not been tested for efficiency and safe handling of Atlantic salmon due in part to the lack of adequate numbers of returning adults. Based on the literature review of effects of other similar fishways, operation of the Ellsworth fishway may affect adult Atlantic salmon through migration delay. Some adult Atlantic salmon that successfully used upstream fishways or had been transported and released upstream have been known to drop back downstream. In studies of upstream migrating adult Atlantic salmon in the Penobscot River, Sigourney et al. (2015) observed a 2.4-2.6% fallback rate for trucked salmon. Spencer et al. (2010, 2011) observed variable fallback rates. Study fish were collected at the Veazie Dam fishway in late spring/summer and then transported and held at the Craig Brook National Fish Hatchery until the fall spawning season. The selected study fish were tagged and released in early October in the upper Piscataquis River, approximately 150 km upstream from the original Veazie capture site in the lower Penobscot River. Nearly half of the study fish moved downstream immediately after release, with the distance traveled varying from a few kilometers to 152 km.

Many of the study fish then resumed upstream movement, while some were suspected to have spawned at other locations. The authors theorized that some of the tagged Atlantic salmon were homing to their original smolt release site near Bradley (Spencer et al. 2010).

Migratory delays for upstream migrating salmon may also be affected by river flow. During the Ellsworth Project relicensing, agencies expressed concern that Project peaking flows may be affecting aquatic habitat and upstream passage effectiveness downstream of the Ellsworth Dam. During the Upstream Fish Passage Study conducted by Black Bear in 2014 and 2015, it was consistently observed that anadromous fish (river herring) occurrence and densities in the river downstream of Ellsworth Dam were higher in the afternoon and evening (prior to sunset) hours, regardless of river flow or other conditions. A review of Project operations/river flow data did not indicate that fish migration or fishway numbers responded to changes in flow. Because river herring are a weaker swimming fish species compared to other diadromous species (Bell 1991) and can access the river below Ellsworth Dam, it is expected that turbine discharge would not affect other diadromous fish species from accessing Ellsworth Dam.

5.1.3 Downstream Passage - Smolts

This section evaluates the effects of the existing Ellsworth Project and its operation on downstream passage of Atlantic salmon smolts. During relicensing, Black Bear conducted downstream Atlantic salmon smolt studies. Black Bear has also undertaken significant additional measures to enhance downstream smolt passage at the Ellsworth Project dams, including structural and operational modifications to the downstream passage facilities. The effects of the existing Project conditions, including recent modifications to downstream passage facilities and operations undertaken by Black Bear are discussed herein. Section 6 describes and evaluates the effects of additional measures for downstream passage of Atlantic salmon smolts to be undertaken in the proposed SPP, which includes the installation of trashracks with reduced clear-spacing (i.e., 1-inch, clear-spaced, full-depth trashracks), modification to the downstream fishways, and improved guidance to these fishways.

Downstream passage facilities are provided at both of the Project dams. The downstream fish passage facility at each of the dams consists of a stoplog-controlled surface weir leading to a plunge

pool immediately downstream of each dam. Historically, the downstream fish passage weirs have been operated from April 1 to December 31 each year, as river conditions allow.

The presence of dams can potentially affect downstream migrating Atlantic salmon smolts in several ways. Dams can cause downstream migration delays for salmon smolts. Also, if salmon pass through the turbines, there is a risk of injury or mortality from blade strike or other factors. To further understand the effects of the Ellsworth Project dams on Atlantic salmon smolts, Black Bear conducted a desktop fish entrainment and downstream passage assessment, as well as undertook 2 years (2016-2017) of downstream smolt passage studies at the Project, which are described below.

5.1.3.1 Downstream Fish Passage Studies

In a 2014 relicensing study, Black Bear conducted a desktop fish entrainment and downstream passage assessment (referred to as the Downstream Fish Passage Study [Black Bear 2014]) to evaluate downstream passage at the Project for Atlantic salmon smolts and kelts (along with other species), including the potential for entrainment, turbine-induced mortality, migratory route selection, and whole station survival. The results of this study are reported in the Initial Study Report (Black Bear 2014). Following the 2014 desktop Downstream Fish Passage Study (Black Bear 2014), Black Bear conducted two field seasons of empirical downstream salmon smolt passage studies in 2016 and 2017. These studies were designed to examine the effectiveness of the downstream passage facilities at Ellsworth. The study plan for the 2016 effort was prepared in consultation with the agencies and in accordance with FERC's December 30, 2014 Determination on Requests for Study Modifications and New Studies for the Ellsworth Hydroelectric Project. The study plan was filed with FERC on March 31, 2015, and approved by Order from the FERC dated April 21, 2015. The study was conducted in spring 2016, and based on those results, a second year of study was proposed and conducted in 2017 to evaluate temporary downstream passage modifications made at both dams. In addition, Black Bear voluntarily conducted an independent study of direct injury and relative survival of fish (juvenile brown trout used as surrogate for Atlantic salmon smolts) that were passed through each turbine type, as well as through the downstream fishway at the Ellsworth Dam (Normandeau 2016, 2017).

Graham Lake Dam

At the Graham Lake Dam in 2016, only 23 percent (23 of 100 smolts) of the smolts released upstream approached the dam and were passed downstream. The median residence time for these smolts was 79.8 hours (range = 2.1-287.4 hours; average = 106.5 hours) (Table 4). Based on the 2016 study results, Black Bear, in consultation with the agencies, undertook some modifications to the downstream passage weir at Graham Lake Dam to try to improve the approach, reduce delay, and increase downstream smolt passage rates and survival. The approach to the downstream passage weir at Graham Lake Dam was modified by adding a sloped floor, two side panels, and a bell-shaped entrance to create an Alden weir to improve approach velocities and fish attraction to the weir. The smolt study was repeated in 2017 following these modifications. In addition, test smolts were released in a different location in 2017 and additional telemetry monitoring locations were added. The 2017 smolt study found improved passage results when 83 percent (86 of 104) of the smolts released upstream approached and passed downstream of Graham Lake Dam. Most of these smolts (73%) utilized the modified downstream bypass route (Table 4), and 67 percent of the smolts that passed downstream of Graham Lake Dam in 2017 did so in less than 24 hours (Normandeau 2016, 2017).

In summary, in 2016 survival of smolts that passed through Graham Lake Dam was 14 percent (95% CI = 8.0 – 21.0%), and included mortality from background effects (e.g., predation), along with direct Project-related effects. In 2017, following modifications to the downstream passage weir, smolt survival at Graham Lake Dam increased to 74.4 percent (95% CI = 65.5 – 82.5%) in 2017, and 82.2 percent (95% CI = 68.4 – 98.2%) when corrected for background mortality (Normandeau 2016, 2017) (Table 4). Comparison of these results suggest that the weir modifications to create an Alden weir improved passage conditions at Graham Lake Dam. Other factors that may have contributed to the improved downstream passage and movement rates were higher spring flows in 2017 compared to 2016, and changes in smolt release location (Normandeau 2017).

TABLE 4
GRAHAM DAM 2016 AND 2017 DOWNSTREAM SMOLT PASSAGE
STUDY RESULTS

	2016	2017
Residence Time	median = 79.8 hours range = 2.1-287.4 hours mean = 106.5 hours	median = 5.6 hours range = 0.1 – 118.1 hours mean = 20.7 hours
Passage Route Utilization	NA	73% bypass 27% undetected during passage or through bottom opening gates
Survival	14% (95% CI = 8.0 – 21.0%) – not corrected for background mortality	74.4 percent (95% CI = 65.5 – 82.5%) – not corrected for background mortality 82.2% (95% CI = 68.4 – 98.2%) – corrected for background mortality

Ellsworth Dam

Acoustic-tagged smolts were utilized in the 2016 and 2017 Ellsworth Dam survival studies to track smolts downstream of the Project and into brackish water. Radio tags were also detected in the 2016 study, and survival was calculated for radio-tagged and acoustic-tagged smolts in 2016 (but not in 2017). In the 2016 study, survival for radio and acoustic-tagged smolts were comparable at the Ellsworth Dam (73.7% [95% CI = 61.4 – 84.2%] for acoustic-tagged smolts; 74.6% [95% CI = 64.8 – 84.5%] for radio-tagged smolts). Background mortality was not accounted for in the 2016 study. In 2016, 59.1 percent of radio-tagged smolts passed downstream through Units 2 and 3⁵, and 37.9 percent via the downstream fish bypass system at the Ellsworth Dam⁶ (Table 5) (Normandeau 2016).

Since the 2016 study showed a high level of smolt passage through the Ellsworth powerhouse and high residence times in the forebay, three approximately 7-foot-wide sections of flashboards adjacent to the existing downstream passage weir were removed to provide an additional bypass passage route through the flashboard section and over the spillway for the 2017 study. In addition, Black Bear resurfaced the section of spillway below the area of removed flashboards to limit injury of smolts utilizing this passage route.

⁵ Unit 1 was not operated during the 2016 smolt study due to low river flows that study year.

⁶ Passage Route percentages do not total 100% because passage routes could not be identified for several radio-tagged smolts each study year.

These modifications resulted in mean and median residence time improvements in 2017 (median = 1.5 hours; range = 0.2 - 39.5 hours; mean = 5.6 hours), compared to 2016 (median = 17.9 hours; range = 0.6 - 213 hours; mean = 29.9 hours) for radio-tagged smolts. Similarly, the 2017 acoustic-tagged smolts had a median residence time of 5.7 hours (range = 0.1 – 104.2 hours; mean = 16.6 hours), compared to 21.9 hours (range = 0.1 – 355.7 hours; mean = 55.1 hours) for acoustic-tagged smolts in 2016 (Table 5). It is also possible that higher mean river flow in 2017 contributed to reduced residence time.

In addition, the flashboard removal combined with operation of Unit 1 created more downstream passage route options for smolts at the Ellsworth Dam in 2017 compared to 2016. In 2017, 30.6 percent of radio-tagged smolts passed through the open flashboards, with 59.4 percent through Units 1-3, and 6.6 percent via the downstream fish bypass system. The percentage of smolts passing through the turbines was similar for both years of study. In 2017, the Ellsworth Dam smolt survival (including background mortality) was estimated at 62.3 percent (95% CI = 48.6 – 74.2%), and at 80.8 percent (95% CI = 64.4 – 93.6%) when corrected for background mortality (Normandeau 2016, 2017) (Table 5).

**TABLE 5
ELLSWORTH DAM 2016 AND 2017 DOWNSTREAM SMOLT PASSAGE
STUDY RESULTS**

	2016	2017
Residence Time (radio-tagged smolts)	median = 17.9 hour range = 0.6 - 213 hour mean = 29.9 hour	median = 1.5 hour range = 0.2 - 39.5 hour mean = 5.6 hour
Residence Time (acoustic-tagged smolts)	median = 21.9 hour range = 0.1 – 355.7 hour mean = 55.1 hour	median = 5.7 hour range = 0.1 – 104.2 hour mean = 16.6 hour
Passage Route Utilization	59.1% through turbines 37.9% bypass	59.4% through turbines 6.6% bypass 30.6% through open flash boards
Survival (radio-tagged smolts)	74.6% (95% CI = 64.8 – 84.5%) – not corrected for background mortality	NA
Survival (acoustic-tagged smolts)	73.7% (95% CI = 61.4 – 84.2%) – not corrected for background mortality	62.3% (95% CI = 48.6 – 74.2%) - not corrected for background mortality 80.8% (95% CI = 64.4 – 93.6%) - corrected for background mortality

5.1.3.2 Delayed Mortality

Delayed mortality is a potential effect from smolt passage at hydropower projects. There is considerable uncertainty regarding how to assess indirect survival (delayed mortality), given the difficulty in measuring it (NMFS and USFWS 2005). Indirect survival, or delayed mortality, has been evaluated at some west coast projects. Alden (2012) used results from these studies that averaged 93 percent for indirect survival, and based on professional judgment, suggested that indirect survival would be 95 percent for Atlantic salmon passing the Penobscot River hydroelectric projects in Maine, due to the low head relative to the west coast projects where the studies were performed. The results of some more recent studies conducted on the Penobscot River system have attempted to quantify differences in survival for smolts migrating through free-flowing river reaches and impounded river reaches and decreased estuarine survival for smolts migrating past multiple dams (Stich et al. 2015). However, challenges remain in regards to quantifying delayed or indirect mortality and, therefore, neither was included as part of this analysis. Rather, only direct survival was evaluated for smolt passage at Ellsworth and Graham Lake dams (Black Bear 2014).

An Injury and Survival Study was performed at the Ellsworth Project as part of the 2017 Downstream Smolt Passage Effectiveness and Survival Study, which address delayed mortality. Results of this study found that juvenile salmonids survived one hour after passage at estimated rates of 84.4 percent, 65.9 percent, and 98.1 percent for Unit 1 (vertical shaft propeller turbine), Unit 2 (Kaplan turbine), and the downstream fish bypass system, respectively. The 48-hour, after-passage survival rate estimates were 81.0 percent, 62.4 percent, and 96.2 percent, respectively. The dominant injuries observed for fish through Unit 1 were bruising (5.6%), severance/decapitation (3.7%), and broken bones (3.7%). Unit 2 injuries included 8.1 percent severance/decapitation, and 8.1 percent gill/operculum damage. Only two fish were injured passing through the downstream bypass system. Compared to other similar studies, the survival estimates are lower and injury rates are higher for the Kaplan turbines (Units 2 and 3) at the Ellsworth Dam than at other hydropower facilities. This may be attributed to the small runner diameter and high runner speed of the Ellsworth turbines compared to other Kaplan units studied; these are known parameters that affect survival (Normandeau 2017). Unit 2 is composed of the smallest runner diameter and highest runner speed compared to all other Kaplan/propeller type turbines evaluated using the HI-Z tag methodology. Two general trends observed from previous

studies suggest that survival decreases with an increase in runner speed and survival increases as runner diameter increases. The relatively small diameters (4.65 and 5.0 feet) and rotational speeds of the runners (200 and 360 rpm) of Units 1 and 2, respectively, increase the probability of injury and mortality during passage through these units (Normandeau 2017).

5.1.4 Downstream Passage - Kelts

As kelt abundance at the Ellsworth Project is currently low, there is no information on Atlantic salmon kelt passage for the Ellsworth Project. However, based on evaluations done for salmon kelts on the Penobscot River, summarized below, it is assumed that kelts at Ellsworth would pass over the spillways, through the downstream bypasses, or, depending on trashrack spacing, through turbines during out-migrations.

Downstream passage success of kelts was assessed on the Penobscot River at Weldon Dam and several other sites in the lower Penobscot River (GNP 1989, Shepard 1989, Hall and Shepard 1990). The study fish were hatchery kelts that were tagged and released in the spring, and the kelts tended to move downstream with high flows in early spring (mostly April through early May). Some of the adult salmon tagged at Weldon Dam during the fall upstream spawning migration returned downstream after spawning, and several of these pre-spawn tagged salmon returned downstream prior to spawning, indicating they may have been imprinted on other areas in the watershed and were trying to locate these areas (GNP 1989).

Kelt studies in the lower Penobscot River documented that most kelts passed the dams during high flow periods, typically over the spillways, but also through gates and sluices (Hall and Shepard 1990). The initial approach of kelts at the Veazie and Milford Dams reflected the distribution of flow, which means the proportion of kelts that approached spillways was highly correlated with spillway flow. Similarly, at the confluence of the Stillwater Branch and the main stem, kelts followed the routes in approximate proportion to flow in the two channels (Shepard 1989). Kelts that approached powerhouse intakes were deterred by trashracks and sought alternative routes of passage, typically passing via spillage after hours to days at the site (GNP 1989, Hall and Shepard 1990) and there were no mortalities in the two years of study (Hall and Shepard 1990).

In 2010, eight fish that migrated downstream of Veazie Dam were recaptured 17 days after being released in the Piscataquis River, and “appeared in excellent condition and showed no adverse

effects from passing downstream over multiple (seven) dams” (Spencer et al. 2011). Spencer et al. (2010) reported a number of tagged Atlantic salmon passing downstream over multiple dams, including a gravid female that was resuming upstream migration and appeared in excellent health despite passing seven dams. It should be noted that in normal flow years, the Ellsworth Dam spills about 11 percent of the time in May, while it spills about 21 percent of the time in April. In addition, the Ellsworth Dam spills approximately 16 percent of the time during the downstream kelt passage season (November 1 – June 1).

From the 2014 desktop Downstream Fish Passage Study (Black Bear 2014) briefly summarized above, Atlantic salmon kelts are expected to be fully excluded by trashrack spacing at the Project (2.44-inch clear space at Unit 1, and 1.0-inch on the top half, and 2.37 inches on the bottom half on Units 2, 3, and 4). This finding is supported by a downstream passage assessment conducted by Alden (2012), which suggests 100 percent kelt exclusion at Maine hydroelectric projects with trashrack clear-spacing less than 2.4 inches. Kelts could experience impingement on trashracks if hydraulic conditions exceed the kelt’s swimming capabilities; however, according to observed burst swim speeds of adult salmon ranging from 16.5 to 19.7 feet per second (Wolter and Arlinghaus 2003), salmon kelts can easily avoid involuntary entrainment or impingement, and have no risk of entrainment due to their inability to pass through trashracks less than 2.4 inches (Alden 2012), and would likely have a 100 percent bypass effectiveness rate at the Project (via downstream bypass, or over the spillway if spill is occurring).

The Ellsworth Project’s effects on downstream passage of Atlantic salmon kelts are expected to be improved through the implementation of the proposed SPP actions described in Section 6, which includes the installation of trashracks with reduced clear-spacing (i.e., 1-inch, clear-spaced, full-depth trashracks), modification to the downstream fishways, and improved guidance to these fishways.

5.1.5 Migration Delay

Smolt migration from freshwater to estuarine environments must be completed during a brief period of suitable environmental conditions—what researchers have termed a “smolt window”—or they may suffer irreversible effects that reduce their survival upon entering seawater (McCormick et al. 1999). Studies of Atlantic salmon smolt migration at other locations have

documented certain migratory patterns, diel behaviors, responses to hydroelectric project structures, and effects of water temperature and river flow.

Smolt migration is primarily nocturnal in the early phases of the run (Ruggles 1980, Mudre and Saunders 1987, Shepard 1991). During the later phases of the smolt run, smolts exhibit movements throughout the day. During daylight, smolts generally cease migrating and hold station to avoid predators, most of which use vision to locate their prey. Daytime holding habitats tend to have characteristics similar to large parr habitats (i.e., moderate velocity, shallow depth, and large substrates), when these habitats are available (BPHA 1994).

Barriers may affect the timing of the smolt migration. Migrating fish that do not reach the sea within the physiological smolt window may start reverting to the parr condition (Hoar 1988, Nielsen et al. 2001, Shrimpton et al. 2000). Thus, any significant delay of smolts may result in fish either becoming residents or reaching the estuary in sub-optimal physiological condition (McCormick et al. 1998; Shrimpton et al. 2000). Late migrants lose physiological smolt characteristics due to high water temperatures during spring migration (McCormick et al. 1999).

The onset of the smolt migration has often been linked to a thermal threshold of 10°C, although the rate of increase may be a more important environmental stimulus than the absolute temperature (Jonsson and Ruud-Hansen 1985). While not specifically assessed in the Union River, naturally-reared and wild smolts in Maine typically enter the sea during May to begin their ocean migration (Fay et al. 2006). In the Penobscot River, smolts migrate between late April and early June with a peak migration in early May (Fay et al. 2006). The peak of movement shifted from year to year in response to environmental conditions (Bakshtansky et al. 1976, Jonsson and Ruud-Hansen 1985). Smolt migratory movement is a combination of passive entrainment with flow, particularly in areas of high water velocity, and active swimming (Ruggles 1980). Active swimming speeds may exceed 1 meter per second for prolonged periods (Vanderpool 1992, Shepard 1993) and can include directed movement through very large lakes and reservoirs in the absence of rheotactic cues (Bourgeois and O'Connell 1986).

At the Ellsworth Project, smolts may pass the Project facilities through a combination of routes. At the Graham Lake Dam, smolts may pass either via the dedicated passage weir, or via the Tainter gates when they are open. At the Ellsworth Dam, smolts may pass via the three dedicated passage weirs that constitute the downstream fish bypass system, via spill depending on operations/river

flow, or via the turbines. Results of passage route utilization and residency time within the Graham Lake Dam and Ellsworth Dam headponds during the 2016 and 2017 studies were presented above.

No information on Atlantic salmon kelt migration is available for the Ellsworth Project, but evaluations were conducted on the Penobscot River. MDMR research tracking tagged adult salmon (transported from Veazie Dam to spawning habitat in the Piscataquis River) has shown that adults can drop downstream quickly past many dams (Spencer et al. 2010, 2011). Researchers noted that “the presence of dams did not appear to impede downstream movement of motivated salmon and some fish passed seven dams in as many days.” In two years of kelt telemetry studies at Veazie and Milford Dams, 35 of 49 kelts were delayed less than 2.0 hours (minimum – 0.1 hour, maximum – 155 hours) before finding a safe route of passage in spilled water.

The Ellsworth Project’s effects on migration delay for Atlantic salmon are expected to be improved through the implementation of the proposed SPP actions described in Section 6, which includes improvements to upstream and downstream fish passage facilities. Also as discussed in Section 6, Black Bear is committed to achieving upstream and downstream performance standards under the new license.

5.1.6 Habitat in Project Area

The Union River watershed is listed as critical habitat for Atlantic salmon (See Section 1.2.2). The Union River contains two main stem dams (the Ellsworth and Graham Lake Dams) and numerous tributary dams, primarily at the outlets of lakes and ponds. The Project’s upstream passage (trap and truck from the Ellsworth Dam) and downstream passage facilities (at both dams) allow access to spawning and rearing habitat but the efficacy of this passage method has not been tested, primarily due to low numbers of returning salmon. Further, low-level stocking has occurred; consequently, very few salmon parr would be expected to utilize the habitat for growth and development to the smolt stage prior to out-migration through the Project area. The proposed SPP actions described in Section 6 are expected to provide increased access to and utilization of habitat in the Project Area.

5.1.6.1 Project Impoundments

Graham Lake is about 10 miles long with a surface area of approximately 10,000 acres; Graham Lake is relatively shallow, with an average depth of approximately 17 feet, and it showed only weak short-term stratification during water quality studies conducted in 2013. The temperature in Graham Lake was fairly uniform through the water column on each of the summer sampling dates. Lake Leonard is about one mile long with a surface area of 90 acres; it averages 25 feet deep and is approximately 55 feet deep at its deepest point. Lake Leonard showed some thermal stratification during the 2013 studies. Article 402 of the 1987 FERC license specifies that the licensee operate the Ellsworth Project so that the following normal water levels are maintained: Lake Leonard 1-foot fluctuation (65.7 feet to 66.7 feet) and Graham Lake 10.8-foot fluctuation (93.4 feet to 104.2 feet). As stated in Section 2.2, Black Bear has proposed in the December 2015 application for a new license to continue these fundamental operating parameters for the Ellsworth Project.

In general, dam impoundments increase water depth, increase the water retention time (decreased flushing rate) within a given river reach, and dampen daily fluctuations in water temperatures (FERC 1997). Large and deep reservoirs that thermally stratify in summer may release water that is warmer or colder than ambient inflows, depending on the depth of withdrawal in relation to the depth of the thermocline, whereas run-of-the-river impoundments are typically shallow and have little effect on water temperatures (EPA modeling conducted on the Columbia River; Public Utility District No. 1 of Chelan County 2005). Water quality studies conducted at Graham Lake during relicensing did not show significant stratification, and therefore the depth of discharge would not affect outflow temperatures. Impoundment conditions that result in reduced flow cues can result in migratory delay and result in habitat changes that are preferred by warmwater species that prey on juvenile Atlantic salmon, such as largemouth and smallmouth bass (NMFS and USFWS 2015). Impounded waters can also result in slower water velocities which may result in longer migration times and increased risk of predation. The 2016 downstream smolt passage study estimated an impoundment mortality rate for the 15.5 km study reach in Graham Lake, which equates to 0.97%/km. This mortality rate is in line with mortality rates observed for Atlantic salmon smolts in riverine reaches (free flowing and impounded) of the Penobscot, Kennebec, and Androscoggin rivers (Normandeau draft 2018).

Additional study is needed to better understand the impoundment mortality rate and predation risk of salmon smolts moving through Graham Lake from the West Branch Union River where the spawning and rearing habitat is located.

Graham Lake provides a majority of the spawning and rearing habitat for river herring in the Union River watershed, and Black Bear's trap and transport efforts have allowed for development of one of the largest alewife runs in the country. NMFS has suggested that increased river herring populations may provide some predation buffer to Atlantic salmon (NOAA 2009). Atlantic salmon adults (depending on their origin) collected in the upstream fish trap are transported upstream of Graham Lake where they have access to suitable spawning habitat in the West Branch of the Union River and other tributaries.

5.1.6.2 Riverine Sections

The Ellsworth Project operates in a store and release mode while maintaining minimum flows and modest generation at all times. The current Project license requires that Black Bear release a continuous minimum flow of 105 cfs from the Graham Lake Dam and the Ellsworth Dam from July 1 through April 30, and a continuous minimum flow of 250 cfs from May 1 through June 30 to protect fishery resources. Black Bear proposes to continue these minimum flows under the terms of a new license. Because the Ellsworth Project starts at the head of tide, there are no Project flow effects on juvenile salmon habitat below the dam. Observations below the Ellsworth dam indicate the river bed remains watered under minimum flow conditions with no evidence of areas of potential stranding.

