DRAFT ENVIRONMENTAL ASSESSMENT
FOR
HYDROPOWER LICENSE

Mattaceunk Hydroelectric Project
FERC Project No. 2520-076
Maine

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
888 First Street, NE
Washington, DC 20426

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ACRONYMS AND ABBREVIATIONS

APE	area of potential effect
ASF	Atlantic Salmon Federation
B.P.	Before Present
°C	Celsius
CFR	Code of Federal Regulations
cfs	cubic feet per second
Commerce	U.S. Department of Commerce
Commission	Federal Energy Regulatory Commission
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
D2SI	FERC Division of Dam Safety and Inspections
DO	dissolved oxygen
dpi	dots per inch
EA	environmental assessment
EFH	essential fish habitat
ESA	Endangered Species Act
°F	degree Fahrenheit
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
FPOMP	Fish Passage Operations and Maintenance Plan
fps	feet per second
fph	feet per hour
FWS	U.S. Fish and Wildlife Service
GIS	geographic information system
GLHA	Great Lakes Hydro America, LLC
HPMP	Historic Properties Management Plan
IAC	Independent Archaeological Consulting, LLC
ILP	Integrated Licensing Process
Interior	U.S. Department of the Interior
Maine DEP	Maine Department of Environmental Protection
Maine DIFW	Maine Department of Inland Fisheries and Wildlife
Maine DMR	Maine Department of Marine Resources
Maine LUPC	Maine Land Use Planning Commission
Maine SHPO	Maine State Historic Preservation Commission Officer
mg/L	milligrams per liter
MW	megawatt
MWh	megawatt-hours
National Register	National Register of Historic Places
NERC	North American Electric Reliability Corporation
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service

NPCC	Northeast Power Coordinating Council, Inc.
NRI	Nationwide Rivers Inventory
PAD	Pre-Application Document
RM	river mile
SCORP	Statewide Outdoor Recreation Plan
SD1	Scoping Document 1
SPP	Species Protection Plan
THPO	Tribal Historic Preservation Officer
TRC	TRC Environmental Solutions
USGS	U.S. Geological Survey

EXECUTIVE SUMMARY

Proposed Action

On August 31, 2016, Great Lakes Hydro America, LLC (GLHA), filed an application for a new license with the Federal Energy Regulatory Commission (Commission or FERC) to continue to operate the Mattaceunk Hydroelectric Project (Mattaceunk Project). The 19.2-megawatt (MW) project is located on the Penobscot River in Aroostook and Penobscot Counties, Maine, within the towns of Medway, Woodville, Mattawamkeag, and the unorganized township of Molunkus. The project sits about 67 miles upstream of Bangor, Maine. The project does not occupy federal land.

Project Description and Operation

The Mattaceunk Project consists of: (1) a 1,060-foot-long, 45-foot-high dam (Weldon Dam) with a variable crest elevation; (2) a 1,664-acre impoundment with a total storage capacity of 20,981 acre-feet at a normal pool elevation of 240.0 feet USGS datum;[1] (3) an overflow spillway with a permanent crest elevation of 236.0 feet and a flashboard crest elevation of 240.0 feet when equipped with 4-foot-high wooden flashboards; (4) an upstream pool and weir fishway; (5) an intake with trash racks that have 1-inch clear bar spacing covering the top 16 feet (at normal pool) and 2.63-inch bar spacing at depths greater than 16 feet; (6) a downstream surface bypass fishway; (7) a 142-foot-long, 99-foot-wide powerhouse (Weldon Station) integral to the dam containing two Kaplan and two fixed blade propeller turbine/generating units with a combined capacity of 19.2 megawatts; (8) a substation adjacent to the powerhouse; (9) a 9-mile-long, 34.5-kilovolt (kV) transmission line; and (10) appurtenant facilities.

Project recreation facilities include a canoe portage on the west side of the dam and a fishing access area located downstream of the dam on the east bank of the river that includes a small picnic shelter, stairs to access the tailrace for fishing, and parking.

The Mattaceunk Project is operated in a run-of-river mode with pondage.[2] GLHA maintains the impoundment surface elevation within 1.0 foot of the flashboard crest elevation of 240.0 feet when the 4-foot-high flashboards are in place. In contrast, the existing license requires GLHA to maintain an impoundment surface elevation no lower

[1] All elevation data are referenced to USGS datum, unless noted otherwise.

[2] Pondage refers to the ability of the project to raise the impoundment above the crest of the dam by using flashboards. Although a prior order indicates that the project would be able to operate under a peaking mode, *Great Northern Nekoosa Corporation*, 55 FERC ¶ 61,472 (1991), the project has never been operated in a peaking mode, nor has there ever been a proposal to operate in a peaking mode.

than 2.0 feet below the top of flashboard elevation of 240.0 feet when the flashboards are in place to allow an adequate margin for debris loads, ice loads, or sudden pool increases that might cause flashboard failure. The existing license also requires GLHA to maintain an impoundment surface elevation no lower than 1.0 foot below the dam crest elevation of 236.0 feet when the flashboards are down (for flashboard repairs).

The existing license also requires a year-round, continuous, minimum flow to the tailrace of 1,674 cubic feet per second (cfs) or inflow, whichever is less. Depending on the season, the existing license requires a daily average minimum flow of 2,392 cfs or inflow, if less, from July 1 through September 30 and of 2,000 cfs or inflow, if less, from October 1 through June 30. The project generates about 123,332 megawatt-hours (MWh) annually. No changes to the project's current mode of operation are proposed.

GLHA operates the upstream pool and weir fishway annually from May 1 to November 10 for Atlantic salmon adults, by providing flows through the fishway that consist of a 6- to 8-cfs transport flow with an additional attraction flow of 7 cfs at the entrance to the fishway. At turbine intakes 3 and 4, GLHA operates the downstream surface bypass fishway at its maximum flow capability (140 cfs) to provide downstream passage for Atlantic salmon smolts (outmigrating juveniles) and kelts (outmigrating, post-spawning adults) from April 1 to June 15 and only kelts from October 17 to December 1. Turbines 3 and 4 are the first units on and the last units off whenever the downstream bypass is operational to reduce entrainment of smolts and kelts through turbine intakes 1 and 2, where there is no surface bypass.

Proposed Environmental Measures

GLHA proposes the following measures to protect or enhance environmental resources:

- Install and maintain, on a seasonal basis, an upstream American eel (eel) ladder within 2 years of the effective date of the new license;

- Monitor the upstream eel ladder for use and effectiveness for one passage season;

- Provide downstream passage for eel by implementing annual nighttime turbine shutdowns (8:00 pm to 4:00 am), in combination with opening the project's roller gate and installing full-depth trash racks with 1-inch clear spacing (see measures included in the Species Protection Plan for Atlantic salmon), beginning the first passage season following license issuance;

- Monitor, for two passage seasons, the effectiveness of the downstream eel passage measures;

- Install an upstream fishway for American shad, blueback herring, and alewife (shad, collectively) in year 15 of a new license, expected to be operational in year 16 of a new license;

- Monitor the use and effectiveness of the upstream fishway for shad for two years, following its completion;

- Provide downstream passage for shad after the upstream fishway for shad is operational (expected in year 16), by: (1) extending the operation of the existing downstream fish bypass such that it operates continuously from April 1 to December 1; and (2) by opening the log sluice (and releasing between 3 percent [225 cfs] and 9 percent [690 cfs] of hydraulic capacity) from June 1 to December 1, as needed for shad, based on monitoring results;

- Monitor, for 2 years, the use of existing downstream passage structures by shad (including the surface bypass and log sluice), once the new upstream fishway for shad is operational;

- Implement additional operational and structural modifications and/or habitat enhancement measures to provide eel and shad passage, if the proposed passage measures for eel and shad are ineffective;

- Continue to implement the Fish Passage Operations and Maintenance Plan (FPOMP), which defines the: (1) operational period for the existing upstream and downstream fishways; (2) annual start-up and shut-down procedures; (3) opening methods; (4) debris management; and (5) safety rules and procedures;

- Continue to maintain and operate the upstream fishway annually from May 1 to November 10 for adult Atlantic salmon, including the 7 cfs attraction flow at the fishway entrance;

- Monitor the upstream fishway and count the number of adult Atlantic salmon passing upstream of the project, using a methodology developed in consultation with resource agencies, to provide an estimate of the number of returning spawners;

- Continue to maintain and operate the downstream surface bypass to provide downstream passage for Atlantic salmon smolts and kelts from April 1 to June 15 and only kelts from October 17 to December 1;

- Implement a Species Protection Plan (SPP) for the federally endangered Atlantic salmon to meet a performance standard of 95 percent effectiveness for upstream passage of adults and 96 percent survival for downstream passage of smolts and kelts, including measures to:

(1) coordinate with resource agencies to stock uniquely marked smolts upstream of Weldon Dam in the first 3 years after relicensing to serve as a source of upper-Penobscot-imprinted adult salmon used for studying upstream passage of adults and downstream passage of kelts;

(2) conduct up to 3 years of upstream fishway effectiveness monitoring for adults and up to 3 years of downstream passage monitoring for kelts, using the returning, imprinted adult salmon;

(3) use trash racks that would have 1-inch clear bar spacing to the full depth of the turbine intakes, and within 2 years after relicensing, be installed seasonally during the downstream migration of eel, shad, and Atlantic salmon;

(4) open the project's log sluice (between 3 percent [225 cfs] and 9 percent [690 cfs] of its hydraulic capacity) starting the first passage season following relicensing to provide additional downstream passage for smolts for a 3-week period during the spring that would be determined in consultation with the resource agencies;

(5) conduct a minimum of 3 years of monitoring to evaluate the effectiveness of existing passage operations and additional measures (installation of the 1-inch clear spacing full-depth trash racks and operation of the log sluice), in passing smolts downstream past the dam;

(6) conduct a study to evaluate the smolt mortality in the project impoundment;

(7) implement adaptive management that would include additional operational, structural, and/or habitat enhancement measures, if necessary, to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon;

- Continue to operate and maintain the project recreation facilities including: (1) a canoe portage trail, and (2) a downstream angler access area with a parking area, stairs leading to the tailrace area, and a covered picnic area;

- Implement recreation facility improvements at the existing downstream angler access area including: (1) a pulley system to help visitors move their boats between the parking area and river; and (2) a wheelchair ramp to provide access to the picnic facilities; and

- Develop a Historic Properties Management Plan (HPMP) to protect archaeological and historic architectural resources eligible for listing on the National Register of Historic Places (National Register), including the project's dam and powerhouse.

Public Involvement and Areas of Concern

Before filing its license application with the Commission, GLHA conducted pre-filing consultation in accordance with the Commission's Integrated Licensing Process. The intent of the Commission's pre-filing process is to involve the public early in the project planning process and to encourage citizens, governmental entities, tribes, and other interested parties to identify and resolve issues prior to an application being formally filed with the Commission. As part of the pre-filing process, staff conducted scoping to identify issues and alternatives. Staff distributed a scoping document to stakeholders and other interested entities on May 1, 2013. Scoping meetings were held in Medway, Maine, on June 5, 2013. A revised scoping document was issued on August 9, 2013.

GLHA filed its license application on August 31, 2016. On March 24, 2017, the Commission issued a public notice accepting the application and soliciting motions to intervene and protests, stating that the application was ready for environmental analysis, and requesting comments, terms and conditions, recommendations, and prescriptions.

The primary issues associated with relicensing the project are upstream and downstream fish passage (for Atlantic salmon, eel, and shad) and cultural resources.

Alternatives Considered

This draft environmental assessment (draft EA) considers the following alternatives: (1) GLHA's proposal, as outlined above; (2) GLHA's proposal with staff modifications (staff alternative); (3) the staff alternative with mandatory conditions; and (4) no action, meaning continued operation of the project with no changes.

Staff Alternative

Under the staff alternative, the project would be operated and maintained as proposed by GLHA, except as noted below. The following nine measures proposed by GLHA are not included under the staff alternative: (1) installation of an upstream fishway for shad in year 15; (2) monitoring the upstream fishway for shad; (3) providing downstream passage for shad; (4) monitoring the downstream passage structures for shad; (5) implementation of additional operational and structural modifications and/or habitat enhancement measures, without final Commission approval, to provide eel and shad passage; (6) counting the number of adult Atlantic salmon passing upstream of the project; (7) using trash racks with 1-inch bar spacing to the full depth of the turbine intakes during the downstream passage of Atlantic salmon; (8) conducting a study to evaluate smolt mortality in the project impoundment; and (9) implementation of additional operational, structural, and/or habitat enhancement measures, without final Commission approval, to improve passage for upstream and downstream migrating Atlantic salmon. The staff alternative includes the remaining measures proposed by

GLHA with some modifications, and additional staff-recommended measures, some of which are preliminary fishway prescriptions filed by Interior and NMFS.

The additional and modified measures included in the staff alternative are summarized below.

- Develop an operation compliance monitoring plan to document compliance with the proposed operations described above (i.e., run-of-river mode with pondage, limited impoundment fluctuations, and minimum flows) for the protection of aquatic resources in the impoundment and downstream of the dam;
- Develop individual monitoring plans for upstream and downstream eel passage, as required by FWS's fishway prescription, that include:

  (1) the goals and objectives of the monitoring;

  (2) performance criteria for determining the success of the eel passage measures;

  (3) the methodology used to monitor the effectiveness and efficiency of the upstream and downstream passage measures to pass eel;

  (4) provisions for reporting the results of the monitoring (i.e., development of a report) and consulting with the agencies regarding the results (including an annual meeting); and

  (5) a provision to identify and implement (upon Commission approval) (a) additional monitoring studies, or (b) operational and structural modifications and/or habitat enhancement measures to provide eel passage, if, after 1 year of upstream monitoring and 2 years of downstream monitoring, the proposed passage measures for eel are ineffective at achieving the upstream and downstream effectiveness and survival performance criteria.
- Re-assess the need for shad passage at the project 14 years after license issuance;
- Modify the FPOMP to include additional provisions for:

  (1) performing routine maintenance before the migration season, such that the existing fishways would be fully operational during the migratory period;

  (2) clearing debris from the trash racks of all turbine intakes prior to the migration season, and identify, with final Commission approval, the frequency of debris clearing during the migration season;

  (3) monitoring outflows from the downstream bypass pipe, to detect debris blockages using a method approved by the Commission;

  (4) procedures for filing with the Commission for informational purposes, an annual report on the operation of the existing fishways and on project generation;

  (5) developing shutdown procedures for the existing fishways; and

  (6) developing procedures for operation and maintenance of the existing fishways during emergencies and project outages;

- Operate the proposed upstream eel ladder for a "shakedown" period subsequent to installation, and prior to the passage season and pertinent effectiveness studies to ensure it is operating as designed and to make minor adjustments to facilities and operations, as needed;
- Modify the SPP to include the following additional provisions:
  (1) remove the provision to seasonally install trash racks with 1-inch clear bar spacing to the full depth of the turbine intakes for the purpose of protecting smolts and kelts;
  (2) revise, with final approval from the Commission, the upstream passage effectiveness study methodology to include the type of telemetry tag to be used on upstream migrating adults and the appropriate timing for stocking tagged smolts, and refile the SPP with the revised study plan;
  (3) include the proposed passage effectiveness study plans as attachments to the SPP;
  (4) determine the need for an additional 1 or 2 years of effectiveness studies, with final approval from the Commission, if the upstream fishway meets the 95 percent performance standard after the first year;
  (5) determine the need for future effectiveness studies or measures, with final approval from the Commission, if after 3 years of upstream passage effectiveness studies, the upstream fishway does not meet the 95 percent effectiveness performance standard;
  (6) revise the number of downstream passage effectiveness studies for smolts to indicate that a minimum of 3 years of study would be conducted;
  (7) revise the criteria for achieving the downstream performance standard for smolts to state that the standard would be considered achieved if a total 3 years of effectiveness studies for smolts demonstrate that the downstream passage structures meet a 96 percent survival performance standard;
  (8) determine, with final approval from the Commission, when to begin implementation of phased spill measures for downstream passage of smolts, with the restriction that phased spill measures would be implemented after a minimum of 1 year and a maximum of 3 years of conducting downstream passage survival studies for smolts, and non-spill passage measures;
  (9) determine, with final approval from the Commission, the 3-week period during which any phased spill measures would occur for downstream passage of smolts;
  (10) determine the need for an additional 1 or 2 years of downstream passage effectiveness studies for kelts, with final approval from the Commission, if the downstream passage structures meet the 96 percent survival performance standard for kelts after the first year;
  (11) determine the need to conduct at least 1 year of additional effectiveness study, with final approval from the Commission, if the downstream

passage structures do not meet the 96 percent survival performance standard for kelts after the first year;

(12) determine the need for future effectiveness studies, and/or downstream passage measures, with final approval from the Commission, if after 3 years of downstream passage effectiveness studies, the downstream passage structures do not meet the 96 percent survival performance standard for kelts;

(13) remove the provision to conduct a study to evaluate smolt mortality in the project impoundment;

(14) remove the provisions requiring reevaluation of upstream and downstream passage effectiveness every 10 years; and

(15) add a provision to file an application to amend the license and get Commission approval prior to implementing any future, and currently unspecified operational, structural, and/or habitat enhancement measures that may be used to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon.

Staff Alternative with Mandatory Conditions

The staff alternative with mandatory conditions includes all the measures included in the staff alternative, with the addition of all of the section 18 preliminary fishway prescriptions filed by Interior (Appendix B) and NMFS (Appendix C) on May 23, 2017.

No-action Alternative

Under the no-action alternative, GLHA would continue to operate the project with no changes. No new environmental protection, mitigation, or enhancement measures would be implemented.

Environmental Effects of the Staff Alternative

Geology and Soils Resources

Continuing to operate the project in run-of-river mode with pondage would minimize fluctuations of impoundment water levels, and maintain stable shorelines and cause no measureable shoreline erosion. Limited fluctuations of impoundment levels would also limit the re-suspension or release of impounded sediment, minimizing turbidity and sedimentation to downstream habitats.

Aquatic Resources

Operating the project in run-of-river mode with pondage would maintain run-of-river conditions most of the time, which would continue to maintain water quality parameters at levels that are protective of aquatic resources in the impoundment and downstream. Operating with minimal fluctuations of the impoundment would protect smallmouth bass spawning habitat. Maintaining continuous minimum flows to the tailrace of 1,674 cfs, a daily average of 2,392 cfs from July 1 through September 30, and a daily average of 2,000 cfs from October 1 through June 30, would maintain water depths and flow conditions downstream that are protective of fish and benthic macroinvertebrates. Further, the development of an operations compliance monitoring plan would help to document that impoundment fluctuations and downstream minimum flows are maintained as required in any new license that may be issued.

Installing and operating an upstream eel ladder at the project would allow juvenile eels to safely and efficiently pass Weldon Dam and access habitat upstream of the dam. Providing downstream eel passage would reduce the entrainment and impingement mortality of downstream migrating adult eels. Evaluating the effectiveness of the proposed upstream and downstream eel passage measures would help to ensure that the eel passage facilities/measures work effectively. Finally, implementing an operation and maintenance plan(s) for upstream and downstream eel passage facilities/measures would help support proper function of eel passage facilities.

Reassessing the need for an upstream fishway for shad in year 14 of any new license issued for the project, could provide the necessary information to establish the need for upstream passage in year 15 of any new license.

Terrestrial Resources

Continuing to operate the project in run-of-river mode with pondage would maintain riparian habitat used by wildlife upstream of the dam. Run-of-river operation would also limit fluctuations downstream of the dam, which would protect against erosion and sedimentation and maintain stable shoreline habitat.

Threatened and Endangered Species

One federally listed species occurs (Atlantic salmon) and two federally listed species potentially occur (Canada lynx, northern long-eared bat) in the Mattaceunk Project vicinity. In addition, the Mattaceunk Project sits within designated critical habitat for Atlantic salmon, but no critical habitat for Canada lynx or northern long-eared bat occurs in the project area.

Atlantic salmon currently migrate upstream and downstream of the Mattaceunk Project using the existing upstream pool and weir fishway and the existing downstream surface bypass, respectively. Continuing to operate the project in a run-of-river mode with pondage would maintain the existing good water quality and flow conditions, providing cool oxygenated water and run-of-river flows to support the migration of salmon through the impoundment and downstream, and would maintain the natural cues needed to trigger the smolt migration to sea. This operational mode would also continue to protect water quality and downstream habitat (i.e., flow and bottom substrate) suitable for spawning and rearing of Atlantic salmon.

Continuing to operate the project with the drawdown limits discussed above would prevent rapid fluctuations of the impoundment, which would prevent stranding of salmon in the impoundment and would maintain aquatic vegetation along shallow areas of the impoundment, which can serve as temporary resting areas during the upstream migration of adult salmon. Further, continuing to maintain the minimum flows discussed above would help to maintain suitable water depths downstream of the project for the migration of Atlantic salmon and prevent dewatering of migratory, spawning, and rearing habitat. Developing an operation compliance monitoring plan would provide a means for documenting the operational requirements of the license, including those measures meant to protect Atlantic salmon.

Continuing to operate the existing upstream fishway for Atlantic salmon during the migration season would provide the necessary passage to spawning habitat located upstream of the project. Continuing to operate the downstream fish bypass for smolts and kelts during the migration season would provide passage to downstream habitats and access to the sea, which is needed for continued growth and development. Operating the log sluice for a 3-week period during the spring would provide an additional safe passage route for smolts to help improve downstream passage. In addition, GLHA's adherence to the FPOMP with staff modifications would ensure that the existing upstream and downstream fish passage facilities are maintained and operated to maximize passage effectiveness for Atlantic salmon.

Implementing the proposed SPP with staff modifications would provide the necessary measures to assess the effectiveness of the upstream and downstream fishways, and implement any measures needed to meet passage performance standards for Atlantic salmon. Specifically, conducting up to 3 years of upstream effectiveness studies for adult Atlantic salmon would help determine whether the upstream fishway is able to meet a performance standard of 95 percent effectiveness. However, if the existing upstream fishway is not able to meet the performance standard, structural and/or operational modifications could be implemented, upon additional Commission approval where necessary, through adaptive management until upstream passage meets the performance standard. Maintaining upstream passage at the 95 percent performance standard, would improve upstream passage effectiveness by up to 24 percent over existing levels, allowing a greater proportion of salmon to spawn, which would help in the recovery of the population.

The SPP would also include provisions for conducting a minimum of 3 years of downstream passage effectiveness studies for smolts, which would help determine whether the existing bypass and addition of the log sluice operations would be able to meet a performance standard of 96 percent survival for smolts. In addition, conducting up to 3 years of downstream passage effectiveness studies for kelts would help determine whether the addition of log sluice operations and full depth trash racks are able to maintain downstream survival of kelts at 96 percent. However, if these passage measures are not able to meet the performance standards, structural and/or operational modifications could be implemented, upon additional Commission approval where necessary, through adaptive management until downstream passage for smolts and kelts meets the performance standard.

In spite of the benefits of the measures discussed above, project operation would likely result in the take of some Atlantic salmon smolts and kelts as they attempt to migrate downstream of the project. Therefore, continued operation may affect, and is likely to adversely affect Atlantic salmon. In addition, with GLHA's proposed SPP and additional modifications, including proposed improvements to upstream and downstream passage to meet specific 95 percent upstream passage effectiveness and 96 percent downstream survival, we conclude that operating the project may affect, but is not likely to adversely affect the designated critical habitat for the GOM DPS of Atlantic salmon.

The federally threatened Canada lynx and the federally threatened northern long-eared bat are listed as potentially occurring in the project area. However, the preferred habitat for Canada lynx and its preferred prey (snowshoe hare) is sparse in the project area, and thus project operation is unlikely to affect the lynx. Summer roosting and foraging habitat for the northern long-eared bat is present in the project boundary; however, project operation would not affect its habitat or food availability because no ground disturbing activities or tree clearing activities would occur. Based on available information, relicensing the project would have no effect on the Canada lynx or northern long-eared bat.