Minimum flow releases from the Project dams have protected and maintained the area fisheries. This was demonstrated in the relicensing study (Instream Flow and Union River Tributary Access Study [Black Bear 2015]) conducted in 2014. Flows analyzed included two low flows (150 and 300 cfs), a mid-range flow (1,230 cfs), and a high level (2,460 cfs) generating capacity flow. The study found that aquatic habitat criteria for Atlantic salmon are sufficient at all flows analyzed. In addition, a zone of passage is provided throughout the Union River during the observed low flows. Projecting the hydraulic parameter curves from 150 cfs to the target 105 cfs, the depths and velocities throughout the study reaches continued to meet the aquatic habitat criteria, and the wetted widths of the channel provided habitat connectivity and an adequate zone of passage for Atlantic salmon (Black Bear 2015).

Pursuant to Article 404 of the current FERC license, the Bangor Hydro-Electric Company (licensee prior to Black Bear) developed a minimum flow study plan in consultation with the USFWS, NMFS, MDMR, and MDEP to study the effectiveness of the seasonal 250 cfs minimum flow downstream of the project to determine if it was adequate to provide sufficient dissolved oxygen (DO) during the river herring migration. Study results, filed with FERC on September 4, 1990, indicated that DO concentrations were not significantly reduced under the operational conditions of the study. The agencies asserted that the study was not conducted during the worst-case scenario and recommended that the licensee repeat the study when annual alewife runs were high to determine potential effects. The licensee repeated the study and found in a 2006 report that the required minimum flow provides sufficient DO and is protective of water quality for upstream migrant alewife, as well as other aquatic life, under all (including worst-case) scenarios. Resource agencies concurred with the conclusion and agreed that the current minimum flow should be maintained and that no additional DO sampling was needed (FERC Order dated October 13, 2006 Modifying Minimum Flow Study Plan Under Article 404). Black Bear proposes to continue these minimum flow releases under a new license.

5.1.6.3 Tributaries

Atlantic salmon spawning and rearing areas have been identified in the West Branch of the Union River upstream of Graham Lake (USFWS 2011) (Figure 9). Juvenile Atlantic salmon, specifically parr, seek riffle habitat associated with diverse rough gravel substrate, as typically found in tributaries (Kircheis and Liebich 2007). Parr can also move great distances into or out of tributaries and main stems to seek out habitat that is more conducive to growth and survival, such as areas of thermal refuge, resistance to dewatering, or increased prey abundance (McCormick et al. 1998). Access to tributaries for all life stages of Atlantic salmon is important.

As demonstrated in the 2014 Union River Tributary Access Study (Black Bear 2014), tributaries to the Union River between Graham Lake and Lake Leonard (Greys, Shackford, Moore, and Gilpatrick brooks) maintained adequate connectivity for Atlantic salmon and other diadromous fish and aquatic species during the flows observed. The study was also conducted in 2015 and 2016 during managed low flow conditions to include observations of additional tributaries of Graham Lake and Lake Leonard. All tributary confluences had adequate depths (> 6 inches) during the observed low flows that would allow Atlantic salmon access. In addition, the tributary

confluences had low velocities that would not preclude access by Atlantic salmon. Therefore, the confluence at each of the tributaries provide a zone of passage into the tributaries for Atlantic salmon to access any suitable spawning habitat that may be present upstream in these tributaries. Natural low flows within the tributaries themselves were observed during the study, suggesting that low flows within the tributaries could potentially be a limiting factor for migratory fish accessibility further up in the tributaries.

It should be noted that Atlantic salmon typically migrate upstream following freshets (Bigelow and Schroeder 2002), rather than during the low flow period observed in this study when Atlantic salmon tend to not migrate upstream in rivers (Bigelow and Schroeder 2002). This further suggests that accessibility to these tributaries is available during the Atlantic salmon migratory season, and access to these tributaries will be improved with the implementation of the proposed SPP actions described in Section 6.

Gilpatrick Brook likely has the most preferable salmon habitat at the confluence to the Union River than the other tributaries observed, as the lower portion of this stream contained adequate depth (>1.25 ft), flow (approximately 2 ft/s), substrate (cobble and gravel), and cover (large woody debris, shoreline vegetation, boulders) suitable for various life stages of Atlantic salmon (Fay et al. 2006) (Black Bear 2014). Other tributaries evaluated and considered to provide access for diadromous fish during low flow conditions include all main Graham Lake tributaries (Hapworth Brook, Webb Brook, East and West Branches on the Union River, Garland Brook, Tannery Brook, Beech Hill Pond Stream, and Reed Brook [outlet of Green Lake]), the primary Lake Leonard tributary (Branch Lake Stream), and all main stem Union River (between lakes) tributaries (Grey Brook, Shackford Brook, and Moore Brook).

5.1.7 Maintenance Activities

Project maintenance activities affecting Atlantic salmon primarily pertain to periodic maintenance to the fishways. Black Bear has developed a site-specific Fish Passage Operations and Maintenance Plan (O&M Plan) for the fishways at this Project to ensure that the upstream and downstream fishways are operating properly, and the O&M Plan will be updated as needed and reviewed with NMFS as it pertains to the approval of the proposed SPP actions described and evaluated in Section 6. The plan, provided in Attachment B, also includes both a list of spare parts

critical to fishway operation and a checklist of proper fishway operating characteristics. Since 2015, Black Bear has hired staff dedicated to operating the Project fish passage facilities; the staff are dedicated to fishway operations, oversight, fish trap tending, and transporting fish upriver. These dedicated fishway staff have completed the daily checklists and prepared weekly reports on fishway operations each year since 2015, which are provided to the fisheries management agencies throughout the fishway operational seasons. The activities performed for upstream and downstream fishway maintenance have a positive effect on Atlantic salmon, as these activities ensure the fishways remain effective.

5.1.8 Predation

Atlantic salmon smolts face predation risk during their migration from freshwater to estuarine and marine environments. Anthropogenic factors may contribute to conditions that support known predators of Atlantic salmon, such as chain pickerel, smallmouth bass, and double crested cormorants (Fay et al., 2006). Dams may increase predation risk due to smolt disorientation, injuries, congregating behavior, and decreased abundance of other diadromous fishes that act as a prey buffer by providing a robust alternative food source for predators (Northeast Salmon Team 2011). Dam passage may also affect predator detection and avoidance by salmonids (Raymond 1979, Mesa 1994).

The Union River drainage supports a variety of resident and migratory fish species. Principal resident sportfish include landlocked Atlantic salmon, brook trout, lake trout, brown trout, splake, landlocked arctic char, smallmouth bass, largemouth bass, chain pickerel, and white perch. Populations of resident fish are maintained through natural reproduction and stocking. The Union River also contains migratory fish such as striped bass and American eel (URFCC 2010) in addition to the robust river herring population.

Fish species such as brook trout and American eel are native to all major drainages in Maine and likely feed on salmon eggs and small salmon. Introductions of top predator fish (e.g., smallmouth bass, chain pickerel, and brown trout are non-native fish species that occur in the Union River watershed) negatively affect resident fish communities by disrupting normal feeding behavior (Bystrom et al. 2007), decreasing prey abundance (He and Kitchell 1990, Findlay et al. 2005), and through extirpation of native species (Findlay et al. 2005, Bystrom et al. 2007). Striped bass are also known predators of Atlantic salmon smolts (Blackwell and Juanes 1998); however, their

abundance in Maine is variable each year, indicating that predation by striped bass doesn't have an appreciable effect on Atlantic salmon populations (Beland et al. 2001).

Smallmouth bass are a warm-water species whose range now extends through north-central Maine and well into New Brunswick (Jackson 2002). Smallmouth bass are numerous in Graham Lake and occur in the riverine reaches of the Union River. Smallmouth bass likely feed on salmon fry and parr, though little quantitative information exists regarding the extent of bass predation. Smallmouth bass are predators of smolts in main stem habitats, and bioenergetics modeling indicates that bass predation is insignificant at 5°C, but increases with increasing water temperature during the smolt migration (Van den Ende 1993). Largemouth bass, another top predator species, were introduced illegally into Graham Lake in 2009 or 2010 and are expanding rapidly (pers. comm. Greg Burr, Maine Department of Inland Fisheries and Wildlife [MDIFW] July 3, 2014).

Chain pickerel, which are also common in Graham Lake, are known to feed upon salmon smolts within the range of the GOM DPS and certainly feed upon fry and parr, as well as smolts, given their piscivorous feeding habits (Van den Ende 1993). Chain pickerel feed actively in temperatures below 10°C (Van den Ende 1993, MDIFW 2002). Smolts were, by far, the most common item in the diet of chain pickerel observed by Barr (1962) and Van den Ende (1993). However, Van den Ende (1993) concluded that, "daily consumption was consistently lower for chain pickerel than that of smallmouth bass," apparently due to the much lower abundance of chain pickerel.

It is important to note that the 2016 and (to a lesser extent) 2017 Downstream Smolt Passage Efficiency and Survival Studies observed high smolt losses in Graham Lake, which is likely due to piscivorous and possibly avian predation on salmon smolts, particularly directly upstream from Graham Lake Dam (Normandeau Associates 2016, 2017). The majority of the smolt losses occurred just upstream of the dam in 2016. As noted previously, the observed smolt mortality rate during the 2016 study was in line with smolt losses observed at other river reaches in Maine when put on a per-kilometer basis. The proposed SPP actions in Section 6 includes further study on the predation of smolts in Graham Lake.

Birds known to prey upon Atlantic salmon throughout their life cycle include species such as mergansers, belted kingfisher, bald eagles, ospreys, double-crested cormorants, gulls, and gannets (Fay et al. 2006). The USFWS has concluded that avian predation poses a high-level threat to the survival and recovery of the GOM DPS of Atlantic salmon (NMFS and USFWS 2005). Blackwell et al. (1997) reported that salmon smolts were the most frequently occurring food items in

cormorants sampled at main stem dam foraging sites. In a study in the Penobscot River, cormorants were present during the spring smolt migration as migrants, stopping to feed before resuming northward migrations, and as resident nesting birds using Penobscot Bay nesting islands (Blackwell 1996, Blackwell and Krohn 1997). Another study found Atlantic salmon comprised 26 percent of cormorant's diet during the smolt run (Hatch and Weseloh 1999). Meister and Gramlich (1967) studied salmon predation by cormorants in the Machias River estuary. The results of this study documented that cormorants consumed an estimated 8,000 tagged hatchery smolts during the period 1966-1967 in the Machias River. Predation rates on migrating hatchery-reared salmon smolts were found to be as high as 13.4 percent in the Machias River (Meister and Gramlich 1967).

Breeding pairs of double-crested cormorants in Maine have increased significantly since the late 1970s, and smolts are a frequent prey item (Northeast Salmon Team 2011). The abundance of alternative prey resources, such as upstream migrating alewife, helps reduce the impacts of cormorant predation on the GOM DPS of Atlantic salmon (Northeast Salmon Team 2011). Common mergansers and belted kingfishers are likely the most important predators of Atlantic salmon fry and parr in freshwater environments, as well as seals that also predate upon adult salmon (Fay et al. 2006). Studies conducted in Canada found mergansers consumed more juvenile Atlantic salmon than cormorants (NMFS and USFWS 2005). These birds are common in Maine, including the Union River watershed (Cornell Lab of Ornithology 2012).

Observations of predatory avian species were conducted as part of the 2017 downstream smolt passage study conducted at the Ellsworth Project (Normandeau 2017). Avian observations immediately upstream and downstream of Graham Lake Dam as noted by both Brookfield and Normandeau personnel, ranged from 0 to 2 birds per day of observation. The species observed included common loon, bald eagle, cormorant, osprey, and unknown gull and heron species. The number of cormorants and gulls observed just upstream of the Ellsworth Dam ranged from 20 to 115 cormorants and 3 to 16 gulls, with some fewer numbers observed downstream of Ellsworth Dam (cormorants ranged from 4 to 40, gulls ranged from 2 to 10).

A restored run of river herring in the Union River drainage is expected to be beneficial to Atlantic salmon restoration efforts, because river herring provide a predation buffer by providing predators with alternative and potentially more abundant prey.

5.2 Atlantic Sturgeon and Shortnose Sturgeon

Because sturgeon only rarely occur in the Project tailwaters, normal Project operations should have minimal effect on shortnose and Atlantic sturgeon, or their habitat. There is a potential that sturgeon could be encountered during maintenance activities, for example, during planned dewatering of the draft tubes for turbine inspection or maintenance activities; however, the likelihood of this occurring is very low due to their rare occurrence in the area. There is also a possibility that sturgeon could be captured in the fish trap and handled during the sorting process. Black Bear has developed and will implement if needed a sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fish lift operations, and in the event of stranding during periodic dewatering of the draft tubes (Appendix A of the proposed SPP).

5.3 Potential for Cumulative Effects

Cumulative effects are those effects of future state and private activities, not involving federal activities, that are reasonably certain to occur within the action area (50 C.F.R. § 402.02). Cumulative effects do not include future federal or federally authorized action, which would be subject to future ESA section 7(a)(2) consultations. Activities that occur now and are expected to continue in the future include recreational fishing and boating, which are regulated by the state of Maine.

Impacts to the GOM DPS of Atlantic salmon from non-federal activities are largely unknown in the Union River. It is possible that occasional recreational fishing could result in incidental takes of GOM DPS Atlantic salmon. There is no information to suggest that the effects of future activities in the action area will be any different from effects of activities that have occurred in the past. The cumulative effects from forestry and agricultural practices will continue to occur in the watershed area, potentially affecting water quality and spawning and rearing habitat.

While not directly linked to Atlantic salmon, the Ellsworth Project will continue to have positive cumulative environmental effects by providing renewable energy, thus decreasing the nation's dependence on fossil fuels and minimizing the substantial adverse cumulative effects that fossil fuels have on the environment. Cumulative effects in the Union River watershed may occur from the need to pass numerous non-licensed small dams, if located within critical habitat.

6.0 Proposed SPP Actions and Effects Analysis

This section describes the measures and actions that Black Bear proposes to undertake during the term of its new Project license as part of the attached proposed SPP (Attachment A), and evaluates the effects of these SPP measures and actions on Atlantic salmon in the Project area, Downeast Coastal SHRU, and overall GOM DPS.

6.1 Upstream Passage

6.1.1 Ellsworth Dam

The following outlines the measures and actions proposed for upstream fish passage at the Ellsworth Dam:

- 1) Maintain and operate the existing upstream fish passage facility at the Ellsworth Project (fishway and trap) for alosines and salmon unless new or modified fish passage measures are provided.
 - a) Conduct effectiveness testing of upstream adult Atlantic salmon attraction into and passage at the existing fish trap facility subsequent to (i) below:
 - i) Coordinate with resource agencies to stock uniquely marked Atlantic salmon smolts upstream of Ellsworth Dam to serve as a source of imprinted adult fish (target of 40 marked returning adults annually) for studying upstream passage once downstream passage improvements have been implemented and downstream passage testing is completed;
 - b) In annual consultation with the agencies, modify the existing fishway entrance or location, and/or attraction water system or other changes, if necessary, to meet the required performance standard (see Section 3 below). Effectiveness testing is anticipated to occur for 1 to 3 years, beginning in the fish passage season following each modification.
- 2) Design and install new upstream Atlantic salmon passage measures 15 years following FERC license issuance. The Licensee may consult with the resource agencies prior to the specified dates/time frames to determine whether changes in management and/or restoration priorities would warrant a delay in construction of new fish passage measures.

- a) Conduct effectiveness testing of new upstream Atlantic salmon passage measures (also requires stocking of smolts with a target of 40 returning adults annually, as detailed above). Effectiveness testing is anticipated to occur for 1 to 3 years, beginning in the second fish passage season after each fish passage measure is operational to allow for one season of commissioning.
- 3) Performance Standard – design modifications to the existing fish passage measures, and any new fish passage measures, to meet a performance standard of 90% passage effectiveness for upstream passage.⁷ Performance standards shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

6.1.2 Graham Lake Dam

The following outlines the measures and actions proposed for upstream passage at the Graham Lake Dam:

- 1) Design and install upstream passage measures for Atlantic salmon concurrent with, but not later than, any new upstream Atlantic salmon passage measure at the Ellsworth Dam. The Licensee may consult with the resource agencies prior to the specified dates/time frames to determine whether changes in management and/or restoration priorities would warrant a delay in construction of new fish passage measures.
 - a) Conduct effectiveness testing of upstream Atlantic salmon passage concurrent with the Ellsworth Dam upstream passage effectiveness testing (also requires stocking of smolts with a target of 40 returning adults annually, as described above). Effectiveness testing is anticipated to occur for 1 and 3 years, beginning in the second fish passage season after each fish passage measure is operational to allow for one season of commissioning.
- 2) Performance standard – any new fish passage measures to meet a performance standard of 90% effectiveness for upstream passage⁸. Performance standard shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

⁷ The 90% upstream fish passage performance standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive); measured as fish passing when the river temperature is at or below 23°C.

⁸ The 90% upstream fish passage performance standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive); measured as fish passing when the river temperature is at or below 23°C.

6.1.3 Effects Analysis of Upstream Passage Measures and Actions

The proposed actions for upstream Atlantic salmon passage described above and in the attached SPP aim to continue existing practices that protect upstream migrating salmon, as well as provide additional actions and measures proposed by Black Bear in the event adult salmon are available to study and/or adult Atlantic salmon returns increase in the Union River during the term of the new license. The implementation of these actions and measures will promote enhanced upstream Atlantic salmon passage in the Union River at the Project by supporting continued existing operations and monitoring in the short-term, with the long-term goal of modifying or installing new fish passage measures for Atlantic salmon at both Project dams. Black Bear will continue to operate the upstream fish passage facility at the Ellsworth Project (fishway and trap) for alosids⁹ and salmon until new or modified fishways or measures are required in the future.

Specific effects resulting from the actions and measures listed above to enhance upstream Atlantic salmon passage at the Ellsworth and Graham Lake Dams are discussed in the following paragraphs.

Limited information suggests the existing fishway is not effective at attracting and capturing upstream migrating Atlantic salmon. Fishway effectiveness has been difficult to evaluate due to the lack of study fish returning to the river. The proposed stocking of Atlantic salmon smolts upstream of Ellsworth Dam in sufficient numbers to provide a minimum target sample size of 40 returning Atlantic salmon should provide necessary numbers of study fish for evaluating the effectiveness of the fishway in coming years. Fish imprinted to waters upstream of the Ellsworth Dam will provide the most realistic evaluation of the upstream fishway effectiveness. The results of this study will provide the information needed to evaluate whether any fishway entrance/attraction water modifications are needed to meet the required performance standard, which would include increasing upstream passage efficiency of the existing or modified fishway, and decreasing migratory delay if the study determines delay occurs. Timing the study to occur after the proposed downstream passage modifications and effectiveness testing will provide the

⁹ Black Bear will continue to coordinate with the MDMR on river herring stocking and escapement targets, as well as continue to coordinate and support river herring harvesting efforts. Black Bear will also consider conducting future effectiveness testing of the existing upstream fish passage facility in consultation with the agencies for American shad if management goals for this species in the Union River changes or alewife passage targets increase.

highest downstream passage survival of the stocked and marked smolts to be used for the upstream passage study when they return as adults.

The installation of new upstream Atlantic salmon passage measures at both the Ellsworth Dam and Graham Lake Dam will improve access to spawning and rearing habitats available in the Union River to support future recovery of Atlantic salmon in the Downeast Coastal SHRU and overall GOM DPS. Currently, upstream migrating Atlantic salmon collected in the Ellsworth Dam upstream fishway are trucked upstream of the Graham Lake Dam. By providing upstream passage at Graham Lake Dam, Atlantic salmon using the upstream passage at Ellsworth Dam will have access to suitable spawning and rearing habitat in tributaries located between the Project dams that are not currently accessible. Termination of the trapping and trucking of Atlantic salmon from Ellsworth Dam to Graham Lake would eliminate the potential injury and stress resulting from the handling and transport process, as well as reduce the potential fallback that has been observed for some Atlantic salmon transported upstream.

The existing trap and truck fishway is currently not operated when temperatures exceed 71.7°F due to expected injury and stress resulting from handling and transport activities. While the frequency varies each year based on environmental conditions, the fishway has been closed several weeks each migration season due to excessive temperatures. Construction of a new upstream fishway that can be operated when summer temperatures exceed 71.7°F will maximize the operational period for the fishway and reduce potential fishway closure.

Follow-up monitoring studies of the new upstream fish passage measures will determine if performance standards are met or whether any additional modifications are needed to meet the standards. Effectiveness testing will be conducted following each modification until the performance standard is met and will ensure the desired passage improvements are realized.

6.2 Downstream Passage

6.2.1 Ellsworth Dam

The following outlines the measures and actions proposed for downstream passage at the Ellsworth Dam:

- 1) Install a fish guidance system (Worthington boom or similar technology) with rigid panel depths between 10 to 15-feet, where water depths are adequate, by May 1 of the third year following license issuance.
- 2) Install 1-inch, clear-space, full-depth trashracks or overlays at the existing trashracks for Units 2, 3, and 4¹⁰ by May 1 of the third year following license issuance, as well as implement unit prioritization during critical downstream passage seasons, determined in consultation with the agencies.
- 3) Improve the existing downstream fish passage system by May 1 of the third year following license issuance, as follows:
 - a) Modify the existing spillway downstream fish passage weir entrance to increase the depth to a minimum of 3 feet, install tapered walls similar to an Alden weir, and increase the spillway downstream fish passage weir capacity to pass up to 5 percent of station hydraulic capacity.
 - b) Increase the height of the flume sides to improve containment of fish passing through the flume. Flume height increase to be determined in consultation with the resource agencies.
 - c) Modify the existing fish transport pipe to improve its discharge angle into the flume to limit potential injury to fish at this transition point.
 - d) Prioritize Units 1 and 4 over Units 2 and 3 for operations during critical downstream passage seasons, determined in consultation with the agencies.
- 4) Starting one year after the new downstream passage measures (fish guidance boom, 1-inch trashracks, and improvements to the existing spillway downstream fish passage weir) are operational, conduct downstream Atlantic salmon smolt passage effectiveness testing (anticipated to occur for 1 to 3 years).

¹⁰Trashracks at Unit 1 cannot be 1-inch due to trashrack raking restrictions.

- 5) If necessary to further improve fish passage effectiveness to meet the performance standard, implement, in consultation with the agencies, the following additional downstream passage Adaptive Management Measures. Such measures may include, in no particular order:
 - a) Additional panels/curtains to deepen the fish guidance boom,
 - b) Increased flows over the spillway through reduced generation or turbine shut-downs at night for two weeks¹¹ during May for Atlantic salmon smolts,
 - c) Modify the ledge/plunge pool and spillway surface, if necessary, to reduce injury to fish passing over the spillway.
- 6) Conduct downstream Atlantic salmon smolt passage effectiveness testing. Effectiveness testing is anticipated to occur for 1 to 3 years following implementation of the additional downstream passage Adaptive Management Measure(s).
- 7) Performance Standard - any design modifications to the existing measures, and any new measures, to meet a performance standard of 90% effectiveness for downstream passage¹². Performance standard shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

6.2.2 Graham Lake Dam

The following outlines the measures and actions proposed for downstream passage at the Graham Lake Dam.

- 1) By May 1 of the third year following issuance of a new license, modify the invert elevation of the existing downstream passage weir to accommodate a 3-foot depth of flow over the full range of lake elevations allowed in the new license, and implement structural modifications of the Alden weir, if necessary, to accommodate changes in headpond elevation.
- 2) Starting one year after modified measures are operational, conduct downstream Atlantic salmon smolt passage effectiveness testing (anticipated to occur for 1 to 3 years).

¹¹ As noted in Section 3.1, the majority of smolts migrate in a short period of time, as demonstrated by NMFS' Penobscot River smolt trapping studies conducted between 2000 and 2005. These data show that 74 percent of the downstream run occurs in 15 days in mid-May, and that the majority of the smolt migration appears to take place after water temperatures rise to 10°C (USFWS unpublished cited in Black Bear 2012).

¹² The 90% downstream passage standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive).

- 3) Within three years of issuance of a new license, conduct 1-year study to investigate the potential cause(s) of smolt losses in the downstream most reaches of the impoundment to continue the research of existing downstream passage conditions at Graham Lake Dam.
- 4) Implement additional downstream passage Adaptive Management Measures, if necessary, through agency consultation following effectiveness testing of any modified downstream passage conditions to further improve fish passage to meet the performance standard.
- 5) Conduct downstream Atlantic salmon smolt passage effectiveness testing. Effectiveness testing is anticipated to occur for 1 to 3 years following implementation of any additional downstream passage Adaptive Management Measure(s).
- 6) Performance Standard - any design modifications to the existing measures, and any new measures, to meet a performance standard of 90% effectiveness for downstream passage¹³. Performance standard shall be demonstrated for two of the test years following implementation of a given measure.

6.2.3 Effects Analysis of Downstream Passage Measures and Actions

Safe and effective downstream passage at the Project is critical for the protection of downstream migrating Atlantic salmon smolts and kelts. Black Bear is proposing to undertake measures and actions in the SPP to enhance downstream passage effectiveness and survival at the Project.

The proposed actions listed above include modifications and upgrades of existing downstream fishways at both Project dams. Specific effects resulting from the actions and measures listed above to enhance downstream Atlantic salmon passage at the Ellsworth and Graham Lake Dams are discussed in the following paragraphs.

Downstream smolt passage studies conducted at the Ellsworth Dam demonstrated that overall dam survival was approximate 74 percent in 2016 and 62 percent in 2017 (without correcting for background mortality). The majority of smolts used the turbine passage route during both years of study, despite modifications made to the spillway and fishway flows in 2017. The installation of a fish guidance system and full-depth, 1-inch, clear-spaced trashracks for three of the units at the Ellsworth Dam should ultimately improve downstream passage efficiency and survival rates. A

¹³ The 90% downstream fish passage standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive).

study of delayed passage mortality using surrogate fish (brown trout smolts) demonstrated that fish using the turbine route, most notably through Unit 2 (Kaplan turbine), had a higher delayed mortality rate compared to fish using the downstream fish bypass system or Unit 1 (vertical shaft propeller turbine). It is reasonable to expect Atlantic salmon smolts would exhibit a similar trend of delayed mortality. Therefore, the added prioritization of Units 1 and 4 (both vertical shaft turbines) over Units 2 and 3 (both Kaplan turbines), as proposed, will provide further protection and benefit to Atlantic salmon by reducing injury and increasing survival for smolts that use the turbine passage route.

Atlantic salmon smolt studies conducted in 2016 demonstrated substantial residence time for smolts that approached Ellsworth Dam and Graham Lake Dam, resulting in migratory delay. Increased residence time likely also resulted in increased predation based on the difference in numbers of smolts approaching the dams and the number that eventually passed. Modifications made to the downstream fishway at Ellsworth Dam and flashboard removals in 2017 reduced the mean residence time at Ellsworth Dam from 17.9 hours in 2016 to 1.5 hours in 2017. Modifications to the downstream weir at Graham Lake Dam in 2017 resulted in reducing the residence time from a mean of 79.8 hours to 5.6 hours, a substantial reduction in delay at both dams. A complicating factor in 2017 is the higher mean river flow that may have contributed to reduced residence time. More study is needed to evaluate the effect of river flow. Improvements to the existing downstream fish passage system provided in the SPP are designed to increase attraction to the downstream fishways and to decrease migratory delay, and for Ellsworth Dam, directing smolts away from the turbine route. These fish passage improvements will ultimately improve fish passage efficiency and survival for Atlantic salmon smolts, but also for Atlantic salmon kelts and river herring.¹⁴ Increased river herring survival will benefit downstream salmon passage, as river herring populations are included in the GOM DPS Atlantic salmon critical habitat component, because of the predation buffer effect that can benefit salmon smolts during downstream migration.

Follow-up monitoring studies of the downstream fish passage measures and improvements, as proposed, will determine if performance standards are met or whether any additional modifications

¹⁴ Observations of river herring mortalities have occurred below the Ellsworth Dam in recent years. Improvements to downstream passage would benefit both river herring and salmon downstream passage. River herring may provide a predation buffer effect that can benefit salmon smolts during downstream migration.

are needed to meet the standards. The SPP contains an Adaptive Management Strategy such that additional downstream passage measures will be implemented, if necessary, through agency consultation to further improve fish passage to meet the performance standard.

As noted previously, additional study is needed to better understand the impoundment mortality rate and predation risk of salmon smolts moving through Graham Lake. The proposed study may reveal options for further increasing smolt survival in the impoundment, allowing more smolts to complete their migration to the ocean to mature and potentially return to the Union River to spawn.

Proposed improvements to downstream fishways will result in increased riverine survival of smolts migrating successfully downstream to the ocean will provide a larger population of salmon able to mature and potentially return to the Union River to spawn. This will provide a benefit to the Downeast Coastal SHRU and the entire GOM DPS of Atlantic salmon. The monitoring studies and adaptive management measures following the upgrades to downstream fishways will ensure these improvements are realized when the performance standards above are achieved.

6.3 Fish Passage Facility Management

Black Bear has developed and implemented a site-specific Fish Passage O&M Plan for the fishways for the Ellsworth Project. The plan includes a daily checklist that has been employed throughout each fish passage season since 2015; the O&M Plan will continue to be utilized in future seasons to ensure that the upstream and downstream fishways are operating properly. The site-specific Fish Passage O&M Plan for the fishways includes both a list of spare parts critical to fishway operations and a checklist of proper fishway operating characteristics. Black Bear will continue providing dedicated staff to implement the site-specific Fish Passage O&M Plan for the fishways each year. The staff are dedicated to fishway operations, oversight, fish trap tending, and trucking of fish upriver at the Project. Black Bear maintains a spare recovery pump, which provides 50 cfs of attraction flow into the two downstream bypass weirs in the main powerhouse intakes, to serve as a backup in the event of a pump failure.

Continued implementation of the Fish Passage O&M Plan for the Project fishways promotes satisfactory operations of the fishways for use by Atlantic salmon passing upstream or downstream of the Project. This plan will be revised in consultation with the agencies when the upstream and downstream passage measures described above are implemented to ensure proper maintenance

and operations of new or modified fishways to support the future recovery of the Atlantic salmon in the Downeast Coastal SHRU and overall GOM DPS.

6.4 Sturgeon Handling Plan

Black Bear has developed and will implement, as part of its SPP, a sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fish lift operations or in the event of stranding during periodic dewatering of the draft tubes (Appendix A of the SPP). Implementation of this plan promotes the protection of Atlantic and shortnose sturgeon in the event they are encountered at the Project. This plan may be revised in consultation with the agencies when the upstream and downstream passage measures described above are implemented at the Project to ensure continued protection of Atlantic and shortnose sturgeon.

7.0 Determination of Effect

Based on the analyses contained in this Draft BA, the Determination of Effect of the Project and SPP measures, including the proposed SPP measures for Atlantic salmon (and its designated critical habitat), shortnose sturgeon, and Atlantic sturgeon is provided below:

7.1 Atlantic Salmon

Based on the existence of the Project, implementation of the proposed actions and protection measures outlined in the proposed SPP, and on the information regarding the likely presence of GOM DPS Atlantic salmon in the Project area, their biology and habitat requirements, this Draft BA concludes that the action is likely to adversely affect (LAA) a small proportion of GOM DPS Atlantic salmon at the Project.

The LAA determination for the Ellsworth Project is based on the likelihood that injury or mortality could occur to a small proportion of downstream migrating GOM DPS Atlantic salmon smolts, if a managed smolt stocking program is initiated upstream of the Project in the future. Black Bear will continue to manage the Project to avoid or minimize this effect through the continued implementation of fish protection and enhancement measures outlined in this document and the SPP.

Black Bear foresees no overall destruction or adverse modification of critical habitat, though there will be continued effects to the migratory primary constituent elements (PCEs) of the critical habitat designated for Atlantic salmon (see discussion in Section 1). The measures to promote restoration of GOM DPS Atlantic salmon in the Union River, as reflected in this document, have resulted in improvements to upstream and downstream fish passage measures at the Project over the years. Additional measures proposed in the SPP, including continued improvements, monitoring, consultation, and adaptive management, will lead to improvement of migratory PCEs for GOM DPS Atlantic salmon. In turn, the migratory PCE for migrating adults and smolts will also be improved as a direct result of the relicensing of the Ellsworth Project by enhancing safe access to spawning and rearing habitat, minimizing migratory delay, and providing safe passage to spawning and rearing habitat for other native anadromous species such as river herring that may serve as a predation buffer for Atlantic salmon.

The Proposed Action developed herein, including development and implementation of an SPP, is expected to minimize adverse effects to Atlantic salmon and its critical habitat.

7.2 Shortnose Sturgeon and Atlantic Sturgeon

Due to the uncommon occurrence of sturgeon species at the Project, normal operations and modifications described in the proposed SPP to protect Atlantic salmon would have minimal or no effect on shortnose sturgeon or Atlantic sturgeon. There is a possibility that sturgeon could be captured in the fish trap and handled during the sorting process, or during planned dewatering of the draft tubes for turbine inspection or maintenance activities. If this occurs, Black Bear staff would take the steps specified in the sturgeon handling plan (Appendix A of the SPP) to return the sturgeon to the river downstream of the Project. Implementation of the sturgeon handling plan will provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during fish lift operations or maintenance activities. However, the handling of any sturgeon collected in the fishway would constitute a take under ESA. Therefore, the Proposed Action is likely to adversely affect (LAA) a small number of sturgeon at the Project.

8.0 Literature Cited

- Alden Research Laboratory (Alden). 2012. Atlantic salmon survival estimates at mainstem hydroelectric projects on the Penobscot River. Holden, Massachusetts.
- Atlantic Sturgeon Status Review Team. 2007. Status review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). National Marine Fisheries Service. February 23, 2007. 188 pp.
- Bakshantsky, E.L., I.A. Barybina, and V.D. Nesterov. 1976. Changes in the intensity of downstream migration of Atlantic salmon smolts according to abiotic conditions. ICES Anadromous and Catadromous Fish Committee C.M.1976/M:4.
- Bangor-Pacific Hydro Associates (BPHA). 1994. 1994 Evaluation of Downstream Fish Passage Facilities at the West Enfield Hydroelectric Project. FERC #2600-029. Bangor-Pacific Hydro Associates. Bangor, ME. 18 pp. and appendices.
- Barr, L.M. 1962. A life history of the chain pickerel, *Esox niger Lesueur*, in Beddington Lake, Maine. M.S. Thesis University of Maine, Orono, ME: 88 pp.
- Baum, E.T. 1997. Maine Atlantic Salmon: A National Treasure. Atlantic Salmon Unlimited. Hermon, ME. 224 pp.
- _____. 1982. The Union River: An Atlantic salmon management plan. Atlantic Sea Run Salmon Commission. Bangor, Maine. 27 p.
- Beland, K.F., J.F. Kocik, J. VandeSande, and T.F. Sheehan. 2001. Striped Bass Predation Upon Atlantic Salmon Smolts in Maine. *Northeastern Naturalist* 8(3):267-274.
- Bell, M.C. 1991. Fisheries handbook of engineering requirements and biological criteria. Report Prepared for US Army Corps of Engineers, North Pacific District, Portland, Oregon.
- Bigelow, H.B. and W.C. Schroeder. 2002. Fishes of the Gulf of Maine. Fishery Bulletin 74, v53. Revision 1.1. United States Government Printing Office: Washington, 1953.
- Black Bear Hydro Partners, LLC (Black Bear). 2012. Draft Biological Assessment for Atlantic salmon, shortnose sturgeon, and Atlantic Sturgeon. Black Bear Hydro Projects - Orono

Project, FERC No. 2710, Stillwater Project, FERC No. 2712, Milford Project, FERC No. 2534, West Enfield Project, FERC No. 2600, and Medway Project, FERC No. 2666. Prepared - March 2012.

_____. 2014. Initial Study Report (ISR), Ellsworth Hydroelectric Project, FERC No. 2727. Submitted by Black Bear Hydro Partners, LLC. September.

_____. 2015. Updated Study Report for the Ellsworth Hydroelectric Project, FERC No. 2727. August 2015.

Blackwell, B.F. 1996. Ecology of double-crested cormorants using the Penobscot River and Bay Maine. Doctoral dissertation, University of Maine.

Blackwell, B.F. and F. Juanes. 1998. Predation on Atlantic salmon smolts by striped bass after dam passage. *North American Journal of Fisheries Management* 18: 936-939.

Blackwell, B.F. and W.B. Krohn. 1997. Spring foraging distribution and habitat selection by double-crested cormorants on the Penobscot River, Maine, USA. *Colonial Waterbirds* 20(1): 66-76.

Blackwell, B.F., W.B. Krohn, N.R. Dube, and A.J. Godin. 1997. Spring prey use by double-crested cormorants on the Penobscot River, Maine, USA. *Colonial Waterbirds* 20(1): 77-86.

Booth, R.K., E.B. Bombardier, R.S. McKinley, D.A. Scruton, and R.F. Goosney. 1997. Swimming Performance of Post Spawning Adult (Kelts) and Juvenile (Smolts) Atlantic Salmon, *Salmo salar*. *Can. Manusc. Rep. Fish. Aquat. Sci. No. 2406*: V + 18 p.

Bourgeois, C.E. and M.F. O'Connell. 1986. Observations on the seaward migration of Atlantic salmon (*Salmo salar L.*) smolts through a large lake as determined by radio telemetry and Carlin tagging. *Canadian Journal of Zoology* 66: 685-691.

Brown L.S., Haro A. and Castro-Santos T., 2009. Three-dimensional movements of silver-phase American eels in the forebay of a small hydroelectric facility. *In*: Casselman J.M. and Cairns D.K. (eds.), *Eels at the edge: science, status and conservation concerns, American Fisheries Society Symposium*, 58, Bethesda, 277–291.

- Bystrom P., J. Karlsson, P. Nilsson, T. Van Kooten, J. Ask, and F. Olofsson. 2007. Substitution of top predators: effects of pike invasion in a subarctic lake. *Freshwater Biology* 52(7): 1271-1280. *Cited in* MDMR and MDIFW 2009.
- College of the Atlantic. 2004. Alewife Restoration in the Union River Watershed, A Report by the River Ecology and conservation Class. June, 2004.
- Cornell. 2012. Cornell Lab of Ornithology. All About Birds. Double-crested cormorant. Online [URL]: <http://www.allaboutbirds.org/guide/search.aspx>. (Accessed July 2012).
- Fay C., M. Bartron, S. Craig, A. Hecht, J. Pruden, R. Saunders, T. Sheehan and J. Trial. 2006. Status review for anadromous Atlantic salmon (*Salmo salar*) in the United States. Report to the National Marine Fisheries Service and U.S. Fish and Wildlife Service. 294 pages.
- Federal Energy Regulatory Commission (FERC). 1997. Final Environmental Impact Statement - Lower Penobscot River Basin, Maine (Basin Mills, Stillwater, and Milford Hydroelectric Projects - FERC Nos. 10981, 2712, and 2534, respectively). FERC, Washington, D.C.
- _____. 1987. Environmental Assessment, Ellsworth Project, FERC No. 2727-003. Issued November 9, 1987.
- Fernandes, S.J., G.B. Zydlewski, J.D. Zydlewski, G.S. Wippelhauser, and M.T. Kinnison. 2010. Seasonal distribution and movements of shortnose sturgeon and Atlantic sturgeon in the Penobscot River Estuary, Maine. *Transactions of the American Fisheries Society* 139: 1436-1449.
- Findlay, D.L., M.J. Vanni, M. Patterson, K.H. Mills, S.E.M. Kasian, W.J. Findlay, and A.G Salki. 2005. Dynamics of a boreal lake ecosystem during a long-term manipulation of top predators. *Ecosystems* (8):603-618. *Cited in* MDMR and MDIFW 2009.
- Great Northern Paper Company (GNP). 1989. 1989 report on downstream passage of Atlantic salmon smolts and kelts at Weldon Dam. Great Northern Paper, Millinocket, Maine. 94 pages plus appendices.

- Hall, S.D. and S.L. Shepard. 1990. 1989 Progress report of Atlantic salmon kelt radio telemetry investigations on the lower Penobscot River. Bangor Hydro-Electric Company. Bangor, Maine. 30 pages.
- Hatch, J.J. and D.V. Weseloh. 1999. Double-crested Cormorant (*Phalacrocorax auritus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/441>. Accessed April 2011.
- Havey, K.A. 1961. Union River fish management and restoration. Maine Dept. of Inland Fish and Wildlife. Machias, Maine. 42 p.
- He, X. and J.F. Kitchell. 1990. Direct and Indirect Effects of Predation on a Fish Community: A Whole-Lake Experiment. Transactions of the American Fisheries Society 119(5): 825-835. Cited in MDMR and MDIFW 2009.
- Hoar, W.S. 1988. The physiology of smolting salmonids. In Fish physiology Vol. XIB (Hoar, W. S. & D. J., Randall eds.). London: Academic Press. Cited in Svendsen 2008.
- Jackson, D.A. 2002. Ecological Effects of Micropterus Introductions: The Dark Side of Black Bass. In Black Bass: Ecology, Conservation, and Management. American Fisheries Society Symposium No. 31:221-232.
- Jonsson, B. and J. Ruud-Hansen. 1985. Water temperature as the primary influence on timing of seaward migrations of Atlantic salmon (*Salmo salar*) smolts. Canadian Journal of Fisheries and Aquatic Sciences 42:593-595.
- Kircheis, D., and T. Liebich. 2007. Draft habitat requirements and management considerations for Atlantic salmon (*Salmo salar*) in the Gulf of Maine Distinct Population Segment (GOM DPS). November 2007.
- Kocik, J.F., J.P. Hawkes, T.F. Sheehan, P.A. Music, K.F. Beland. 2009. Assessing Estuarine and Coastal Migration and Survival of Wild Atlantic Salmon Smolts from the Narraguagus River, Maine Using Ultrasonic Telemetry. American Fisheries Society Symposium 69:293-310.

Maine Department of Environmental Protection (Maine DEP), Maine Department of Inland Fisheries and Wildlife (MDIF&W), and Maine Office of GIS (MEGIS). 2009. Maine Lakes: Geographic & Morphometric Information. [Online] URL: <http://www.gulfofmaine.org/kb/2.0/record.html?recordid=9680>.

Maine Department of Inland Fisheries and Wildlife (MDIFW). 2002. Fishes of Maine. Augusta, ME. 38 pp.

Maine Department of Marine Resources (MDMR). 2015 draft. Atlantic Salmon Trap Operating and Fish-Handling Protocols. Revised February 2015. Division of Sea Run Fisheries and Habitat, Bangor, Maine.

_____. 2018. Atlantic Salmon Trap Operating and Fish-Handling Protocols. Updated May 2018. Division of Sea Run Fisheries and Habitat, Bangor, Maine. Online URL: https://www.maine.gov/dmr/science-research/searun/programs/documents/5-03-018%20Maine%20Department%20of%20Marine%20Resources%20Adult%20Atlantic%20SalmonTrap%20and%20Fish%20Handling%20Protocol%202018_final.pdf. Accessed August 29, 2018.

Maine Department of Marine Resources (MDMR) and Maine Department of Inland Fisheries and Wildlife (MDIFW). 2009. Operational Plan for the Restoration of Diadromous Fishes to the Penobscot River. Prepared for the Atlantic Salmon Commission. April 10, 2009 draft. 293 pp.

McCormick, S.D., L.P. Hansen, T.P. Quinn, and R.L. Saunders. 1998. Movement, migration, and smolting of Atlantic salmon (*Salmo salar*). Canadian Journal of Fisheries and Aquatic Sciences 55, 77-92. Cited in Svendsen 2008 and Kircheis and Liebich 2007.

McCormick, S.D., R.A. Cunjack, B. Dempson, M.F. O'Dea and J.B. Carey. 1999. Temperature-related loss of smolt characteristics in Atlantic salmon (*Salmo salar*) in the wild. Canadian Journal of Fisheries and Aquatic Sciences 56:1649-1658.

Meister, A.L. and F. J. Gramlich. 1967. Cormorant predation on tagged Atlantic salmon smolts. Final report of the 1966-67 Cormorant - Salmon Smolt Study. Atlantic Sea Run Salmon Commission, Orono, Maine.

- Mesa, M.G. 1994. Effects of multiple acute stressors on the predator avoidance ability and physiology of juvenile chinook salmon. *Transactions of the American Fisheries Society* 123(5): 786-793. *Cited in* USFWS and NMFS 2009.
- Mudre, J.M. and W.P. Saunders. 1987. Radio telemetric investigation of downstream passage of Atlantic salmon smolts at Bellows Falls station. Prepared for New England Power and Northeast Utilities; 21 pages w/appn.
- National Marine Fisheries Service (NMFS). 1987. (Draft) Status Review of shortnose sturgeon (*Acipenser brevirostrum* LeSueur 1818) *Listed under the Endangered Species Act of 1973*.
- _____. 1998. Recovery plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland 104 pp.
- _____. 2008. Endangered Species Act Section 7 formal consultation regarding proposed funding of fisheries sampling in the Penobscot River, Maine, to be funded by NMFS. Gloucester, MA. Biological Opinion, September 4.
- _____. 2009a. Endangered and Threatened Species. Designation of critical habitat for Atlantic salmon (*Salmo salar*) Gulf of Maine Distinct Population Segment. Final rule. Federal Register, Vol. 74, No. 117. June 19, 2009.
- _____. 2009b. Biological evaluation of Atlantic salmon habitat within the Gulf of Maine Distinct Population Segment.
- _____. 2012. Dam Impact Assessment Model. Lab Reference Document. Northeast Fisheries Science Center, Woods Hole, MA.
- National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2005. Final Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (*Salmo salar*). NMFS, Silver Spring, MD; USFWS, Hadley, MA. 325 pp.

National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (MDMR), U.S. Fish and Wildlife Service (USFWS), and Penobscot Indian Nation (PIN). 2011. Atlantic Salmon Recovery Framework. [Online] URL: <https://www.fws.gov/northeast/atlanticsalmon/PDF/FrameworkWorkingDraft031211MC.pdf>. Accessed July 3, 2018.

National Oceanic and Atmospheric Administration (NOAA). 2009. Draft Gulf of Maine Distinct Population Segment Management Guidance for Recovery.

_____. 2012a. Endangered and Threatened wildlife and plants; threatened and endangered status for distinct population segments of Atlantic Sturgeon in the Northeast Region. Final rule. Federal Register, Vol. 77 No. 24. February 6, 2012.

_____. 2012b. Endangered and Threatened wildlife and plants; Final listing determination for two distinct population segments of Atlantic Sturgeon in the Southeast Region. Final rule. Federal Register, Vol. 77 No. 24. February 6, 2012.

Nielsen, C., G. Holdensgaard, H.C. Petersen, B.T. Björnsson and S.S. Madsen. 2001. Genetic differences in physiology, growth hormone levels and migratory behavior of Atlantic salmon smolts. *Journal of Fish Biology* 59, 28-44. *Cited in Svendsen 2008.*

Northeast Salmon Team. 2011. Managing the Impacts of Cormorant Predation on Smolts. NMFS. [Online] URL: <http://www.nefsc.noaa.gov/salmon/Finalcormorantfactsheet.html>. Accessed July 2011.

Normandeau Associates. 2016. Evaluation of Atlantic Salmon Smolt Passage - Spring 2016. Ellsworth Project, FERC No. 2727.

_____. 2017. Evaluation of Atlantic Salmon Smolt Passage - Spring 2017. Ellsworth Project, FERC No. 2727.

_____. 2018. Draft: 2018 Lower Penobscot River Atlantic Salmon Smolt Passage Report.

Peake, S.J., McKinley, R.S. and Scruton, D.A. 1997. Swimming performance of various freshwater Newfoundland salmonids relative to habitat selection and fishway design. *Journal of Fish Biology* 51: 710-723.

- Power, J.H. and J.D. McCleave. 1980. Riverine movements of hatchery reared Atlantic salmon (*Salmo salar*) upon return as adults. *Environmental Biology of Fishes* 5(1):3-13.
- Raymond, H.L. 1979. Effects of dams and impoundments on migrations of juvenile chinook salmon and steelhead from the Snake River, 1966 to 1975. *Transactions of the American Fisheries Society* 108(6): 505-529. *Cited in* USFWS and NMFS 2009.
- Ruggles, C.P. 1980. A review of downstream migration of Atlantic salmon. Canadian Technical Report of Fisheries and Aquatic Sciences No. 952. Freshwater and Anadromous Division.
- Shepard, S.L. 1989. 1988 Progress Report of Atlantic Salmon Kelt Radio Telemetry Investigations in the Lower Penobscot River. Bangor Hydro-Electric Company. 30 pp.
- _____. 1991. A radio telemetry investigation of Atlantic salmon smolt migration in the Penobscot River of Maine. Proceedings of the Atlantic salmon workshop, Rockport, Maine March 6-7, 1991. U.S. Fish and Wildlife Service. Pages 101-118.
- _____. 1993. Survival and Timing of Atlantic Salmon Smolts Passing the West Enfield Hydroelectric Project. Bangor-Pacific Hydro Associates. 27 pp.
- _____. 1995. Atlantic salmon spawning migrations in the Penobscot River, Maine: fishways, flows and high temperatures. MS Thesis. Univ. Maine. Orono, ME. 111 pp.
- Shrimpton, J.M., B.T. Björnsson, and S.D. McCormick. 2000. Can Atlantic salmon smolt twice? Endocrine and biochemical changes during smolting. *Canadian Journal of Fisheries and Aquatic Sciences* 57, 1969 - 1976. *Cited in* Svendsen 2008.
- Sigourney, D.B., and J.D. Zydlewski, E. Hughes, and O. Cox. 2015. Transport, dam passage, and size selection of adult Atlantic salmon in the Penobscot River, Maine. *N. Am. J. Fish. Mgmt.* 35:1164-1176.
- Spencer, R., K. Gallant, and D. Buckley. 2010. Migratory behavior and spawning activity of adult sea-run Atlantic salmon translocated to novel upriver habitat within the Penobscot Basin, Maine. A Progress Report to the West Enfield Fisheries Fund Committee. March 1, 2010.
- _____. 2011. 2010 Progress Report. Migratory behavior and spawning activity of adult sea-run

- Atlantic salmon translocated to novel upriver habitat within the Penobscot Basin, Maine. A Report for the West Enfield Fisheries Fund Committee. April 25, 2011.
- Stich, D. S., M. M. Bailey, C. M. Holbrook, M.T. Kinnison, J. D. Zydlewski. 2015. Catchment-wide survival of wild- and hatchery-reared Atlantic salmon smolts in a changing system. *Canadian Journal of Fisheries and Aquatic Sciences*. 72(9):1352-1365.
- U.S. Atlantic Salmon Assessment Committee (USASAC). 1992. Annual Report of the U.S. Atlantic Salmon Assessment Committee. Report No. 4 – 1991 Activities.
- _____. 2018. Annual Report of the U.S. Atlantic Salmon Assessment Committee. Report No. 30 – 2017 Activities.
- U.S. Fish and Wildlife Service (USFWS). 2011. USFWS Gulf of Maine Coastal Program (GOMP), GIS data: (USFWS MEASHS) Maine Atlantic Salmon Habitat Surveys. Publication_Date: 20110621. Title: ashab3. Geospatial Data Presentation Form: vector digital data. Available at <http://www.maine.gov/megis/catalog/>.
- U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 2000. Endangered and Threatened Species. Gulf of Maine Distinct Population Segment of Atlantic salmon. Listing as endangered. Final rule. Federal Register, Vol. 65, No. 223. November 17, 2000.
- _____. 2009. Endangered and Threatened Species. Determination of endangered status for the Gulf of Maine Distinct Population Segment of Atlantic salmon. Final rule. Federal Register, Vol. 74, No. 117. June 19, 2009.
- _____. 2015. SHRU Recovery Workplan [Online] URL: <http://atlanticsalmonrestoration.org/resources/documents/atlantic-salmon-recovery-plan-2015/appendix-to-recovery-plan>. Accessed July 2, 2018.
- _____. 2016. Draft recovery plan for the Gulf of Maine Distinct Population Segment of Atlantic salmon (*Salmo salar*). 61 pp.
- Union River Fisheries Coordinating Committee (URFCC). 2000. Comprehensive Fishery Management Plan for the Union River Drainage. 57 pp.