Recreation

Continued operation and maintenance of the project's canoe portage and downstream angler access area would protect boating and fishing opportunities in the Penobscot River near the project. The proposed facility enhancement measures to the downstream angler access area would improve access to the project's recreation amenities for persons with disabilities and also increase the ease of boater access to the project's tailrace.

Cultural Resources

Continued operation and maintenance of the project has the potential to adversely affect resources that are eligible for listing on the National Register, including the Weldon Dam and Roy V. Weldon Power Station. Developing an HPMP in consultation with the Maine State Historic Preservation Officer (Maine SHPO) and Penobscot Indian Nation Tribal Historic Preservation Officer (THPO) would help protect historic properties from the effects of operating and maintaining the project over the term of a license by directing the licensee to avoid, minimize, or mitigate activities that could affect the integrity or significance of a historic property.

No Action Alternative

Under the no-action alternative, the project would continue to operate as it has in the past. None of the proposed or recommended measures would be implemented and there would be no enhancement of environmental resources.

License Conditions

The application was prepared under the Integrated Licensing Process (ILP) and therefore, the environmental assessment document includes draft license articles (see Appendix A).[3]

Conclusion

Based on our analysis, we recommend licensing the project as proposed by GLHA, with staff modifications and additional measures.

In Section 4.2, *Comparison of Alternatives*, we estimate the likely cost of alternative power for each of the four alternatives identified above. Our analysis shows that during the first year of operation under the no-action alternative, project power would cost $1,026,122 (or $8.32/MWh) less than the cost of alternative generation. Under the proposed action alternative, project power would cost $1,616,882 (or $13.11/MWh) more than the likely cost of alternative power. Under the staff alternative, project power would cost $107,299 (or $0.87/MWh) more than the likely cost of alternative power. Under the staff alternative with mandatory conditions, project power would cost $770,825 (or $6.25/ MWh) more than the likely cost of alternative power.

We chose the staff alternative as the preferred alternative because: (1) the project would continue to provide a dependable source of electrical energy for the region (112,759 MWh annually); (2) the 19.2 MW of electric capacity comes from a renewable resource that does not contribute to atmospheric pollution, including greenhouse gases; and (3) the recommended environmental measures proposed by GLHA, and additional measures recommended by staff, would adequately protect and enhance environmental resources affected by the project. The overall benefits of the staff alternative would be worth the cost of the proposed and recommended environmental measures. Therefore, issuing a new license for the project, with the environmental measures we recommend,

[3] 18 C.F.R §5.25(b) (2017).

would not be a major federal action significantly affecting the quality of the human environment.

DRAFT ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
Washington, DC

MATTACEUNK HYDROELECTRIC PROJECT
Project No. 2520-076 - Maine

1.0 INTRODUCTION

1.1 APPLICATION

On August 31, 2016, Great Lakes Hydro America, LLC (GLHA) filed an application with the Federal Energy Regulatory Commission (Commission or FERC) for a new license to continue to operate and maintain the existing Mattaceunk Hydroelectric Project (Mattaceunk Project). The 19.2-megawatt (MW) project is located on the Penobscot River, in Aroostook and Penobscot counties, Maine, within the towns of Medway, Woodville, Mattawamkeag, and the unorganized township of Molunkus. The Mattaceunk Project sits about 67 miles upstream of Bangor, Maine (figure 1). It does not occupy federal land.

1.2 PURPOSE OF ACTION AND NEED FOR POWER

1.2.1 Purpose of Action

The purpose of the Mattaceunk Project is to provide a source of hydroelectric power. Therefore, under the provisions of the Federal Power Act (FPA), the Commission must decide whether to issue a new license to GLHA for the Mattaceunk Project and what conditions should be placed on any license issued. In deciding whether to issue a license for a hydroelectric project, the Commission must determine that the project will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and developmental purposes for which licenses are issued (such as flood control, irrigation, and water supply), the Commission must give equal consideration to the purposes of: (1) energy conservation; (2) the protection, mitigation of damage to, and enhancement of fish and wildlife resources; (3) the protection of recreational opportunities; and (4) the preservation of other aspects of environmental quality.

Issuing a license for the Mattaceunk Project would allow GLHA to continue to generate electricity at the project for the term of the new license, making electric power from a renewable resource available to the regional grid.

This draft environmental assessment (draft EA) assesses effects associated with operation of the project, alternatives to operating and maintaining the project, and makes recommendations to the Commission on whether to issue a license, and under what terms and conditions.

In this draft EA, we assess the environmental and economic effects of operating and maintaining the project: (1) as proposed by the applicant; and (2) the applicant's proposal with our recommended measures (staff alternative); and (3) the staff alternative with mandatory conditions. We also considered the effects of the no-action alternative. The primary issues associated with relicensing the project are upstream and downstream passage for Atlantic salmon, American eel (eel), American shad, alewife, and blueback herring (shad, collectively), and cultural resources.

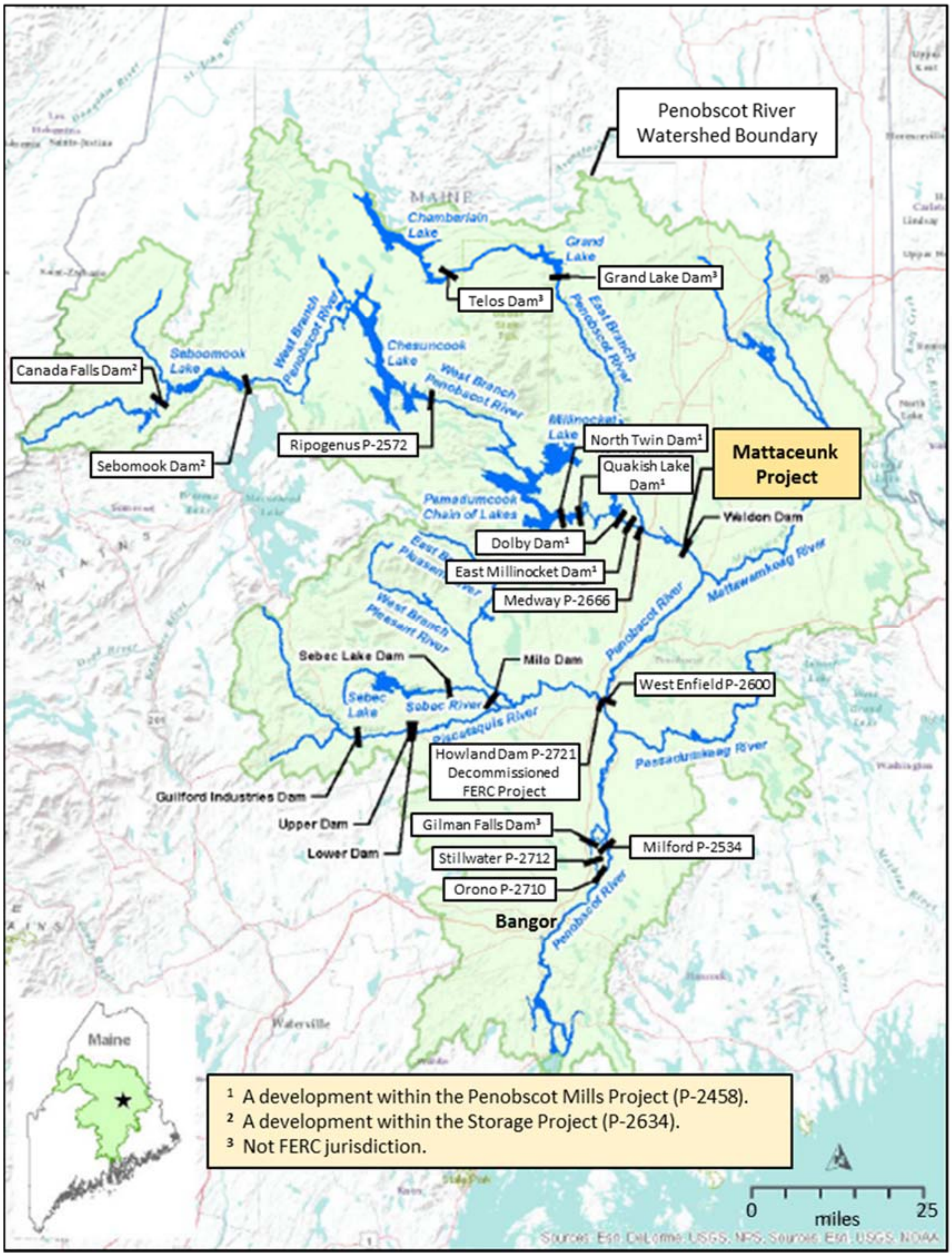

Figure 1. Location of the Mattaceunk Project and other dams in the Penobscot River Basin.
(Source: GLHA, as modified by staff)

1.2.2 Need for Power

The power generated is sold to the Independent System Operator of New England. To assess the need for power, we looked at the needs in the operating region in which the project is located.

The Mattaceunk Project provides power that helps meet part of the region's power requirements, resource diversity, and capacity needs. The project has an installed capacity of 19.2 MW and generates an average of about 123,332 MWh per year.

The North American Electric Reliability Corporation (NERC) annually forecasts electrical supply and demand nationally and regionally for a 10-year period. The Mattaceunk Project is located within the Northeast Power Coordinating Council's New England region (NPCC-New England) of the NERC. According to NERC's most recent forecast in December 2016, the summer internal demand for this region is projected to increase by 0.21 percent from 2016 to 2025.

We conclude that power from the Mattaceunk Project helps to meet the need for power in the NPCC-New England region, in both the short and long term. The project provides power that can displace non-renewable, fossil-fired generation and contribute to a diversified generation mix. Displacing the operation of non-renewable facilities may avoid some power plant emissions and create an environmental benefit.

1.3 STATUTORY AND REGULATORY REQUIREMENTS

Any new license for the project would be subject to numerous requirements under the FPA and other applicable statutes. The major regulatory and statutory requirements are described below.

1.3.1 Federal Power Act

1.3.1.1 Section 18 Fishway Prescriptions

Section 18 of the FPA states that the Commission is to require construction, operation, and maintenance by a licensee of such fishways as may be prescribed by the Secretaries of the U.S. Department of Commerce (Commerce) or the U.S. Department of the Interior (Interior). On May 23, 2017, the National Maine Fisheries Service (NMFS), on behalf of Commerce, and Interior, on behalf of the U.S. Fish and Wildlife Service (FWS), each timely filed a preliminary fishway prescription for the project to request that the Commission include a reservation of authority to prescribe fishways under section 18 in any license issued for the project. The agencies' preliminary fishway prescriptions are summarized in section 2.3, *Modifications to Applicant's Proposal – Mandatory Conditions*, and included in Appendix B (Interior) and Appendix C (NMFS).

1.3.1.2 Section 4(e) Conditions

Section 4(e) of the FPA provides that any license issued by the Commission for a project within a federal reservation shall be subject to and contain such conditions as the Secretary of the responsible federal land management agency deems necessary for the adequate protection and use of the reservation. On May 23, 2017, Interior, on behalf of the Bureau of Indian Affairs (BIA), requested to reserve authority under section 4(e) of the FPA. On July 17, 2017, the Commission issued a request for additional information to clarify the federal reservation for which the reservation of authority applied. On August 11, 2017, the BIA replied stating that the boundaries of the Penobscot Reservation and the Penobscot Indian Nation's hunting, fishing, and gathering rights in the waters of the Penobscot River are currently the subject of federal court litigation. Because the outcome of the litigation is unknown, the BIA chose to reserve section 4(e) authority for "any tribal lands embraced within federal reservations and within the project boundary."

1.3.1.3 Section 10(j) Recommendations

Under section 10(j) of the FPA, each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

On May 22, 2017, the Maine Department of Marine Resources (Maine DMR) filed timely recommendations under section 10(j). In addition, on May 23, Interior and NMFS filed timely recommendations under section 10(j). These recommendations are summarized in table 24 and discussed in section 5.3, *Summary of Section 10(j) Recommendations*.

1.3.2 Clean Water Act

Under section 401(a)(1) of the Clean Water Act (CWA), 33 U.S.C. § 1341(a)(1), a license applicant must obtain either a water quality certification (certification) from the appropriate state pollution control agency verifying that any discharge from a project would comply with applicable provisions of the CWA, or a waiver of such certification. A waiver occurs if the state agency does not act on a request for certification within a reasonable period of time, not to exceed one year, after receipt of such request.

On May 22, 2017, GLHA applied to the Maine Department of Environmental Protection (Maine DEP) for section 401 certification for the Mattaceunk Project. Maine DEP received this request on the same day. Maine DEP has not yet acted on the application.

1.3.3 Endangered Species Act

Section 7 of the Endangered Species Act (ESA), 16 U.S.C. § 1536, requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. During the consultation process, FWS indicated to GLHA that there are three federally listed species known to occur in the Mattaceunk Project vicinity, the endangered Gulf of Maine Distinct Population Segment of Atlantic salmon (*Salmo salar*),[4] the threatened Canada lynx (*Lynx canadensis*) and the threatened northern long-eared bat (*Myotis septentrionalis*).

On November 2, 2017, we accessed FWS's Information, Planning, and Conservation (IPaC) System to determine federally listed species that occur in the project vicinity. According to the IPaC database, the following species potentially occur in the project area: endangered Atlantic salmon, threatened Canada lynx and threatened northern long-eared bat.[5] In addition, designated critical habitat for Atlantic salmon occurs within the project boundary. No critical habitat for Canada lynx and northern long-eared bat is present in the project boundary.

Our analysis of project impacts on the Canada lynx, northern long-eared bat, and Atlantic salmon is presented in section 3.3.3.2, *Threatened and Endangered Species*. Based on available information, we conclude that relicensing the project would have no effect on the Canada lynx and the northern long-eared bat. However, in the same section we conclude that relicensing the project and its operation may affect and is likely to adversely affect the Atlantic salmon, but is not likely to adversely affect the designated critical habitat for the GOM DPS of Atlantic salmon.

[4] There are three other population segments of Atlantic salmon that are not federally listed: (1) Long Island Sound; (2) Central New England; and Outer Bay of Fundy.

[5] See Interior's official list of threatened and endangered species accessed by staff using the IPaC website (https://ecos.fws.gov/ipac/) on November 2, 2017 and filed on November 3, 2017.

1.3.4 Coastal Zone Management Act

The Coastal Zone Management Act of 1972 (CZMA), as amended, requires review of the project's consistency with a state's Coastal Management Program for projects within or affecting the coastal zone. Under section 307(c)(3)(A) of the CZMA, 16 U.S.C. §1456(3)(A), the Commission cannot issue a license for a project within or affecting a state's coastal zone unless the state's CZMA agency concurs with the license applicant's certification of consistency with the state's 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.

In an email dated October 29, 2012,[6] the Maine Department of Agriculture, Conservation, and Forestry stated that the Mattaceunk Project is not located within Maine's coastal boundary and would not affect Maine's coastal resources. Therefore, the project does not require certification of consistency with Maine's CZMA Program.

1.3.5 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA), 54 U.S.C. § 306108, requires that a federal agency "take into account" how its undertakings could affect historic properties. Historic properties are districts, sites, buildings, structures, traditional cultural properties, and objects significant in American history, architecture, engineering, and culture that are eligible for inclusion in the National Register of Historic Places (National Register).

On May 1, 2013, the Commission designated GLHA as its non-federal representative for the purposes of conducting section 106 consultation under the NHPA. Pursuant to section 106, and as the Commission's designated non-federal representative, the applicant consulted with the Maine Historic Preservation Commission (Maine SHPO) and potentially affected Indian tribes to identify historic properties, determine National Register-eligibility, and assess potential adverse effects on historic properties within the project's area of potential effects (APE). This consultation, and other investigations conducted to date, identified one archeological site and portions of the project's facilities as eligible for listing on the National Register.

In the license application, GLHA proposes to develop a Historic Properties Management Plan (HPMP) in consultation with the Maine SHPO and the Penobscot Indian Nation. The HPMP would direct the management of historic properties within the project's APE, including measures to avoid, minimize, or mitigate adverse effects on historic properties throughout the term of a new license.

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[6] See Appendix E-1 of final license application.

To meet the requirements of section 106 of the NHPA, we intend to execute a Programmatic Agreement (PA) with the Maine SHPO for the protection of historic properties from the effects of continued operation and maintenance of the Mattaceunk Project. The terms of the PA would ensure that the GLHA addresses and treats all historic properties identified within the project's APE through the finalization of its proposed HPMP.

1.3.6 Magnuson Stevens Fishery Conservation and Management Act

Section 305 of the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. § 1855(b)(2), requires federal agencies to consult with the National Marine Fisheries Service (NMFS) on all actions that may adversely affect Essential Fish Habitat (EFH). EFH for Atlantic salmon has been defined as, "all waters currently or historically accessible to Atlantic salmon within the streams, rivers, lakes, ponds, wetlands, and other water bodies of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut," which includes the project area.

Our analysis of project effects on Atlantic salmon EFH is presented in section 3.3.3.2, *Environmental Effects, Atlantic Salmon*. We conclude that relicensing the project as proposed and with the staff recommended measures would have minor adverse effects on Atlantic salmon EFH, but by maintaining upstream and downstream fish passage at the proposed performance standards (i.e., 95 percent effectiveness for upstream passage, 96 percent survival for downstream passage), relicensing the project would provide a net benefit to EFH. Therefore, over the long term, aquatic habitat and EFH would be enhanced under the applicant's proposal and the additional staff modifications and measures discussed in section 5.1, *Comprehensive Development and Recommended Alternative*. We are providing NMFS with our EFH assessment and requesting that NMFS provide any EFH recommendations.

1.4 PUBLIC REVIEW AND COMMENT

The Commission's regulations (18 C.F.R. §§ 5.1 to 5.16) require applicants to consult with appropriate resource agencies, tribes, and other entities before filing an application for a license. This consultation is the first step in complying with the Fish and Wildlife Coordination Act (16 U.S.C. §§ 661-667e), the ESA, the NHPA, and other federal statutes. Pre-filing consultation must be completed and documented according to the Commission's regulations.

Relicensing of the project was formally initiated March 1, 2013, when GLHA filed with the Commission a Pre-Application Document (PAD) and a Notice of Intent to license the project using the Integrated Licensing Process (ILP). The Commission issued a Notice of Commencement of Proceeding on May 1, 2013.

1.4.1 Scoping

Before preparing this draft EA, we conducted scoping to determine what issues and alternatives should be addressed. During the pre-filing consultation process, scoping meetings were held to determine what issues and alternatives should be addressed in the draft EA. Scoping Document 1 (SD1) was issued on May 1, 2013. Scoping meetings were held in Medway, Maine, on June 5, 2013, to request comments on the project. A court reporter recorded all comments and statements made at the scoping meetings, and these are part of the Commission's public record for the project. An environmental site review was also held on June 5, 2013.

In addition to comments provided at the scoping meetings, the following entities provided written comments pertaining to SD1, the PAD, and additional study needs:

Commenting Entity	Date Filed
Maine Department of Marine Resources (Maine DMR)	June 24, 2013
GLHA	June 25, 2013
Maine Department of Environmental Protection (Maine DEP)	June 27, 2013
NMFS	June 28, 2013
FWS	July 1, 2013
Maine Department of Agriculture, Conservation, and Forestry (Maine DACF)	July 1, 2013
Maine Department of Inland Fisheries and Wildlife (Maine DIFW)	July 1, 2013
Atlantic Salmon Federation	July 2, 2013
Maine Rivers	July 2, 2013
Natural Resources Council of Maine	July 2, 2013
GLHA	July 2, 2013
Penobscot Indian Nation	July 17, 2013

A revised Scoping Document, addressing these comments, was issued on August 9, 2013.

1.4.2 Interventions

On March 24, 2017, the Commission issued a notice accepting the application and setting May 23, 2017, as the deadline for filing protests and motions to intervene. In response to the notice, the following entities filed motions to intervene (none opposed issuance of a license):

Commenting Entity	Date Filed
Interior	April 25, 2017
Penobscot Indian Nation	May 17, 2017
Maine DEP	May 18, 2017
Maine Rivers	May 18, 2017
Maine DIFW	May 19, 2017
Atlantic Salmon Federation	May 23, 2017

1.4.3 Comments on the Application

A notice requesting comments, recommendations, and preliminary terms and conditions was issued on March 24, 2017. The following entities responded:

Commenting Entity	Date Filed
Atlantic Salmon Federation	February 2, 2017
Bureau of Indian Affairs	February 6, 2017
Bureau of Indian Affairs	March 23, 2017
Maine DEP	May 4, 2017
Maine Rivers	May 18, 2017
Bruce A. Haines	May 22, 2017
Maine DMR	May 22, 2017
Atlantic Salmon Federation	May 23, 2017
Interior	May 23, 2017
NMFS[7]	May 23, 2017
NMFS	May 24, 2017
NMFS	May 26, 2017
Penobscot Indian Nation	May 23, 2017
NMFS	June 2, 2017
FWS	June 5, 2017

GLHA filed reply comments on July 7, 2017.

[7] NMFS's May 23, 2017 filing included its section 18 preliminary fishway prescriptions. On May 24, 2017 NMFS also filed a USB drive containing the administrative record for its section 18 preliminary fishway prescriptions, but the Commission could not accept this form of filing. NMFS filed its administrative record in an acceptable form on May 26, 2017.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 NO ACTION ALTERNATIVE

Under the no-action alternative, the project would continue to operate under the terms and conditions of the existing license, and no new environmental protection, mitigation, or enhancement measures would be implemented. We use this alternative as the baseline environmental condition for comparison with other alternatives.

2.1.1 Existing Project Facilities

The Mattaceunk Project is located approximately 67 river miles upstream of Bangor, Maine, on the Penobscot River. The project facilities are shown in figure 2.

Mattaceunk Impoundment

The Mattaceunk impoundment is about 8.5 miles long, with a surface area of 1,664-acres and a total storage capacity of 20,981 acre-feet at a normal pool elevation of 240.0 feet USGS datum.[8]

Weldon Dam

Weldon Dam contains: (1) an earthen embankment at the north shoreline; (2) an intake/powerhouse structure (described in more detail below); (3) an upstream pool and weir fishway; (4) a log sluice; (5) a roller gate spillway; (6) an ungated overflow spillway; and (7) the right abutment. These structures have a combined length of approximately 1,060 feet and a maximum height above the riverbed of about 45 feet.

The upstream fishway and log sluice structure are located between the powerhouse and roller gate and have a total length of 36.5 feet. Discharge to the 10-foot-wide log sluice is controlled by a 10-foot-wide by 8-foot-high vertical slide gate. The log sluice is used for debris management and, in combination with the roller gate, for passing flows in excess of the project's turbine capacity.

The roller gate spillway is a reinforced-concrete structure measuring 114 feet long beginning at the northeast end of the log sluice structure and extending to the ungated spillway. The structure is approximately 75 feet high from its assumed base (i.e., elevation 175 feet to the top of the concrete piers at elevation 250 feet). The spillway contains a single steel roller (drum) gate measuring 90 feet long and 19 feet high, an ogee-shaped spillway section with a crest elevation of 221.0 feet, and a bridge at elevation 250.0 feet spanning 90 feet between the piers. The gate is operated by a motor-

[8] All elevation data are referenced to USGS datum, unless noted otherwise.

driven chain hoist located on the left side. The roller gate is used to release water during plant shutdowns or when flows are in excess of turbine capacity of approximately 7,438 cfs. The roller gate has a discharge capacity of 25,637 cfs at normal pond elevation of 240.0 feet when the gate is opened 13.3 feet.

The ungated overflow spillway is a concrete gravity structure measuring 657.5 feet long and has a maximum height of approximately 70 feet from the spillway's foundation to the top of the flashboards. The ogee-shaped spillway has a permanent crest elevation of 236.0 feet and when equipped with 4-foot-high wooden flashboards, has a flashboard crest elevation of 240.0 feet.

Intake

The intake is a concrete structure integral with the powerhouse having a total length of 142 feet. Individual intake openings, which consist of two openings per generating unit for a total of eight openings, include steel trash racks and 12-foot-wide by 16-foot-high vertical slide headgates. The trash racks and headgates are located within an enclosed gatehouse. The gates are operated by two 12.5-ton electric hoists that travel on a roof-mounted trolley beam. Intakes 3 and 4 also include downstream fish passage inlets. The intake is equipped with trash racks with 1-inch clear bar spacing covering the top 16 feet (at normal pond) of the water column. At depths greater than 16 feet, the trash racks have 2.63-inch clear bar spacing.

Fishways

The current upstream fishway consists of a pool and weir design that has 36 pools with a drop of approximately 14 inches between pools. Fish are able to ascend the fishway by way of either submerged orifices or weir notches. Flows through the fishway consist of 6- to 8-cfs transport flow with an additional attraction water flow of 7 cfs for a total flow of 13 to 15 cfs. The impoundment is maintained with minimal fluctuation in elevation when the flashboards are in place, thereby maintaining relatively stable fishway inflows. The fishway is typically operated from May 1 through November 10. Under the infrequent conditions of high flows causing flashboard failure and a need for replacement or repair, the impoundment is temporarily drawn down (typically no more than 1 to 3 days) up to 1 foot below the permanent crest of the dam. Under these conditions, the upstream fishway is not operational. The upstream fishway also is not operated under flood flow conditions. A fish trap is located at the upstream exit (top) of the fishway, so that fish enter the trap for monitoring purposes through a funnel-like opening.

The downstream fishway (i.e., surface bypass) consists of single surface inlets integral with the trash racks in two of the four turbine forebays (intakes 3 and 4), and a buried 42-inch-diameter stainless steel pipe for passing fish to the tailrace area at a maximum flow capability of 140 cfs. In addition, a trapping and monitoring facility is present at the outlet of the bypass pipe. This monitoring facility includes an entrance chamber, an inclined dewatering system, and a holding chamber. Water flows passing through the downstream passage system empty into the monitoring facility's entrance chamber from the underground passage pipe.

Powerhouse

The 142-foot-long, 99-foot-wide powerhouse (Weldon Station) is integral to the dam and contains two Kaplan turbines rated at 5,479 kilowatt (kW) and two fixed-blade propeller turbines rated at 5,489 kW, each driving a 6,000-kilovolt-ampere (kVA), 4,800-kW vertical synchronous generator for an authorized installed capacity of 19.2 megawatts (MW). Water from the powerhouse discharges directly to the river downstream. The Mattaceunk Project generates 123,332 megawatt-hours (MWh) of electricity annually.

Transmission Facilities

Project generators connect to a substation located adjacent to the powerhouse, then to a 9-mile-long, 34.5-kilovolt (kV) transmission line to a point of interconnection.

Recreation Facilities

GLHA operates and maintains a canoe portage on the west side of the Penobscot River, with a takeout located about 650 feet upstream of the dam and a put-in below the dam. GLHA also operates and maintains a downstream angler access area on the east bank of the river, about 1,000 feet downstream from the dam, which includes parking for six to eight vehicles, a covered picnic area, and stairs that provide access from the parking and picnic area to the river.

Project Boundary

The existing project boundary around the Mattaceunk Project includes lands up to contour elevation 240.0 feet (normal pool elevation) and lands associated with project structures, such as the dam, generator leads, powerhouse, recreational facilities, transmission line, and appurtenant facilities.

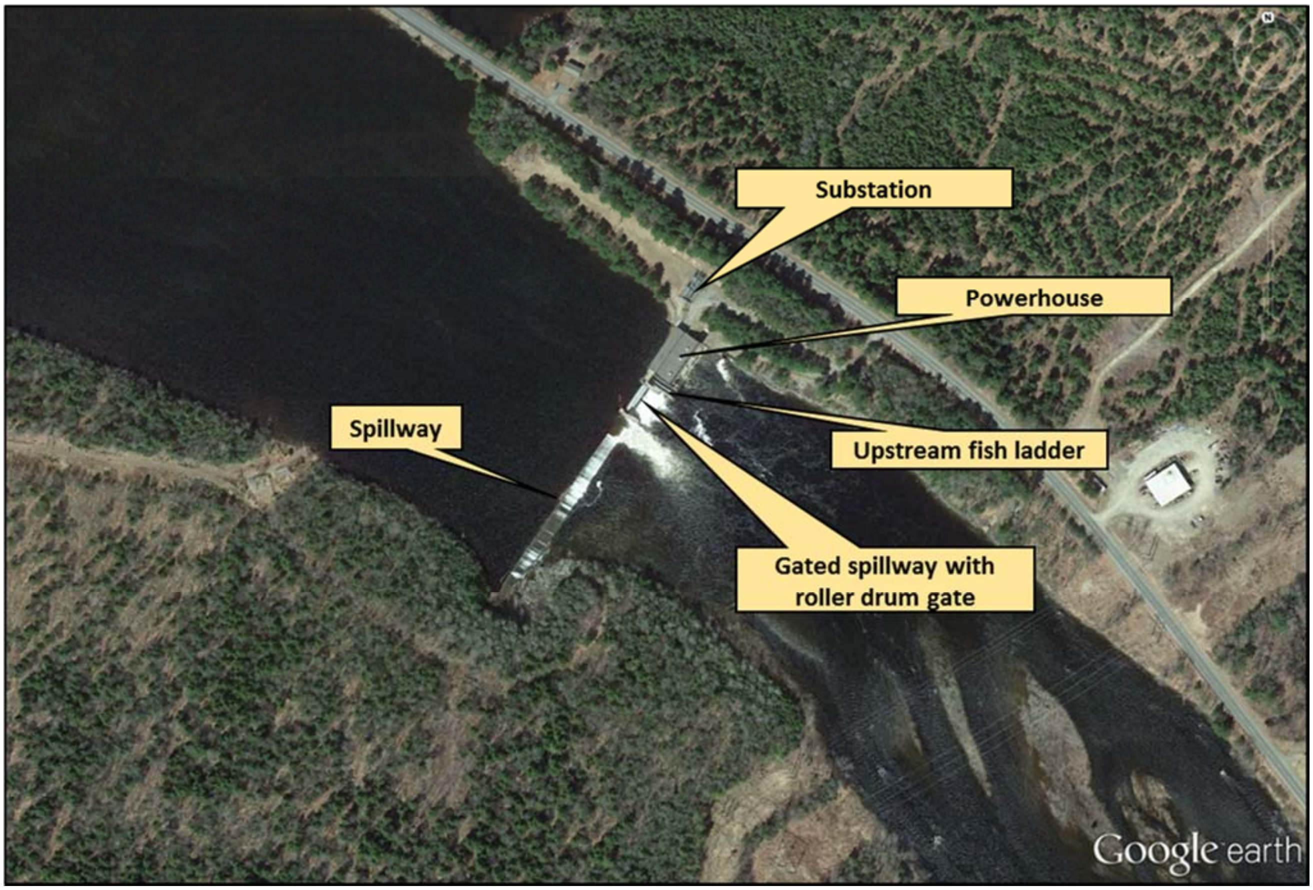

Figure 2. Mattaceunk Project facilities.
(Source: Google Earth, 2014, as modified by staff).

2.1.2 Project Safety

The Mattaceunk Project has been operating for more than 29 years under its existing license. During this time, Commission staff has conducted operational inspections focusing on the continued safety of the structures, identification of unauthorized modifications, efficiency and safety of operations, compliance with the terms of the license, and proper maintenance.

As part of the relicensing process, Commission staff will evaluate the continued adequacy of the project's facilities under a new license. Special articles will be included in any license issued, as appropriate. Commission staff will continue to inspect the project during the term of the new license to assure continued adherence to Commission-approved plans and specifications, special license articles relating to construction (if any), operation and maintenance, and accepted engineering practices and procedures.

2.1.3 Existing Project Operation

The Mattaceunk Project is operated in a run-of-river mode with pondage,[9] maintaining the fluctuation of the impoundment surface elevation within 1.0 foot of the flashboard crest elevation of 240.0 feet when the flashboards are in place.[10] In contrast, the existing license requires GLHA to maintain an impoundment surface elevation no lower than 1.0 foot below the dam crest elevation of 236.0 feet when the 4-foot-high flashboards are down (for flashboard repairs), and no lower than 2.0 feet below the top of flashboard crest elevation of 240.0 feet when the 4-foot-high flashboards are in place to allow an adequate margin for debris loads, ice loads, or sudden pool increases that might cause flashboard failure.[11]

The project uses flows between 471 cfs (minimum hydraulic capacity) and 7,438 cfs (maximum hydraulic capacity) to generate electricity. When flows exceed 7,438 cfs, excess flows are normally released through the roller drum gate. However, the log sluice is used as the first opened and last closed gate for releasing excess flows during periods when the downstream fishway is in operation. The existing license, as amended on June 21, 1991, also requires a year-round continuous minimum flow of 1,674 cfs or inflow, whichever is less, and a daily average minimum flow of 2,392 cfs or inflow, if less, from July 1 through September 30, and 2,000 cfs or inflow, if less, from October 1 through June 30. The minimum flows are released through the turbines and fish passage structures when in operation. When inflow is less than the minimum hydraulic capacity, the minimum flows are released through the log sluice, roller drum gate, fish passages, and/or over the spillway.

GLHA operates the upstream pool and weir fishway annually from May 1 to November 10 for Atlantic salmon adults, by providing flows through the fishway that consist of 6- to 8-cfs transport flow with an additional attraction flow of 7 cfs at the entrance to the fishway. GLHA operates the downstream surface bypass fishway at its maximum flow capability (140 cfs) to provide downstream passage for Atlantic salmon smolts and kelts from April 1 to June 15 and only kelts from October 17 to December 1.

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[9] Pondage refers to the ability of the project to raise the impoundment above the crest of the dam by using flashboards. Although a prior order indicates that the project would be able to operate under a peaking mode, *Great Northern Nekoosa Corporation*, 55 FERC ¶ 61,472 (1991), the project has never been operated in a peaking mode, nor has there ever been a proposal to operate in a peaking mode.

[10] The limited fluctuation within 1.0 foot of the flashboard crest elevation, is not a requirement of the existing license but represents existing operations, which based on a letter filed on July 7, 2017, GLHA is proposing to continue.

[11] *See Great Northern Paper Co.*, 50 FERC ¶ 61,163 (1990).

Turbines 3 and 4 are the first units on and the last units off whenever the downstream bypass is operational.

2.2 APPLICANT'S PROPOSAL

2.2.1 Proposed Operation and Environmental Measures

GLHA proposes to:

- Continue to operate the project in a run-of-river mode with pondage with year-round use of 4-foot-high flashboards;
- Continue to operate the impoundment with fluctuation limits that consist of maintaining the impoundment surface elevation: (1) within 1.0 foot of the flashboard crest elevation (240.0 feet) on a regular basis when the flashboards are in place; (2) no lower than 2.0 feet below the flashboard crest elevation when needed for maintenance, to allow an adequate margin for wave action, debris loads, ice loads, or sudden pool increases that might cause flashboard failure when the flashboards are in place; and (3) no lower than 1.0 foot below the dam crest elevation of 236.0 feet when the flashboards are not in place;
- Continue to provide a year-round continuous minimum flow of 1,674 cfs or inflow, whichever is less, downstream from the project, and continue to provide a daily average minimum flow of 2,392 cfs from July 1 through September 30 and 2,000 cfs from October 1 through June 30, or average inflow, whichever is less, to protect aquatic resources downstream of the project;
- Install and maintain, on a seasonal basis, an upstream eel ladder within 2 years of the effective date of the new license;
- Monitor the upstream eel ladder for use and effectiveness for one eel passage season;
- Provide downstream passage for eel by implementing annual nighttime turbine shutdowns (8:00 pm to 4:00 am), in combination with opening the project's roller gate and installing full-depth trash racks with 1-inch bar clear spacing (see measures included in the Species Protection Plan (SPP) for Atlantic salmon), beginning the first passage season following license issuance;[12]

[12] GLHA would develop the annual schedule in consultation with the resource agencies and based on a predictive model for eel movement through the project. GLHA refined its proposed window for downstream passage events as follows: "until such time

- Monitor, for two passage seasons, the effectiveness of the downstream eel passage measures;

- Install an upstream fishway for shad in year 15 of a new license, expected to be operational in year 16 of a new license;

- Monitor the use and effectiveness of the upstream fishway for shad for 2 years following its completion;

- Provide downstream passage for shad after the upstream fishway for shad is operational (expected in year 16), by: (1) extending the operation of the existing downstream fish bypass such that it operates continuously from April 1 to December 1; and (2) by opening the log sluice (and releasing between 3 percent [225 cfs] and 9 percent [690 cfs] of hydraulic capacity) from June 1 to December 1, as needed for shad, based on monitoring results;

- Monitor, for 2 years, the use of existing downstream passage structures by shad (including the surface bypass and log sluice), once the upstream fishway for shad is operational;

- Implement additional operational and structural modifications and/or habitat enhancement measures to provide eel and shad passage, if the proposed passage measures for eel and shad are ineffective (passage criteria for eel and shad shall be based on a review of the performance of comparable fish passage measures in New England);

- Continue to implement the Fish Passage Operations and Maintenance Plan (FPOMP, filed on August 31, 2016), which defines the: (1) operational period for the existing upstream and downstream fishways; (2) annual start-up and shut-down procedures; (3) opening methods; (4) debris management; and (5) safety rules and procedures;

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that a predictive model is developed, GLHA would implement a night-time shutdown period of up to 6 weeks (8 pm to 4 am nightly) as early as the first significant rain event (defined as greater than 1 inch of precipitation) occurring on or after August 15, but that the nighttime shutdown period will start no later than September 15 in years that a significant rain event does not occur during the August 15-September 15 time period. The schedule for nighttime shutdowns within the 6-week period could be reduced based on the predictive model, and after consultation with the resource agencies. *See* GLHA's July 7, 2017 Comments, attach. 1 at 40.

- Continue to maintain and operate the upstream fishway annually from May 1 to November 10 for adult Atlantic salmon, including the 7 cfs attraction flow at the fishway entrance.[13]

- Monitor the upstream fishway and count the number of adult Atlantic salmon passing upstream of the project, using a methodology developed in consultation with resource agencies, to provide an estimate of the number of returning spawners;

- Continue to maintain and operate the downstream surface bypass to provide downstream passage for Atlantic salmon smolts and kelts from April 1 to June 15 and only kelts from October 17 to December 1;

- Implement a Species Protection Plan (SPP) for the federally endangered Atlantic salmon to meet a performance standard of 95 percent effectiveness for upstream passage of adults and 96 percent survival for downstream passage of smolts and kelts, including measures to:
  (1) coordinate with resource agencies to stock uniquely marked smolts upstream of Weldon Dam in the first 3 years after relicensing to serve as a source of upper-Penobscot imprinted[14] adult salmon used for studying upstream passage of adults and downstream passage of kelts;
  (2) conduct up to 3 years of upstream fishway effectiveness monitoring for adults and up to 3 years of downstream passage monitoring for kelts, using the returning, imprinted adult salmon;
  (3) use trash racks that would have 1-inch clear bar spacing to the full depth of the turbine intakes, and within 2 years after relicensing, be installed seasonally during the downstream migration of eel, shad, and Atlantic salmon;
  (4) open the project's log sluice (between 3 percent [225 cfs] and 9 percent [690 cfs] of station hydraulic capacity) starting the first passage season following

[13] GLHA proposes to continue operating the existing upstream fishway throughout the duration of any new license, including after construction and operation of the proposed upstream fishway for shad.

[14] Salmon are able to locate their natal habitat (and future spawning habitat), because they learn as juveniles and remember as adults the chemical cues (e.g., odors) of the habitat they experienced as juveniles (Quinn, 2005). This learning at specific stages in development and remembering without reinforcement is called imprinting. Imprinted adult salmon would be motivated to migrate to habitats upstream of Weldon Dam and thus are needed to study upstream passage effectiveness.

relicensing to provide additional downstream passage for smolts for a 3-week period during the spring that would be determined in consultation with the resource agencies;[15]

(5) conduct a minimum of 3 years of monitoring to evaluate the effectiveness of existing passage operations and additional measures (installation of the 1-inch clear spacing full-depth trash racks and operation of the log sluice), in passing smolts downstream past the dam;[16]

(6) conduct a study to evaluate the smolt mortality in the project impoundment;

(7) implement adaptive management that would include additional operational, structural, and/or habitat enhancement measures, if necessary, to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon;[17]

- Continue to operate and maintain the existing project recreation facilities including: (1) a canoe portage trail; and (2) a downstream angler access area with a parking area, stairs leading to the tailrace area, and a covered picnic area;

- Implement recreation facility improvements at the existing downstream angler access area within 3 years of license issuance, including installation of: (1) a pulley system to assist boaters with moving car top boats and other small watercraft up and down the stairs; and (2) a ramp adjacent to the existing recreation pavilion to provide wheel chair access to the pavilion and associated picnic table; and

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[15] In a letter filed on January 25, 2017, GLHA indicated that the 3-week period would be determined in consultation with the resource agencies.

[16] In the final license application filed on August 31, 2017, GLHA stated that it would conduct at least 3 years of monitoring to evaluate the effectiveness of the downstream passage for smolts; however, in response to comments filed on July 7, 2017, GLHA stated that it would conduct a minimum of 3 years of monitoring, until the performance standard for downstream smolt survival is met for a total of 3 years.

[17] GLHA's proposed SPP included two adaptive management measures to: (1) address performance criteria for downstream passage, should the proposed measures be inadequate; and (2) implement additional operational and structural modifications and/or habitat enhancement measures, if necessary, to address outmigrating Atlantic salmon smolts and kelts and upstream migrating Atlantic salmon adults. Because of the similarity in these two measures, staff combined them into this single adaptive management measure that captures the intent of the two measures proposed by GLHA.

- Develop a Historic Properties Management Plan (HPMP) to protect archaeological and historic architectural resources eligible for listing on the National Register of Historic Places (National Register), including the project's dam and powerhouse.

2.3 MODIFICATIONS TO APPLICANT'S PROPOSAL – MANDATORY CONDITIONS

The following mandatory conditions have been provided, and are summarized below.

Section 18 Prescriptions

Interior's preliminary section 18 prescription specifies that permanent upstream and downstream fish passage for eel at the Mattaceunk Project be operational no later than 2 years after the date of issuance of a new license, and that GLHA:

- Design upstream and downstream fish passage for eel that is sufficient to pass all available upstream and downstream migrating eel that arrive at the project;
- Operate the project to (a) minimize project effects on upstream migration for juvenile eel that approach the project tailwater and spillway,[18] and (b) exceed the minimum downstream survival efficiency criterion of 76 percent of the adult (i.e., silver) eel moving downstream past the project;[19]
- Design and construct, consistent with FWS's eel passage design criteria (FWS, 2017a), an upstream eel passage ramp at the west abutment of the spillway within 2 years of license issuance;
- Shutdown all generation nightly (8:00 pm to 4:00 am) from August 1 through October 31, annually, to provide out-migrating eel safe and timely downstream passage;
- Install full-depth trash racks that have 1-inch clear bar spacing, as either permanent structures or seasonal overlays, during the downstream eel passage operations;

[18] Once eel have entered the eel ramp, 90 percent must move upstream and exit within 24 hours.

[19] This performance standard is based upon Sweka *et al*. (2014).

- Operate the upstream eel fishway during the months of June through August, and provide downstream passage for out-migrating eel during the months of August through October;[20]

- Develop a Fishway Operation and Maintenance Plan (Eel Passage Operations Plan) that covers all operations and maintenance of the upstream and downstream eel passage facilities, and make revisions to the plan annually if changes are warranted;[21]

- Develop a Upstream Fishway Effectiveness Monitoring Plan (Upstream Eel Monitoring Plan) within 6 months of license issuance to document the efficiency and effectiveness of the upstream eel passage measures, including an efficiency study of juvenile eel using the new upstream eel fishway;[22]

- Develop a Downstream Passage Effectiveness Monitoring Plan (Downstream Eel Monitoring Plan) within 6 months of license issuance to document that 76 percent of the adult eel migrating downstream past the project survive passage;

- Provide FWS personnel, and FWS-designated representatives, timely access to the fish passage facilities at the project, and to pertinent project operational records, to document compliance with the fishway prescription.

In addition to the specific fish passage measures listed above, Interior reserves authority to prescribe fishways at the project during the term of the new license under section 18 of the FPA.

NMFS's preliminary section 18 prescription would require GLHA to:

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[20] The seasonal schedule for downstream eel passage operations may be modified in consultation with the resource agencies, based upon empirical passage timing data developed for the project, and/or a predictive model for eel movement through project waters.

[21] GLHA would also provide information on fish passage operations, and project operation that may affect fish passage, within 10 days of a written request from FWS.

[22] The Upstream Eel Monitoring Plan would include standard study methods to evaluate (a) attraction efficiency to the facility, and (b) the effectiveness of passing eel that have entered the upstream eel ladder.

- Install trash racks with 1-inch clear bar spacing to the full depth of the turbine intakes, during the downstream migration for eel, shad,[23] and Atlantic salmon;

- Begin installing the seasonal trash racks with 1-inch clear bar spacing to the full depth of the turbine intakes within 2 years;

- Measure approach velocities annually using point measurements, and ensure approach velocities do not exceed 2.0 feet per second (fps);

- Design new fishways using the following provisions: (1) submit design plans to the resource agencies for review and consultation; (2) provide conceptual designs to the resource agencies; (3) provide the resource agencies with conceptual designs for the proposed full-depth trash racks with 1-inch bar spacing; (4) submit final design plans to the Commission for final approval after resource agency approval and prior to the commencement of fishway construction activities; and (5) file final as-built drawings with NMFS and FWS;

- Submit fishway design plans for new fishway structures to the resource agencies for review and consultation;

- Follow NMFS's general provisions for all fishway effectiveness monitoring.

- Monitor the seasonal upstream eel ramp for use and effectiveness during one eel passage season;

- Monitor downstream eel passage for 2 years to determine the effectiveness of the nighttime shutdowns and full depth trash racks with 1-inch bar spacing;

- Install an upstream passage structure for shad in year 15 of the new license, to be operational in year 16;

- Operate the new upstream shad fishway from May 1 to July 31 of each year;

- Conduct 2 years of upstream passage monitoring for shad;

- Extend the seasonal operation of the downstream fishway and log sluice to include the period from June 1 to December 1, as necessary based on shad study results, once upstream passage for shad is operational (expected in year 16 of a new license);

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[23] NMFS refers to American shad, alewife, and blueback herring as alosines, which refers to the scientific subfamily (Alosinae) of these shad species.

- Conduct 2 years of downstream passage monitoring for shad;

- Implement additional protective measures or alternative actions (e.g., additional spill or intake screening) sufficient to attain performance standards for out-migrating shad;

- Continue to maintain and operate the upstream fishway annually from May 1 to November 10 for adult Atlantic salmon;

- Operate the existing upstream fishway from May 1 to November 10 for adult Atlantic salmon, unless the Milford fishway begins capturing fish earlier in the calendar year, in which case the fishway should open prior to May 1;

- Maintain and monitor the existing fish trap at the exit of the existing upstream fishway for counting adult Atlantic salmon;

- Continue to maintain and operate the downstream fish bypass to provide downstream passage for Atlantic salmon smolts and kelts from April 1 to June 15 and Atlantic salmon kelts from October 17 to December 1;

- Open the project's log sluice starting the first passage season following relicensing to provide additional passage for downstream Atlantic salmon smolts for a 3-week period during the spring that would be determined in consultation with resource agencies;

- Conduct up to 3 years of upstream fishway effectiveness monitoring for adult Atlantic salmon and up to 3 years of downstream passage monitoring for kelts, using returning imprinted adult salmon;

- Conduct up to 3 years of monitoring to evaluate the effectiveness of existing downstream passage operations and additional measures (operation of the log sluice and installation of the 1-inch clear spacing full-depth trash racks), in passing Atlantic salmon smolts;

- Implement adaptive management that would include additional operational, structural, and/or habitat enhancement measures, if necessary, to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon;

In addition to the specific fish passage measures listed above, Commerce reserves authority to prescribe fishways at the project during the term of the new license under section 18 of the FPA.