- _____. 2010. Comprehensive Fishery Management Plan for the Union River Drainage 2011-2014. 29 pp.
- _____. 2012. 2011 Annual Report, Union River Fisheries Coordinating Committee. Prepared by Black Bear Hydro partners, LLC on behalf of URFCC. February 2012.
- _____. 2015. Comprehensive Fishery Management Plan for the Union River Drainage, 2015-2017. February 2015.
- _____. 2018. 2017 Annual Report, Union River Fisheries Coordinating Committee. Prepared by Black Bear Hydro partners, LLC on behalf of URFCC. February 2018.
- Van den Ende, O. 1993. Predation on Atlantic salmon smolts (*Salmo salar*) by smallmouth bass (*Micropterus dolomeiu*) and chain pickerel (*Esox niger*) in the Penobscot River, Maine. M.S. Thesis. University of Maine. Orono, ME. 95 pp.
- Vanderpool, A.M. 1992. Migratory Patterns and Behavior of Atlantic Salmon Smolts in the Penobscot River, Maine. Thesis. University of Maine, Orono. 61pp.
- Wolter, C. and R. Arlinghaus. 2003. Navigation impacts on freshwater fish assemblages: the ecological relevance of swimming performance. *Reviews in Fish Biology & Fisheries* 13: 63-89.
- Zydlewski, G. 2009. Cianbro Constructors, LLC Penobscot River Operations, Brewer, Maine Shortnose Sturgeon monitoring, July 2008 – October 2008. University of Maine. School of Marine Sciences.
- Zydlewski, G. B., M. T. Kinnison, P. E. Dionne¹, J. Zydlewski and G. S. Wippelhauser. 2011. Shortnose sturgeon use small coastal rivers: the importance of habitat connectivity. *J. Appl. Ichthyol.* 27 (Suppl. 2) (2011), 41–44 © 2011 Blackwell Verlag, Berlin. ISSN 0175–8659.

ATTACHMENT A
SPECIES PROTECTION PLAN

**SPECIES PROTECTION PLAN
ELLSWORTH PROJECT**

September 2018

**SPECIES PROTECTION PLAN
ELLSWORTH PROJECT**

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APPENDIX A - STURGEON HANDLING PLAN

1.0 Background and Purpose of Protection Measures

1.1 Species Protection Plan Overview

Black Bear Hydro Partners, LLC (Black Bear) owns and operates the Ellsworth Hydroelectric Project (Federal Energy Regulatory Commission [FERC] No. 2727) (“Ellsworth Project” or “Project”) on the Union River pursuant to the license issued by the FERC on January 1, 1988.

As discussed in the Draft Biological Assessment (BA), Gulf of Maine (GOM) Distinct Population Segment (DPS) Atlantic salmon, shortnose sturgeon, and Atlantic sturgeon are fish species listed under the Endangered Species Act (ESA) that do or could occur in the Project area. FERC is, therefore, required to engage in endangered species consultation with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) pursuant to Section 7 of the ESA for the relicensing (Section 7 of the ESA mandates that federal agencies consult with the Secretaries of Commerce [through NMFS] and Interior [through the USFWS] to determine whether a pending federal action [issuance of a new FERC license for the Project] is likely to result in adverse effects to listed species and/or designated critical habitat). Endangered species consultation has been an important part of the relicensing process.

As discussed in the Draft BA, the occurrence of either sturgeon species is very uncommon in the vicinity of the Project, and the Project is not likely to significantly affect sturgeon but may adversely affect a small number of sturgeon if any are collected in the fishway. However, implementing the proposed sturgeon handling plan (Appendix A) will help to minimize any incidental take of sturgeon should they be incidentally trapped in the fishway or otherwise encountered at the Project facilities.

In 2017 and 2018, Black Bear held six meetings with the agencies to identify measures to minimize potential adverse effects of Project operation on listed Atlantic salmon and designated critical habitat at the Ellsworth Project. Black Bear developed this proposed Species Protection Plan (SPP) to present the measures agreed to during these meetings to avoid and minimize potential adverse effects of Project operation of the Ellsworth Project on Atlantic salmon and designated critical habitat. Provisions of this SPP will require Black Bear to implement several proposed actions and conduct studies to evaluate the effectiveness of existing and any new upstream and downstream fish passage measures for passing Atlantic salmon.

Black Bear anticipates that in 2018, NMFS will issue a Biological Opinion (BO), based on the Draft BA and SPP with protective measures and monitoring, which also will include an Incidental Take Statement related both to the continued operation of the Project and conduct of further studies related to fish passage at the Project that may affect Atlantic salmon. It is expected that FERC will then incorporate protective measures and monitoring as outlined in the BO into the new license for the Project.

The following section outlines the proposed actions for upstream passage at the Ellsworth Dam and Graham Lake Dam, followed by the proposed actions for downstream passage at the Ellsworth Dam and Graham Lake Dam.

2.0 Protection Measures and Monitoring Studies

The Ellsworth Project already includes a number of measures for the protection and enhancement of Atlantic salmon, such as providing upstream¹ and downstream passage facilities and maintaining minimum flows (summarized in the Draft BA). In this section, Black Bear proposes additional actions and monitoring studies to further protect and enhance the GOM DPS of Atlantic salmon. The proposed actions and monitoring studies are intended to develop the site-specific information needed to determine the adequacy of proposed protection measures and to inform estimates of incidental take of GOM DPS Atlantic salmon.

2.1 Proposed Actions for Upstream Passage

2.1.1 Ellsworth Dam

The following outlines the measures and actions proposed for upstream fish passage at the Ellsworth Dam:

- 1) Maintain and operate the existing upstream fish passage facility at the Ellsworth Project (fishway and trap) for alosines and salmon unless new or modified fish passage measures are provided.

¹ The upstream fish passage facility is designed to trap Atlantic salmon and other anadromous fish and to transport fish by truck to upstream suitable habitat located above the Project facilities.

- a) Conduct effectiveness testing of upstream adult Atlantic salmon attraction into and passage at the existing fish trap facility subsequent to (i) below:
 - i) Coordinate with resource agencies to stock uniquely marked Atlantic salmon smolts upstream of Ellsworth Dam to serve as a source of imprinted adult fish (target of 40 marked returning adults annually) for studying upstream passage once downstream passage improvements have been implemented and downstream passage testing is completed;
 - b) In annual consultation with the agencies, modify the existing fishway entrance or location and/or attraction water system or other changes, if necessary, to meet the required performance standard (see Section 3 below). Effectiveness testing is anticipated to occur for 1 to 3 years, beginning in the fish passage season following each modification.
- 2) Design and install new upstream Atlantic salmon passage measures 15 years following FERC license issuance. The Licensee may consult with the resource agencies prior to the specified dates/time frames to determine whether changes in management and/or restoration priorities would warrant a delay in construction of new fish passage measures.
 - a) Conduct effectiveness testing of new upstream Atlantic salmon passage measures (also requires stocking of smolts with a target of 40 returning adults annually, as detailed above). Effectiveness testing is anticipated to occur for 1 to 3 years, beginning in the second fish passage season after each fish passage measure is operational to allow for one season of commissioning.
- 3) Performance Standard – design modifications to the existing fish passage measures, and any new fish passage measures, to meet a performance standard of 90% passage effectiveness for upstream passage.² Performance standards shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

2.1.2 Graham Lake Dam

The following outlines the measures and actions proposed for upstream passage at the Graham Lake Dam:

² The 90% upstream fish passage performance standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive); measured as fish passing when the river temperature is at or below 23°C.

- 1) Design and install upstream passage measures for Atlantic salmon concurrent with, but not later than, any new upstream Atlantic salmon passage measure at the Ellsworth Dam. The Licensee may consult with the resource agencies prior to the specified dates/time frames to determine whether changes in management and/or restoration priorities would warrant a delay in construction of new fish passage measures.
 - a) Conduct effectiveness testing of upstream Atlantic salmon passage concurrent with the Ellsworth Dam upstream passage effectiveness testing (also requires stocking of smolts with a target of 40 returning adults annually, as described above). Effectiveness testing is anticipated to occur for 1 and 3 years, beginning in the second fish passage season after each fish passage measure is operational to allow for one season of commissioning.
- 2) Performance standard – any new fish passage measures to meet a performance standard of 90% effectiveness for upstream passage³. Performance standard shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

2.2 Proposed Actions for Downstream Passage

2.2.1 Ellsworth Dam

The following outlines the measures and actions proposed for downstream passage at the Ellsworth Dam:

- 1) Install a fish guidance system (Worthington boom or similar technology) with rigid panel depths between 10 to 15-feet, where water depths are adequate, by May 1 of the third year following license issuance.
- 2) Install 1-inch, clear-space, full-depth trashracks or overlays at the existing trashracks for Units 2, 3, and 4⁴ by May 1 of the third year following license issuance, as well as implement unit prioritization during critical downstream passage seasons, determined in consultation with the agencies.
- 3) Improve the existing downstream fish passage system by May 1 of the third year following license issuance, as follows:

³ The 90% upstream fish passage performance standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive); measured as fish passing when the river temperature is at or below 23°C.

⁴ Trashracks at Unit 1 cannot be 1-inch due to trashrack raking restrictions.

- a) Modify the existing spillway downstream fish passage weir entrance to increase the depth to a minimum of 3 feet, install tapered walls similar to an Alden weir, and increase the spillway downstream fish passage weir capacity to pass up to 5 percent of station hydraulic capacity.
 - b) Increase the height of the flume sides to improve containment of fish passing through the flume. Flume height increase to be determined in consultation with the resource agencies.
 - c) Modify the existing fish transport pipe to improve its discharge angle into the flume to limit potential injury to fish at this transition point.
 - d) Prioritize Units 1 and 4 over Units 2 and 3 for operations during critical downstream passage seasons, determined in consultation with the agencies.
- 4) Starting one year after the new downstream passage measures (fish guidance boom, 1-inch trashracks, and improvements to the existing spillway downstream fish passage weir) are operational, conduct downstream Atlantic salmon smolt passage effectiveness testing (anticipated to occur for 1 to 3 years).
- 5) If necessary to further improve fish passage effectiveness to meet the performance standard, implement, in consultation with the agencies, the following additional downstream passage Adaptive Management Measures. Such measures may include, in no particular order:
- a) Additional panels/curtains to deepen the fish guidance boom,
 - b) Increased flows over the spillway through reduced generation or turbine shut-downs at night for two weeks⁵ during May for Atlantic salmon smolts,
 - c) Modify the ledge/plunge pool and spillway surface, if necessary, to reduce injury to fish passing over the spillway.
- 6) Conduct downstream Atlantic salmon smolt passage effectiveness testing. Effectiveness testing is anticipated to occur for 1 to 3 years following implementation of the additional downstream passage Adaptive Management Measure(s).
- 7) Performance Standard - any design modifications to the existing measures, and any new measures, to meet a performance standard of 90% effectiveness for downstream passage⁶.

⁵ As noted in Section 3.1, the majority of smolts migrate in a short period of time, as demonstrated by NMFS' Penobscot River smolt trapping studies conducted between 2000 and 2005. These data show that 74 percent of the downstream run occurs in 15 days in mid-May, and that the majority of the smolt migration appears to take place after water temperatures rise to 10°C (USFWS unpublished cited in Black Bear 2012).

⁶ The 90% downstream passage standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive).

Performance standard shall be demonstrated to be achieved for two of the test years following implementation of a given measure.

2.2.2 Graham Lake Dam

The following items outline the measures and actions proposed for downstream passage at the Graham Lake Dam:

- 1) By May 1 of the third year following issuance of a new license, modify the invert elevation of the existing downstream passage weir to accommodate a 3-foot depth of flow over the full range of lake elevations allowed in the new license, and implement structural modifications of the Alden weir, if necessary, to accommodate changes in headpond elevation.
- 2) Starting one year after modified measures are operational, conduct downstream Atlantic salmon smolt passage effectiveness testing (anticipated to occur for 1 to 3 years).
- 3) Within three years of issuance of a new license, conduct 1-year study to investigate the potential cause(s) of smolt losses in the downstream most reaches of the impoundment to continue the research of existing downstream passage conditions at Graham Lake Dam.
- 4) Implement additional downstream passage Adaptive Management Measures, if necessary, through agency consultation following effectiveness testing of any modified downstream passage conditions to further improve fish passage to meet the performance standard.
- 5) Conduct downstream Atlantic salmon smolt passage effectiveness testing. Effectiveness testing is anticipated to occur for 1 to 3 years following implementation of any additional downstream passage Adaptive Management Measure(s).
- 6) Performance Standard - any design modifications to the existing measures, and any new measures, to meet a performance standard of 90% effectiveness for downstream passage⁷. Performance standard shall be demonstrated for two of the test years following implementation of a given measure.

⁷ The 90% downstream fish passage standard is for whole Project effectiveness (Graham Lake and Ellsworth facilities inclusive).

2.3 Fish Passage Facility Management

Black Bear has developed and implemented a site-specific Fish Passage O&M Plan for the fishways for the Ellsworth Project. The plan includes a daily checklist that has been employed throughout each fish passage season since 2015; the O&M Plan will continue to be utilized in future seasons to ensure that the upstream and downstream fishways are operating properly. The site-specific Fish Passage O&M Plan for the fishways includes both a list of spare parts critical to fishway operations and a checklist of proper fishway operating characteristics. Black Bear will continue providing dedicated staff to implement the site-specific Fish Passage O&M Plan for the fishways each year. The staff are dedicated to fishway operations, oversight, fish trap tending, and trucking of fish upriver at the Project. Black Bear maintains a spare recovery pump, which provides 50 cfs of attraction flow into the two downstream bypass weirs in the main powerhouse intakes, to serve as a backup in the event of a pump failure.

3.0 Implementation Provisions of Proposed Actions

3.1 Effective Date and Schedule

Several of the proposed actions to protect GOM DPS Atlantic salmon at the Ellsworth Project are currently being implemented. These include execution of the Fish Passage O&M Plan developed and approved through agency consultation, and the hiring and training of dedicated staff annually to ensure that all fishway facilities are operated as designed and any issues that develop are corrected. In addition, Black Bear continues to prioritize unit operations to favor Units 1 and 4 during downstream fish migratory periods, as well as maintain the bypass modifications (e.g., Alden weir, resurfaced spillway, etc.) at both dams that showed improved downstream passage movement and survival rates.

The implementation schedule for the additional proposed actions for upstream and downstream passage improvement at the Ellsworth Dam and Graham Lake Dam are described above in Section 2.

3.2 Funding of Proposed Actions

Black Bear has and shall continue to provide funding for the fishway maintenance, dedicated fishway staff, new fish passage facilities, improvements to existing fish passage facilities, and monitoring studies described in Section 2.

3.3 Adaptive Management

The proposed fish passage activities and GOM DPS Atlantic salmon enhancements, which have been developed in consultation with the agencies, will be implemented within an adaptive management framework, with integration of management and research in order to provide feedback and the ability to adapt these measures, as necessary, for further protection and enhancement of GOM DPS Atlantic salmon in the Union River. Adaptive Management Measures are described in Section 2. Since the proposed SPP process is intended to be adaptive, Black Bear will be coordinating and consulting with NMFS throughout implementation of all measures, which will also be adopted as license requirements.

Black Bear shall prepare annual reports by March 31 each year to review the previous year's fish passage activities and/or applicable study results with resource agencies, and assess the need to continue or modify monitoring studies or implement Adaptive Management Measures described in Section 2.

Appendix A
Sturgeon Handling Plan

Sturgeon Handling Plan for the Ellsworth Development

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and shortnose sturgeon (*Acipenser brevirostrum*) have the potential to occur in the Union River immediately downstream of the Ellsworth Project. Black Bear will implement the following sturgeon handling plan to provide for safe handling of any Atlantic or shortnose sturgeon that may be encountered by personnel during operations of the fish trap or during maintenance of the Project facilities.

Fish Trap Operations

If sturgeon are found in the Project's fish trap, the following procedures will be implemented:

- For each sturgeon detected, the licensee shall:
 - Record the weight, length and condition of the fish.
 - The species of sturgeon should be determined by the ratio of mouth width to interorbital distance (method described in Damon-Randall et al. 2010 - see worksheet attached below).
 - Each sturgeon should also be scanned for PIT (passive integrated transponder) tags.
 - Collect a 1 cm² fin clip from one of the pelvic fins (the pelvic fin is regarded as the least intrusive, particularly for small individuals) from living sturgeon should be taken and placed in a labeled vial fitted with an O-ring cap containing 95% non-denatured ethyl alcohol (EtOH) for genetic analysis (following the procedures described in Damon-Randall et al. 2010). Fin clips of mortalities must be taken prior to preservation of other fish parts or whole bodies. All fin clips taken will be submitted to the National Oceanic and Atmospheric Administration (NOAA) for further analysis. At the time of capture, river flow, bypass reach flow, and water temperature will be recorded. All relevant information will be recorded on the reporting sheet (i.e., Sturgeon Reporting Sheet, a copy of which is attached hereto).
- Black Bear shall follow the contact procedure outlined below that was developed in coordination with the National Oceanic and Atmospheric Administration (NOAA) to obtain a contact with the appropriate Endangered Species Act (ESA) representative for handling shortnose and Atlantic sturgeon.

- If alive and uninjured, the sturgeon will be immediately returned downstream. A long-handled net outfitted with non-abrasive knotless mesh will be used to place the sturgeon back into the river downstream of the dam. The fish should be properly supported during transport in the net to ensure that it is not injured.
- If any injured sturgeon are found, Black Bear shall report immediately to NOAA Fisheries (see contact information below). Injured fish must be photographed and measured, if possible, and the reporting sheet must be submitted to NOAA Fisheries within 24 hours. If the fish is badly injured, the fish should be retained by Black Bear, if possible, until obtained by a NOAA Fisheries-recommended facility for potential rehabilitation.
- If any dead sturgeon are found, Black Bear must report the mortality immediately to NOAA Fisheries (see contact information below). Any dead specimens or body parts should be photographed, measured, scanned for tags, and all relevant information should be recorded on the Salvage Form included below. Specimens should be stored in a refrigerator or freezer by Black Bear until they can be obtained by NOAA Fisheries for analysis.

Unit Inspection and Maintenance

On occasion, the Ellsworth Development units are dewatered for inspection or for maintenance activities. Prior to dewatering, the headgate and tailwater gates are closed, and then water is pumped from the unit. Black Bear will follow the protocols outlined here:

- Designated Black Bear employees will conduct a visual check for the presence of any sturgeon in the draft tube area as soon as possible once the water levels allow. If sturgeon are observed in the draft tube, Black Bear will refill the draft tube as necessary and remove the sturgeon. The process of dewatering would be repeated, and a visual check would be conducted to see if any sturgeon remain in the draft tube as it is dewatered.
- If sturgeon are observed in the draft tubes, they will be removed by dip net or other appropriate equipment and placed in the river downstream of the powerhouse.
- Unit dewatering for annual inspections will not be scheduled during April or May unless there is an emergency, in which case consultation with the appropriate resources agencies will take place.

- For each sturgeon removed, Black Bear will record the weight, length, and condition. Fish would also be scanned for PIT tags. All relevant information will be recorded on the reporting sheet (attached Sturgeon Reporting Sheet for the Ellsworth Development).
- If any injured sturgeon are found, Black Bear will report it immediately to NOAA Fisheries (see contact information below). Injured fish must be photographed and measured, if possible, and the reporting sheet will be submitted to NOAA within 24 hours. If the fish is badly injured, the fish shall be retained by Black Bear, if possible, until obtained by a NOAA Fisheries -recommended facility for potential rehabilitation.
- Black Bear shall report any dead sturgeon immediately to NOAA Fisheries (see contact information below). Any dead specimens or body parts should be photographed, measured, scanned for tags, and all relevant information shall be recorded on the Salvage Form included below. Specimens should be stored in a refrigerator or freezer by Black Bear until they can be obtained by NOAA Fisheries for analysis.

Contact Information

In the event a sturgeon is captured in a fish trap or found in the draft tube during maintenance, the following individuals shall be contacted:

Contact information:

- If any sturgeon are detected –
 - Richard Dill (207-852-2993), or
 - Kevin Bernier, (207-951-5006)
- If unavailable, contact – Maine Department of Marine Resources
 - Gail Wippelhauser (207-624-6349), or
 - Mike Brown (207-624-6341)
- NOAA Fisheries (must be contacted within 24 hours)
 - Dan Tierney (207-866-3755), or
 - Julie Crocker (978-282-8480), or
 - NOAA Fisheries Northeast Regional Office – Protected Resources Division Main Number (978-281-9328),
 - and be sure to fax any reporting sheets to 978-281-9394

Reports at End of Season

At the end of the season, copies of all reporting sheets will be send to:

Julie Crocker
Protected Resource Division
NOAA Fisheries
26 Katherine Drive
55 Great Republic Drive
Gloucester, MA 01930-2298

Literature Cited

Damon-Randall K, Bohl R, Bolden S, Fox D, Hager C, Hickson B, Hilton E, Mohler J, Robbins E, Savoy T, Spells A. 2010. Atlantic Sturgeon Research Techniques. NOAA Technical Memorandum NMFS NE 215; 19 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at <http://www.nefsc.noaa.gov/nefsc/publications/>

Sturgeon Reporting Sheet for the _____ Project

Date: _____ Time: _____

Physical conditions

Is spill being released over the dam? YES NO

What is the approximate river flow? _____ (Ex. 45,000 cfs)

What is the approximate flow in the bypass reach? _____

Water temperature (°C): _____

Is the fishway operating (circle) YES NO

Is project generating? YES NO

If yes, what units are currently operating?

Location from where species was recovered (circle): FISHWAY / LIFT / BYPASS POOLS

OTHER _____

If fish lift, estimate condition of lift: EMPTY / FEW FISH / MODERATE FULL / VERY FULL

Species information:

Total Length _____ Fork length: _____ Weight: _____

Condition of fish: _____

Does the sturgeon have visible injuries or abrasions: YES NO

If Yes, circle and code area of abrasions on sturgeon diagram on back side of sheet.