2.4 STAFF ALTERNATIVE

Under the staff alternative, the project would be operated as proposed by GLHA except for nine proposed measures, and with all but 16 of the fishway prescriptions filed by Interior (Appendix B) and NMFS (Appendix C). The staff alternative includes the remaining measures proposed by GLHA with some modifications and additional staff-recommended measures described below.

The staff alternative for the project includes modifications of and additions to GLHA's proposed measures as follows:

- Develop an operation compliance monitoring plan to document compliance with the proposed operations described above (i.e., run-of-river mode with pondage, limited impoundment fluctuations, and minimum flows) for the protection of aquatic resources in the impoundment and downstream of the dam;

- Develop individual monitoring plans for upstream and downstream eel passage, as required by FWS's fishway prescription, that include:
  (1) the goals and objectives of the monitoring;
  (2) performance criteria for determining the success of the eel passage measures;
  (3) the methodology used to monitor the effectiveness and efficiency of the upstream and downstream passage measures to pass eel;
  (4) provisions for reporting the results of the monitoring (i.e., development of a report) and consulting with the agencies regarding the results (including an annual meeting); and
  (5) a provision to identify and implement (upon Commission approval): (a) additional monitoring studies, or (b) operational and structural modifications and/or habitat enhancement measures to provide eel passage, if after 1 year of upstream monitoring and 2 years of downstream monitoring, the proposed passage measures for eel are ineffective at achieving the upstream and downstream effectiveness and survival performance criteria.

- Re-assess the need for shad passage at the project 14 years after license issuance;

- Modify the FPOMP to include additional provisions for:
  (1) performing routine maintenance before the migration season, such that the existing fishways would be fully operational during the migratory period;
  (2) clearing debris from the trash racks of all turbine intakes prior to the migration season, and identify, with final Commission approval, the frequency of debris clearing during the migration season;

(3) monitoring outflows from the downstream bypass pipe, to detect debris blockages using a method approved by the Commission;
(4) procedures for filing with the Commission for informational purposes, an annual report on the operation of the existing fishways and on project generation;
(5) developing shutdown procedures for the existing fishways; and
(6) developing procedures for operation and maintenance of the existing fishways during emergencies and project outages;

- Operate the proposed upstream eel ladder for a "shakedown" period subsequent to installation, and prior to the passage season and pertinent effectiveness studies to ensure it is operating as designed and to make minor adjustments to facilities and operations, as needed;

- Modify the SPP to include the following additional provisions:
  (1) remove the provision to seasonally install trash racks with 1-inch clear bar spacing to the full depth of the turbine intakes for the purpose of protecting smolts and kelts;
  (2) revise, with final approval from the Commission, the upstream passage effectiveness study methodology to include the type of telemetry tag to be used on upstream migrating adults and the appropriate timing for stocking tagged smolts, and refile the SPP with the revised study plan;
  (3) include the proposed passage effectiveness study plans as attachments to the SPP;
  (4) determine the need for an additional 1 or 2 years of effectiveness studies, with final approval from the Commission, if the upstream fishway meets the 95 percent performance standard after the first year;
  (5) determine the need for future effectiveness studies or measures, with final approval from the Commission, if after 3 years of upstream passage effectiveness studies, the upstream fishway does not meet the 95 percent effectiveness performance standard;
  (6) revise the number of downstream passage effectiveness studies for smolts to indicate that a minimum of 3 years of study would be conducted;
  (7) revise the criteria for achieving the downstream performance standard for smolts to state that the standard would be considered achieved if a total 3 years of effectiveness studies for smolts demonstrate that the downstream passage structures meet a 96 percent survival performance standard;
  (8) determine, with final approval from the Commission, when to begin implementation of phased spill measures for downstream passage of smolts, with the restriction that phased spill measures would be implemented after a minimum of 1 year and a maximum of 3 years of

conducting downstream passage survival studies for smolts, and non-spill passage measures;

(9) determine, with final approval from the Commission, the 3-week period during which any phased spill measures would occur for downstream passage of smolts;

(10) determine the need for an additional 1 or 2 years of downstream passage effectiveness studies for kelts, with final approval from the Commission, if the downstream passage structures meet the 96 percent survival performance standard for kelts after the first year;

(11) determine the need to conduct at least 1 year of additional effectiveness study, with final approval from the Commission, if the downstream passage structures do not meet the 96 percent survival performance standard for kelts after the first year;

(12) determine the need for future effectiveness studies, and/or downstream passage measures, with final approval from the Commission, if after 3 years of downstream passage effectiveness studies, the downstream passage structures do not meet the 96 percent survival performance standard for kelts;

(13) remove the provision to conduct a study to evaluate smolt mortality in the project impoundment;

(14) remove the provisions requiring reevaluation of upstream and downstream passage effectiveness every 10 years; and

(15) add a provision to file an application to amend the license and get Commission approval prior to implementing any future, and currently unspecified operational, structural, and/or habitat enhancement measures that may be used to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon.

Fishway Prescriptions Not Recommended

The staff alternative does not include Interior's fishway prescriptions to:

- Provide downstream passage for eel from August 1 through October 31 each year by implementing annual nighttime turbine shutdowns, in combination with opening the project's roller gate and installing full-depth trash racks with 1-inch clear bar spacing, beginning the first passage season after license issuance.

- Provide FWS personnel, and FWS-designated representatives, timely access to the fish passage facilities at the project, and to pertinent project operational records, to document compliance with the fishway prescription.

The staff alternative also does not include NMFS's fishway prescriptions to:

- Install trash racks with 1-inch bar spacing to the full depth of the turbine intakes during the downstream migration of Atlantic salmon.

- Estimate approach velocities in front of the trash racks annually.

- File final as-built drawings for new fishways with NMFS and FWS.

- Install an upstream passage structure for shad in year 15 of the new license, to be operational in year 16.

- Operate the upstream fishway for shad from May 1 to July 31 of each year.

- Conduct 2 years of upstream passage monitoring for shad.

- Extend the seasonal operation of the downstream bypass fishway and log sluice to include the period from June 1 to December 1, as necessary, based on shad study results, once upstream passage for shad is operational (expected in year 16 of a new license).

- Conduct 2 years of downstream passage monitoring for shad.

- Implement additional protective measures or alternative actions (e.g., additional spill or intake screening) sufficient to attain performance standards for out-migrating shad.

- Open the existing upstream fishway prior to May 1, if adult Atlantic salmon are caught in the Milford fishway prior to May 1.

- Begin effectiveness monitoring studies at the start of the first migratory season after each fishway facility is operational.[24]

- Maintain and monitor the existing fish trap at the exit of the existing upstream fishway for counting adult Atlantic salmon.

- Conduct up to 3 years of monitoring to evaluate the effectiveness of existing passage operations and additional measures in passing Atlantic salmon smolts downstream.

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[24] This was included as one of five provisions in NMFS's fishway prescription that would require GLHA to follow its general provisions for studying the effectiveness of all fishways.

- Implement adaptive management that would include additional operational, structural, and/or habitat enhancement measures, if necessary, to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon.

Section 10(j) Measures Not Recommended[25]

The staff alternative does not include the following section 10(j) recommendations:

- NMFS's recommendations regarding: (1) developing a flow monitoring plan; (2) conducting continuous stream temperature monitoring to assure that operations do not intensify the effects of climate change; and (3) developing a mitigation plan for the loss of Atlantic salmon smolts caused by the project impoundment.

- Maine DMR's recommendations regarding: (1) fishway "shakedown" periods; (2) as-built fishway drawings; (3) copies of fish operating procedures; (4) meeting annually to review passage operations data; (5) counting fish passed in fishways and reporting those numbers; (6) drafting an annual fishway operations plan for all fishways; (7) an upstream shad fishway; (8) modifications to fishway operating schedules; (9) implementation of future operational or structural modifications to meet performance standards for fish passage; (10) nighttime turbine shutdowns for downstream eel passage; and (11) conducting 3 years of studies to assess the source of impoundment mortality for Atlantic salmon smolts.

Section 10(a) Measures Not Recommended

The Staff Alternative does not include the following section 10(a) recommendations:

- NMFS's recommendation to conduct real-time monitoring of the downstream bypass fishway.

- Penobscot Indian Nation's recommendation to develop a plan to monitor water temperature in the impoundment for multiple years.

- Bruce Haines' recommendations to: (1) install upstream and downstream passage for shad as soon as possible; (2) redesign the downstream bypass to

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[25] See section 5.3, *Summary of Section 10(j) Recommendations* for additional details on the recommendations.

provide 5 percent attraction flow; and (3) operate the downstream bypass 365 days per year.

- Interior's recommendation for developing a portage plan, in consultation with the Penobscot Indian Nation, for canoe portage around the project.

2.5 STAFF ALTERNATIVE WITH MANDATORY CONDITIONS

We recognize that the Commission is required to include all section 18 fishway prescriptions in any license issued for the project. Therefore, the staff alternative with mandatory conditions includes all the measures included in the staff alternative with the addition of the section 18 fishway prescriptions not included in the staff alternative, as discussed above in section 2.4, *Staff Alternative*.

2.6 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

The following alternatives were considered but have been eliminated from further analysis because they are not reasonable in the circumstances of this case: (1) issuing a non-power license, (2) Federal Government takeover of the project, and (3) retiring the project.

2.6.1 Issuing a Non-Power License

A non-power license is a temporary license that the Commission would terminate when it determines that another governmental agency will assume regulatory authority and supervision over the lands and facilities covered by the non-power license. At this point, no agency has suggested a willingness or ability to do so. No party has sought a non-power license for the project and we have no basis for concluding that the project should no longer be used to produce power.

2.6.2 Federal Government Takeover of the Project

Federal takeover and operation of the project would require Congressional approval. While that fact alone would not preclude further consideration of this alternative, there is currently no evidence to indicate that federal takeover should be recommended to Congress. No party has suggested federal takeover would be appropriate, and no federal agency has expressed an interest in operating the project.

2.6.3 Retiring the Project

As the Commission has previously held, decommissioning is not a reasonable alternative to relicensing a project in most cases, when appropriate protection, mitigation, and enhancement measures are available.[26] The Commission does not speculate about possible decommissioning measures at the time of relicensing, but rather waits until an applicant actually proposes to decommission a project, or there are serious resource concerns that cannot be addressed with appropriate measures, making decommissioning a reasonable alternative.[27] This is consistent with NEPA and the Commission's obligation under section 10(a) of the FPA to issue licenses that balance developmental and environmental interests.

Project retirement could be accomplished with or without dam removal.[28] Either alternative would involve denial of the relicense application and surrender or termination of the existing license with appropriate conditions.

No participant has recommended project retirement, and we have no basis for recommending it. The Mattaceunk Project is a source of clean, renewable energy. This source of power would be lost if the project were retired, and replacement power would need to be found. There also could be significant costs associated with retiring the project's powerhouse and appurtenant facilities.

Project retirement without dam removal would involve retaining the dam and disabling or removing equipment used to generate power. Certain project works could remain in place and could be used for historic or other purposes. This approach would require the State of Maine to assume regulatory control and supervision of the remaining facilities. However, no participant has advocated this alternative, nor do we have any

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[26] *See, e.g.*, *Eagle Crest Energy Co.*, 153 FERC ¶ 61,058, at P 67 (2015); *Public Utility District No. 1 of Pend Oreille County*, 112 FERC ¶ 61,055, at P 82 (2005); *Midwest Hydro, Inc.*, 111 FERC ¶ 61,327, at PP 35-38 (2005).

[27] *See generally Project Decommissioning at Relicensing; Policy Statement*, FERC Stats. & Regs., Regulations Preambles (1991-1996), ¶ 31,011 (1994); *see also City of Tacoma, Washington*, 110 FERC ¶ 61,140 (2005) (finding that unless and until the Commission has a specific decommissioning proposal, any further environmental analysis of the effects of project decommissioning would be both premature and speculative).

[28] In the unlikely event that the Commission denies relicensing a project or a licensee decides to surrender an existing project, the Commission must approve a surrender "upon such conditions with respect to the disposition of such works as may be determined by the Commission." 18 C.F.R. § 6.2 (2017). This can include simply shutting down the power operations, removing all or parts of the project (including the dam), or restoring the site to its pre-project condition.

basis for recommending it. Removing the dam would be more costly than retiring it in place, and removal could have substantial, negative environmental effects.

3.0 ENVIRONMENTAL ANALYSIS

This section includes: (1) a general description of the project vicinity, (2) an explanation of the scope of cumulative effects analysis, and (3) our analysis of the proposed action and recommended environmental measures. Sections are organized by resource area (aquatic, recreation, etc.). Historic and current conditions are described under each resource area. The existing conditions are the baseline against which the environmental effects of the proposed action and alternatives are compared, including an assessment of the effects of the proposed protection, mitigation, and enhancement measures, and any cumulative effects of the proposed action and alternatives. Staff conclusions and recommended measures are discussed in section 5.1, *Comprehensive Development and Recommended Alternative*.[29]

3.1 GENERAL DESCRIPTION OF THE PENOBSCOT RIVER BASIN

The Mattaceunk Project is located on the main stem of the Penobscot River. The Penobscot River Basin, which is the largest basin in Maine and the second largest in New England, is 125 miles long and 115 miles wide with a total drainage area of 8,525 square miles. The Penobscot River is formed by two major tributaries, the West Branch Penobscot River (West Branch) and the East Branch Penobscot River (East Branch), that join to form the main stem of the Penobscot River near the town of Medway. The Mattaceunk Project is located about 7 miles downstream of the confluence of the East and West Branches, and this entire stretch of river is impounded by the Weldon Dam. The project impoundment also extends about 800 feet up the West Branch and about 2 miles up the East Branch, including a portion of an East Branch tributary named Salmon Stream. From Weldon Dam, the river then flows southeasterly for about 240 miles to the Atlantic Ocean in Penobscot Bay near Bucksport, about 20 miles south of Bangor, Maine.

Topography in the Penobscot Basin is relatively uniform, with hills and low mountains near the headwaters, and undulating plains, with lakes, ponds, and swamps closer to the coast. The climate has four distinct seasons. The summers are moderately cool, but winters are severe, with an average annual precipitation of approximately 41 inches, uniformly distributed throughout the year. Temperatures range from summer highs in the 90's to winter lows in the -30's on the Fahrenheit scale with snowfall contributing to the water equivalent of six to eight inches per year (Maine Department of

[29] Unless otherwise indicated, our information is taken from the application for license filed by GLHA on August 31, 2016, and responses to requests for additional information filed on January 25, 2017, and March 16, 2017.

Conservation [Maine DOC], 2007). The majority of land in the project vicinity is heavily forested, primarily privately-owned timberland, and is mostly undeveloped.

3.2 SCOPE OF CUMULATIVE EFFECTS ANALYSIS

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (40 C.F.R. § 1508.7), a cumulative effect is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time, including hydropower and other land and water development activities.

Based on our review of the license application and agency and public comments, we have identified water quality, downstream aquatic habitat, and diadromous fish (i.e., Atlantic salmon, eel, alewife, American shad, and blueback herring) as resources that could be cumulatively affected by continued operation of the project.

3.2.1 Geographic Scope

The geographic scope of the cumulative analysis defines the physical limits or boundaries of the proposed action's effects on the resource, and contributing effects from other hydropower and non-hydropower activities within the Penobscot River Basin.

We have identified the Penobscot River Basin as our geographic scope of analysis for water quality, downstream aquatic habitat, and diadromous fishery resources. We chose this geographic scope because the operation and maintenance of the Mattaceunk Project, in combination with other hydroelectric projects in the Penobscot Basin may affect habitat quality and access for diadromous fish species from upstream of the Mattaceunk Project down to the mouth of the Penobscot River. The Mattaceunk Project is one of 128 dams in the Penobscot River Basin, consisting of 19 federally-licensed hydropower projects (25 dams) and 102 non-hydropower dams.[30] There are six existing FERC-licensed hydroelectric projects on the West Branch and mainstem of the Penobscot River (see figure 1; no federally-licensed projects are located on the East Branch). On the West Branch in descending order are the Ripogenus Hydroelectric Project (FERC

[30] The *Strategic Plan for the Restoration of Diadromous Fishes to the Penobscot River* indicates that there are 20 federally licensed hydropower projects (27 dams) and 102 non-hydropower dams in the Penobscot River watershed. The number of federally licensed dams in the strategic plan includes Great Works Dam and Veazie Dam, which were removed in 2012 and 2013, respectively. Thus, there are now 25 federally licensed dams in the Penobscot River watershed.

Project No. 2572), Penobscot Mills Hydroelectric Project (FERC Project No. 2458), and Medway Hydroelectric Project (FERC Project No. 3440). The Mattaceunk Project is one of three hydroelectric projects on the mainstem of the Penobscot River, with the West Enfield Hydroelectric Project (FERC Project No. 2600) and the Milford Hydroelectric Project (FERC Project No. 2534) located about 29 miles and 54 miles downstream of the Mattaceunk Project, respectively. Operation of these dams may cumulatively affect diadromous fish species due to migratory barriers and loss of spawning habitat. Other contributors to cumulative effects on water quality, downstream aquatic habitat, and diadromous fishery resources in the basin include introductions of non-native fish species, high intensity land development, logging, and industrial phosphorus discharge (paper mills and municipal treatment facilities).

In section 3.3.2.2, *Aquatic Resources*, we discuss the cumulative effects of licensing the project on water quality and fishery resources, and in section 3.3.4.2, *Environmental Effects, Atlantic Salmon* we discuss the cumulative effects of licensing the project on Atlantic salmon.

3.2.2 Temporal Scope

The temporal scope of analysis includes a discussion of the past, present, and reasonably foreseeable future actions and their effects on fishery resources. Based on the potential new license term, the temporal scope looks 30 to 50 years into the future, concentrating on the effects on the resources from reasonably foreseeable future actions. The historical discussion is limited, by necessity, to the amount of available information for each resource. We identified the present resource conditions based on the license application, agency comments, and comprehensive plans.

3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

In this section, we discuss the project-specific effects of the project alternatives on environmental resources. For each resource, we first describe the affected environment, which is the existing condition and baseline against which we measure project effects. We then discuss and analyze the specific cumulative and site-specific environmental issues.

Only the resources that would be affected, or about which comments have been received, are addressed in detail in this draft EA. Based on this, we have determined that geology and soils, aquatic resources, terrestrial resources, threatened and endangered species, land use, recreational access and facilities, and cultural resources may be affected by the proposed action and alternatives. We have not identified any substantive issues related to aesthetic resources or socioeconomics associated with the proposed action; and therefore, these resources are not addressed in the draft EA. We present our recommendations in section 5.1, *Comprehensive Development and Recommended Alternative*.

3.3.1 Geology and Soil Resources

3.3.1.1 Affected Environment

Geology

The Mattaceunk Project is situated within the New England Upland Physiographic Region. The majority of this region is characterized by gentle slopes and flat plains, but steep, mountainous terrain also occurs. Topography of the area surrounding the project is primarily low, rolling hills and valleys. The region is bounded to the north and south by the Allagash and Kennebec River basins, respectively.

The region is principally underlain by resistant metasedimentary rock, including shale, slate, and schist, with some igneous intrusions. Bedrock within the project vicinity is delineated by the Lawler Ridge Formation, part of the greater Madrid Formation, consisting of medium-to-thick bedded greywacke, a calcareous sandstone, dissected by planes of gray to black slate (Roy, 1981). Quartz, disseminated pyrite, and carbonate cement are also prevalent in the greywacke formation. The bedding is steeply inclined, dipping between 80 degrees and the vertical, and striking parallel to the dam.

The project stretches across two biophysical regions, the Western Foothills and the Eastern Interior (Maine DIFW, 2005). The majority of the Western Foothills region is characterized by hilly terrain underlain by moderate-to-strongly metamorphosed pelite,[31] limestone, and dolostone.[32] Small bodies of granitic rock are also present in the southwest of the region. Average elevations in this region range from 600 feet to 1,000 feet.

The Eastern Interior biophysical region consists of gently rolling terrain underlain by pelite, calcareous sandstone, and sulfidic quartz sandstone (Maine DIFW, 2005). Small formations of gabbro[33] and granodiorite[34] are also present along the eastern

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[31] A fine-grained sedimentary rock consisting of clay or mud particles.

[32] A sedimentary carbonate rock composed of the mineral dolomite.

[33] A dark, coarse-grained intrusive igneous rock composed mainly of the mineral plagioclase.

[34] A coarse-grained intrusive igneous rock composed mainly of quartz and plagioclase feldspar.

boundary of the region. Elevations in the Eastern Interior range from 200 feet to 400 feet.

The surrounding area was exposed to significant glacial modification. Surficial geologic materials adjacent to the project consist of glacial till and glacial stream deposits of permeable sands and gravel. The glacial till is primarily a stiff, bouldery, clayey soil with sporadic lenses of sand and gravel (Osberg *et al*., 1985). Glaciomarine deposits and pockets of esker[35] surround the project impoundment. These deposits, in addition to stream alluvium, are also present along the length of the transmission line.

Soils

The primary soils found within the project boundary are the Monarda, Burnham, Howland, Plaisted, and Thorndike series. The most significant variance in soil type occurs between the transmission line right of way (ROW) and the project impoundment.

Soils along the transmission line ROW consist of Thorndike very stony silt loam (29 percent), Plaisted very stony loam (22 percent), Howland very stony loam (21 percent), and Monarda and Burnham very stony silt loams (21 percent) (GLHA, 2016a). Thorndike soils, formed in loamy till,[36] are shallow and excessively drained. Plaisted soils, derived from dense glacial till on drumlins[37] and ridges, are very deep and well drained. Similarly, Howland soils form on drumlins and till ridges, and are a very deep, fairly well-drained series. The slope of soil ranges from 0 to 45 percent in the Thorndike and Plaisted series, and from 0 to 25 percent in the Howland series.

Monarda very stony silt loam is a poorly drained soil developed in dense glacial till on till plains. Burnham soils, formed in dense glacial till on glaciated uplands, are very deep and very poorly drained. The slope of the Monarda series ranges from 0 to 15 percent, and from 0 to 3 percent in the Burnham series.

Soils surrounding the project impoundment, impoundment shoreline, and stream banks include Plaisted very stony loam (14 percent), Limerick silt loam (5 percent), Monarda very stony silt loam and Burnham very stony silt loam (4 percent) (figures 3

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[35] A winding ridge of gravel and sand deposited by glacial drift.

[36] Till refers to unsorted glacial sediment produced by erosion and entrainment of substrate by the movement of ice.

[37] A landform consisting of glacial till, sand, and gravel, typically in the shape of an elongated hill, formed by the movement of glacial ice across underlying rock and substrate.

and 4; GLHA). Limerick soils are deep and poorly drained, and form in loamy alluvium on flood plains.

Sediment

Geophysical and sediment sampling surveys of the Penobscot River were conducted in 1999 by the USGS in collaboration with the BIA and Penobscot Indian Nation Department of Natural Resources (USGS, 2001). As reported in the study, the surveys indicate that substrate within the main river channel consists primarily of gravel, sand, and rock. This is consistent with a more recent mussel survey conducted in the Mattaceunk impoundment in 2012, which indicated that substrate consists primarily of silt, followed by sand, gravel, and small cobble in the lower half of the Mattaceunk impoundment. The 1999 survey also identified fine-grained sediment deposits in thin bands along both island and mainland shorelines, at the mouth of streams and brooks, and at the downstream ends of islands. The most extensive deposition of fine-grained, readily-transportable sediment types was found in the Mattaceunk impoundment.

Ground-penetrating radar and sediment grab samples were used to identify sediments in the main river channel and the project impoundment (figure 3). The impoundment contained the largest deposit of fine-grained sediment, consisting of sand, silt, and clay, within the 50-mile river reach sampled as part of the study. The depth and composition of deposits in the impoundment also differed from any other site surveyed along the river. The thickness of sediment deposits ranged upwards of 15 feet in some areas, and samples from the bottom of those deposits yielded fines homogenously mixed with wooden fibers. Moreover, streambed samples taken near the dam yielded gray and brown, gelatinous material emitting an unusual odor. The cause or source of that material was not identified by the study.

The study attributes the depth of the deposits in the Mattaceunk impoundment to the size and location of the dam, and the relatively large, deep impoundment that has formed as a result. The predominantly low velocities in the project impoundment, as compared to the main reaches of the river, allow transported sediment to settle out of the water column and accumulate along the streambed. The impoundment has in the past, and may continue to, receive high loads of suspended sediment and wooden fibers from historical uses of the river for industry and wood product manufacturing upstream of the dam.

A preliminary contaminant screening of the Penobscot River was conducted in 2015 by the EPA in collaboration with the Penobscot Indian Nation, USGS, FWS, and the Agency for Toxic Substances and Disease Registry (ATSDR), and referenced in the Penobscot Indian Nation's comments and recommendations[38] on the final license

[38] *See* letter filed by the Penobscot Indian Nation on May 23, 2017.

application (EPA, 2015). The objective of the research study was to evaluate the health of the riverine system and assess tribal exposure to potentially contaminated sediments as a consequence of cultural and sustenance practices surrounding the river.

Sediment and biota samples were collected from six reaches along an 87 mile stretch of the river between Old Town and Medway (figure 3). The study reaches were chosen based on the aforementioned sediment mapping conducted by USGS in their 1999 study, the presence of riverine features with the potential to impact sediment transport, such as dams and impoundments, and known or suspected depositional zones of fine-grained materials. The samples were analyzed for the presence of polychlorinated biphenyl[39] (PCB) congeners,[40] total PCBs, dioxins and furans,[41] total organic carbon (TOC), methyl mercury,[42] and total mercury.

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[39] PCBs are toxic organic compounds composed of chlorinated hydrocarbons that are produced intentionally, or as by-products of industrial processes.

[40] Congeners are unique, individual PCB compounds that specify the total number and position of each chlorine atom in the compound.

[41] Dioxins and furans are common names for a group of toxic organic compounds with shared chemical characteristics, including polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, and polychlorinated biphenyls.

[42] Methyl mercury is a toxic organic compound formed by the dilution of inorganic mercury in freshwater and saltwater.

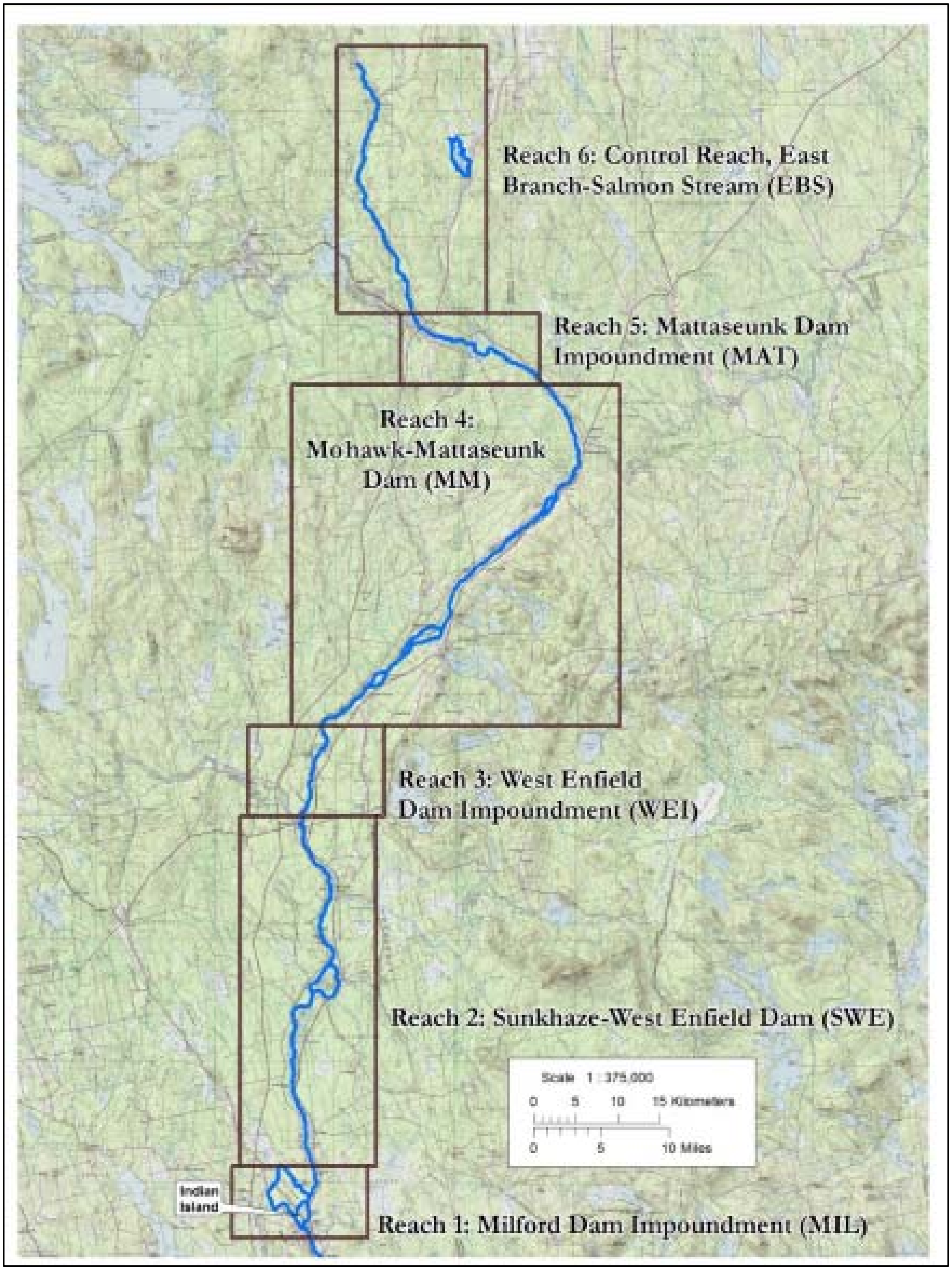

Figure 3. Penobscot River study reaches 1 through 6.
(Source: EPA RARE Report, 2015).

Analysis of sediment samples from reach 5, in the Mattaceunk impoundment, indicated the presence of several target contaminants, including dioxins and furans, PCBs, and mercury (table 1). Impoundment sediments contained the largest single and average concentrations of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans,[43] and co-planar PCBs than any of the other 5 reaches. These contaminants were present in quantities more than 200-times and 15-times greater, respectively, than the quantities identified in sediment samples from reach 6 (table 2), the East Branch of the Penobscot River and Salmon Stream Lake. Both the East Branch and Salmon Stream Lake are upstream of any known pollution sources and thus constituted the study's control reach.

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[43] These are both chemically related toxic organic compounds, more broadly classified as dioxins and furans, which occur as by-products of various industrial processes.

Table 1. Contaminant concentrations in sediment and biota in Reach 5 (*see* figure 3), Mattaceunk Project impoundment.

Contaminant concentrations in sediment and biota in Reach 5, Mattaseunk Dam Impoundment (MAT)							
SAMPLES (A,B,C,D)		Dioxins/Furans (17 Congeners) Concentration TEQ pg/g	WHO-PCBs (12 Congeners) Concentration TEQ pg/g	Total TEQ (29 Congeners) Concentration TEQ pg/g	Total PCBs (142 Congeners) Concentration ng/g	Methyl Mercury Concentration ng/g	Mercury Concentration µg/g
Sediment (SED)	A[Imp]	19.9[a]	0.407[a]	20.3[a]	76.7[a]	1.15[a]	0.24[a]
	B	54.8[a]	0.952[a]	55.8[a]	168[a]	5.28[a]	0.56[a]
	C	94.9[a]	1.23[a]	96.1[a]		3.65[a]	0.64[a]
	D	93.8[a]	4.41[a]	98.2[a]		8.98[a]	3.48[a]
Average		65.9[a]	1.75[a]	67.8[a]	122[a]	4.77[a]	1.23[a]
Chain Pickerel (CP)	A	0.0579[b]	0.0677[b]	0.126[b]			0.588[b]
Yellow Perch (YP)							
White Perch (WP)	A A[d]	0.495[b] 0.531[b,d]	0.311[b] 0.281[b,d]	0.806[b] 0.812[b,d]			0.627[b] 0.545[b,d]
Smallmouth Bass (SMB)	A	0.0740[b]	0.109[b]	0.183[b,c]	1.10[b]		0.961[b]
Brown Bullhead (BBH)	A	0.534[b]	0.193[b]	0.727[b]			0.416[b]
American Eel (EEL)	A	4.02[b]	1.43[b]	5.45[b]			0.739[b]
Wood duck (WODU)							
Fiddlehead Ostrich Fern (OSF)							
Medicinal Plant (MP)	A	0.0240[b]	ND[b,e]	0.0240[b]		ND[b]	0.00853[b]
Snapping Turtle (SNTU)	A	2.26[b]	0.536[b]	2.80[b]		938[b]	1.046[b]

(Source: EPA RARE Report, 2015).

Table 2. Contaminant concentrations in sediment and biota in Reach 6 (*see* figure 3), Control Reach – East Branch and Salmon Stream Lake.

Contaminant concentrations in sediment and biota in Reach 6, Control Reach- East Branch- Salmon Stream Lake (EBS)

SAMPLES (A,B,C)		Dioxins/Furans (17 Congeners) Concentration TEQ pg/g	WHO-PCBs (12 Congeners) Concentration TEQ pg/g	Total TEQ (29 Congeners) Concentration TEQ pg/g	Total PCBs (142 Congeners) Concentration ng/g	Methyl Mercury Concentration ng/g	Mercury Concentration µg/g
Sediment (SED)	A	0.651[a]	0.126[a]	0.777[a]	25.2[a]	1.65[a]	0.058[a]
	B	0.0760[a]	0.0650[a]	0.141[a]		0.197[a]	0.026[a]
	C	0.148[a]	0.0784[a]	0.226[a]		ND[a,f]	0.084[a]
Average		0.292[a]	0.0898[a]	0.381 [a]	25.2[a]	0.924[a]	0.056[a]
Chain Pickerel (CP)	A	0.0161[b]	0.0395[b]	0.0556[b]			0.544[b]
Yellow Perch (YP)	A	0.00370[b]	0.0117[b]	0.0154[b]			0.284[b]
White Perch (WP)	A	0.146[b]	0.173[b]	0.319[b]			0.477[b]
Smallmouth Bass (SMB)	A	0.0428[b]	0.168[b]	0.211 [b]	0.899[b]		0.809[b]
Brown Bullhead (BBH)	A	0.107[b]	0.102[b]	0.209[b]			0.135[b]
American Eel (EEL)	A A [d]	0.178[b]	0.283[b]	0.461[b]			0.209[b] 0.214[b,d]
Wood duck (WODU)							
Fiddlehead Ostrich Fern (OSF)	A	ND[b,e]	ND [b,e]	ND[b,e]	0.170[b]	0.8[a]	ND[a,e]
Medicinal Plant (MP)	A A [d]	ND[b,e] ND[b,d,e]	0.0360[b] ND[b,d,e]	0.0360[b] ND[b,d,e]		ND[b] ND[b]	0.00289[b] 0.00292[b,d]
Snapping Turtle (SNTU)	A [f] B [g]	0.0213[b,f] 0.0198[b,g]	0.0876[b,f] 0.124[b,g]	0.109[b,f] 0.144[b,g]	0.170[b]	277[b] 166[b]	0.215[b,f] 0.228[b,g]

(Source: EPA RARE Report, 2015).

Erosion

On June 10, 2010, HDR Engineering, Inc., conducted independent field inspections of the project site and structures, including the upstream and downstream impoundment shorelines. No significant erosion issues were observed. Based on HDR's findings, which are included in the 2010 Ninth Independent Consultant's Safety Inspection Report,[44] GLHA concludes that erosion does not appear to be a significant issue on the project impoundment and downstream river reach.

3.3.1.2 Environmental Effects

Operational Effects on Geology and Soils

Sediment Resuspension

Our Analysis

Findings from the USGS and EPA studies indicate that the Mattaceunk impoundment contains large quantities of fine-grained silt, sand, and clay deposits, as well as chemically contaminated sediments. The primary concern associated with the presence of impacted sediment behind the dam is the potential for resuspension and downstream mobilization of contaminants as a result of project operations.

The identified contaminants, dioxins and furans, PCBs, and mercury, are considered bioaccumulative toxins that have the potential to pose a significant ecological risk to aquatic species. These contaminants are relatively insoluble and can remain in various environmental media for long periods of time. The pollutants have a tendency to bind with fine-grained sediment and progressively bioaccumulate within biota.

The applicant does not propose any new construction, major modification to project structures, or changes to existing operations. Under normal operating conditions, impoundment drawdowns are limited to within 2.0 feet, at most, of the normal pond elevation of 240.0 feet. Temporary drawdowns due to flashboard failures, could require drawdowns to 235.0 feet, or 5.0 feet below normal pond elevation, but are typically limited to a period of less than three days. Further, based on recorded data of impoundment elevations from 2008 to 2015, these types of drawdowns occur on average, less than once per year (GLHA, 2016). Thus, the drawdowns required for flashboard repair are infrequent and short in duration, and unlikely to cause any substantial resuspension of sediments. Larger drawdowns of 20 to 25.0 feet for maintenance and repair activities are relatively infrequent and occur, on average, once every 15 to

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[44] See the 2010 Ninth Independent Consultant's Safety Inspection Report filed by GLHA on December 7, 2010.

20 years. During these events, GLHA conducts resource agency consultation beyond what is required under FERC license protocol.

Existing and historic sources of contaminants entering the impoundment are fairly well documented. Numerous point sources of pollution exist within the Penobscot River Basin, including five major discharging facilities currently regulated by the National Pollutant Discharge Elimination System (NPDES). The primary industrial uses of the river include paper manufacturing, saw mills, lumber preservation, and wood product manufacturing. Other uses include textile, leather, and allied product manufacturing. According to the EPA study, known discharges into the river from both public and private facilities include chlorinated organics, dioxin, and mercury.

Given that the source of contaminants entering the river basin is not project-related, and because GLHA is not proposing any activities that would disturb impounded sediment, staff does not anticipate that continued operation of the project would substantially contribute to the resuspension or mobilization of impacted sediment. At present, Weldon Dam acts as a barrier sequestering and preventing further downstream transport of existing contaminants. While limited quantities of fine-grained or contaminated sediments may be carried with flow during normal project operation, the resulting risks, primarily short-term increases in turbidity or sedimentation downstream, would be temporary. At present, the project does not appear to have a significant effect on the resuspension or release of contaminated sediments.

Erosion

Our Analysis

GLHA proposes to continue to operate the project in run-of-river mode with pondage, with minimal fluctuation in impoundment surface elevation for the installation and operation of the project flashboards. Interior,[45] NMFS, and Maine DMR all provide recommendations that are consistent with GLHA's proposed limits on impoundment surface elevations.

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[45] Interior provided a 10(j) recommendation that was consistent with GLHA's proposal, except that rather than maintaining impoundment surface elevations within 1.0 foot of normal pond elevation (240.0 feet) on a regular basis, Interior recommended that GLHA maintain impoundment water levels at or near normal pond elevation (240.0 feet) during normal operations. Because Interior's recommendation is not specific, and because operating within 1.0 foot of normal pond elevation is near normal pond elevation, we interpret Interior's recommendation to be consistent with GLHA's proposal.

Fluctuations of impoundment surface elevations associated with hydroelectric project operations can cause or exacerbate soil and shoreline erosion. Historically, impoundment drawdowns at the project have been infrequent and limited to within 2.0 feet of the normal pond elevation of 240.0 feet under normal operating conditions, and within 5.0 feet of the normal pond elevation during flashboard failure. Temporary drawdowns associated with flashboard repairs have typically been limited to a period of less than three days and have occurred, on average, less than once per year (GLHA, 2016). As a result, the project has operated in a manner that maintains relatively stable flows and minimizes fluctuations in surface water levels, in turn minimizing the potential for bank erosion, as evidenced by the conclusions presented in HDR Engineering Inc.'s Safety Inspection Report. Continuing to operate the project in run-of-river mode with pondage would continue to limit fluctuations in impoundment water levels, and, therefore, result in no measurable shoreline erosion.

Given the existing site and sediment characteristics, and because GLHA is not proposing any new construction or changes in project operations, staff does not anticipate that continued operation of the project will significantly affect geology and soil resources. While limited and natural amounts of erosion may occur within the project boundary, the project has a limited effect, if any, on mass soil movement or erosion, and these events are not exacerbated by project operations.

3.3.2 Aquatic Resources

3.3.2.1 Affected Environment

Water Quantity

The Mattaceunk Project receives water from both the West Branch and East Branch and has a total drainage area of about 3,310 square miles. The majority of inflow to the Mattaceunk Project impoundment is from the West Branch, which is partially regulated by the Ripogenus Project[46] and the Penobscot Mills Project.[47] The Penobscot Mills Project's storage impoundment regulates the river flows on a seasonal basis to

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[46] *Great Northern Paper Co.*, 77 FERC 61,316 (1996) (order issuing new license). The Ripogenus Hydroelectric Project is located about 39.5 miles upstream from the project.

[47] *Great Northern Paper Co.*, 77 FERC ¶ 61,068 (1996) (order issuing new license). The Penobscot Mills Hydroelectric Project is located about 8.5 miles upstream from the project and consists of five developments; one storage (Millinocket Lake) and four generation facilities (North Twin, Millinocket, Dolby, and East Millinocket Developments).

provide flows downstream to the Mattaceunk. Additional flow in the project area comes from the East Branch, which is unregulated, and has no hydroelectric developments.

Table 3 shows the monthly flow data for the Penobscot River at the Mattaceunk Project. The mean annual flow is approximately 6,204 cfs,[48] with monthly flows generally highest from April through June and lowest in August. Flows exceed 7,438 cfs (i.e., the maximum hydraulic capacity of the project) less than 20 percent of the time and exceed 1,674 cfs (i.e., the minimum flow required by the current license) about 99.9 percent of the time.

Table 3. Mean, minimum, and maximum monthly discharge in cfs for the Penobscot River (1996-2015[a]).

Month	Average Flow	Minimum Flow	90% Exceedance	10% Exceedance	Maximum Flow
January	5,437	1,163	2,821	8,338	24,645
February	5,216	1,287	3,003	8,002	22,111
March	5,800	1,231	2,908	9,148	25,699
April	9,715	1,740	3,687	17,911	59,738
May	9,280	1,673	3,428	17,964	69,936
June	6,269	2,189	3,204	10,243	27,541
July	5,071	1,899	2,851	8,760	41,321
August	4,427	1,891	2,873	6,636	27,796
September	5,106	2,232	3,431	6,890	31,691
October	6,152	1,726	2,987	9,808	45,108
November	5,738	1,266	2,773	10,188	33,421
December	6,215	1,087	2,824	9,541	46,240
Annual	6,204	1,087	2,999	10,529	69,936

(Source: GLHA, 2016a).

[a] The Ripogenus and Penobscot Mills projects located upstream from the Mattaceunk Project were relicensed in 1996, resulting in water management modifications. This period of record reflects the current flow management on the Penobscot River and at the Mattaceunk Project.

[48] Average annual flow using data collected from 1996 to 2015 based on combined, prorated, and adjusted data from four USGS gages (i.e., gage number 01028000 at West Branch of the Penobscot River near Medway, gage number 01030000 Penobscot River near Mattawamkeag, gage number 01029500 the East Branch of the Penobscot River at Grindstone, and gage number 01030500 the Mattawamkeag River near Mattawamkeag).

Water Quality

The Mattaceunk Project impoundment is largely contained within the main stem of the Penobscot River, but extends 2 miles into the East Branch and several hundred feet into the West Branch. The portion of the impoundment located in the mainstem of the Penobscot River is classified as Class C waters.[49] Class C waters' designated uses include drinking water supply after treatment, fishing, agriculture, recreation in and on the water, industrial process and cooling water supply, hydroelectric power generation, navigation, and as a habitat for fish and other aquatic life. The portion of the impoundment located in the East Branch is classified as Class AA waters.[50] Class AA waters have the designated uses of drinking water after disinfection, fishing, agriculture, recreation in and on the water, navigation, and as habitat for fish and other aquatic life. Habitat in Class AA waters is characterized as free-flowing and natural. Currently, Maine has no standards for temperature, although dissolved oxygen percent saturation is dependent on temperature. Table 4 summarizes the stream classifications and associated water quality criteria in the vicinity of the project.

Table 4. Summary of stream classifications and water quality criteria.

Stream Classification	Class C	Class AA
Dissolved Oxygen (DO)	May not be less than 5 milligrams per liter (mg/L) or 60 percent of saturation, whichever is higher.	As naturally occurs.
Aquatic life (Biological)	Discharges may cause some changes to aquatic life, provided that the receiving waters shall 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.	Habitat shall be characterized as natural and free flowing. Aquatic life shall be as naturally occurs.

[49] Class C waters include the reach from the confluence of the East Branch and the West Branch to the confluence of the Mattawamkeag River, including all impoundments.

[50] Class AA waters include the East Branch from a point located 1,000 feet downstream from the dam located at the outlet of Grand Lake Mattagamon to its confluence with the West Branch.

Stream Classification	Class C	Class AA
pH (measure of water acidity)	6.0 - 8.5	6.0 - 8.5
Water column chlorophyll-a	≤ 8.0 micrograms/liter (µg/L)	≤ 3.5 µg/L (≤ 5.0 µg/L[a])
Secchi disk depth	≥ 2.0 meters	≥ 2.0 meters

[a] Applicable to low gradient Class AA waters with water velocity less than 5.0 cfs.

(Source: Me. Stat. tit. 38, § 465; Me. Stat. tit. 38, § 583 [June 12, 2012, Draft])

In 1997, 2001 and 2007, Maine DEP conducted water quality monitoring throughout the basin for DO, temperature, and nutrients (i.e., total phosphorus, chlorophyll *a*,[51] and Secchi disk transparency[52]) during the summer months at low flows (Maine DEP, 2008). Based on the monitoring results, Maine DEP categorized the Penobscot River mainstem above the Mattawamkeag River (located 4.3 miles downstream from the Mattaceunk Project) as impaired for failing to attain DO and nutrient/eutrophication levels. In 2007, Maine DEP linked excess phosphorus discharged from industrial sources within the basin to eutrophication, phytoplankton blooms, and extreme diurnal DO swings[53] leading to DO non-attainment classification[54] (Maine DEP,

[51] Chlorophyll a is a pigment in plants that is central to photosynthesis and can serve as a measure of the abundance of phytoplankton and a reflection of the biological productivity of the water body.

[52] Secchi depth is a measure of water transparency. To measure Secchi depth, an 8-inch disk with a black and white pattern is lowered into the water column until it is no longer visible from the surface and then the disk is raised until it is visible again. The depths at which the disk disappears and reappears are averaged and reported as the Secchi depth.