Comments/other:

Name of observer: _____

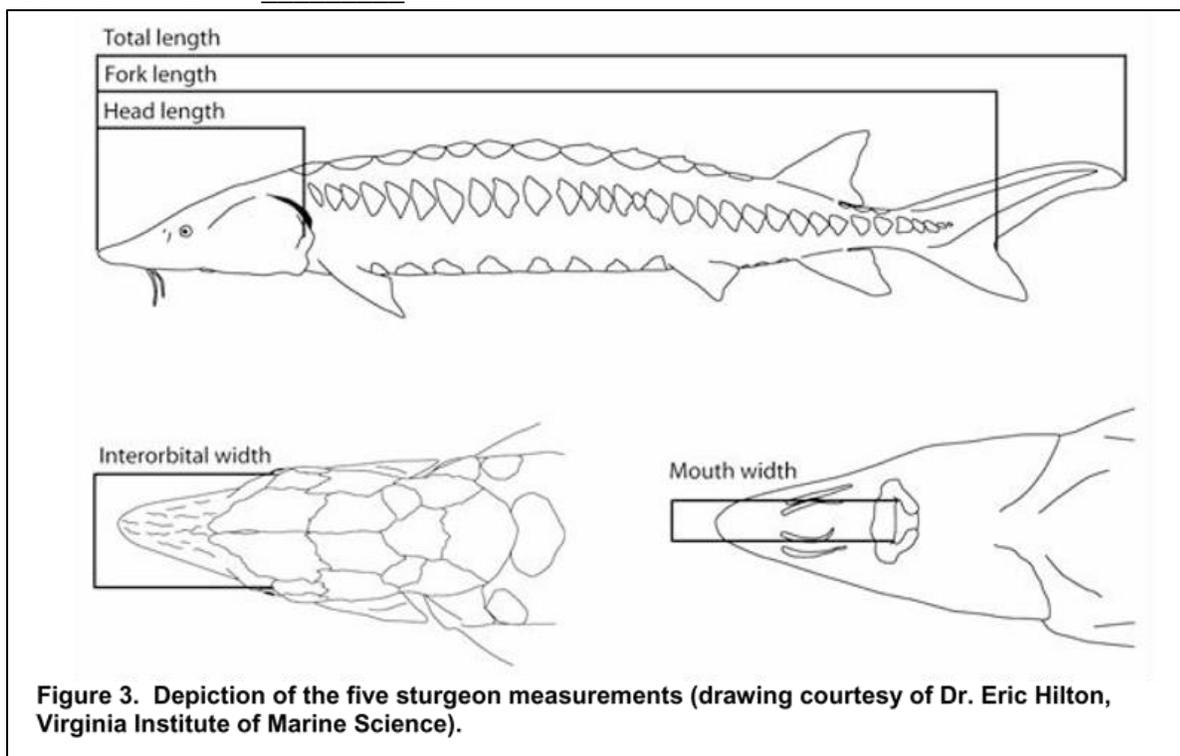
Observer's Signature: _____

Ratio of Interorbital Width to Mouth Width Worksheet

Interorbital Width: Distance between the lateral margins of the bony skull at the midpoint of the orbit (eye socket)

Mouth Width: distance between the left and right inside corners of the mouth (i.e., excluding the lips); this should be measured with the mouth closed.

Mouth Width: _____ mm



Interorbital Width : _____ mm

Ratio: _____ %

Shortnose sturgeon (>62%)

Atlantic sturgeon (<55%)

Abrasion Codes

None

Light

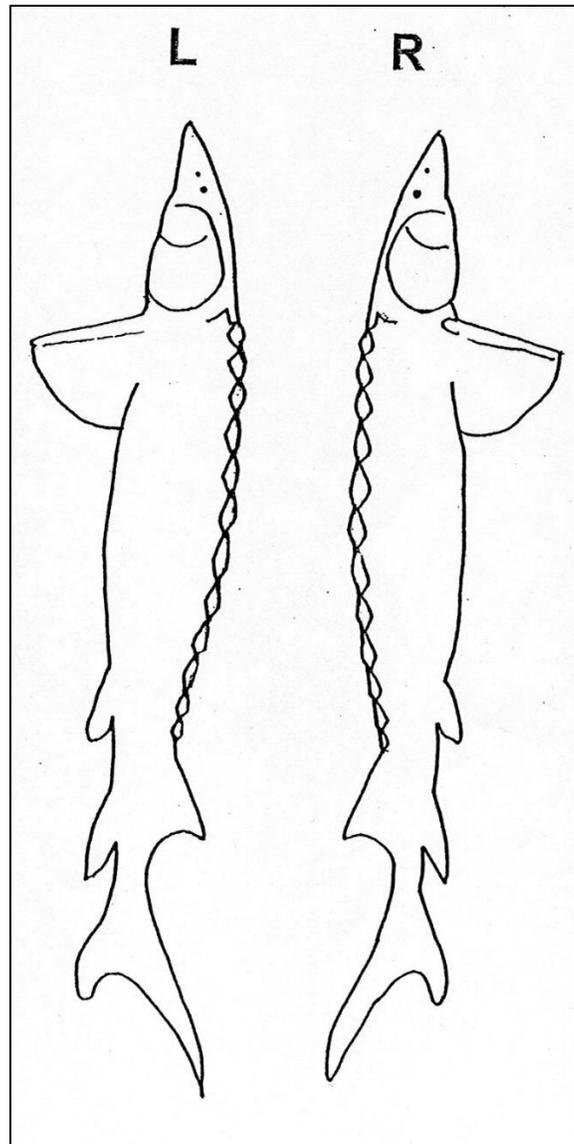
Whitening or smoothed scutes,
Early sign of skin abrasion.

Moderate

Early sign of redness on skin, scutes or fins, Erosion of skin over bony structures,
Loss of skin pigment

Heavy

Large portion of skin red, scutes excessively worn,
Damaged, or missing; patches of skin missing,
Bony structures exposed; flaccid musculature.



STURGEON SALVAGE FORM

For use in documenting dead sturgeon in the wild under ESA permit no. 17273-02 (version 7-26-2016)

INVESTIGATOR'S CONTACT INFORMATION Name: First _____ Last _____ Agency Affiliation _____ Email _____ Address _____ Area code/Phone number _____	UNIQUE IDENTIFIER (Assigned by NMFS) DATE REPORTED: Month <input type="checkbox"/> <input type="checkbox"/> Day <input type="checkbox"/> <input type="checkbox"/> Year 20 <input type="checkbox"/> <input type="checkbox"/> DATE EXAMINED: Month <input type="checkbox"/> <input type="checkbox"/> Day <input type="checkbox"/> <input type="checkbox"/> Year 20 <input type="checkbox"/> <input type="checkbox"/>
--	---

SPECIES: (check one) <input type="checkbox"/> shortnose sturgeon <input type="checkbox"/> Atlantic sturgeon <input type="checkbox"/> Unidentified <i>Acipenser</i> species <i>Check "Unidentified" if uncertain.</i> See reverse side of this form for aid in identification.	LOCATION FOUND: <input type="checkbox"/> Offshore (Atlantic or Gulf beach) <input type="checkbox"/> Inshore (bay, river, sound, inlet, etc) River/Body of Water _____ City _____ State _____ Descriptive location (be specific) _____ _____ Latitude _____ N (Dec. Degrees) Longitude _____ W (Dec. Degrees)
--	---

CARCASS CONDITION at time examined: (check one) <input type="checkbox"/> 1 = Fresh dead <input type="checkbox"/> 2 = Moderately decomposed <input type="checkbox"/> 3 = Severely decomposed <input type="checkbox"/> 4 = Dried carcass <input type="checkbox"/> 5 = Skeletal, scutes & cartilage	SEX: <input type="checkbox"/> Undetermined <input type="checkbox"/> Female <input type="checkbox"/> Male How was sex determined? <input type="checkbox"/> Necropsy <input type="checkbox"/> Eggs/milt present when pressed <input type="checkbox"/> Borescope	MEASUREMENTS: Circle unit Fork length _____ cm / in Total length _____ cm / in Length <input type="checkbox"/> actual <input type="checkbox"/> estimate Mouth width (inside lips, see reverse side) _____ cm / in Interorbital width (see reverse side) _____ cm / in Weight <input type="checkbox"/> actual <input type="checkbox"/> estimate _____ kg / lb
--	--	--

TAGS PRESENT? Examined for external tags including fin clips? <input type="checkbox"/> Yes <input type="checkbox"/> No Scanned for PIT tags? <input type="checkbox"/> Yes <input type="checkbox"/> No		
Tag # _____ _____	Tag Type _____ _____	Location of tag on carcass _____ _____

CARCASS DISPOSITION: (check one or more) <input type="checkbox"/> 1 = Left where found <input type="checkbox"/> 2 = Buried <input type="checkbox"/> 3 = Collected for necropsy/salvage <input type="checkbox"/> 4 = Frozen for later examination <input type="checkbox"/> 5 = Other (describe) _____	Carcass Necropsied? <input type="checkbox"/> Yes <input type="checkbox"/> No Date Necropsied: _____ Necropsy Lead: _____	PHOTODOCUMENTATION: Photos/video taken? <input type="checkbox"/> Yes <input type="checkbox"/> No Disposition of Photos/Video: _____ _____ _____
--	--	--

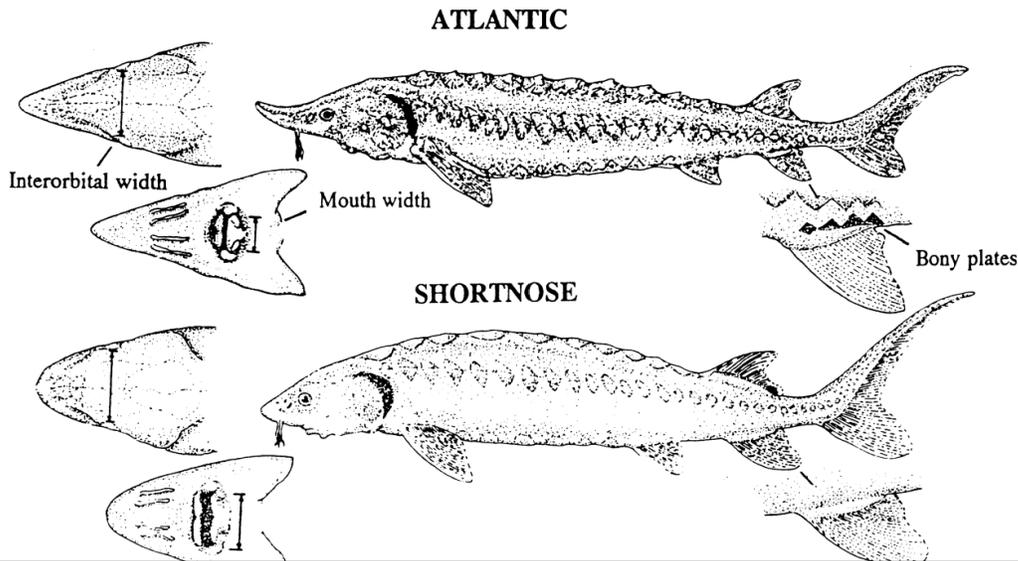
SAMPLES COLLECTED? <input type="checkbox"/> Yes <input type="checkbox"/> No		
Sample _____ _____ _____ _____ _____ _____ _____	How preserved _____ _____ _____ _____ _____ _____ _____	Disposition (person, affiliation, use) _____ _____ _____ _____ _____ _____ _____

Comments:

Distinguishing Characteristics of Atlantic and Shortnose Sturgeon (version 7-26-2016)

Characteristic	Atlantic Sturgeon, <i>Acipenser oxyrinchus</i>	Shortnose Sturgeon, <i>Acipenser brevirostrum</i>
Maximum length	> 9 feet/ 274 cm	4 feet/ 122 cm
Mouth	Football shaped and small. Width inside lips < 55% of bony interorbital width	Wide and oval in shape. Width inside lips > 62% of bony interorbital width
*Pre-anal plates	Paired plates posterior to the rectum & anterior to the anal fin.	1-3 pre-anal plates almost always occurring as median structures (occurring singly)
Plates along the anal fin	Rhombic, bony plates found along the lateral base of the anal fin (see diagram below)	No plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations

* From Vecsei and Peterson, 2004



Describe any wounds / abnormalities (note tar or oil, gear or debris entanglement, propeller damage, etc.). **Please note if no wounds / abnormalities are found.**

Data Access Policy: Upon written request, information submitted to National Marine Fisheries Service (NOAA Fisheries) on this form will be released to the requestor provided that the requestor credit the collector of the information and NOAA Fisheries. NOAA Fisheries will notify the collector that these data have been requested and the intent of their use.

Submit completed forms (within 30 days of date of investigation) to: Greater Atlantic Regional Fisheries Office
Contacts – Julie Crocker (Julie.Crocker@noaa.gov, 978-282-8480) or Lynn Lankshear (Lynn.Lankshear@noaa.gov, 978-282-8473);
Southeast Region Contact- Andrew Herndon (Andrew.Herndon@noaa.gov; 727-824-5312).

ATTACHMENT B
ELLSWORTH PROJECT FISH PASSAGE OPERATIONS &
MAINTENANCE PLAN

ELLSWORTH HYDROELECTRIC PROJECT

FERC NO. 2727

FISH PASSAGE OPERATIONS & MAINTENANCE PLAN

May 09, 2018

Operated by:

Black Bear Hydro Partners, LLC

A member of

Brookfield Renewable Energy Group

Milford, ME

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ELLSWORTH FISH PASSAGE OPERATIONS & MAINTENANCE PLAN

1.0 - INTRODUCTION

This Fish Passage Operations and Maintenance Plan (the “Plan”) is intended to define how Black Bear Hydro Partners, LLC (an indirect subsidiary of Brookfield Renewable Energy Group), owner and Licensee of the Ellsworth Hydroelectric Project FERC No. 2727 (“Ellsworth Project” or the “Project”) will operate and maintain the existing fish passage facilities. This Plan is part of Brookfield’s commitment to our environmental principles that are based on the fundamental values of accountability, partnership and open communication. As such, we have accepted the responsibility entrusted to us to manage natural resources in ways to ensure sustainable development.

The Plan will define what fish passage facilities (the “Facilities”) currently exist at the Project, the period in which the Facilities are to be operated, guidance on the annual start-up and shut-down procedures, routine operating guidelines, debris management, and safety rules and procedures that are in place. Along with these defined procedures and guidelines, the Plan includes the necessary supporting information such as contact information, daily inspection forms, drawings, and spare parts on-site.

2.0 - BACKGROUND

The Ellsworth Hydroelectric Project is located on the Union River in the City of Ellsworth and the Towns of Mariaville, Otis, and Waltham, in Hancock County, Maine. The Project consists of two dams; the Ellsworth Dam (also known as Leonard Lake Dam) adjacent to the Ellsworth Powerhouse forms Leonard Lake Reservoir, and the Graham Lake Dam located approximately 3.5 miles upstream forms the storage reservoir known as Graham Lake.

Graham Lake Dam is a flood control and storage facility that does not contain a powerhouse or hydroelectric turbines. Graham Lake Dam is 30 feet high and consists of a 670-foot-long non-overflow earth dike and an 80-foot-long concrete gate structure. The concrete gate structure contains three 20-foot-wide radial gates and an eight-foot-wide bay with a four-foot-wide sluice that is used for downstream fish passage. This sluice empties into a plunge pool which subsequently discharges into the river below the dam structure. There is no upstream fish passage at the Graham Dam.

Ellsworth Dam maintains Leonard Lake at a normal maximum normal water surface elevation of 66.7 feet. Principle water-retaining structures at Ellsworth Dam include a 275-foot-long overflow spillway, a non-overflow section, east and west abutments, and two intake structures. Units 1 and 4 are vertical shaft propeller turbines, and Units 2 and 3 are vertical shaft Kaplan turbines. One concrete intake structure contains intakes for two, eight foot diameter penstocks serving turbine-generator Units No. 2 and 3, and a 12 foot diameter intake serving Unit No. 4. Trashracks and slide gates for each intake are provided. The second intake contains the 10' diameter penstock for Unit 1. The top of the intake structure is at elevation 74.0 feet. A powerhouse containing four hydroelectric turbine-generator units is located immediately downstream of the dam on the west bank of the river.

The overflow spillway has a permanent crest elevation of 64.5 feet and is equipped with 2.2 foot-high flashboards. The hydraulic capacity of the overflow spillway is approximately 17,000 cfs at a water surface elevation of 71 feet.

Ellsworth Dam provides upstream passage for migratory fish via a vertical slot fishway that is equipped with a trap. Brookfield operates the fish passage facility in accordance with the Union River Fisheries Coordinating Committee's Comprehensive Fishery Management Plan for the Union River. The Company transports migrating

river herring and Atlantic salmon to habitat in the upriver reaches of the Union River drainage. The downstream fish passage facility at Ellsworth Dam consists of three stop-log-controlled surface weirs and a transport pipe and sluice leading to a plunge pool immediately downstream of the dam. The downstream fishway is operated from April 1 to December 31 each year, as river conditions allow.

3.0 - DESCRIPTION OF FISH PASSAGE FACILITIES

3.1 - UPSTREAM FISH PASSAGE - DESCRIPTION

The upstream fish passage at the Project is a vertical slot design with a 3 foot wide entrance and trapping hopper located at the end of the passage. The entrance is located on the west side of the powerhouse near the dam and capable of passing up to 50 cfs of flow. The entrance gate is adjusted, if required, to maintain a wave ripple effect that extends as far as possible out in the tailrace. This usually requires about an 18 inch differential between the fishway and tailrace water levels. The tailwater of the Ellsworth dam is influenced by tidewater. The entrance gate is manually adjusted with a hand wheel or with an electric actuator with local controls. The entrance opens into a single gallery that runs along the driveway of the powerhouse. The first attraction pump is a Worthington Model 20KLD24 pump that is capable of pushing 28 cfs of water through a pipe to the diffusion chamber above the trap. The second pump, a Flygt Model 4451, thrusts approximately 22 cfs of water from the tailrace into a diffuser system located just inside the fishway entrance gate, providing additional attraction flow to the fishway entrance. The head differential between the attraction flow chamber and the tailwater should not exceed five feet.

There are two fish trap hoppers used depending on mode of operation. The “stocking hopper” is mostly solid metal construction which retains water in the hopper tank when lifted for stocking. The “harvest hopper” is constructed with metal screen material and allows for the water to drain when the hopper is lifted. The Town of

Ellsworth, which controls the commercial alewife harvest rights for the Union River, sub-contracts with a “harvesting agent” who catches and sells the alewives to lobster fishermen.

During trap and truck operations, fish are lifted out of the hopper pit in the stocking hopper, and then transferred into a transport tank on a trailer. Alewives are typically transported upstream to Graham Lake in 750 gallon circular tanks, while a smaller 200 gallon rectangular tank is used to transport adult Atlantic salmon upstream to the West Branch Union River where they are released at Goodwin’s Bridge in Mariaville, Maine.

3.2 - DOWNSTREAM FISH PASSAGE - DESCRIPTION

The downstream fish passage has three entrance weirs, each being three feet wide. Entrance weirs #1 and #2 are located above the turbine intake area for Units 2 through 4. Each weir has stop logs that control the flow and are operated at approximately 21 inches of depth conveying approximately 20 cfs through each. Weirs 1 and 2 flow through a gallery into a transition box, and then through a 2 foot diameter pipe that discharges into the downstream sluiceway located on the overflow section of the dam. A Flygt Model 4501 pump located in the downstream migrant pit recirculates approximately 35 cfs from the transition box and back into the headpond. Stop logs (over topped by 12 inches of water depth) is used to control the 5 cfs of conveyance flow needed to transport the downstream migrating fish from the transition box to the downstream sluiceway located on the face of the spillway. Entrance weir #3 is located on the overflow section of the dam beside the turbine intake for Unit No.1 and flows directly into the downstream sluiceway. It is operated at approximately 17 inches of water depth over the stop logs.

4.0 - OPERATION AND MAINTENANCE OF FISH PASSAGE FACILITIES

4.1 - UPSTREAM FISH PASSAGE – OPERATIONS & MAINTENANCE

OPERATIONAL PERIOD

According to the conditions of the 2018 MDMR USFWS Section 10 Sub-Permit, the upstream fish passage will be operated as follows for the 2018 passage season:

- **Operational Dates:** By May 1 or when river herring are present in reasonable quantities until October 31, Operated Daily
- **Operational Hours:** Open 7:00 am – close 6:00 pm, or 1 hour before sunset in the spring/fall
- **Tending Frequency:**
 - a. May 1 – July 15
 - i. Minimum of at least three times per day (9:00 am, 1:00 pm, and 6:00 pm, or 1 hour before sunset)
 - b. July 15 – October 31
 - i. Minimum or twice per day (~10:00 am & 1 hour before sunset)
- Brookfield Renewable fish passage staff will be on site (*at all times*) during river herring harvest and stocking operations in May/June
- All persons listed on the MDMR Section 10 sub permit must be familiar with the terms of the permit, trapping protocols, and aquaculture suspect identification protocol.
- All persons listed on the sub permit who will be operating the trapping facility must participate in MDMR training on the proper handling of Atlantic salmon. This shall occur at the Milford fish lift once Atlantic salmon have begun returning
- Salmon handling protocol (see step-wise procedure in *Maine Department of Marine Resources Suspected Aquaculture Origin Atlantic Salmon Identification and Notification Protocol* and *DMR trap (AQSP) and Fish Handling Protocol* for a full description of the protocols)
 - a. If a visual inspection of fish (step 1 of AQSP) indicates restoration fish, then
 - i. Collect biological data per the adult salmon handling protocol
 - ii. Collect scale samples from every adult Atlantic salmon (step 3 of AQSP).
 - iii. Apply an adipose punch if an adipose fin exists; otherwise, apply an upper caudal fin punch
 - iv. Transport the Atlantic salmon to the release site above Graham Lake at on the West Branch of the Union River at Goodwin’s Bridge in Mariaville

b. If visual inspection of the adult Atlantic salmon (Step 1 of AQSP) suggests aquaculture escapee, then hold the salmon in a suitable tank with appropriate dissolved oxygen levels and call MDMR for further instructions, which could include:

- i. Collect scale sample, mount on slide, send picture of scale to MDMR staff and await further instructions
- ii. If no response from MDMR, then collect scale, apply punch (retain tissue for genetic analysis), floy-tag, and release fish to the tailwater (see step 4 of AQSP)
- iii. If MDMR suspects the Atlantic salmon is an aquaculture escapee (step 6 of AQSP), then hold fish for MDMR. If MDMR believes the scale pattern is inconclusive MDRM will advise that the Atlantic salmon be

OPENING METHODS

- Refer to PM# 17183 & 17184 - Upstream Fish Passage opening method procedure
- Inspect the deck grating over the entrance area. This is done as soon as tailwater levels allow safe access to the entrance areas
- Remove plywood from around Worthington pump, attraction water pump for pipe. (Installed for winter storage)
- Open fishway entrance gate approximately 18 inches, or until there is a wave ripple effect in the tailrace.
- Lower trap into pit and adjust height to allow fish to enter through flume entrance.
- Start the Worthington pump, attraction water pump for pipe.
- Lower the Flygt attraction pump into place with hand crank.
- Start the Flygt attraction pump.
- Raise the trap entrance screen to allow fish to access trap.

SPARE PARTS

- Attraction pump fuses
- Primary 75 HP Attraction Pump
- Secondary 20 HP Attraction Pump

WORKFORCE PLANNING

- Staffing Requirements:
 - Start Up - Crew of 2
 - Routine Operations – Crew of 1
 - Routine Maintenance – Crew of 2 for standard maintenance, crew of 1 for fishway entry for cleaning
 - Shut Down – Crew of 2

- Daily basis:
 - The fishway is visually inspected for debris accumulation. If debris is found, staff will remove debris from fishway. If debris is not manageable by hand, operations crew will shut down pumps, remove deck grate, and remove debris with boom truck.
 - The attraction pumps are inspected for proper operation
 - The Entrance Gates are adjusted for proper outflow
 - The fishway log sheets are completed consistent with Appendices A and C.

- Weekly basis:
 - Facility's lead fishway technician to provide via email a completed Fishway Operations Report consistent with Appendix C to Oliver Cox of MDMR and Jeff Murphy of NMFS by Monday at 0800

- Cleaning process:
 - Inspect fishway for stranded fish.
 - Set up fall arrest/fall retrieval device. Inspect fall harness.
 - Prep chainsaw for operation. Inspect all chainsaw PPE.
 - Inspect access ladder for damage.
 - Inspect rigging for large debris removal with crane.
 - Cut smaller debris to allow removing out of fishway.

- Preventative Maintenance process:
 - Daily :
 - Fill vegetable oil cup and adjust drip rate
 - Yearly:
 - Refer to PM# 23075 for attraction pump inspection procedure
 - Inspect the attraction pump
 - Inspect hoist for lifting trap (Somatex)
 - Inspect the entrance gates gear drive units

WINTERIZING METHODS

- Refer to PM# 17184 - Upstream Fish Passage winterizing method procedure
- Close the trap entrance screen.
- Stop the Flygt attraction pump.
- Raise the Flygt attraction pump with the hand crank.
- Stop the Worthington pump, attraction water for pipe.
- Remove trap from the pit.
- Add plywood to Worthington pump.
- Remove any debris from fishway.

NOTICE:

- Contact NMFS within 24 hours of any interactions with Atlantic salmon, Atlantic sturgeon or shortnose sturgeon, including non-lethal and lethal take
- In the event of any lethal takes, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS.¹
- Notify NMFS of any changes in project and fishway operations (including maintenance activities such as flashboard replacement and draft tube dewatering)²
- The first Brookfield point of contact for all Fishway related issues is the local Supervisor of Operations
- Refer to Section 6.0 for contact information

4.2 - DOWNSTREAM FISH PASSAGE – OPERATIONS & MAINTENANCE**OPERATIONAL PERIOD**

- April 1 - December 31.

OPENING METHODS

- Refer to PM# 17181 & 17182 - Downstream Fish Passage opening method procedure
- The downstream fishway, including the downstream pipe entrance, shall be inspected seasonally for damage and debris via divers or video inspection.
- Inspect the downstream pipe entrance and exit for debris and clean.
- Inspect floor screen above recovery pump, clean as necessary.
- Lower the recovery pump to its bottom seat using the rack rake.
- Open 2 weirs by intake racks for Units 2-4 to approximately 21" depth of water over the entrances.
- Open the weir between Unit 1 and overflow dam section to approximately 17" depth of water over the entrance.
- Turn on recovery pump. Set frequency to half speed (30 cycles).
- Adjust weir just before pipe to be approximately 12" going over entrance
- Pipe entrance should be half full when running recirculating pump.

¹. This would typically include date collected, species, measurements, photographs, etc...

². This does not include typical operational changes such as generator load swings, putting generators online and offline, normal impoundment and flow fluctuations, and opening/closing gates to control spillage. NMFS should be notified for any fishway dewaterings or maintenance issues, problems meeting fishway operational dates, impoundment drawdowns for flashboard or other maintenance, or any other atypical project operations such as dewatering of tunnels, conduits, or penstocks.

SPARE PARTS

- 20 HP Attraction Pump

WORKFORCE PLANNING

- Staffing Requirements:
 - Start Up – Crew of 2
 - Routine Operations – Crew of 1
 - Routine Maintenance – Crew of for standard maintenance, crew of 2 for fishway entry cleaning
 - Shut Down – Crew of 2
- Daily basis:
 - Visually inspect the fishway entrance for debris. If debris is present, operations crew will remove debris. Notify agencies if fishway cannot be cleaned the same day. Fishway shall remain closed during this time frame.
 - Verify proper outflow of fishway. If flow is reduced, clear debris.
 - The fishway log sheets are completed consistent with Appendices A and C.
- Weekly basis:
 - Conduct a thorough inspection of the fishway facility for any debris or damage through the use of cameras. If debris or damage is present, operations crew will remove debris. Notification to the agencies will be conducted if fishway cannot be cleaned or repaired the same day. Fishway shall remain closed during this time frame.
 - Facility's lead fishway technician to provide via email a completed Fishway Operations Report consistent with Appendix C to Oliver Cox of MDMR and Jeff Murphy of NMFS by Monday at 0800
- Cleaning process:
 - De-water fishway (refer to Section 4.2 DOWNSTREAM FISH PASSAGE DE-WATERING METHOD)
 - Inspect fishway for stranded fish
 - Set up fall arrest/fall retrieval device. Inspect fall harness.
 - Prep electric chainsaw for operation. Inspect all chainsaw PPE.
 - Lay out extension cords with GFCI's. Test GFCI prior to use.
 - Inspect all rigging for hoisting debris

- Preventative Maintenance process:
 - Yearly:
 - Refer to PM# 23074 for attraction pump inspection procedure
 - Inspect attraction pump
 - Inspect the trash rake hoist

DOWNSTREAM FISH PASSAGE DE-WATERING METHOD

- Place stoplogs to shut off fishway flow.
- Fish passage may now be dewatered by pumping out fish passage pit.

WINTERIZING METHODS

- Shutoff recovery pump.
- Close all three entrance weirs.
- Remove all weir stoplogs just before pipe entrance.
- Inspect the fishway via divers or video inspection for any damage or debris. Clean any debris from the entrances exits, and pipe.
- Raise recovery pump to winter storage area using the trash rake.

NOTICE:

- Contact NMFS within 24 hours of any interactions with Atlantic salmon, Atlantic sturgeon or shortnose sturgeon, including non-lethal and lethal take
- In the event of any lethal takes, any dead specimens or body parts found must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS³
- Notify NMFS of any changes in project and fishway operations (including maintenance activities such as flashboard replacement and draft tube dewatering)⁴
- The first Brookfield point of contact for all Fishway related issues is the local Supervisor of Operations
- Refer to Section 6.0 for contact information

³. This would typically include date collected, species, measurements, photographs, etc...

⁴. This does not include typical operational changes such as generator load swings, putting generators online and offline, normal impoundment and flow fluctuations, and opening/closing gates to control spillage. NMFS should be notified for any fishway dewaterings or maintenance issues, problems meeting fishway operational dates, impoundment drawdowns for flashboard or other maintenance, or any other atypical project operations such as dewatering of tunnels, conduits, or penstocks

5.0 - SAFETY

5.1 - SAFETY RULES & PROCEDURES

- Pursuant to Brookfield's Safety Procedure SP9, Job Safety and Environmental Plans are completed prior to, and ideally, well in advance of any work at the various fishways are started. Job Safety and Environmental Plans are to be completed using the standard form which may be updated from time to time. Review of prior Job Safety and Environmental Plans for similar work is encouraged to help capture all safety risks that may be present at the site.

6.0 - CONTACT INFORMATION

6.1 NOTICE:

- The Maine Department of Marine Resources fish lift operating procedure and Atlantic salmon handling procedure is located at the agency webpage (at the bottom of page).
<http://www.maine.gov/dmr/science-research/searun/programs/trapcounts.html>
- Contact NMFS within 24 hours of any interactions with Atlantic salmon, Atlantic sturgeon or shortnose sturgeon, including non-lethal and lethal take
- In the event of any lethal takes, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS⁵
- Notify NMFS of any changes in project and fishway operations (including maintenance activities such as flashboard replacement and draft tube dewatering)⁶

⁵. This would typically include date collected, species, measurements, photographs, etc...

⁶. This does not include typical operational changes such as generator load swings, putting generators online.

- The first Brookfield point of contact for all Fishway related issues is the local Supervisor of Operations
- Refer to Section 6.0 for contact information

6.2 CONTACTS

BROOKFIELD

- Robert Brochu, Supervisor Operations, Brookfield
 - (w) 207-827-4067
 - (c) 207-461-3618
 - Robert.Brochu@brookfieldrenewable.com
- James Cole, Senior Operations Manager, Brookfield
 - (w) 207-723-4341 x 127
 - (c) 207-447-1706
 - James.Cole@brookfieldrenewable.com
- Kevin Bernier, Senior Compliance Specialist, Brookfield
 - (w) 207-723-4341 x 118
 - (c) 207-951-5006
 - Kevin.Bernier@brookfieldrenewable.com
 -
- Richard Dill, Biologist, Brookfield
 - (c) 207-852-2993
 - Richard.Dill@brookfieldrenewable.com

AGENCY CONTACTS

- Jeff Murphy, Fishery Biologist, NMFS
 - (w) 207-866-7379
 - (c) 207-299-7339
 - Jeff.Murphy@noaa.gov
- Sean Ledwin, Director MDMR Fisheries and habitat
 - (w) 207-624-6348
 - sean.m.ledwin@maine.gov

- Don Dow, Hydro Engineer, NMFS
 - (w) 207-866-3758
 - (c) 207-416-7510
 - Donald.Dow@noaa.gov

- Dan Tierney, Fishery Biologist, NMFS
 - (w) 207-866-3755
 - (c) 207-416-7676
 - Dan.Tierney@noaa.gov

- Antonio Bentivoglio, Fishery Biologist, USFWS
 - (w) 207-866-3344 x151
 - (c) 207-974-6965
 - [Antonio Bentivoglio@fws.gov](mailto:Antonio_Bentivoglio@fws.gov)

- Bryan Sojkowski, Fish Passage Engineer, USFWS
 - (w) 413-253-8645
 - [Bryan Sojkowski@fws.gov](mailto:Bryan_Sojkowski@fws.gov)

- Steve Shepard, Hydro Power Licensing & Fish Passage ,USFWS
 - (w) 207-866-3344 ext. 116
 - (c) 207-949-1288
 - [Steven Shepard@fws.gov](mailto:Steven_Shepard@fws.gov)

- Gail Wippelhauser, DMR
 - (w) 207-624-6349
 - Gail.Wippelhauser@maine.gov

- Mitch Simpson, DMR
 - (c) 207-941-4464
 - Mitch.Simpson@maine.gov

- John Perry, Environmental Coordinator ,MDIFW
 - (w) 207-287-5254
 - (c) 207-446-5145
 - John.Perry@maine.gov

- Nels Kramer, Fishery Biologist, MDIFW
 - (w) 207-732-4131
 - Gordon.Kramer@maine.gov

- Kathy Howatt, Hydropower Coordinator ,MDEP
 - (w) 207-446-2642
 - Kathy.Howatt@maine.gov

7.0 - APPENDICES

Appendix A: DAILY INSPECTION FORM and DAILY FISH LIFT LOG FORMS

Ellsworth Fish Passage Daily Inspection Form

Date: _____ Time: _____ Inspector: _____ Spill: **Yes / No**

Head Pond Elevation: _____ River Flow (cfs): _____ % Flashboards Down: _____

Tailwater Elevation: _____ Water Temp °C: _____

Turbine Operation: _____
 (%) 1 2 3 4

Upstream Fish Lift

(Describe maintenance performed in comments below)

Fishway debris Ok?: _____ Check cables for damage or wear: _____

Primary Pump On: _____ Check load block wheel for rotation: _____

Auxillary Pump On: _____ Check load block hook and latch: _____

Entrance Gate Ok?: _____ Check that limit switches function: _____

Check for proper travel through range: _____

Downstream Fish Passages

(Describe maintenance performed in comments below)

Fishway debris Ok?: _____

Bypass Pump: **On / Off**

Weir Depths (in): _____
 1 2 3 Bypass Pit

Comments and Requirements:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

Ellsworth Fish Lift Daily Log

Date: _____ Staff: _____ # Prev Lifts to Date: _____

Fishway Start Time: _____ Air Temp (°F): _____ # Lifts Today: _____

Fishway Stop Time: _____ Water Temp (°C): _____ Weather: _____

* For all ATS, add MSW/G, tagged status, and release location to the comments, and fill out DMR Salmon Handling Sheet

Lift #	Time	RIV Trucked	RIV Harvested	ATS*			
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Daily Count:							
Previous Season Total:							
New Season TOTAL:							

Comments:

Appendix B: DRAWINGS

Electronic drawing documents can be found at:

MLT01/Drawings/2015 Ellsworth/

Appendix C: FISHWAY OPERATIONS WEEKLY REPORT

Fishway Operations Weekly Report

Project Name: _____
Fishway Facility: _____
Date: _____

Species	#'s Detected
<i>Atlantic Salmon (MSW):</i>	_____
<i>Atlantic Salmon (1SW):</i>	_____
<i>River Herring:</i>	_____
<i>American Shad:</i>	_____
<i>Striped Bass:</i>	_____
<i>Sea Lamprey:</i>	_____

Weekly Operational Status:

Note:
Weekly Fishway Operations report to be provided to NMFS and MDMR personnel each Monday by 1200.

Appendix D: MORTALITY EVENT PLAN

Alewife

Alewife mortality at the Ellsworth facility occurring outside of normal harvest effort from routine operation is very low. Mortality events of less than 50 alewife in the fish lift get sluiced to the tailrace. Mortality events of more than 50 alewife in a single day will be collected by Alan Atherton (207-460-4940) for immediate disposal as bait.

Atlantic Salmon and Sturgeon

Atlantic salmon or sturgeon mortalities at the Ellsworth fish lift will be handled as follows until the terms of the new operating license for the Project are finalized:

- a) Contact NMFS within 24 hours of any interactions with Atlantic salmon, Atlantic sturgeon or shortnose sturgeon, including non-lethal and lethal takes (Jeff Murphy: by email Jeff.Murphy@noaa.gov or phone (207) 866- 7379 and the Section7 Coordinator incidentaltake@noaa.gov)
- b) In the event of any lethal takes, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS.

**ATTACHMENT 7
ADDITIONAL INFORMATION
RESPONSE OCTOBER 10, 2018**

October 10, 2018

VIA E-FILING

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

***Ellsworth Hydroelectric Project FERC No. 2727-086
Additional Information***

Dear Secretary Bose:

Black Bear Hydro Partners, LLC (Black Bear), licensee for the Ellsworth Hydroelectric Project (Project), filed an Application for New License (Application) for the Project on December 30, 2015. On September 12, 2018 the Commission's staff contacted Black Bear to request several items of additional information that they determined would be useful in preparing the Environmental Assessment for the Project relicensing (Nicholas Palso, September 13, 2018 Communication Memorandum). The following are Black Bear's responses to the additional information requests.

1. Please provide daily elevation data for Graham Lake for 2016.
The data is attached hereto, the daily readings are for 7:00 a.m.
2. At what elevations is the Graham Lake boat launch near the dam useable, both high and low elevations?
The pre-construction drawings for the boat launch show the toe of the boat ramp at approximately elevation 97' (USGS 1929). Black Bear visually inspected the ramp in October 2018 to generally confirm the elevations of the boat launch ramp. The concrete planks forming the boat ramp start at approximately elevation 107'. While the concrete planks are clearly visible down to elevation 99' (based on a comparison to the known lake elevation on that date), the toe of the concrete ramp is covered by gravel and staff were not able to confirm an absolute elevation. It is apparent however that the planks extend at least to the planned elevation of 97' and that the launch is useable to approximately elevation 94'. Black Bear notes that, generically, the recreation boating season in Maine runs through Labor Day. The long-term target elevation for Graham Lake on this date is approximately elevation 99' with the historic operating curve for 1998-2014 (see Final License Application and attached) showing that the lake level on this date averages approximately elevation 99.8'.
3. For the downstream migrant pipe at Ellsworth Dam, what is the monthly min., max. and average flow?

The stoplog weir at the outlet of the downstream fish passage system transition box (entrance to the downstream migrant pipe) is 48" wide and, since at least 2015, has been maintained at constant depth of about 12". This results in a conveyance flow of approximately 12 cfs through the downstream transport pipe. The weir depth is only adjusted during periods when the impoundment is drawn down for maintenance activities at which time stoplogs are removed to maintain the same approximate flow. It has been observed that passing more than 12 cfs of flow through the pipe results in water escaping the sluice way.

4. Provide the dimensions of the spillway flume (fish flume or sluiceway) at Ellsworth Dam in terms of length, width and height and the conveyance flow capacity.

The surface weirs at the downstream fish passage system at the Ellsworth dam are approximately 36" wide. Weir 3 (outboard of Unit 1 on the spillway) is set at about 17 inches of depth, providing about 16 cfs of flow into the spillway flume. The spillway flume is 48 inches wide with approximately 18-inch-high plate steel sidewalls and a heavy plastic bottom. The flume extends the entire height of the spillway. Black Bear did not find whether there was an intended design flow capacity for the flume.

5. Provide the depth of the plunge pool at Graham Lake, and at Ellsworth at both high and low tide.

Graham Dam: The floor of the bay containing the downstream fish passage weir is at elevation 71.0' and the normal tailwater is at elevation 80.5', therefore the plunge pool is generally around 9.5 ft deep.

Ellsworth Dam: Normal low tide is 4.5' and normal high tide is 9.0'. The bottom of the tailrace at the immediately adjacent Unit 1 is no higher than approximately -3.5'.

Although Black Bear does not have confirmatory drawings at the bottom of the plunge pool location, the minimum depth of the plunge pool appears to be several feet with a potential depth of approximately 12 feet. There is no exposed ledge in this location even at the lowest tide.

If you have any questions regarding this filing, please contact me by phone at (207) 755-5603 or by email at Frank.Dunlap@BrookfieldRenewable.com.

Sincerely,



Frank H. Dunlap
Licensing Specialist
Brookfield Renewable

Encl.: 2016 Graham Lake Elevations

Cc: Distribution List
FERC: Nicolas Palso, Bill Connelly
Brookfield; S. Murphy, K. Maloney, R. Dill, K. Bernier

Ellsworth Project FERC No. 2727
October 2018 Additional Information

CERTIFICATE OF SERVICE
Ellsworth Hydroelectric Project (FERC No. 2727)
October 2018 Additional Information

I, Frank H. Dunlap, Licensing Specialist, Brookfield Renewable, hereby certify that a link to the foregoing document on the Commission website has been transmitted to the following parties on October 10, 2018.



Frank H. Dunlap

One copy, via e-filing to:

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street N.E.
Washington, D.C. 20426

Federal Agencies

John T. Eddins
Advisory Council on Historic Preservation
The Old Post Office
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Washington, DC 20004-2501

John Spain
Regional Engineer
Federal Energy Regulatory Commission
New York Regional Office
19 W. 34th St., Room 400
New York, NY 10001-3006

Sean McDermott
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Administration
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October 2018 Additional Information

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October 2018 Additional Information

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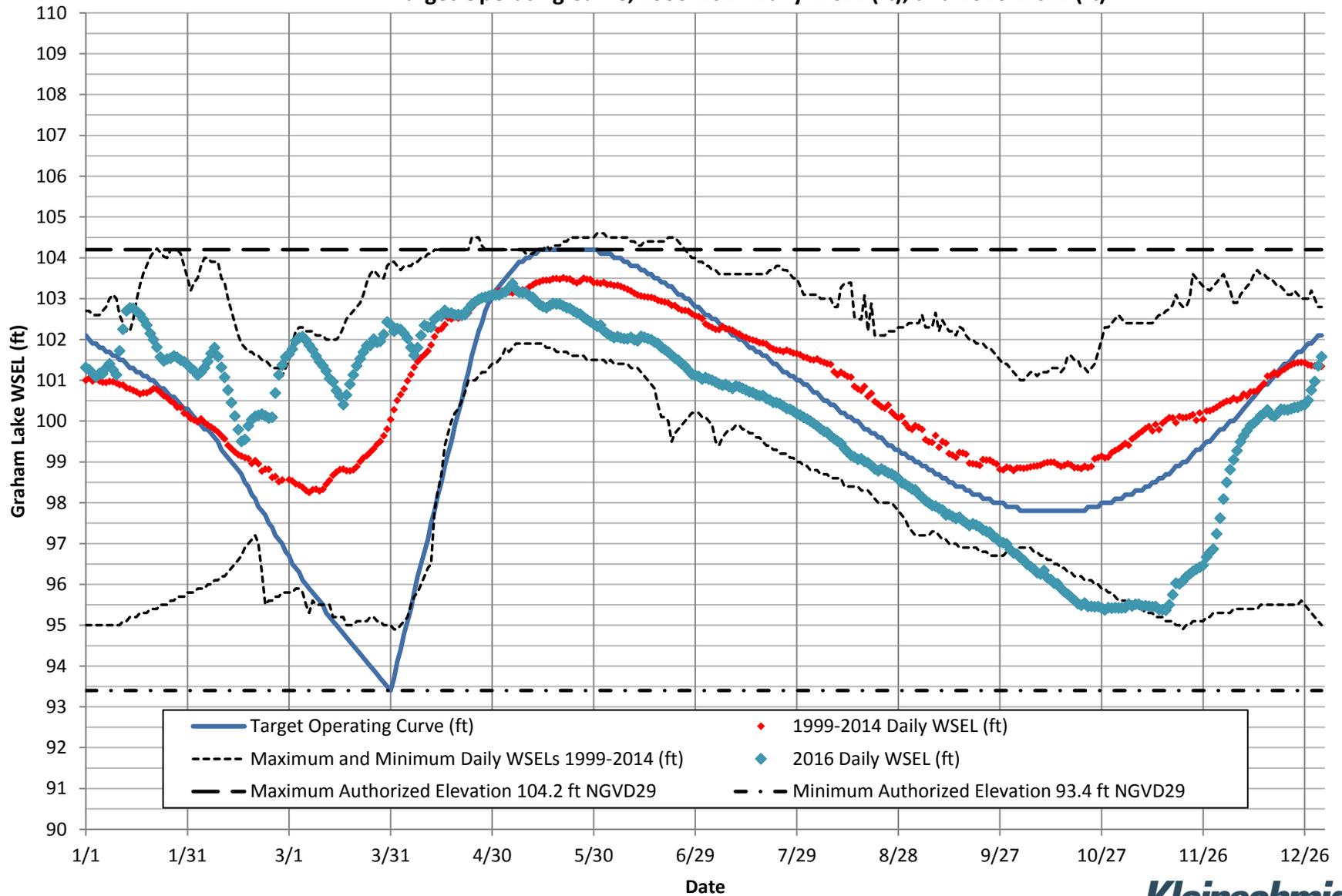
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BBHP Graham Lake Reservoir Operating Curves Target Operating Curve, 1999-2014 Daily WSEL (ft), and 2016 WSEL (ft)



DOCUMENTS SUBMITTED ON JANUARY 31, 2020
AS SUPPLEMENT TO WQC APPLICATION

2019
Macroinvertebrate Sampling Study
Downstream
of
Graham Lake Dam
Ellsworth Maine
FERC No. 2727

Submitted by:

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Date: January 30, 2020

Introduction

This macroinvertebrate sampling study was conducted in support of the relicensing of the Ellsworth Hydroelectric Project, Federal Energy Regulatory Commission (FERC) Project No. 2727. This report details the 2019 study efforts as part of the Water Quality Certification Process.

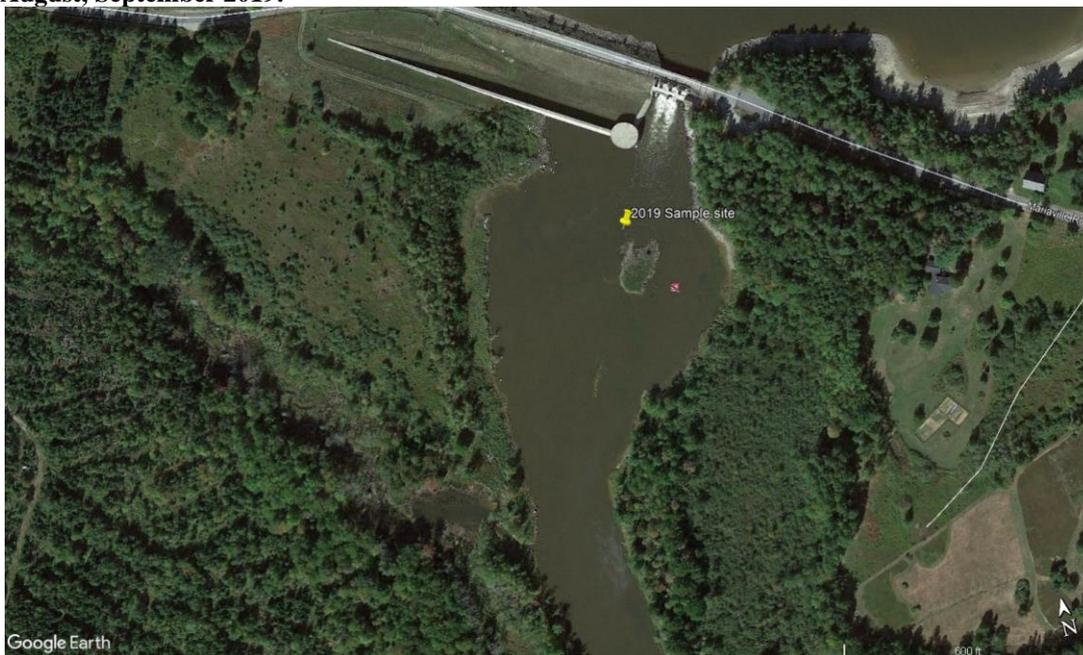
Study Objectives

The goal of the macroinvertebrate sampling study was to generate data on the aquatic macroinvertebrate community in the Union River downstream of the Graham Lake Dam and assess this community in terms of Maine's Aquatic Life Standards.

Study Area

In 2019 we placed samples at one (1) site in the Union River to study aquatic macroinvertebrates (Figure 1). **Site 1** was located upstream of the “pool” below the Graham Lake Dam. This site was approximately 350 ft downstream of the dam.

Figure 1. Location of aquatic macroinvertebrate sampling site downstream of the Graham Lake Dam. Union River, August, September 2019.



Water Classification

The Union River downstream of the Graham Lake Dam is classified Class B ((38 M.R.S.A § 467(4) (18)(A)(1))). With respect to designated uses, the Maine Water Quality Law requires that “Class B waters must be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as habitat for fish and other aquatic life. The habitat must be characterized as unimpaired” (38 M.R.S.A. § 465(3)(A)). The word “unimpaired” is defined to mean “without a diminished capacity to support aquatic life” (38 M.R.S.A. § 466(11)). In addition, for Class B waters, “Discharges to Class B waters may not cause adverse impact to aquatic life in that the receiving waters must be of sufficient quality to support all aquatic species indigenous to the receiving water without detrimental changes in the resident biological community” (38 M.R.S.A. § 465(3)(C)). The term “resident biological community” is defined as “aquatic life expected to exist in a habitat which is free from the influence of the discharge of any pollutant” ((38 M.R.S.A. § 466(10)). The term “without detrimental changes in the resident biological community” means no significant loss of species or excessive dominance by any species or group of species attributable to human activity” ((38 M.R.S.A. § 466(12)).

Study Methods

The objective of the macroinvertebrate sampling study was to determine if the aquatic life, in this case the macroinvertebrate community, attained these Class B standards. The Maine Department of Environmental Protection (DEP) "Methods for Biological Sampling and Analysis of Maine's Inland Waters" (Davies and Tsomides Revised 2014) were used as the basis of the field and laboratory procedures in the macroinvertebrate sampling study. A summary of these methods is given below.

The DEP standard rock bag samplers were used for this study. These samplers hold approximately 16 lbs of clean, washed, bank-run cobble, graded to uniform diameter range of 1.5 to 3 inches. Three (3) samplers were placed at the sample site; samplers are left in the river for approximately 28 days (\pm 4 days) to allow for invertebrate colonization. Retrieval of the

samplers was done using an aquatic D-net. The net was placed directly downstream of a sampler; the sampler was then picked up and placed in the net. The contents of each sampler and the net were washed through a sieve bucket and preserved in labeled jars. Habitat measurements including substrate type, depth, and temperature were collected at sampler collection retrieval.

Samples were collected, preserved, and transported to the Moody Mountain Environmental laboratory. The three (3) samplers (replicates) were sorted, identified, and enumerated.