[53] Diurnal DO is the difference in DO concentrations measured in the early morning and late afternoon at a specific sampling location on a given day. Large diurnal DO fluctuations indicate the presence of algal activity and a productive system; marked by low early morning DO occurring after an extended period of nighttime plant respiration and high mid- to late-afternoon daily maximum DO concentrations (Maine DEP, 2008).

[54] In 2002 through 2008 and 2010 through 2014, respectively, Maine DEP categorized the Penobscot River mainstem, above Mattawamkeag River, as impaired for failing to attain adequate DO concentrations and showing signs of high nutrient levels,

2011a). In 2011, Maine DEP monitored the 13-mile stretch of the river between the upstream Dolby Pond[55] and the Mattaceunk Project's impoundment to determine the cause for listing this segment for eutrophication, phytoplankton blooms, and DO non-attainment classification in 2001, 2004, and 2007. The 2011 monitoring report linked phytoplankton blooms in the Mattaceunk impoundment to excess phosphate discharged into Dolby Pond and to conditions favorable to phytoplankton growth in the 13-mile reach flowing into the Mattaceunk Project impoundment. The excess phosphate was attributed to two industrial sources and a municipality located in this river reach.[56] Based on their findings, Maine DEP developed nutrient restrictions for point sources within this 13-mile stretch (Maine DEP, 2011b) to decrease phosphate discharge into Dolby Pond and significantly reduce the likelihood of algae blooms recurring in the Mattaceunk Project impoundment (Maine, 2011a).

Water Quality Monitoring

During the summer and early fall of 2014, GLHA conducted continuous water quality monitoring in the deepest part of the project impoundment (i.e., at a 39-foot depth, about 1,030 feet upstream from the dam). Parameters sampled included water temperature and DO.

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indicating eutrophication. In May 2014, Maine delisted this area and imposed limits on nutrient loads discharged from point sources (industrial, permitted dischargers) upstream from the project (Maine, 2014).

[55] Dolby Pond is one of five developments in the Penobscot Mills Project. This development is located on the West Branch of the Penobscot, about 13 miles upstream of the Mattaceunk Project.

[56] Between Dolby Pond and the Mattaceunk impoundment, the river flows through a series of four dams, where laminar flows and extended hydraulic residence times foster algae blooms (Maine, 2011b).

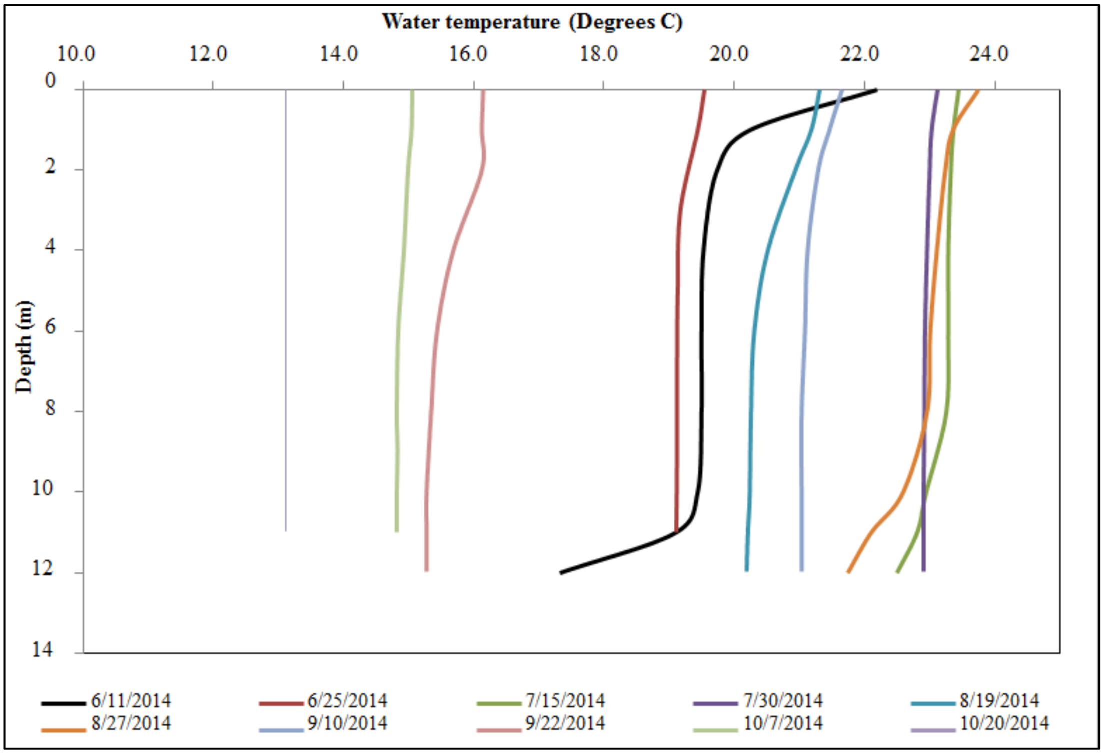

Figure 4. Temperature profiles taken mid-channel, 1,030 feet upstream from Weldon Dam from June through October 2014.
(Source: GLHA, 2016a).

Water temperatures ranged from 13.1° to 23.8° Celsius (°C) (about 56° to 75° Fahrenheit [°F]) and were uniform throughout the water column (figure 4). Temperatures were lowest in early fall (late September through October) and highest in late summer (June through early September). The greatest difference in temperature occurred on June 11, 2014, when water temperatures declined by about 2°C (about 3.6° F) between the water surface and bottom of the impoundment (a depth of 12 meters). The rapid change in the surface water temperature on that day was likely a rapid spring turn over, which can occur in lakes with a relatively small surface area, and do not experience a lasting contrast in seasonal conditions (Wetzel, 2001). Further, this temperature difference across depths did not extend into the summer, indicating that the impoundment does not stratify.[57]

[57] Stratification occurs when there is a change of one degree Celsius per one-meter depth change (Maine DEP, 1997).

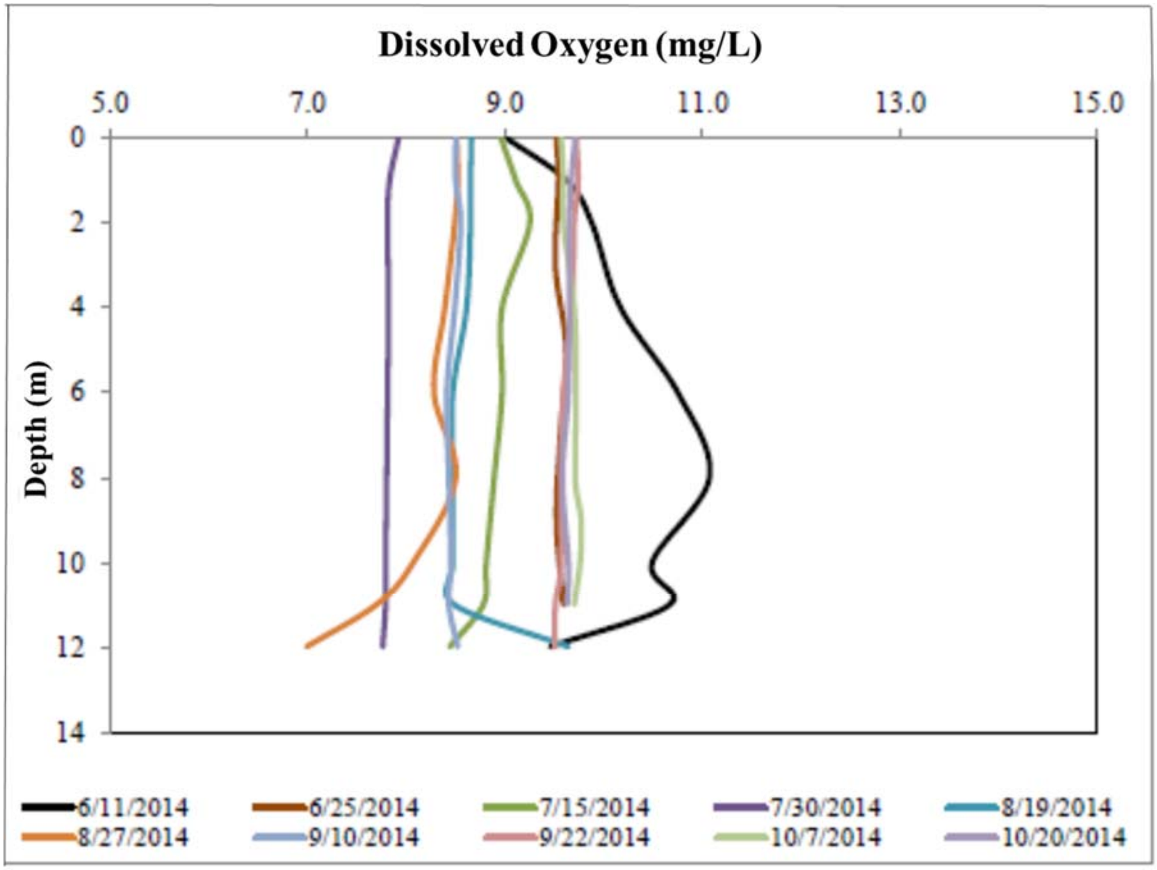

Figure 5. DO profiles taken mid-channel, 1,030 feet upstream from Weldon Dam from June through October 2014.
(Source: GLHA, 2016a).

DO levels in the impoundment exceeded 5.0 mg/L, the minimum DO level for Class C waters. Generally, DO water surface concentrations ranged from 8.0 to 9.8 mg/L and were lowest in late summer and highest in the early fall (figure 5). Concentrations were relatively stable throughout the water column, except for June 11, 2014, when DO levels were relatively erratic with a range of 9.0 to 11.1.

GLHA also sampled water in the impoundment to evaluate its trophic status (i.e., nutrient loads). The values in table 5 for total phosphorus, chlorophyll *a*, and Secchi depth indicated that the impoundment could be characterized as intermediate between oligotrophic and mesotrophic based on Maine's lake trophic status guidelines (Maine DEP, 2014).

Tailwater Macroinvertebrates

During the low-flow period of the late summer of 2014, GLHA conducted benthic macroinvertebrate sampling in the riffle/run habitat of the project tailwater about 1,198 feet downstream from the dam. The purpose was to further assess attainment of the

Maine DEP water quality classification. The macroinvertebrate community downstream from the project was found to have a high mean abundance, with an estimated 3,000 organisms per sample. The community was found to attain Class C aquatic life criteria.

Continuous Water Temperature Data

From May to September 2012, GLHA collected continuous water temperature data at the project (GLHA, 2016a). Water temperature data were collected from three locations: at the upstream end of the impoundment next to the Interstate 95 Bridge, the downstream end of the impoundment near the powerhouse, and about 1,000 feet downstream from Weldon Dam near the angler access area (see figure 20). Continuous water temperature data were similar among all sample sites, with similar warming and cooling patterns throughout the season (figure 6) (GLHA, 2016a).

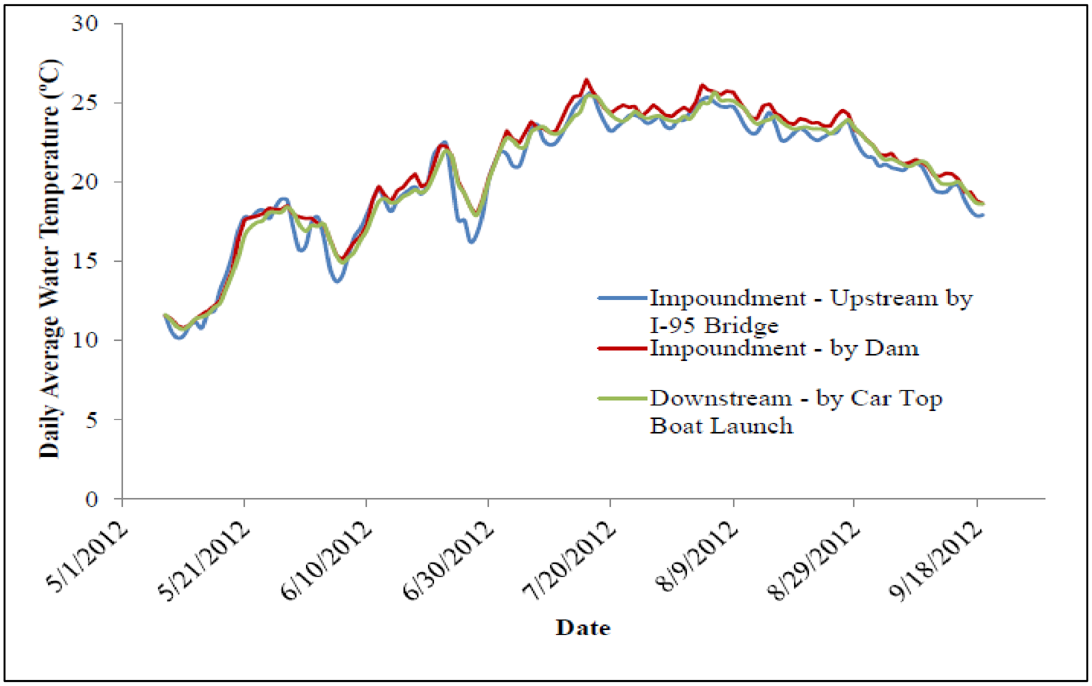

Figure 6. Daily average water temperature at the Mattaceunk Project, May to September 2012.
(Source: GLHA, 2016a).

Aquatic Habitat

Impoundment Habitat

An impoundment bathymetry map shows that the upper reach of the impoundment is narrow and relatively shallow, with depths less than 16.5 feet at full pond (figure 7). More broadly, during a mussel survey conducted by GLHA in 2012, the average depth surveyed across 12 transects was 21.4 feet (Normandeau, 2012). The middle reach of the impoundment, in the vicinity of Lawrence Island, contains large areas of shallow water habitat, while the lower reach of the impoundment was characterized by a wide, deep channel interspersed with shallow-water cove and wetland complexes. The main channel is the deepest area of the impoundment, with depths up to 39 feet measured in the lower portion of the impoundment (Normandeau, 2012).

As discussed in section 3.3.1.1, *Sediment*, the substrate consists primarily of silt, followed by sand, gravel, and small cobble in the lower half of the Mattaceunk impoundment. Wood and bedrock are infrequently observed along the shoreline (Normandeau, 2012).

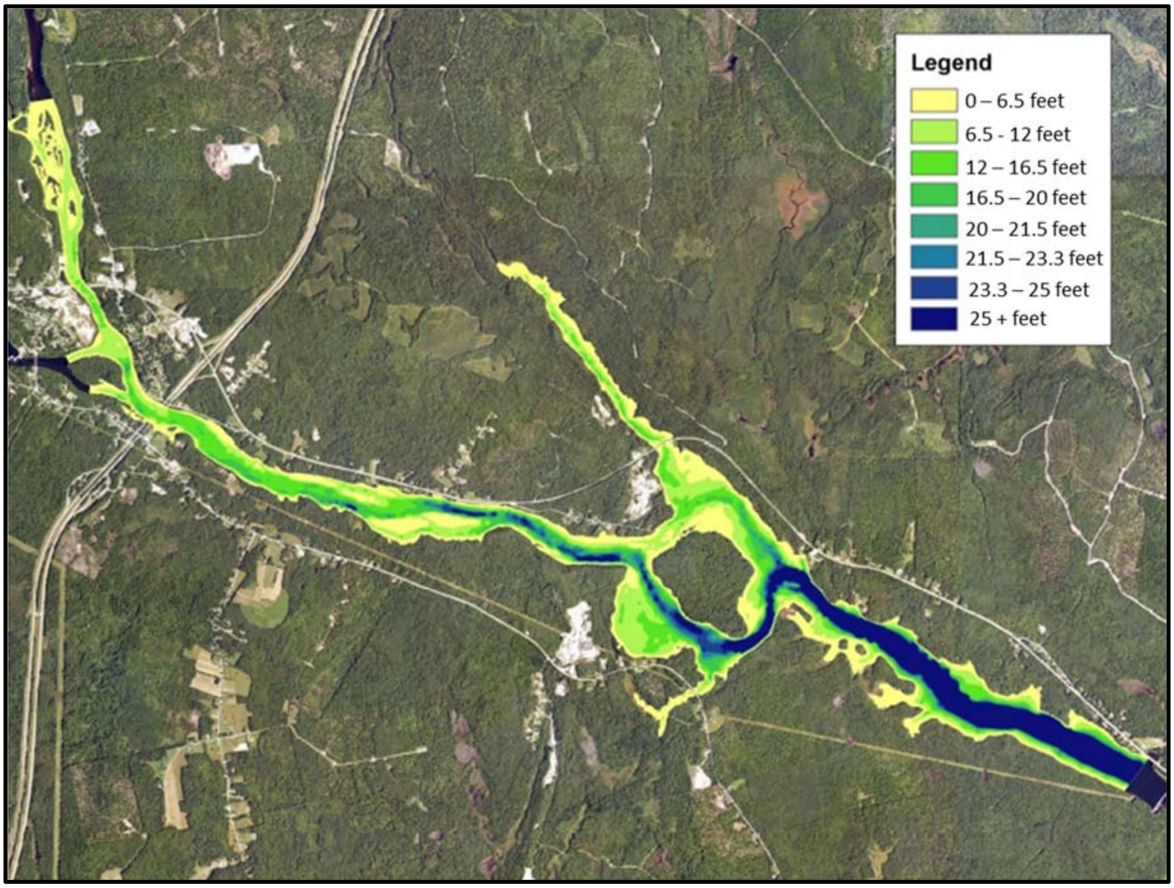

Figure 7. Mattaceunk impoundment bathymetry.
(Source: GLHA, 2016a, as modified by staff).

Along island perimeters and in shallow water there are beds of submerged aquatic vegetation (GLHA, 2015 and 2016b). The largest areas of emergent wetlands occur in protected coves in the eastern portion of the impoundment. Along forested floodplains of the project there are palustrine, forested wetlands. Shrub swamps are also common in the project vicinity. These vegetated, wetland habitat types provide suitable cover as well as forage, spawning, and rearing habitats for various fish and other aquatic species.

Downstream Habitat

GLHA conducted a study to evaluate aquatic habitat downstream of the project dam under the minimum base flow of 1,674 cfs, which is both the existing and proposed, year-round, continuous minimum flow. Actual flows during the survey ranged from 1,765 to 1,783 cfs. In addition to characterizing the types of habitat available at the minimum flow, the study addressed whether a migratory corridor, or zone of passage, would be maintained during minimum flow conditions. The survey was conducted from Weldon Dam to a location about 3,117 feet downstream of the dam.

Immediately below the dam GLHA found that there is a large, deep pool that extends about (800 feet) to a downstream area that transitions into run habitat (figure 8). The pool has a maximum depth of 24.3 feet. Substrate consists primarily of cobble and boulders.

A small portion of habitat occurring along the southern shoreline is relatively shallow with a couple of isolated pools. The average depth of this habitat is 0.5 feet, with a maximum depth of 2.5 feet. This habitat consists primarily of bedrock with large woody debris cover, some of which is exposed during minimum flows. There also is a high-gradient, bedrock outcropping that extends to the toe of the dam. This habitat receives leakage flow from the spillway.

The thalweg[58] runs along the northern shoreline, or generation side, of the channel through the study reach and is characterized by relatively fast water that extends more than 100 feet from shore into the channel, with maximum depths up to about 10 feet (figure 8). Riffles, which typically occur between the islands, range from 0.3 to 2.5 feet in depth and are dominated by cobble substrate. Glide habitat, which is present near gravel bars and islands, is dominated by finer substrate while other shallow water habitats are characterized by rockier substrate. Multiple gravel bars are exposed under minimum flow conditions and a few isolated pools are present. Though shallow areas exist on the thalweg margins, GLHA concluded that there are no areas in the thalweg that would impede fish migration at minimum flow (GLHA, 2015).

[58] The thalweg is the path of the fastest flow in a river and usually is centered over the lowest point of any cross section of the river.

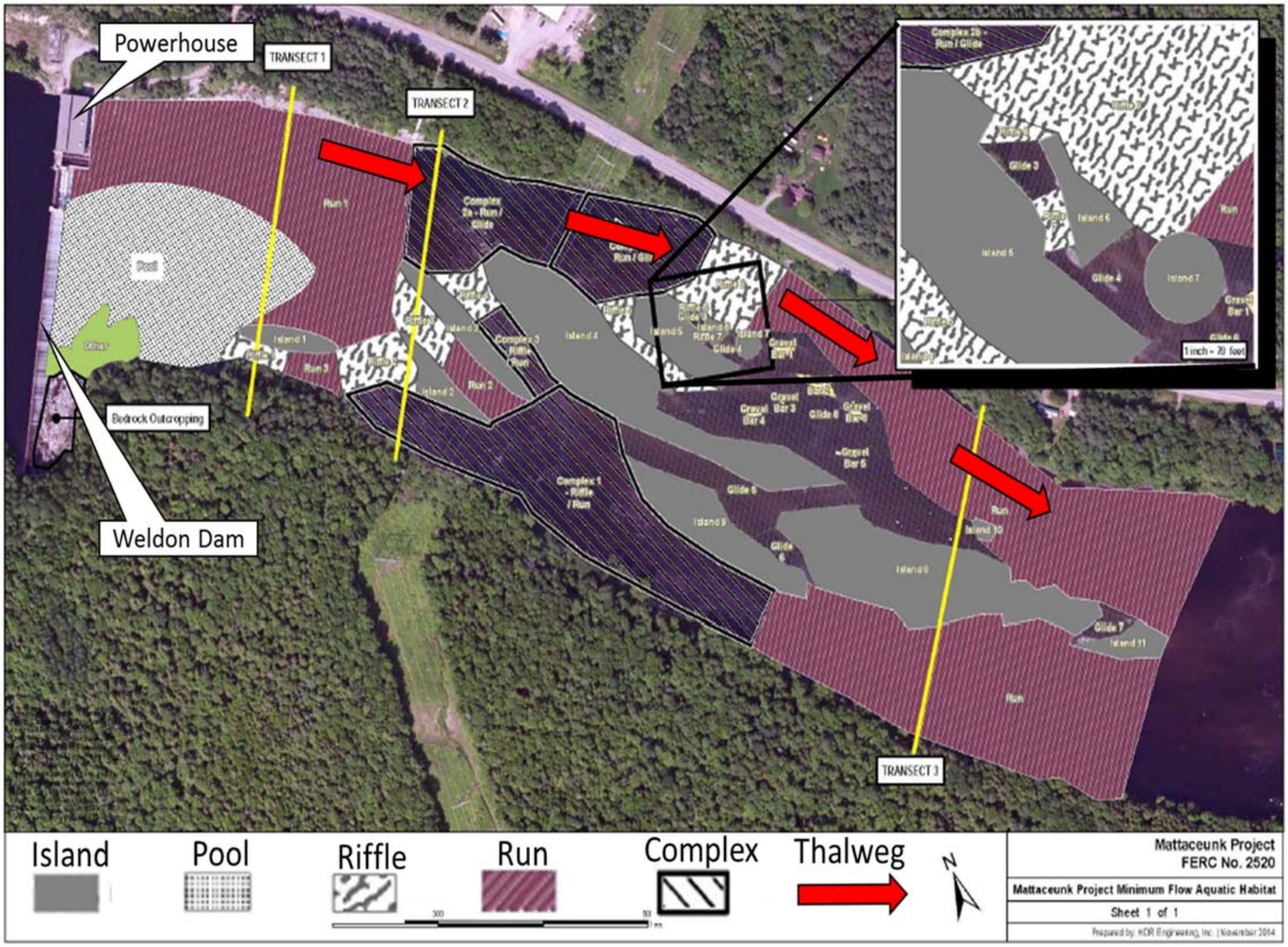

Figure 8. Habitat characteristics downstream of Weldon Dam.
(Source: GLHA, 2016a, as modified by staff).