Results

The samplers were placed in the river on August 9, 2019. Samplers were retrieved on September 6, 2019. Habitat measurements are shown in Table 1 and Appendix 1.

Table 1. Habitat measurements in the Union River downstream of Graham Lake Dam for aquatic macroinvertebrate sampling. August 2019

Macroinvertebrate Field Data Sheet

Log _____	Directions _____	Type of Sampler RB
Station Number _____	_____	Date Deployed 8/9/19
Waterbody Union R.	_____	Number Deployed 3
River Basin Union R.	Lat-Long Coordinates _____	Date Retrieved 9/6/19
Town Ellsworth	N 44°35'24.15"N	Number Retrieved 3
Stream Order 6	W 68°26'29.66"W	Collector(s) P Leeper MME

1. Land Use (surrounding watershed)	2. Terrain	3. Canopy Cover
<input type="checkbox"/> Urban	<input checked="" type="checkbox"/> Upland conifer	<input type="checkbox"/> Dense (75-100% shaded)
<input type="checkbox"/> Cultivated	<input type="checkbox"/> Swamp hardwood	<input type="checkbox"/> Partly open (25-75% shaded)
<input type="checkbox"/> Pasture	<input type="checkbox"/> Swamp conifer	<input checked="" type="checkbox"/> Open (0-25% shaded)
<input checked="" type="checkbox"/> Upland hardwood	<input type="checkbox"/> Marsh	(% daily direct sun) _____
	<input type="checkbox"/> Hilly	
	<input type="checkbox"/> Mountains	

4. Physical Characteristics of Bottom estimate % over 12 m stretch			
<input type="checkbox"/> Bedrock	[60]	<input type="checkbox"/> Cobble (2.5" – 10")	<input type="checkbox"/> Sand (<1/8")
<input type="checkbox"/> Boulders (>10")	[20]	<input type="checkbox"/> Gravel (1/8" – 2.5")	<input type="checkbox"/> Silt
			<input type="checkbox"/> Clay
			<input type="checkbox"/> Muck

5. Habitat Characteristics (immediate area)		Temp. Probe #	7. Water Samples
Time 1000h	Time _____	<input type="checkbox"/> deployed	<input type="checkbox"/> Standard
Wetted Width 200m	Wetted Width (m) _____	6. Observations attached algae/bacteria on bottom	<input type="checkbox"/> Other
Bank Fl Width _____	Bank Full Width (m) _____		Lab Number _____
Depth 79cm	Depth _____	8. Photograph	
Velocity 0.12m/s	Velocity _____	Put-In Yes	
Diss. O ₂ (ppm) 8.2ppm	Diss. O ₂ (ppm) _____	Take-Out _____	
Temp (C) 23.6	Temp (C) _____		
Turbidity _____	Turbidity _____		
DO Meter # _____ Cal? Y /	DO Meter # _____ Cal? Y /		

LDM Results

The LDM biocriteria results are shown in Table 2 and Appendix 1. To attain a particular class a site must have a 60% or greater score in the test for that class. The model results indicate that the community was in non-attainment of Aquatic Life Class Standards.

The make-up of this community and a discussion of the results are presented below.

Table 2. Results of the DEP linear discriminant model (LDM) for a site on the Union River in Ellsworth Maine downstream of the Graham Lake Dam in 2019. A score of 60% or greater is needed to attain a particular class.

Site	Probability of Class A	Probability of Class B	Probability of Class C	Probability of Non-Attainment
1	0%	0%	20%	80%

Community Analysis

The macroinvertebrate community sampled downstream of the Graham Lake Dam was abundant but not very rich in taxa (Table 3 and Appendix 1). The community was populated with 21 different taxa with a Mean Total Abundance of 1182. The community were dominated by filter-feeding caddisflies, representing over 80% of Total Abundance. The Diversity value was 2.42, high considering the hyper-dominance of the filter-feeding caddisflies. Structural indices for the sampled community are shown in Tables 3 and 4.

Table 3. Indices of community structure for the aquatic invertebrate community downstream of the Graham Lake Dam. Union River, August-September 2019.

Tot. Abund.	Taxa Richness	S-W Div.	Hils. Biotic Index (HBN)	Water Quality indication from HBN	Mayfly, Stonefly, Caddisfly (EPT) Richness	Mayfly, Stonefly (EP)		Midge	
						Rich	% Ab	Rich	% Ab
1182	21	2.42	5.85	Fair	10	3	1.0	6	5.0

Indexes measuring the tolerance to poor water quality conditions revealed that caddisflies adapted to a wide range of conditions dominated the community. The EP index of sensitive mayflies and stoneflies showed 3 taxa. These insect orders represented only 1% of the community. No stoneflies were collected. The Hilsenhoff Biotic Index values, 5.85 indicated

fair to poor water quality (Hilsenhoff 1987).

Dominant organisms (representing over 5% of the Total Abundance) in the community are shown in Table 3 arranged from the most sensitive organisms to the organisms most tolerant of poor water quality conditions. The community had four (4) organisms that made up 87% of the total abundance. This community was dominated by intermediate organisms (middling between sensitive and tolerant).

Table 4. Dominant aquatic invertebrate organisms downstream of the Graham Lake Dam. Union River, August- September 2019.

Sensitivity to Poor Water Quality	Dominant Organism	% of Community
Sensitive		
Intermediate	<i>Cheumatopsyche</i>	42
	<i>Neureclipsis</i>	29
	<i>Polycentropus</i>	10
Tolerant	Planariidae	6

The community structure and function found downstream of the Graham Lake Dam on the Union River indicates evidence of organic enrichment and filter-feeder dominance which is a common phenomenon below lake outlets and impoundments (Hynes 1970, Spence and Hynes 1970, Parker and Voshell 1983).

Enrichment and caddisfly dominance downstream of lake outlets and dam outlets is a common phenomenon that has long been reported in the literature. Illies (1956 in Spence and Hynes 1970) reported an increase in the number of filter-feeding Trichoptera below a lake when compared to upstream communities. He attributed this to an increase in food availability. Filter-feeding organisms, including *Cheumatopsyche* and *Neureclipsis*, are often the dominant organism in streams and rivers (Hynes 1970) and frequently are very abundant at lake outlets (Carlsson et al. 1977; Valett and Stanford 1987). The density or biomass of these filter-feeders typically decline the farther one looks downstream (Osgood 1979). This blossoming and decline of the aquatic community may be in response to a gradient in the quantity and/or quality of the food resources. High quality lake seston (the particulate matter in the water), typically made up

of algal cells, is processed by the filter-feeders near the outlet and may be transformed to lower quality detritus (Benke and Wallace 1980, Valett and Stanford 1987).

This phenomenon has also been long observed at impoundment outlets. Spence and Hynes (1971) reported increased numbers of Hydropsychidae (*Cheumatopsyche* is a genus in the family Hydropsychidae) and other organisms downstream of an impoundment and stated that the downstream differences were comparable to mild organic enrichment. Parker and Voshell (1983) reported production of filter-feeding Trichoptera to



Hydropsychidae and filter-feeding net
Photo by: J Montem



Hydropsychidae
and net
© David H. Funk

be the highest at a site closest to the dam when compared to sites farther downstream and sites on free-flowing rivers. They concluded that, not only the amount of high quality food, but the specific size of the seston, contributed to the ability of the caddisflies to occupy this niche.

The community sampled is influenced by the food suspended in the water. This resource allows the aquatic caddisfly filter feeders to flourish. However, the lack of stoneflies in the community, and the small proportion of mayflies, indicates changes to the resident biological community.

Therefore, is my professional opinion that the community sampled downstream of Graham Lake Dam on the Union River does not attain class B aquatic life standards.

Summary

1. The objective of the macroinvertebrate sampling study was to generate data on the aquatic macroinvertebrate community in the Union River downstream of the Graham Lake Dam and assess this community in terms of Maine's Aquatic Life Standards. The Union River downstream of the dam is classified Class B.
2. The Maine Department of Environmental Protection (DEP) "Methods for Biological Sampling and Analysis of Maine's Inland Waters" (Davies and Tsomides Revised 2014) were used as the basis of the field and laboratory procedures in this study.
3. Samplers were retrieved from one (1) sample site approximately 350 ft downstream of the dam, on September 6, 2019 within an acceptable colonization time frame.
4. The LDM biocriteria results indicate that the community is in non-attainment of Aquatic Life Class Standards.
5. The invertebrate community sampled downstream of the Graham Lake Dam were abundant, and dominated by filter-feeders. The dominance of filter-feeders is a natural response to the food resource exiting the lake. This response is also found at natural lake outlets.
6. The community structure and function found downstream of the Graham Lake Dam: specifically, the lack of stoneflies and the small number of mayflies, indicates that there have been changes to the resident biological community.
7. It is my professional opinion that the macroinvertebrate community in the tailwater section of Graham Lake Dam on the Union River does not attain class B aquatic life standards.

References

- Benke, A.C. and J.B. Wallace. 1980. Trophic basis of production among net-spinning caddisflies in a southern Appalachian stream. *Ecology* 61: 108-118.
- Carlsson, M., L.M. Nilsson, Bj. Svensson, and S. Ulfstrand, 1977. Lacustrine seston and other factors influencing blackflies (Diptera: Simuliidae) inhabiting lake outlets in Swedish Lapland. *Oikos* 29: 229-238.
- Davies, S.P. and L. Tsomides. Revised 2014. Methods for biological sampling and analysis of Maine's rivers and streams. ME Dept. of Env. Prot. Augusta, ME. 31p.
- Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. *The Great Lake Entomologist*. Pgs. 31-39.
- Hynes, H.B.N. 1970. *The Ecology of Running Waters*. Univ. of Toronto. Toronto, CA 555p.
- Osgood, M.W. 1979. Abundance patterns of filter-feeding caddisflies (Trichoptera: Hydropsychidae) and seston in a Montana (U.S.A.) lake outlet. *Hydrobiologia* Vol. 63 (2):177-183.
- Parker, C.R. and J.R. Voshell Jr. 1983. Production of filter-feeding Trichoptera in an impounded and a free-flowing river. *Can. J. Zool.* 61:70-87.
- Spence, J.A., and H.B.N. Hynes. 1971. Differences in benthos upstream and downstream of an impoundment. *J. Fish. Res. Bd. Canada* 28: 35-43.
- Valett, H.M. and A. Stanford. 1987. Food quality and Hydropsychidae caddisfly density in a lake outlet stream in Glacier National Park, Montana, U.S.A. *Can. J. Fish Aquat. Sci.* 44: 77-82.

Appendix 1- LDM Model Report including Model results, field data, and individual replicate data.



**Maine Department of Environmental Protection
Biological Monitoring Program
Aquatic Life Classification Attainment Report**

Station Information

Station Number: S-1051	River Basin:	Maine Coastal	
Waterbody:	Union River - Station 1051	HUC8 Name:	Maine Coastal
Town:	Ellsworth	Latitude:	44 35 22.72 N
Directions:	100 METERS BELOW THE DAM.	Longitude:	68 26 28.28 W
		Stream Order:	4

Sample Information

Log Number: 2785	Type of Sample:	ROCK BAG	Date Deployed:	8/9/2019	
Subsample Factor:	X1	Replicates:	3	Date Retrieved:	9/6/2019

Classification Attainment

Statutory Class: B	Final Determination: NA	Date:	1/21/2020
Model Result with $P \geq 0.6$:	NA	Reason for Determination:	Model
Date Last Calculated:	1/21/2020	Comments:	

Model Probabilities

<u>First Stage Model</u>		<u>C or Better Model</u>	
Class A	0.00	Class C	0.66
Class B	0.00	NA	0.33
<u>B or Better Model</u>		<u>A Model</u>	
Class A or B	0.00	Class A	0.00
Class C or Non-Attainment	1.00	Class B or C or Non-Attainment	1.00

Model Variables

01 Total Mean Abundance	1182.00	18 Relative Abundance Ephemeroptera	0.01
02 Generic Richness	21.00	19 EPT Generic Richness	10.00
03 Plecoptera Mean Abundance	0.00	21 Sum of Abundances: <i>Dicrotendipes</i> , <i>Micropsectra</i> , <i>Parachironomus</i> , <i>Helobdella</i>	0.00
04 Ephemeroptera Mean Abundance	12.33	23 Relative Generic Richness- Plecoptera	0.00
05 Shannon-Wiener Generic Diversity	2.42	25 Sum of Abundances: <i>Cheumatopsyche</i> , <i>Cricotopus</i> , <i>Tanytarsus</i> , <i>Ablabesmyia</i>	532.16
06 Hilsenhoff Biotic Index	5.85	26 Sum of Abundances: <i>Acroneuria</i> , <i>Maccaffertium</i> , <i>Stenonema</i>	4.00
07 Relative Abundance - Chironomidae	0.05	28 EP Generic Richness/14	0.21
08 Relative Generic Richness Diptera	0.29	30 Presence of Class A Indicator Taxa/7	0.00
09 <i>Hydropsyche</i> Abundance	0.00		
11 <i>Cheumatopsyche</i> Abundance	500.83		
12 EPT Generic Richness/ Diptera Generic Richness	1.67		
13 Relative Abundance - Oligochaeta	0.00		
15 Perlidae Mean Abundance (Family Functional Group)	0.00		
16 Tanypodinae Mean Abundance (Family Functional Group)	4.00		
17 Chironomini Abundance (Family Functional Group)	3.00		

Five Most Dominant Taxa

Rank	Taxon Name	Percent
1	<i>Cheumatopsyche</i>	42.37
2	<i>Neureclipsis</i>	28.93
3	<i>Polycentropus</i>	9.95
4	Planariidae	5.75
5	<i>Oecetis</i>	2.88



**Maine Department of Environmental Protection
Biological Monitoring Program
Aquatic Life Classification Attainment Report**

Station Number: S-1051 Town: Ellsworth Date Deployed: 8/9/2019
Log Number: 2785 Waterbody: Union River - Station 1051 Date Retrieved: 9/6/2019

Sample Collection and Processing Information

Sampling Organization: PAUL LEEPER (MOODY MOUNTAIN ENVIRONMENTAL) Taxonomist: PAUL LEEPER (MOODY MOUNTAIN ENVIRONMENTAL)

Waterbody Information - Deployment

Temperature: 23.6 deg C
Dissolved Oxygen: 8.2 mg/l
Dissolved Oxygen Saturation:
Specific Conductance:
Velocity: 12 cm/s
pH:
Wetted Width:
Bankfull Width:
Depth:

Waterbody Information - Retrieval

Water Chemistry

Summary of Habitat Characteristics

<u>Landuse Name</u>	<u>Canopy Cover</u>	<u>Terrain</u>	
Swamp Hardwood	Open	Rolling	
Upland Hardwood			
<u>Potential Stressor</u>	<u>Location</u>	<u>Substrate</u>	
Regulated Flows	Below Dam	Boulder	20 %
		Clay	10 %
		Gravel	10 %
		Rubble/Cobble	69 %

Landcover Summary - 2004 Data

Sample Comments

ATTACHED ALGAE



**Maine Department of Environmental Protection
Biological Monitoring Program
Aquatic Life Taxonomic Inventory Report**

Station Number: S-1051 Waterbody: Union River - Station 1051 Town: Ellsworth
Log Number: 2785 Subsample Factor: X1 Replicates: 3 Calculated: 1/21/2020

Taxon	Maine Taxonomic Code	Count (Mean of Samplers)		Hilsenhoff Biotic Index	Functional Feeding Group	Relative Abundance %	
		Actual	Adjusted			Actual	Adjusted
Planariidae	03010101	68.00	68.00		--	5.8	5.8
<i>Hyalella</i>	09010203006	6.67	6.67	8	CG	0.6	0.6
Odonata	090203	0.33	0.33		--	0.0	0.0
Heptageniidae	09020402	7.67	7.67		--	0.6	0.6
<i>Stenonema</i>	09020402016	4.00	4.00	4	SC	0.3	0.3
<i>Tricorythodes</i>	09020411038	0.67	0.67	4	CG	0.1	0.1
<i>Chimarra</i>	09020601003	18.33	18.33	2	CF	1.6	1.6
<i>Neureclipsis</i>	09020603008	342.00	342.00	7	CF	28.9	28.9
<i>Polycentropus</i>	09020603010	117.67	117.67	6	PR	10.0	10.0
Hydropsychidae	09020604	79.33			--	6.7	
<i>Cheumatopsyche</i>	09020604015	422.67	500.83	5	CF	35.8	42.4
<i>Macrostemum</i>	09020604018	6.33	7.50	3	CF	0.5	0.6
<i>Agraylea</i>	09020607024	0.33	0.33	8	P	0.0	0.0
<i>Oecetis</i>	09020618078	34.00	34.00	8	PR	2.9	2.9
<i>Thienemanimyia</i>	09021011020	4.00	4.00	3	PR	0.3	0.3
<i>Cricotopus</i>	09021011037	31.33	31.33	7	SH	2.7	2.7
<i>Eukiefferiella</i>	09021011041	6.33	6.33	8	CG	0.5	0.5
<i>Nanocladius</i>	09021011049	3.67	3.67	3	CG	0.3	0.3
<i>Rheotanytarsus</i>	09021011072	16.00	16.00	6	CF	1.4	1.4
<i>Polypedilum</i>	09021011102	3.00	3.00	6	SH	0.3	0.3
Hydrobiidae	10010104	9.33	9.33		--	0.8	0.8
<i>Gyraulus</i>	10010203029	0.33	0.33		SC	0.0	0.0

2019

Graham Lake

Macroinvertebrate Community Study

Ellsworth Maine

FERC No.2727

Submitted by:

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1.0 INTRODUCTION

This is a report on a 2019 Benthic Macroinvertebrate Survey in Graham Lake. This survey was conducted in Graham Lake in support of the relicensing of the Ellsworth Hydroelectric Project, Federal Energy Regulatory Commission (FERC) No. 2727. The Graham Lake Dam impounds the approximately 10,000-acre Graham Lake at a normal maximum surface elevation of 104.2 feet msl. Graham Lake is operated as a water storage facility where water is stored for later use in supplementing downstream generation at the Ellsworth Dam. There are no generating facilities at the Graham Lake Dam. The current project license requires the water level in Graham Lake to be maintained between 93.4 and 104.2 feet msl. The Graham Lake Development generally follows an informal target operating curve where the impoundment is drawn down during the summer and winter and refilled in the fall and spring. According to the operating curve, Graham Lake is drawn down from a target elevation of approximately 102 feet msl on January 1 to a target elevation of 93.4 feet msl on March 31. Graham Lake is then filled to a target elevation of 104.2 feet msl between April 1 and mid-May, and is gradually drawn down over the summer to a target elevation of 97.8 feet msl by early October. Graham Lake is then partially refilled from mid-October to the end of December to a target elevation of approximately 102 feet msl.

Graham Lake is classified GPA. Under 38 MRSA §464(9), as a hydropower project impoundment, the aquatic life must, at a minimum, attain Class C aquatic life standards. Class C waters may cause some changes to aquatic life, provided the receiving waters shall be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community. This study concentrated on the resident biological community, namely aquatic invertebrates.

2.0 GOALS

The goals of this study were to:

1. Survey the aquatic macroinvertebrates in the shallow littoral (nearshore) habitats in Graham Lake and describe the communities and habitat;

2. Make a determination on whether the aquatic life in Graham Lake, as shown by the nearshore macroinvertebrate communities, is meeting its Class GPA standard.

3.0 STUDY AREA

The study area consisted of the approximately 10,000 acres of Graham Lake in the towns of Ellsworth, Fletchers Landing, Waltham, and Mariaville (Figure 1). The tributaries, including the East and West Branches of the Union River were not included in the study.

4.0 METHODS

This study followed previous Maine lake and impoundment study methodologies (Leeper 1998 and Normandeau 2009). Benthic macroinvertebrates (aquatic insects and non-insects) were sampled at six locations in Graham Lake (Figure 1). Sampling targeted three (3) general substrates, coarse substrates (cobble-gravel), fine substrates (sand), and wetlands (aquatic bed, soft muds and aquatic vegetation). A Surber sampler was used to collect samples from cobble-gravel and sand substrates. These substrates had little or no aquatic vascular plants and occurred in areas generally exposed to wind, wave and ice action. Aquatic sweep samples were collected from soft silt-mud substrates in protected areas which contained aquatic vascular plant growth. Sampling took place on August 15 and September 19, 2019 under typical reservoir level conditions.

Macroinvertebrate sampling in cobble-gravel substrates was conducted at two (2) locations, Cobble Gravel-1 and Cobble Gravel-2 (Figure 1). The two (2) sand substrate locations are denoted Sand-1 and Sand-2 in Figure 1. Three replicate quadrat samples were collected at each location using a square foot Surber sampler that was placed on the substrate in water depths between 0.5 and 2 feet.

Figure 1. Graham Lake and the location of nearshore aquatic macroinvertebrate community sample sites in 2019.



A grain scoop was used to excavate the substrate within the sampler to a depth of about 5 inches. The contents of the scoops were placed in the Surber collection bag. The remaining substrate was agitated and then the Surber was retrieved. The contents of each replicate Surber sample was washed in a 595 μm sieve bucket to remove fine grained material, placed in a labeled sample jar, and preserved with denatured alcohol for laboratory processing.

Two (2) wetland locations, Aq. Bed-1 and Aq. Bed-2 are shown in Figure 1. Three replicate samples were collected at each wetland location using an aquatic D-frame sweep net. Each replicate was collected by dragging the sweep net in a straight line for three feet with the handle held perpendicular to the bottom. The bottom of the net penetrated the substrate by approximately one-half inch. The contents of each replicate sweep net sample were washed in a 595 μm sieve bucket to remove fine grained material, placed in a labeled sample jar, and preserved with denatured alcohol for laboratory processing.

All samples were transported to the Moody Mountain Environmental laboratory where they were sorted, identified, and enumerated. At each station, mean values of three replicate samples were used to calculate the following metrics:

Total Abundance – Total Abundance is the mean of the total number of specimens collected from a sampling station and gear type on a given date.

Community Density – Community Density (no./m²) was only calculated from quantitative samples, therefore density estimates were only calculated from Surber samples in cobble-gravel and sand substrates.

Taxa Richness – Taxa richness is the number of distinct taxa (types of organisms) in a sample and provides an estimate of the size of a macroinvertebrate community. A relatively large number of taxa would indicate less environmental stress.

Shannon-Weiner Diversity Index – This metric compares the distribution of individuals among all taxa present in a sample. The Shannon-Wiener diversity index (H) is a measure of diversity that combines species richness (the number of species in a given area) and their relative abundances. Maximum diversity is obtained when the numbers of individuals are equally

distributed among the taxa. A value near 0 would indicate a large number of individuals representing one or a few species. High values indicate that the numbers of individuals are evenly distributed among several species.

EPT Richness – Three groups of benthic insects are considered particularly sensitive to pollution. EPT Richness is the number of distinct taxa (types of organisms) in a sample that represents the groups (taxonomic Orders) of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), which are collectively referred to as the EPT taxa. Low values for this metric indicate potentially stressful environmental conditions; values for this metric generally increase with increasing water quality.

Midge Abundance – Midge (Diptera: Chironomidae) taxa are generally more tolerant of stressful environmental conditions. Values for this metric generally increase with decreasing water quality.

Percent Dominant Taxa – This metric uses the abundance of the most commonly collected taxon as a measure of community balance. A community dominated by one or relatively few taxa suggests environmental stress. If a dominant taxon accounts for a large percentage of the individuals present, it is an indication of stress because the community is dominated by one taxon, whereas unstressed communities typically exhibit a more evenly balanced abundance among several taxa.

In addition to characterizing the Graham Lake macroinvertebrate community, this study compared that community to the community in Attean Pond. Attean Pond is a 2,745 acre lake located in the Moose River drainage. It is a natural, unregulated lake with no shoreline development and excellent water quality. Normandeau (2009) previously studied the shallow, near shore macroinvertebrate community using similar methods. The data set from August 2008 sampling in cobble-gravel substrates and soft silt-mud substrates in protected areas which contained aquatic vascular plant growth were compared to the August Graham Lake community. It should be noted that the Aquatic Life standard for Graham Lake allows for some changes in aquatic life as long as the structure and function of resident biological community is maintained. Therefore, the Graham Lake community does not have to be exactly like that of a natural lake,

but the basic structure and function must be maintained. The metrics described above were compared between the lake communities as well as an additional metric:

Community Loss Index – The community loss index measures the loss of benthic taxa in samples from an experimental station (Graham Lake) compared to those found at the reference station (Courtemanch and Davies 1987). It also factors in the replacement of missing taxa with different taxa. The value of this index can range from 0 to infinity, and increases as the test station becomes increasingly dissimilar to the reference station; therefore, lower values indicate less stressful conditions.

5.0 RESULTS

Physical habitat characteristics of each sampling station are provided in Table 1. Photographs of the sites are included in Appendix 1. Aquatic sweep samples were collected from sites Aq. Bed-1 and -2 (Figure 1). Overall, these sites had a substrate that was predominately composed of soft muds, clay, and detritus (organic matter). Submerged aquatic vegetation (SAV) and floating aquatic vegetation was abundant at both sites. Surber samples were collected from sites Cobble Gravel-1 and -2. As named, the substrates at these sites were predominantly cobble and gravel, although it was noted at both sites that the cobble was embedded in clay or mud. Neither site had extensive aquatic vegetation but some attached algae was present. Surber samples were also used at sites Sand-1 and -2. These sites were predominantly sands with some gravel and muds. No aquatic vegetation was present at these sites. Both the Cobble Gravel and Sand sites were located in areas that received more wave action than the Aquatic Bed sites, which precluded the presence of silt, mud, and extensive vegetation.