GLHA also evaluated the wetted width of downstream habitat under the same minimum flow study conditions discussed above. The results indicate that the wetted width, at a flow volume near that of the minimum flow, averaged 77.2 percent of the bankful wetted width across the three habitats that were investigated (pool, riffle, and run habitat).[59] The wetted width in the riffle area, which is typically the focus of wetted width analysis, was 87.4 percent of that of bankful.

Fish Community

The Penobscot River Basin has historically supported diverse populations of resident and diadromous[60] fish, as well as other aquatic organisms (*e.g.*, freshwater mussels and macroinvertebrates). Pre-colonial conditions supported a robust diadromous fishery, including Atlantic salmon,[61] shad (i.e., American shad, blueback herring, and alewife), striped bass, rainbow smelt, sea lamprey, Atlantic sturgeon, Shortnose sturgeon, and sea run brook trout, Atlantic tomcod, and eel.

The native inhabitants of the region harvested American shad for at least 8,000 years, and sturgeon for at least 3,000 years (Penobscot River Restoration Trust [Penobscot Trust], 2012), and the Penobscot Indian Nation still uses the Penobscot River for subsistence fishing. Commercial harvesting of diadromous fish from the Penobscot River began in the 1760s, and the lower river was dammed in the 1830s with the construction of the Veazie and Great Works Dams (both now removed). Historically, the primary species harvested from the Penobscot River have been alewife, American shad, and Atlantic salmon. As a result of effects associated with the Industrial Revolution and subsequent development, the Penobscot River fishery and aquatic resources (e.g., freshwater mussels and macroinvertebrates) have declined from the historical levels (Penobscot Trust, 2012).

In addition to diadromous species, the Penobscot River contains a variety of resident riverine fish species that offer high quality sport fishing. Such species include

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[59] Flows during the survey were slightly above the proposed minimum and ranged from 1,765 to 1,783 cfs.

[60] The term "diadromous" is used to describe a life history strategy where fish migrate between freshwater and saltwater to complete their life-cycle.

[61] Atlantic salmon (*Salmo salar*) in the Penobscot River was listed as endangered on June 19, 2009, under the ESA. Because the salmon is a listed species under the ESA, we describe the species and its habitat, as well as discuss any potential effects of the proposed action in section 3.3.3, *Threatened and Endangered Species*.

brook trout, landlocked salmon, white perch, and chain pickerel, as well as the non-native smallmouth bass and northern pike. *See* description below.

Penobscot River Fisheries Management

Fisheries management on the Penobscot River is guided by several state and federal management plans. Maine DMR and Maine DIFW completed the "Strategic Plan for the Restoration of Diadromous Fishes to the Penobscot River" in 2008, which was developed in conjunction with FWS, NMFS, Penobscot Indian Nation, and other interested stakeholders. The plan defined four strategic goals: (1) coordinating fisheries management activities into a cohesive multispecies management program; (2) providing safe, timely, and effective fish passage (upstream and downstream); (3) maintaining or improving habitat for diadromous and select resident species; and (4) adopting an adaptive, ecosystem-based management program. The plan outlines production estimates for American shad and alewife for reaches of the Penobscot River, including the project area, and identifies effective upstream and downstream fish passage at the project as a strategic goal.

Maine DMR and Maine DIFW prepared the "Operational Plan for the Restoration of Diadromous Fishes to the Penobscot River" in 2009 (Maine DMR and Maine DIFW, 2009). The goal of this plan is to "restore and guide management of diadromous fish populations, aquatic resources, and the ecosystems on which they depend, for their intrinsic, ecological, economic, recreational, scientific, and educational values for use by the public" by removing barriers and improving access to the Penobscot River. The plan identifies operational objectives, measures, and strategies for the restoration of diadromous fish, including shad, over a 50-year period. The plan identifies river habitat historically occupied by shad in the project area, identifies increased upstream and downstream fish passage effectiveness at mainstem dams as a strategic goal, provides estimates for quantity of suitable habitat and production potential for American shad and alewife in the Penobscot River watershed.

To facilitate the restoration of diadromous fish in the Penobscot River, the Penobscot Trust[62] undertakes the activities of the Penobscot River Restoration Project (Penobscot Restoration Project). The activities have included: (1) the removal of the Veazie and Great Works Dams (in 2012 and 2013, respectively), the two lowermost dams on the Penobscot River;[63] (2) construction of a nature-like fishway around Howland Dam on the Piscataquis River, a major tributary to the Penobscot River downstream from the

[62] The Penobscot Trust is a consortium of conservation groups, federal and state agencies, and hydropower companies.

[63] With the removal of Veazie and Great Works Dams, Mattaceunk Dam is now the third dam on the mainstream of the Penobscot River.

Mattaceunk Project; and (3) construction of new fish lifts at the Milford and Orono Dams.

Management of American shad in the Penobscot River is also guided by Maine DMR's American Shad Habitat Plan (Maine DMR, 2014). The plan provides river-specific information for the major American shad spawning rivers, including the Penobscot River. It also identifies nearly 500 river miles of potential American shad habitat, and specifies that one of the main goals of the Penobscot Restoration Project is to expand available habitat for American shad. The timeline to begin implementing several goals of the plan is 2020, with the exception of water quality sampling and shad counts/surveys. Water quality sampling and shad counts/surveys already occur, and will continue to occur, annually (Maine DMR, 2014).

Management of Atlantic salmon in the Penobscot River is guided by the Final Recovery Plan for the Gulf of Maine distinct Population Segment of Atlantic Salmon (*Salmo salar*) (Recovery Plan) (NMFS and FWS, 2005). The goals and objectives of the Recovery Plan are further discussed in section 3.3.3, *Threated and Endangered Species*.

Finally, the section of the Penobscot River within the project area is managed as a smallmouth bass fishery, and is known to provide some of the best smallmouth bass fishing in the eastern United States, particularly the 60-mile stretch of river from Medway to downstream of Old Town (Maine DIFW, 2006). Management activities include periodic sampling to determine size quality and growth rates of smallmouth bass, which is used to develop fishing regulations to improve the size quality of the species. Maine DIFW encourages anglers to harvest smaller bass to increase growth rates (Maine DIFW, 2006).

Resident Fish

The Penobscot River near the Mattaceunk Project supports a community of common cool and warm water riverine fish species (Dube *et al*., 2011). Kiraly *et al*. (2015) found 27 resident fish species in the Penobscot River tributaries and mainstem, in addition to 7 anadromous and 1 catadromous[64] fish species (American eel), and land-locked Atlantic salmon.[65] In sampling focused only in the mainstem of the river

[64] The term "catadromous" is used to describe a life history strategy where fish reproduce and spend early life stages in saltwater, move into freshwater to rear as sub-adults, then move back into saltwater to spawn as adults.

[65] The data analyzed by Kiraly *et al*. (2015) was collected using a boat-based electroshocking device, with which researchers sampled several stretches of shoreline along the river and its tributaries.

downstream of the Mattaceunk Project, 24 resident species were collected (Kiraly *et al*., 2015).[66] Resident fish most abundant by number were common shiner, fallfish, redbreast sunfish, white sucker, smallmouth bass, pumpkinseed sunfish, and golden shiner. Those most abundant by mass were smallmouth bass, redbreast sunfish, white sucker, fallfish, brown bullhead, chain pickerel, and common shiner.[67]

In spite of the riverine appearance of the impoundments, Kiraly *et al*. (2015) observed differences in the composition between the impounded waters and faster flowing sections in the mainstem. In the impoundments, fewer fish were captured for the same amount of effort applied, and the catch was less varied in species composition than in flowing reaches (table 5).

Table 5. Catch per unit effort of fish species (Atlantic salmon excluded) observed in 2009 and 2010 in the Penobscot River Watershed.

Fish Species Observed			**Number Observed**	
Common Name	**Scientific Name**	**Native**	**2009**	**2010**
Brook trout	*Salvelinus fontinalis*	X		
Smallmouth bass	*Micropterus dolomieu*			
Largemouth bass	*Micropterus salmoides*		43	0
White sucker	*Catostomus commersonii*	X	41	67
Fallfish	*Semotilus corporalis*	X	73	56
Eastern blacknose dace	*Rhynichthys atralulus*	X	487	554
Creek chub	*Semotilus atromaculatus*	X	244	12
Common shiner	*Notropis cornutus*	X	189	17
Slimy sculpin	*Cottus cognatus*	X	393	236
Burbot	*Lota lota*	X	16	6
American eel	*Anguilla rostrata*	X	188	1
Sea lamprey	*Petromyzon marinus*	X	10	4

[66] One species, the slimy sculpin, was found only in tributaries to the Penobscot River and not in the mainstem. Two species, the black crappie and mummichog, were found only below Veazie Dam, where the river is under tidal influence and the habitat differs from the area near the Mattaceunk Project.

[67] Similar results were found in the river by NOAA in 2008 and Kleinschmidt Associates in 2009 and 2010.

Fish Species Observed			Number Observed	
Common Name	Scientific Name	Native	2009	2010
Sunfish[a]	*Lepomis spp.*	X	40	0
Golden shiner	*Notemigonus crysoleucas*	X	30	0
Yellow perch	*Perca flavescens*	X	2	0
Chain pickerel	*Esox niger*	X	1	0
Alewife	*Alosa pseudoharengus*	X	4	0

[a] Redbreast sunfish (*L. auritus*) and pumpkinseed (*L. gibbosus*) are both native species (Dube *et al*., 2011).
(Source: GLHA, 2016a).

Kiraly *et al*. (2015) found that there was some evidence that smallmouth bass were spawning in impoundments and using flowing reaches for most of the remaining time. The movement of resident fish species was also indicated in upstream fish passage studies conducted at the Mattaceunk upstream fishway between 1983 and 1986. Resident species appearing in the fish ladder at the project were brook trout, fallfish, landlocked Atlantic salmon,[68] longnose sucker, white sucker, and smallmouth bass (GNP, 1983, 1984, 1985, 1986) (table 6).

Table 6. Resident fish species counted within the Mattaceunk upstream fishway trap between 1983 and 1986.

Species	1983	1984	1985	1986
American eel*	many	many	many	many
Brook trout	1	2	32	29
Fallfish	1	0	3	0
Landlocked salmon	14	115	77	133
Longnose sucker	-	-	-	27
Smallmouth bass	39	22	65	35
White sucker	5	1	109	8

* Many juvenile eel (likely elvers) were observed in the upstream fishway, but they were not counted or captured in the fish trap.

[68] Landlocked salmon generally have the same life history as Atlantic salmon, with the exception of smolts outmigrating to lakes or reservoirs (rather than the ocean) to mature before migrating back to their natal streams to spawn.

Source: (GNP, 1983, 1984, 1985, 1986).

Six of the resident species identified by Kiraly *et al*. (2015) were introduced into the Penobscot River and have become residents. Four of those six, smallmouth bass, chain pickerel, largemouth bass, and yellow perch, are predators, with smallmouth bass and chain pickerel both being abundant by mass. The presence of the introduced predators, particularly smallmouth bass and chain pickerel, could influence the community composition through top-down effects on the food web (Kiraly *et al*., 2015).

The upper mainstem of the Penobscot River is a popular sport fishing area, where common target species include smallmouth bass, brook trout, white perch, landlocked salmon, and chain pickerel. Brook trout are commonly stocked and managed in the Penobscot River and its tributaries. Maine DIFW manages a popular smallmouth bass sport fishery throughout Maine, including in the project area, as is discussed elsewhere.

Diadromous Fish[69]

Of the diadromous species historically found in the Penobscot River, Atlantic sturgeon, shortnose sturgeon, rainbow smelt, Atlantic tomcod, and sea-run brook trout likely did not migrate upstream of the historic falls located at the site of Milford Dam (Maine DMR and Maine DIFW, 2009), which is located approximately 54 river miles downstream from the Mattaceunk Project. The Mattaceunk Project is located in the historical range of Atlantic salmon, shad (American shad and river herring), striped bass,[70] sea lamprey, and eel. Because of the presence of an upstream fish lift at the Milford Project, as well as an upstream vertical slot fishway and eel ladder at the West Enfield Project, upstream passage to the Mattaceunk Project is unimpeded for all of those species whose ranges currently and historically occurred upstream of the Mattaceunk Project. Downstream fishways at West Enfield and Milford also allow those species that migrate downstream from the Mattaceunk Project to reach the ocean. Currently, NMFS, FWS, Maine DMR, Maine DIFW, and Penobscot Indian Nation are working to restore diadromous fish populations in the Penobscot River through the Penobscot Restoration

[69] The term "diadromous" is used to describe a life history strategy where fish migrate between freshwater and saltwater for the purposes of reproduction.

[70] There is no available information on the historical distribution of striped bass. While this species was commonly captured in the Veazie fish trap, and currently at the Milford fish lift, the species is not expected to reach the Mattaceunk Project (Maine DMR and Maine DIFW, 2009).

Project and the "Operational Plan for the Restoration of Diadromous Fishes to the Penobscot River" (Maine DMR and Maine DIFW, 2009).

Catadromous Fish

American eel

The American eel is the most widely distributed diadromous fish in the Penobscot River (Yoder *et al*., 2005; NOAA, 2008). The species spends most of its life in fresh or brackish water before migrating to the Sargasso Seas to spawn. It occurs throughout warm and cold waters of the Atlantic Ocean and Atlantic coastal drainages in North America (Boschung and Mayden, 2004). Within its range, it is most abundant throughout the Atlantic coastal states (ASMFC, 1999).

Spawning likely occurs from February through April in the Sargasso Sea, although the act of spawning has never been observed (Boschung and Mayden, 2004). Fertilized eggs and larvae, known as the planktonic phase, drift with the Gulf Stream currents along the east coast of the United States (Jenkins and Burkhead, 1993). Following this phase, the planktonic leptocephali, ribbon-like eel larvae, metamorphose (or transform) into what is termed a "glass" eel as it approaches coastal waters. Glass eel are completely transparent and make their way into brackish waters by the use of flood tides. Once skin pigments develop in glass eel, they are considered "elvers."[71]

As eel mature, elvers become juvenile, or "yellow" eel. The majority of eel collected in freshwater rivers are typically yellow eel, which is considered the primary growth phase of its life cycle (Ross *et al*., 2001). Yellow eel are typically sedentary during the day, often burying in mud or silt, and becoming active at night to feed (Jenkins and Burkhead, 1993). They associate with pools or backwater habitats, and often have relatively small home ranges (Gunning and Shoop, 1962). The juvenile stage can last from five to 40 years before final maturation into the silver eel and out-migration in the fall and mid-winter months to spawning grounds (*i.e.*, Sargasso Sea) occur (Boschung and Mayden, 2004).[72] Adult eel are presumed to die after spawning (Boschung and Mayden, 2004: Jenkins and Burkhead, 1993).

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[71] Elvers often serve as important forage fish for striped bass and other large piscivores.

[72] Juvenile eel that reside in estuaries reach maturity and migrate earlier than juveniles found in freshwaters, and that these eel can reach full maturation while never migrating to freshwater (FWS, 2007).

Eel are opportunistic carnivores, selecting a range of prey items from small aquatic insects and crustaceans to larger macroinvertebrates and fish (Ross *et al*., 2001).[73] Eel may live up to 40 years, depending on latitude, and grow greater than 39 inches in total length (Boschung and Mayden, 2004; Jenkins and Burkhead, 1993).

In the Penobscot River, the eel has been commercially harvested as far upstream as Millinocket on the West Branch as recently as the 1990s, and is still present (Yoder *et al*., 2005; NOAA, 2008; and HDR, 2013, 2014). Juvenile and adult eel are known to occur upstream of the Mattaceunk Project, though there is currently no upstream passage provided for eel at the project. Upstream eel passage has been observed at the project using the upstream pool and weir fish ladder.[74]

In a 2008 river-wide fish assemblage study, the National Oceanic and Atmospheric Administration (NOAA) documented that eel composed a significant portion of the biomass sampled via electrofishing in the Penobscot River (NOAA, 2008). More specifically, juvenile eel represented 35 percent of the overall fish biomass upstream of the Mattaceunk Project on the East Branch of the Penobscot River near Grindstone (in September 2008), and 12 percent of the fish biomass near river mile 2.5 on the East Branch of the Penobscot River (in June 2008).

In 2014, GLHA conducted an American Eel Passage Study at the Mattaceunk Project to identify areas where upstream migrating juvenile eel concentrate, and to assist in developing a conceptual upstream eel passage design (GLHA, 2015). Surveys were conducted during no spill conditions from mid-May through September. The estimated number of eel observed during each survey ranged from 11 to 200. The total number of eel observed was about 456, with peak numbers occurring in July (table 7).

Table 7. Summary of 2014 night-time American eel counts at the Mattaceunk Project.

Survey Location *	**Survey Date**					**Total Number**	**Relative Abundance (%)**
	6/25	**7/21**	**7/29**	**8/19**	**9/9**		
Spillway	0	0	0	0	0	0	0
Lower TOD	15	35	24	0	0	74	16.2
Upper TOD	45	80	52	12	5	194	42.6

[73] Larger eel (greater than 13.8 inches) may consume more fish or large macroinvertebrates, and even scavenge, while smaller (5.9 to 13.8 inches) or younger eel may feed primarily on benthic invertebrates (Boschung and Mayden, 2004).

[74] Elvers have been observed but not counted, with the greatest numbers being observed within the fishway when it was shut down for maintenance activities (GNP, 1983, 1984, 1985, 1986).

Survey Location *	Survey Date					Total Number	Relative Abundance (%)
	6/25	**7/21**	**7/29**	**8/19**	**9/9**		
Bedrock	15	20	124	23	6	188	41.2
TOTAL	**75**	**135**	**200**	**35**	**11**	**456**	**100.0**

* TOD = Toe of dam.

(Source: License Application at E-85).

The eel observed during the Weldon Dam night-time surveys ranged from an estimated 4 to 24 inches in length. Approximately 366 were 5 to 8 inches in length, which were the most abundant sizes observed. Approximately 55 eel were 4 to 5 inches in length; 34 eel were 10 to 18 inches in length; and 1 eel was about 24 inches in length. The majority of the eel were observed staging or in the process of migrating up the face of Weldon Dam, along the right descending bank (looking downstream from the dam), in leakage flow at the upper portion of the toe of the dam, or within the two upper pools of the bedrock habitat (figure 9).[75]

[75] Based on the night-time observations, most of the eel navigated to the right descending bank portion of the toe of the dam by ascending the cascading bedrock habitats. Eel were also observed within crevices along the lower portion of the toe, either climbing directly up the spillway or toward the upper portion of the toe. *See* figure 9.

Figure 9. Upstream American eel migration routes for Weldon Dam**.** Arrows indicate upstream eel migration routes: yellow arrows indicate the primary upstream eel migration routes and red arrows are secondary routes.
(Source: License Application at E-86).

Based on the upstream eel passage study, GLHA developed a conceptual design for seasonal upstream passage for eel at the project (figure 10; GLHA, 2015). The design would consist of a seasonal, upstream eel ladder, which would be located adjacent to the right descending bank, along the west abutment of the spillway. This type of eel passage is similar to typical upstream eel ramps installed at other hydropower facilities in Maine. The facility would include: (1) a siphon or pump system installed in the head pond (to provide attraction and conveyance flow); (2) a sloped aluminum or wooden eel ramp with Enkamat attached as the climbing substrate; (3) a temporary trapping component (*e.g.*, holding tank); and (4) a small-diameter flexible conduit extension leading directly into the head pond (for future volitional passage).

Figure 10. Conceptual design of upstream American eel passage facility at Weldon Dam.
(Source: GLHA, 2015).

Downstream passage for eel has been studied for a number of years at the Medway Project, which is located approximately 7 miles upstream of the Mattaceunk Project on the West Branch of the Penobscot River. The studies focused on the timing and relative abundance of silver migrating eel in an attempt to secure an adequate number of eel to conduct a scientifically defensible downstream passage study. These studies were conducted over the expected migration season from August to October. Few eel were caught between 2004 and 2006 (Aquatic Science Associates, 2005, 2007). The consensus among the resources agencies, the Penobscot Indian Nation, and GLHA, at the time, was that insufficient numbers of silver eel were available for the study.

GLHA reassessed downstream migrating eel abundance at the Medway Project in 2012 and 2013. In 2012, a total of 11 eel were captured, with six eel potentially being out-migrating (silver) eel. An additional 16 eel were observed and not captured during the 2012 study (HDR, 2013). In 2013, 20 eel were captured, but only two were potentially silver eel. An additional 30 eel were observed, but not captured during the

2013 study (HDR, 2014). As with the earlier studies, the resource agencies, the Penobscot Indian Nation, and GLHA concluded that there were insufficient silver eel to conduct a statistically valid downstream passage study, though downstream passage remains a concern at the Medway and Mattaceunk Projects.[76]

Anadromous Fish[77]

Shad (American shad and River Herring[78])

American shad, blueback herring, and alewife spend most of their lives at sea, but return to their natal (home) rivers along the eastern seaboard of North America to reproduce (Melvin *et al*., 1986; Greene *et al*., 2009). Spawning runs of alewives occur earlier (May through June in Maine) than those of blueback herring and American shad (June through July) (Loesch, 1987; Saunders *et al*., 2006). In New England, blueback herring and American shad primarily spawn in lotic (mainstem river) habitats, whereas alewives generally spawn in lentic (lake or pond) habitats within a river basin (Loesch, 1987). In the Penobscot River, the historical spawning range of American shad extends upstream at least as far as the mouth of Wassataquoik Stream (on the East Branch of the Penobscot River) based on historical commercial catch data (Foster and Atkins, 1867). Although not well documented, the historical spawning range of blueback herring in the Penobscot River is thought to be similar to American shad based on their similar spawning habitat preferences (Maine DMR and DIFW, 2008). The current upstream extent of wild American shad and blueback herring[79] in the Penobscot River is thought to be Weldon Dam, as river herring have been observed in, but have not successfully passed, the Mattaceunk upstream fishway, and American shad have been observed

[76] GLHA plans to evaluate the new downstream fishways for eel at the downstream Milford, Stillwater, and Orono Projects in 2016. The information obtained from this evaluation would be used to inform decisions about downstream eel passage measures and future studies at other hydropower projects, including the Medway and Mattaceunk Projects. *See* GLHA's March 31, 2016 filing at 3.

[77] The term "anadromous" is used to describe a life history strategy whereby adults spend most of their time (feeding and overwintering) at sea but return to freshwater to reproduce.

[78] Blueback herring and alewife are difficult to distinguish visually and, therefore, are often collectively referred to as river herring.

[79] American shad and blueback herring are not currently stocked in the Penobscot River, but alewives are stocked.

passing through the upstream fishway at the West Enfield Project (next dam downstream), but not at Mattaceunk (GLHA, 2016a; HDR, 2017).

In northern latitudes (New England), shad often survive spawning, unlike in southern regions (south of Cape Hatteras) where most fish die after spawning (Leggett and Carscadden, 1987). For instance, Grote *et al*. (2014) found that 75 to 95 percent of American shad in the Penobscot River were repeat spawners;[80] and in the nearby Connecticut River, Loesch and Lund (1977) estimated that 81 percent of blueback herring were repeat spawners.

Young shad generally remain in river habitats for a few months before out-migrating to the sea as juveniles during late summer and early fall, as peak out-migration occurs once water temperatures begin to steadily fall below 66-69 ^{o}F (O'Leary and Kynard, 1986). Although the timing of out-migration in a given river system can vary from year to year depending on environmental conditions (O'Leary and Kynard, 1986; Limburg *et al*., 2003), out-migration of juveniles and adults in Maine generally occurs from mid-July through October (Saunders *et al*., 2006). Juveniles generally spend three to five years at sea, where they mature, and subsequently return to their natal rivers in the spring to spawn to complete their life cycle (Saunders *et al*. 2006; Greene *et al*., 2009).