Table 1. Substrate Composition, temperature and dissolved oxygen at littoral macroinvertebrate sampling sites on Graham Lake, August, September 2019.

Station	Date	Sample Type	Substrate % Composition							Water Quality			
			Boulder	Cobble	Gravel	Sand	Silt/Mud	Clay	Muck	Detritus	Temp (°C)	Diss Oxy (mg/l)	
G-CG-1	15-Aug-19	Surber	5	60	25				10			24.9	7.8
G-CG-2	15-Aug-19	Surber	10	40	30	10	10					24	7.5
G-Snd-1	15-Aug-19	Surber			30	60	10					27	8.1
G-Snd-2	15-Aug-19	Surber			25	70	5					23.2	8
G-Wtl-1	15-Aug-19	Aq. Sweep						50	20		30	24.7	7.6
G-Wtl-2	15-Aug-19	Aq. Sweep						40	40		20	22.7	7.8

A complete list of site data including taxa and the number of individuals per taxon collected from each sample is provided in Appendix 3. Summarized benthic macroinvertebrate data are provided in Table 2. Overall a total of 7881 organisms representing 71 taxa were collected in the study. S-W Diversity values were generally low, ranging from 1.37 to 2.50. Sensitive mayflies and caddisflies (EPT) taxa made up 30% of the total taxa collected. The wetland habitats were the most numerous, by an order of magnitude, and rich communities. Sand and cobble-gravel habitats were much less numerous and had 15% and 35% less taxa respectively. As mentioned above, overall diversity values for these communities were generally low. The sand communities had the highest values overall. Sensitive EPT taxa were well represented in all communities and made up over a third of the taxa at sand and cobble-gravel sites. Mean total abundance of EPT rose in all habitats from August to September. Midge larvae, generally more adaptable to stressful environmental conditions, were a minor component of the communities reaching a high of 15% of the abundance in sand habitat in August. However, the midges *Tanytarsus* and *Tribelos* were dominant taxa in sand habitat in August and September respectively. The aquatic snail, *Amnicola* sp. and the amphipod *Hyaella azteca* were dominant taxa (>5%) in all habitats in both months. Combined these two (2) taxa represented between 21% and 72% of the communities across habitats and months. Sensitive mayflies *Stenacron* and *Eurylophella* were major components of the cobble gravel communities and the wetland communities in September.

Table 2. Summarized metrics from the nearshore aquatic macroinvertebrate communities in Graham Lake, 2019.

Sample Site	Mean Tot. Abund.	Density Ind./sq. meter	Taxa Richness	S-W Div. Minimum	S-W Div. Maximum	Mayfly, Stonefly, Caddisfly (EPT) Richness	EPT		Midge	
							Tot. Ab.	% Ab	Tot. Ab.	% Ab
August Sampling										
Cob/Gr	33.83	364.18	22	1.39	1.94	11	7.33	21%	1.67	5%
Sand	69.00	742.71	27	1.68	2.04	7	5.33	8%	10.17	15%
Wetl	684.17		44	1.76	2.24	5	34.17	5%	46.00	7%
September Sampling										
Cob/Gr	43.67	470.02	21	1.91	2.15	7	9.67	38%	1.67	7%
Sand	41.53	447.02	26	1.97	2.50	8	15.33	37%	4.83	12%
Wetl	529.60		24	1.37	1.58	5	78.00	15%	1.20	0%
Totals by Substrate										
Cob/Gr	38.75	417.10	32	1.39	2.15	13				
Sand	55.25	594.71	42	1.68	2.50	13				
Wetl	603.88		49	1.37	2.15	5				

Table 2b. Dominant taxa in nearshore aquatic macroinvertebrate communities in Graham Lake, 2019.

Cobble/ Gravel				Sand				Wetland			
August		Sept		August		Sept		August		Sept	
Amnicola	39%	Hyalella azteca	23%	Amnicola	34%	Eurylophella	16%	Amnicola	38%	Hyalella azteca	52%
Oligochaeta	19%	Eurylophella	21%	Oligochaeta	32%	Oligochaeta	14%	Hyalella azteca	34%	Amnicola	15%
Hyalella azteca	13%	Oligochaeta	19%	Tanytarsus	7%	Hyalella azteca	11%	Cladocera	6%	Eurylophella	13%
Stenacron	12%	Amnicola	12%	Hyalella azteca	6%	Tribelos	10%			Cladocera	7%
		Stenacron	6%			Amnicola	10%			Enallagma	5%
		Polycentropus	6%			Planariidae	6%				

A comparison of communities in Graham Lake to communities in Attean Pond, an unregulated, natural Great Pond is shown in Table 3. Data from cobble-gravel and wetland communities were compared from the month of August. This comparison presents a mixed picture. Overall the Graham Lake community is as abundant, or more so, than the Attean community and as diverse. However, the Graham Lake community has fewer taxa and the most dominant taxa represent a greater proportion of the community.

Comparisons of the wetland communities shows total abundance is greater at Graham Lake, taxa richness is similar, as is diversity, indicating little difference between the communities. However, the most dominant taxon represents over a third of the community and sensitive EPT taxa are less represented. The Community Loss Index value (0.81) indicates some

change in the Graham Lake community and some missing taxa are replaced with different taxa. This is within the range of Community Loss Index values that Courtemanch and Davies (1987) found indicated water segments essentially unaffected by human use.

Comparisons of the cobble-gravel communities shows total abundance and diversity to be similar and sensitive EPT taxa are represented similarly. But taxa richness is depressed at Graham and the most dominant taxon represents over a third of the community. The Community Loss Index value (1.23) indicates a loss of taxa at Graham Lake and there has been little replacement of those taxa with different ones. This indicates a greater change to the Graham Lake community.

Table 3. Comparisons of community metrics between 2019 Graham Lake nearshore aquatic macroinvertebrates and those of Attean Pond in 2008.

August Aquatic Sweep Samples- wetland (SAV mud) substrate			
Metric	Attean Pond	Graham Lake	Comments
Total Abundance	290.6	684.2	Graham moderately different
Taxa Richness	54	43	minor depression of richness indicated
Percent Dominant Taxon	27%	38%	minor adverse effects indicated
EPT Richness	10	5	some adverse effects indicated
Shannon Diversity	2.00	1.88	no adverse effects indicated
Community Loss Index	0.81		some change in Graham community some missing taxa are replaced
August Surber Samples- cobble-gravel substrates			
Metric	Attean Pond	Graham Lake	Comments
Total Abundance	26.8	34.17	no adverse effects indicated, moderate increase at Graham
Density (No./m ²)	291.1	367.77	no adverse effects indicated, moderate increase at Graham
Taxa Richness	35	22	adverse effects indicated at Graham
Percent Dominant Taxon	23%	39%	some adverse effects indicated at Graham
EPT Richness	10	11	no adverse effects indicated
Shannon Diversity	2.20	1.97	no adverse effects indicated
Community Loss Index	1.23		community loss at Graham, less taxa replaced

6.0 DISCUSSION

The goal of this study is to make a determination on whether the aquatic life in Graham Lake, as shown by the nearshore macroinvertebrate communities, is meeting its Class GPA standard. Graham Lake Dam is classified GPA and under 38 MRS §464(9), as a hydropower

project impoundment, the aquatic life must, at a minimum, attain Class C aquatic life standards. Class C waters may cause some changes to aquatic life, provided the waters maintain the structure and function of the resident biological community, in this case, the near shore aquatic invertebrate community. The data show that the communities in the typical habitats in Graham Lake are rich in taxa, and organisms sensitive to environmental stress are present, and in some cases, abundant in the communities. Overall the communities were dominated by common and ubiquitous lake organisms, namely *Amnicola* snails and the amphipod *Hyaella azteca*. *Hyaella azteca* is "the most abundant amphipod of lakes [in North America]" (Mason 2002).

Comparisons with communities from a natural unregulated lake, show some changes. Wetland communities in Graham Lake are similar to communities in Attean Pond but are different enough that Community Loss values were indicative of stressed conditions. Cobble-gravel communities in Graham Lake show greater change when compared to Attean communities. The most notable difference is that taxa richness at Graham is over 30% less than at Attean. The Community Loss values reflect this and indicate greater change or stress to the community.

Based on this data, it is my professional opinion that the structure and function of the resident biological community is maintained in Graham Lake. The community is dominated by common lake organisms and sensitive organisms are well represented in all typical habitats. Comparisons of community metrics from Graham Lake to the unregulated Attean Pond show the communities are different, especially the cobble gravel communities. However, the structure and function of the community in Graham Lake aquatic communities is still maintained.

7.0 SUMMARY

1. The objectives of this study were to survey the aquatic macroinvertebrates in the shallow littoral (nearshore) habitats in Graham Lake and describe the communities and habitat and to;
2. Make a determination on whether the aquatic life in Graham Lake, as shown by the nearshore macroinvertebrate communities, is meeting its Class GPA standard.

3. Previous Maine lake and impoundment study methodologies were followed in this study. Sampling targeted three (3) general substrates, coarse substrates (cobble-gravel), fine substrates (sand), and wetlands (aquatic bed, soft muds and aquatic vegetation). Surber samplers were used on cobble-gravel and sand substrates, aquatic sweep samples were collected from wetland (soft silt-mud substrates). Sampling took place on August 15 and September 19, 2019 under typical reservoir level conditions.
4. The results show that the communities in the typical habitats in Graham Lake are rich in taxa, and organisms sensitive to environmental stress are present, and in some cases, abundant in the communities. Overall the communities were dominated by common and ubiquitous lake organisms, namely *Amnicola* snails and the amphipod *Hyalella azteca*.
5. Comparisons to the communities in Attean pond, a natural, unregulated lake show differences in the communities. Wetland communities were more similar to Attean communities and metrics indicated some stressed conditions at Graham Lake. Cobble-gravel communities were less similar to Attean and metrics indicated more stressed conditions at Graham Lake.
6. Based on these results it is my professional opinion that the structure and function of the resident biological community is maintained in Graham Lake. The community is dominated by common lake organisms and sensitive organisms are well represented in all typical habitats. Comparisons of community metrics from Graham Lake to the unregulated Attean Pond show changes to the Graham Lake communities. However, the structure and function of the community in Graham Lake is still maintained.

Literature Cited

- Courtemanch, D.L. and S.P. Davies. 1987. A coefficient of community loss to assess detrimental change in aquatic communities. *Wat. Res.* 21(2): 217-222.
- Leeper, P.C. 1988. Quantitative comparison study of the nearshore aquatic macroinvertebrate communities at Flagstaff Lake, Attean Pond, and Second Musquacook Lake. Eco-Analysts Inc. Report to FPL Energy Maine Hydro LLC.
- Mason C. F. 2002. "Acidification". *Biology of Freshwater Pollution* (4th ed.). Pearson Education. pp. 175–204.
- Normandeau Associates, Inc. 2009. Brassua hydroelectric project (FERC No. 2615) macroinvertebrate survey initial study report. Prepared for Owners of Brassua Dam.

Appendix 1- Macroinvertebrate Site Photos

Photo 1 & 2. Cobble Gravel Site 1



Photo 3 & 4. Cobble Gravel Site 2



Photo 5 & 6. Sand Site 1



Photo 7 & 8. Sand Site 2.



Photo 9 & 10. Aquatic Bed Site 1



Photo 11 & 12. Aquatic Bed Site 2



Appendix 2- Sample Site data and benthic macroinvertebrates collected in Graham Lake, August and September, 2019.

EDD for Rivers/Streams Macroinvertebrate Field Data					
Waterbody Name	Graham lake				
Town	Waltham				
Station Number	CG-1	Number only (omit 'S-')			
Log Number					
Sampled By	ain Environmental	List			
Sample Method	SB-Surber	List			
Deployment Date	8/15/2019		Retrieval Date	8/15/2019	
Deployment Time	11:28 AM		Retrieval Time	11:28 AM	
Number Deployed	3		Number Retrieved	3	
Deployed Depth Rep 1	46	cm-required			
Deployed Depth Rep 2	46	cm-required			
Deployed Depth Rep 3	46	cm-required			
Physical Characteristics					
Land Use 1	Upland hardwood	List			
Land Use 2	Upland conifer	List			
Land Use 3		List			
Land Use 4		List			
Terrain	Flat	List			
Canopy Cover	Open	List			
Location 1	Impoundment	List			
Location 2		List			
Location 3		List			
Potential Stressor(s)					
Stressor 1	Impounded	List			
Stressor 2		List			
Stressor 3		List			
Stressor 4		List			
Physical Characteristics of Bottom					
Bedrock		%			
Boulders (>10")	5	%			
Rubble/Cobble (2.5" - 10")	60	%			
Gravel (1/8" - 2.5")	25	%			
Sand (<1/8")		%			
Silt		%			
Clay	10	%			
Muck		%			
Detritus		%			
Sum	100				
Habitat Characteristics					
Wetted Width		Unit	Habitat Characteristics	Retrieval Value	Unit
Bankfull Width		m	Wetted Width		m
Depth		m	Bankfull Width		m
Velocity		cm	Depth		cm
DO		cm/sec	Velocity		cm/sec
DO Percent Saturation	7.8	mg/L	DO		mg/L
Temperature		%	DO Percent Saturation		%
SPC		24.9	Temperature		Deg C
pH		Deg C	SPC		
DO Meter #	YSI Pro ODO - 1	uS/cm	pH		uS/cm
DO Meter calibrated?	Yes	STU	DO Meter #		List
SPC/pH Meter #			DO Meter calibrated?		List
SPC/pH Meter calibrated?			SPC/pH Meter #		List
HETL Folder #			SPC/pH Meter calibrated?		List
HETL Folder # - DUP					
Comments at Deployment:			Comments at Retrieval:		
Wind N<2mph					
clay embedded cobble					

EDD for Rivers/Streams Macroinvertebrate Field Data					
Waterbody Name	Graham lake				
Town	Mariaville				
Station Number	CG-2	Number only (omit 'S-')			
Log Number					
Sampled By	ain Environmental	List			
Sample Method	SB-Surber	List			
Deployment Date	8/15/2019		Retrieval Date	8/15/2019	
Deployment Time	2:00 PM		Retrieval Time	2:00 PM	
Number Deployed	3		Number Retrieved	3	
Deployed Depth Rep 1	46	cm-required			
Deployed Depth Rep 2	46	cm-required			
Deployed Depth Rep 3	46	cm-required			
Physical Characteristics					
Land Use 1	Upland hardwood	List			
Land Use 2	Upland conifer	List			
Land Use 3		List			
Land Use 4		List			
Terrain	Flat	List			
Canopy Cover	Open	List			
Location 1	Impoundment	List			
Location 2		List			
Location 3		List			
Potential Stressor(s)					
Stressor 1	Impounded	List			
Stressor 2		List			
Stressor 3		List			
Stressor 4		List			
Physical Characteristics of Bottom					
Bedrock		%			
Boulders (>10")		10%			
Rubble/Cobble (2.5" - 10")		40%			
Gravel (1/8" - 2.5")		30%			
Sand (<1/8")		10%			
Silt		10%			
Clay		%			
Muck		%			
Detritus		%			
Sum		100			
Habitat Characteristics					
Wetted Width		Unit	Wetted Width	Retrieval Value	Unit
Bankfull Width		m	Bankfull Width		m
Depth		m	Depth		cm
Velocity		cm/sec	Velocity		cm/sec
DO			DO		mg/L
DO Percent Saturation	7.5	mg/L	DO Percent Saturation		%
Temperature		%	Temperature		Deg C
SPC		24	SPC		Deg C
pH		uS/cm	pH		uS/cm
DO Meter #	YSI Pro ODO - 1	List	DO Meter #		List
DO Meter calibrated?	Yes	List	DO Meter calibrated?		List
SPC/pH Meter #		List	SPC/pH Meter #		List
SPC/pH Meter calibrated?		List	SPC/pH Meter calibrated?		List
HETL Folder #					
HETL Folder # - DUP					
Comments at Deployment:			Comments at Retrieval:		
Wind NE<5mph					
cast skins of lakeflies abound					

EDD for Rivers/Streams Macroinvertebrate Field Data					
Waterbody Name	Graham lake				
Town	Fletcher's Landing				
Station Number	S-1	Number only (omit 'S-')			
Log Number					
Sampled By	ain Environmental	List			
Sample Method	SB-Surber	List			
Deployment Date	8/15/2019		Retrieval Date	8/15/2019	
Deployment Time	1:00 PM		Retrieval Time	1:00 PM	
Number Deployed	3		Number Retrieved	3	
Deployed Depth Rep 1	46	cm-required			
Deployed Depth Rep 2	46	cm-required			
Deployed Depth Rep 3	46	cm-required			
Physical Characteristics					
Land Use 1	Upland hardwood	List			
Land Use 2	Upland conifer	List			
Land Use 3		List			
Land Use 4		List			
Terrain	Flat	List			
Canopy Cover	Open	List			
Location 1	Impoundment	List			
Location 2		List			
Location 3		List			
Potential Stressor(s)					
Stressor 1	Impounded	List			
Stressor 2		List			
Stressor 3		List			
Stressor 4		List			
Physical Characteristics of Bottom					
Bedrock		%			
Boulders (>10")		%			
Rubble/Cobble (2.5" - 10")		%			
Gravel (1/8" - 2.5")	30	%			
Sand (<1/8")	60	%			
Silt	10	%			
Clay		%			
Muck		%			
Detritus		%			
Sum	100				
Habitat Characteristics					
Wetted Width		m	Wetted Width		m
Bankfull Width		m	Bankfull Width		m
Depth		cm	Depth		cm
Velocity		cm/sec	Velocity		cm/sec
DO	8.1	mg/L	DO		mg/L
DO Percent Saturation		%	DO Percent Saturation		%
Temperature	27	Deg C	Temperature		Deg C
SPC		uS/cm	SPC		uS/cm
pH		STU	pH		STU
DO Meter #	YSI Pro ODO - 1	List	DO Meter #		List
DO Meter calibrated?	Yes	List	DO Meter calibrated?		List
SPC/pH Meter #		List	SPC/pH Meter #		List
SPC/pH Meter calibrated?		List	SPC/pH Meter calibrated?		List
HETL Folder #					
HETL Folder # - DUP					
Comments at Deployment:			Comments at Retrieval:		
Wind SE 5mph					

EDD for Rivers/Streams Macroinvertebrate Field Data					
Waterbody Name	Graham lake				
Town	Fletchers Landing				
Station Number	S-2	Number only (omit 'S-')			
Log Number					
Sampled By	ain Environmental	List			
Sample Method	SB-Surber	List			
Deployment Date	8/15/2019		Retrieval Date	8/15/2019	
Deployment Time	7:50 AM		Retrieval Time	7:50 AM	
Number Deployed	3		Number Retrieved	3	
Deployed Depth Rep 1	40	cm-required			
Deployed Depth Rep 2	40	cm-required			
Deployed Depth Rep 3	40	cm-required			
Physical Characteristics					
Land Use 1	Upland hardwood	List			
Land Use 2	Upland conifer	List			
Land Use 3		List			
Land Use 4		List			
Terrain	Flat	List			
Canopy Cover	Open	List			
Location 1	Impoundment	List			
Location 2		List			
Location 3		List			
Potential Stressor(s)					
Stressor 1	Impounded	List			
Stressor 2		List			
Stressor 3		List			
Stressor 4		List			
Physical Characteristics of Bottom					
Bedrock		%			
Boulders (>10")		%			
Rubble/Cobble (2.5" – 10")		%			
Gravel (1/8" – 2.5")	25	%			
Sand (<1/8")	70	%			
Silt	5	%			
Clay		%			
Muck		%			
Detritus		%			
Sum	100				
Habitat Characteristics					
Wetted Width		Unit	Habitat Characteristics	Retrieval Value	Unit
Bankfull Width		m	Wetted Width		m
Depth		cm	Bankfull Width		m
Velocity		cm/sec	Depth		cm
DO		8 mg/L	Velocity		cm/sec
DO Percent Saturation		%	DO		mg/L
Temperature	23.2	Deg C	DO Percent Saturation		%
SPC		uS/cm	Temperature		Deg C
pH		STU	SPC		uS/cm
DO Meter #	YSI Pro ODO - 1	List	pH		STU
DO Meter calibrated?	Yes	List	DO Meter #		List
SPC/pH Meter #		List	DO Meter calibrated?		List
SPC/pH Meter calibrated?		List	SPC/pH Meter #		List
HETL Folder #			SPC/pH Meter calibrated?		List
HETL Folder # - DUP					
Comments at Deployment:			Comments at Retrieval:		
Wind N<5mph					
water level raised, drake cast skin					

EDD for Rivers/Streams Macroinvertebrate Field Data					
Waterbody Name	Graham lake				
Town	Mariaville				
Station Number	W-1	Number only (omit 'S-')			
Log Number					
Sampled By	ain Environmental	List			
Sample Method	KQ-Kick/Qualitative	List			
Deployment Date	8/15/2019		Retrieval Date	8/15/2019	
Deployment Time	10:43 AM		Retrieval Time	10:43 AM	
Number Deployed	3		Number Retrieved	3	
Deployed Depth Rep 1	61	cm-required			
Deployed Depth Rep 2	61	cm-required			
Deployed Depth Rep 3	61	cm-required			
Physical Characteristics					
Land Use 1	Upland hardwood	List			
Land Use 2	Marsh	List			
Land Use 3		List			
Land Use 4		List			
Terrain	Flat	List			
Canopy Cover	Open	List			
Location 1	Impoundment	List			
Location 2		List			
Location 3		List			
Potential Stressor(s)					
Stressor 1	Impounded	List			
Stressor 2		List			
Stressor 3		List			
Stressor 4		List			
Physical Characteristics of Bottom					
Bedrock		%			
Boulders (>10")		%			
Rubble/Cobble (2.5" – 10")		%			
Gravel (1/8" – 2.5")		%			
Sand (<1/8")		%			
Silt		50%			
Clay		20%			
Muck		%			
Detritus		30%			
Sum		100			
Habitat Characteristics					
		Unit		Retrieval Value	Unit
Wetted Width		m			m
Bankfull Width		m			m
Depth		cm			cm
Velocity		cm/sec			cm/sec
DO	7.6	mg/L			mg/L
DO Percent Saturation		%			%
Temperature	24.7	Deg C			Deg C
SPC		uS/cm			uS/cm
pH		STU			STU
DO Meter #	YSI Pro ODO - 1	List			List
DO Meter calibrated?	Yes	List			List
SPC/pH Meter #		List			List
SPC/pH Meter calibrated?		List			List
HETL Folder #					
HETL Folder # - DUP					
Comments at Deployment:			Comments at Retrieval:		
Wind NE<5mph					
wild rice rushes, potomogeton, bladderwort, swamp candles					

EDD for Rivers/Streams Macroinvertebrate Field Data					
Waterbody Name	Graham lake				
Town	Waltham				
Station Number	W-2	Number only (omit 'S-')			
Log Number					
Sampled By	ain Environmental	List			
Sample Method	KQ-Kick/Qualitative	List			
Deployment Date	8/15/2019		Retrieval Date	8/15/2019	
Deployment Time	9:00 AM		Retrieval Time	9:00 AM	
Number Deployed	3		Number Retrieved	3	
Deployed Depth Rep 1	40	cm-required			
Deployed Depth Rep 2	40	cm-required			
Deployed Depth Rep 3	40	cm-required			
Physical Characteristics					
Land Use 1	Upland hardwood	List			
Land Use 2	Upland conifer	List			
Land Use 3	Rural residential	List			
Land Use 4		List			
Terrain	Flat	List			
Canopy Cover	Open	List			
Location 1	Impoundment	List			
Location 2		List			
Location 3		List			
Potential Stressor(s)					
Stressor 1	Impounded	List			
Stressor 2		List			
Stressor 3		List			
Stressor 4		List			
Physical Characteristics of Bottom					
Bedrock		%			
Boulders (>10")		%			
Rubble/Cobble (2.5" – 10")		%			
Gravel (1/8" – 2.5")		%			
Sand (<1/8")		%			
Silt	40	%			
Clay	40	%			
Muck		%			
Detritus	20	%			
Sum	100				
Habitat Characteristics					
Wetted Width		Unit	Habitat Characteristics		Retrieval Value
Bankfull Width		Unit	Retrieval Value		Unit
Depth		Unit	Retrieval Value		Unit
Velocity		Unit	Retrieval Value		Unit
DO		7.8 mg/L	Retrieval Value		Unit
DO Percent Saturation		%	Retrieval Value		Unit
Temperature		22.7 Deg C	Retrieval Value		Unit
SPC		uS/cm	Retrieval Value		Unit
pH		STU	Retrieval Value		Unit
DO Meter #	YSI Pro ODO - 1	List	DO Meter #		List
DO Meter calibrated?	Yes	List	DO Meter calibrated?		List
SPC/pH Meter #		List	SPC/pH Meter #		List
SPC/pH Meter calibrated?		List	SPC/pH Meter calibrated?		List
HETL Folder #					
HETL Folder # - DUP					
Comments at Deployment:			Comments at Retrieval:		
Wind N<5mph					
rushes, potamogeton, damselfies, scud					