Sea Lamprey

Like the shad described above, sea lamprey spend most of their life at sea, with the early life stages occurring in freshwater. The life of the sea lamprey begins in freshwater, where egg and larval (ammocoetes) life stages occur in streams after they are spawned. After ammocoete transformation, sea lamprey move out to sea for the parasitic phase of its life (up to 2 years). Sea lamprey will parasitize fish as their source of food, and this often results in the death of the host fish.

After up to 2 years at sea, sea lamprey adults move into gravel areas of tributary streams during spring and early summer to spawn (Great Lakes Fishery Commission, 2000). Immediately after spawning, females drop downstream and soon die, while the male may remain on the nest for a short period before dying.

The historical distribution and abundance of sea lamprey in the Penobscot River is not well understood (Maine DMR and Maine DIFW, 2008). Sea lamprey were collected upstream of the project in the Piscataquis River in 1832, and in the East Branch in 1903 (Kendall, 1914). However, the numbers collected by Kendall (1914) are not known, and there is no other historical documentation of sea lamprey abundance upstream of the project. Recently (2010-2011), but prior to the removal of Veazie and Great Works

[80] The term "repeat spawners" refers to adult shad that survive spawning and return to the river in subsequent years to spawn.

Dams, sea lamprey were collected between Milford Dam and West Enfield Dam (Kiraly *et al.*, 2015). Since the removal of Veazie and Great Works Dams, sea lamprey have been captured at the new Milford Dam fish lift and released upstream. A total of 485 sea lamprey were counted and passed upstream of the Milford Dam fish lift in 2015, and 3,833 were counted and passed in 2016 (Maine DMR, 2015; 2016). In addition, an unknown number of lamprey have been observed passing the Milford fish lift sorting facility. Preliminary data from the West Enfield fish passage facility indicates that about 2,432 sea lamprey passed upstream of West Enfield Dam (the next dam downstream from Mattaceunk) in 2016.

Freshwater Mussels

Ten species of freshwater mussels have been documented in Maine (Swartz and Nedeau, 2007), including three that are state-listed as threatened: brook floater, tidewater mucket, and yellow lampmussel. Seven freshwater mussel species have been reported to occur in the project area (table 8).

In September 2012, GLHA conducted a mussel survey to document species presence, distribution, and relative abundance within the project impoundment in anticipation of a substantial impoundment drawdown (20-25 feet) for dam maintenance. After an initial reconnaissance survey along the impoundment perimeter, GLHA visually surveyed 12 transects: 2 transects each within the East and West Branches of the Penobscot River in the upstream section of the impoundment and eight transects in the middle and downstream sections. A total of 18,574 mussels representing seven species were observed during the survey. In June and July 2013, 11,157 mussels were surveyed and relocated to suitable areas before and during impoundment drawdown.

Table 8. Freshwater mussel species reported occurring in the project area.

Common Name	Location	Percentage Relative abundance
Eastern elliptio	East Branch, West Branch, and impoundment	81.9
Eastern lampmussel	East Branch, West Branch, and impoundment	16.9
Tidewater mucket floater	Southeastern side of Nicatou Island, 0.3 miles downstream of Interstate 95, and near the western point of Lawreance Island	0.8
Yellow lampmussel	Southeastern side of Nicatou Island, 0.3 miles downstream of Interstate 95, and near the western point of Lawreance Island	0.2

Common Name	Location	Percentage Relative abundance
Creeper	West Branch and impoundment	0.1
Eastern floater	West Branch	0.1
Triangle floater	West Branch	0.1

(Source: Normandeau 2012, modified by staff)

The overwhelming dominant species was the eastern elliptio, followed by the eastern lampmussel, and tidewater mucket, which were found in all transects. Yellow lampmussel's relative abundance increased from upstream to downstream and creeper's relative abundance increased from downstream to upstream. Eastern elliptio's relative abundance increased from upstream to downstream with the highest concentration at the confluence of the East and West Branches of the Penobscot River. GLHA observed brook floater during the survey in the upper reach of the impoundment in the West Branch with no specific numbers detailed in the report.

3.3.2.2 Environmental Effects

Impoundment Levels

GLHA proposes to continue to operate the project in run-of-river mode with pondage, while maintaining impoundment fluctuations: (1) within 1 foot or less from the top of the 4-foot-high flashboard crest elevation (240.0 feet) during normal project operation, or within 2.0 feet of normal flashboard crest elevation when necessary (i.e., to allow an adequate margin for debris, or sudden pool increases that might cause flashboard failure); and (2) within 1 foot of the dam crest elevation (236.0 feet) when the flashboards are down for repair or installation. Thus, other than when drawdowns are needed, the project is operated as a run-of-river facility, with inflow approximately equal to outflow. Interior, NMFS, and Maine DMR all provide recommendations that are consistent with GLHA's proposed limits on impoundment surface elevations.

Our Analysis

GLHA recorded the impoundment fluctuation curves for 2008 through 2015 (figure 11), depicting typical water levels of the Mattaceunk Project during normal impoundment elevations.

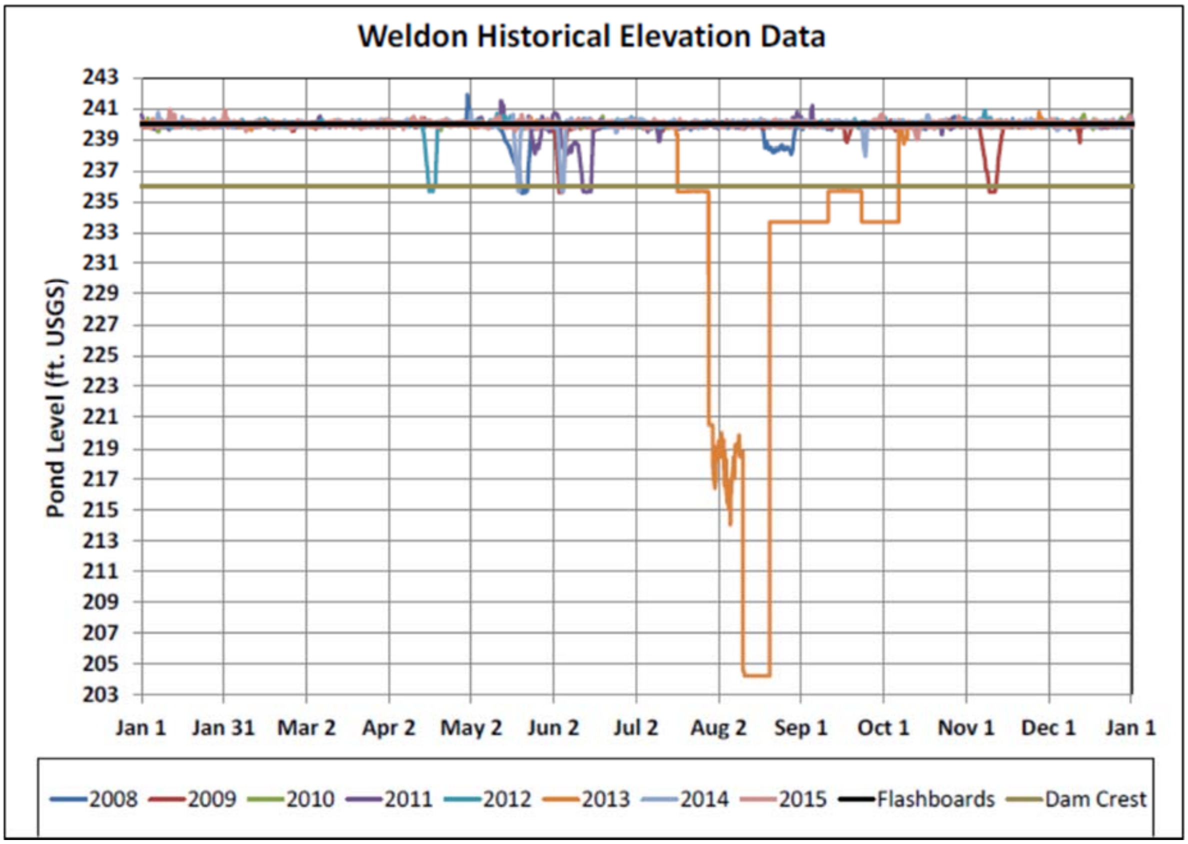

Figure 11. Summary of impoundment fluctuation curves from 2008 through 2015. (Source: GLHA, 2016a)

Based on analysis, water levels rarely deviated by more than 0.2 to 0.5 feet from the normal pond elevation of 240.0 feet when the 4-foot-high flashboards were in place (figure 11). The only exceptions were for flashboard replacement and downstream fishway repairs, which occurred 8 times over 9 years, including several scheduled maintenance activities. In addition, GLHA conducted numerous studies for the purpose of relicensing that considered the effects of impoundment fluctuation on aquatic resources, soil and geology, terrestrial, and cultural resources. These studies indicated that under normal operation, minimal impoundment fluctuations resulted in stable impoundment and downstream habitats.

An impoundment fluctuation of anything less than 0.2 to 0.5 feet from the normal pond elevation of 240.0 feet would be hard to maintain in the presence of variations in wind, inflow, and other factors. Therefore a buffer greater than 0.5 feet from the top of the flashboards is needed to allow an adequate margin for wave action. Finally, some flexibility regarding impoundment elevations is needed to remove debris and to prevent flashboard failure under stress from ice and flooding.

Minimum Flows

Minimum flows downstream from hydropower projects have the potential to affect the quality of habitat for fish and aquatic organisms and potentially create fish migration barriers by affecting the frequency, timing, and duration of flows released downstream of a project. As previously discussed, GLHA proposes to continue to provide a year-round continuous minimum base flow of 1,674 cfs, or inflow, whichever is less as it does under its current license. Additionally, GLHA proposes to continue to maintain a daily average minimum flow of 2,392 cfs, or average inflow, whichever is less, from July 1 through September 30, and 2,000 cfs, or average inflow, whichever is less, from October 1 through June 30. Maine DMR and NMFS recommend these minimum flows.

Our Analysis

The existing and proposed continuous minimum flow of 1,674 cfs initially was based on providing a flow volume approximating the historical, unregulated, median August flow in the Penobscot River. Because the aquatic communities downstream from the project have adapted to the effects of the August low-flow period on water quality and aquatic habitat (e.g., higher temperatures, lower dissolved oxygen, and reduced habitat availability), FWS, in their response to Great Northern's application for a new license in 1984, concluded that providing at least the median streamflow in August was sufficient to sustain aquatic communities throughout the year. It also would not interfere with the project's mode of operation. Based on historical data, the project would release 1,674 cfs about 99.9 percent of the time.

In 2014, GLHA conducted a Minimum Flow Habitat Study, as discussed in *3.3.3.2, Affected Environment*, *Aquatic Habitat*. GLHA concluded that there are no areas in the thalweg that would impede fish migration at minimum flows (see figure 8). Additionally, GLHA analyzed the historical river flow data from 1996 – 2012 to evaluate the frequency, timing, and duration of minimum flow releases during the migratory seasons of eel and Atlantic salmon in the Penobscot River (table 9). And, as discussed previously, flows were the highest in the spring (April through June), as a result of annual spring runoff (see table 3).

Table 9. Aquatic Passage Seasonal Flows in cfs (1996-2012).

Species / Life stage	Primary Migratory Period	Average Flow	Minimum Flow	90 percent Exceedance	10 percent Exceedance	Maximum Flow
American Eel Upstream	Early June to late August	5,100	1,891	2,893	8,410	41,321

American Eel Downstream	Early August to Lake November	5,433	1,266	2,925	8,838	45,108
Atlantic Salmon (adult upstream)	Early June to Late October	5,366	1,726	2,943	8,714	45,108
Atlantic Salmon (smolt downstream)	May	9,664	1,673	3,409	18,807	69,936
Annual		**6,258**	**1,163**	**2,948**	**10,868**	**69,936**

(Source: GLHA, 2016a).

The Minimum Flow Habitat Study demonstrated that aquatic habitat and a zone of passage for fish migration remain suitable during minimum flow conditions. During the 1996-2012 period, average minimum flows at, or below, 1,674 cfs only occurred on 48 days from 1996 to 2012, or less than 1 percent of the total days (table 10). The majority of these days occurred from January to March. From May to November, the months when migration is known to occur, flows at, or below, 1,674 cfs only occurred 4 times from 1996-2012, or on about 0.1 percent of the days during these months. Minimum flows at, or below, 2,000 cfs occurred on 120 days from 1996 to 2012, but occurred every month except June and September. There were 16 days during the potential migration period of eel and Atlantic salmon when flows were between 1,674 cfs and 2,000 cfs.

Table 10. Number of days daily average low flows occurred at the project (POR 1996-2012).

Month	Less than or equal to 1,674 cfs	Less than or equal to 2,000 cfs
January	16	28
February	17	29
March	10	34
April	0	1
May	1	3
June	0	0
July	0	1
August	0	3
September	0	0
October	0	2
November	3	7
December	1	12
Total	**48**	**120**

Under the proposed and existing minimum flow of 1,674 cfs at the Mattaceunk Project, the reach downstream from Weldon Dam provides adequate habitat to support aquatic life and a zone of passage for fish migration. Based on the habitat mapping and transect profile data, which show extensive connectivity of deep-water habitats along both shorelines; the deep-water habitats extend well into the channel. Additionally, GLHA assessed the wetted perimeter of three transects for pool, riffle, and run habitats (see figure 8), located in the outlet stream habitat below the dam. The calculated wetted perimeters at low flow for the three transects were 78.4, 87.4, and 71.2 percent, respectively, and averaged 79 percent of the bankfull perimeter. This information supports the conclusion that the minimum flow of 1,674 cfs provides access to pool, riffle, and run habitat downstream from the project, as well as provides a zone of passage for fish migration.

In addition to the wetted-perimeter information, the flow data from 1996 to 2012 shows that the 1,674 cfs minimum flow was almost always exceeded at Weldon Dam during months when eel and Atlantic salmon migrations typically occur (May to November). The rare occurrences when flows dropped below 1,674 cfs typically represented drought conditions within the watershed that were out of the GLHA's control. Providing GLHA's proposed minimum and daily average flows would continue to provide aquatic habitat and an adequate zone of passage for migratory fish during minimum flow conditions.

Water Quality

Dissolved Oxygen

GLHA does not propose any new water quality measures. Maine DEP states that the results of GLHA's water quality study demonstrate that: (1) the Mattaceunk Project's impoundment is free of culturally-induced algae blooms[81] and so is expected to meet the designated use for swimming and recreation in and on the water; (2) the current and proposed project operations (impoundment drawdowns) do not appear to have significant adverse impacts on the aquatic life in the impoundment and is expected to meet the applicable aquatic life and habitat standards and designated use of habitat for fish and other aquatic organisms; (3) DO concentrations in the outlet stream meets or exceeds applicable Class C standards for DO under critical water quality conditions; and (4) outlet stream effects on benthic macroinvertebrates exhibit some adverse effect from the

[81] Algae blooms are sudden, massive growths of green or blue-green algae, which naturally develop in lakes or reservoirs, when conditions are sufficient, and the water contains enough nutrients to support rapid algae growth. Excessive organic loading (nutrients) into a receiving water body from industry or a non-point sources can cause culturally-induced algae blooms.

impoundment, but that those effects are not greater than the effects seen downstream of a natural lake or pond and, thus, are expected to meet Class C aquatic life criteria under the current and proposed minimum flows.

Our Analysis

As described above, in section 3.3.2.1, *Aquatic Resources*, *Affected Environment,* Maine DEP reported that the water quality at the Mattaceunk Project was within the state water quality standards for Class C waters. The data also indicated that the impoundment did not stratify. Vertical water temperatures and DO concentrations in the impoundment were relatively uniform throughout the water column. Water temperatures in the impoundment reflected seasonal air temperatures, with lowest temperatures in early fall and highest temperatures in late summer. Inversely, DO concentrations decreased as temperature increased. DO concentrations ranged from 7.0 mg/L to 9.8 mg/L, consistently above the minimum concentration of 5.0 mg/L for Class C waters. The impoundment had low levels of nutrients and did not foster high densities of algal populations, suggesting that the impoundment was oligotrophic. The macroinvertebrate data were consistent with the characteristics fitting the Class C aquatic life criteria and demonstrating that the structure and function of the resident biological community were maintained and would be expected to continue to be maintained with no change to project operation.

Water Temperature

GLHA does not propose any temperature monitoring measures. Though some dam operations have the potential to increase water temperature, Maine does not have a state standard for temperature to address such potential affects.[82] However, NMFS recommends that GLHA conduct continuous stream temperature monitoring between April 1 and October 31 to ensure that the dam and its operations do not intensify the effects of climate change that can affect smolt emigration, adult immigration, and juvenile development in nursery habitats downstream of the dam.[83] The Penobscot Indian Nation comments that GLHA's 4.5-month water temperature monitoring in 2012 does not adequately characterize the water temperature for the project (see figure 6), and states that a plan for monitoring for multiple years is necessary.

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[82] Me. Stat. tit. 38, § 465.

[83] NMFS did not specify the location of stream temperature monitoring; however, because its recommendation includes references to "habitats downstream of the dam" and "stream temperature" (not impoundment), we assume the recommendation is to monitor temperature downstream of the dam.

Our Analysis

Dam operations that increase downstream water temperatures are normally the result of one or both of two processes. In one process, increasing the residence time of the water in the impoundment upstream of the dam allows more time and exposure to the heat of the sun, causing the water released to be warmer than it otherwise would be. In another, sometimes related process, water in an impoundment can physically stratify into horizontal layers by water temperature. If the project water intake is at a depth of a warmer layer of water, the project release would be higher in temperature than in the impoundment inflow. Changes in temperature are most evident during low flow periods when residence time is already longer because of the reduced volume of water reaching the impoundment. High temperatures are associated with lower DO[84] and shifts in water chemistry that can be harmful to fish and other aquatic organisms.

GLHA proposes to continue to operate the project in a run-of-river mode, with pondage, as occurs under existing conditions (*see* discussion in section *2.1.3, Existing Project Operation*). GLHA's studies of the impoundment from June to October 2014, indicate that impoundment does not stratify by temperature, is generally shallow (20,891 acre-feet storage capacity), and has a hydraulic residence time of about 41 hours[85] (see figures 4 and 5in section 3.3.2.1., *Aquatic Resources, Affected Environment*). The relatively short residence time and lack of temperature stratification indicate that project operation would be unlikely to cause substantial increases in water temperature through the impoundment.

GLHA also monitored water temperatures upstream of the project, within the impoundment, and in the downstream tailrace from May to September 2012 (see figure 6*)*. As discussed in 3.3.2.1, *Aquatic Resources*, *Affected Environment*, the 2014 monitoring data indicates that: (1) there is little temperature deviation between the three sites; (2) DO concentrations exceeded the minimum DO standard of 5.0 mg/L; and (3) the macroinvertebrate community was consistent with Class C aquatic life criteria. Additionally, the existing, resident fish population within the project vicinity is diverse, self-sustaining, and similar to other areas of the river. Taken together these findings

[84] The quantity of dissolved gas, such as oxygen, decreases with increasing temperature.

[85] The hydraulic residence time is a measurement of the average length of time that water is stored in an impoundment. Residence times can range from less than 40 days for relatively small impoundments to many years for the largest reservoirs (Baxter, 1977; Petts, 1984; Kelly, 2001). At the Mattaceunk Project, the residence time is calculated as 40.7 hours using 20,891 acre-feet storage capacity divided by 6,204 cfs, mean annual flow.

support the conclusion that there are no substantial project-related temperature issues associated with current project operation.

Regarding the NMFS recommendation that GLHA continuously monitor stream temperature downstream from the dam, water temperature, of course, will vary both through natural, short-term factors, and global trends. During dry periods, the water temperature will tend to be higher and conditions more stressful for aquatic organisms. The project, however, is not substantially changing the temperature of water in the Penobscot River, nor is there a proposal to change how the project operates that would alter the river's water temperature.

The Penobscot Indian Nation is concerned that GLHA's 4.5 months of water temperature monitoring in 2012 is inadequate to characterize the water temperature variation at the project. While the 4.5 months of monitoring data was collected over only one season, it was a relatively dry, low-flow year.[86] Thus, the existing data shows the effects of project operation when the effects would likely be greater than normal. The existing monitoring data supports the finding that even under relatively dry conditions, the project has little effect on water temperature in the Penobscot River. In addition, because existing conditions provide good water quality that supports aquatic life, and because GLHA does not propose any changes to project operation, there would be no benefit to monitoring water temperature continuously.

Operation Compliance Monitoring

Although compliance measures do not directly affect environmental resources, they do allow the Commission to ensure that a licensee complies with the environmental requirements of a license. Therefore, operational compliance monitoring and reporting are typical requirements in Commission-issued licenses. Under the existing license, GLHA monitors compliance with project operation and minimum flows using an existing monitoring system[87] that allows GLHA to: (1) maintain and store mean daily and hourly

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[86] According to the U.S. Drought Monitor, Maine was abnormally dry in the spring of 2012 (U.S. Drought Monitor, ND). In April 2012, one month prior to GLHA's water temperature monitoring, Maine was categorized as D1 (moderate drought) with rain deficits between 25 and 50 percent. During the 2012 monitoring period, Maine's drought category improved from D1 to D0 (abnormally dry – used for areas not yet in or recovering from a drought) and low stream-flow and groundwater concerns. http://droughtmonitor.unl.edu/DroughtSummary.aspx

[87] Headpond levels are measured directly by the system and transmitted to the power dispatcher within the control center located in Marlborough, Massachusetts. Pressure transducers record both headpond levels and flow through individual turbines.

data for inflow to the impoundment, outflow from the project, and water levels in the project impoundment; and (2) provide these data to the agencies within 30 days of a request.

GLHA proposes no changes to project operation, and GLHA would continue to monitor impoundment elevations and tailwater levels remotely, using records of gate setting and turbine operation (GLHA, 2016a), as described above. Maine DEP recommends that GLHA develop a project operation and monitoring plan that specifies the methods used to monitor project operation, and to maintain minimum flows and impoundment elevations within the licensing limits.[88] NMFS also recommends that GLHA develop a plan to monitor impoundment water levels, and consult with the resource agencies and USGS in developing the plan. Additionally, NMFS recommends that GLHA develop a flow monitoring plan. This plan would include (a) installing flow monitoring equipment in the project tailrace to confirm that minimum flow requirements are being met, and (b) making flow data electronically accessible and consistent with USGS website format.

Our Analysis

Impoundment Surface Elevation Monitoring

GLHA's records indicate that GLHA has maintained the project impoundment within a narrow elevation range. Historically, fluctuations have ranged from 0.2 to 0.5 feet from the normal pond elevation of 240.0 feet, when the 4-foot-high flashboards are in place (figure 11). The only exceptions occur during flashboard replacement, downstream fishway repairs, and scheduled maintenance activities.

GLHA's records show that impoundment fluctuations are minimal under normal operation. However, monitoring impoundment levels on a more regular basis would allow GLHA to verify and evaluate operations throughout the term of the license. As recommended by Maine DEP and NMFS, formalizing GLHA's existing monitoring protocol in a project operation and monitoring plan would help GLHA document its compliance with the operational provisions of any new license, provide a mechanism for

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Flow data is stored in the computer in mean hourly increments. Mean daily summaries are printed and archived. Headpond level is monitored continuously and stored in hourly increments. Data are supplied to the resource agencies within 30 days of a request for the data. *See* 55 FERC ¶ 62,259 (1991).

[88] In a letter filed on July 7, 2017, GLHA indicated that it was amenable to the type of operation and monitoring plan recommended by Maine DEP.

reporting operational data and deviations, facilitate administration of the license, and ensure the protection of resources that are sensitive to impoundment fluctuations.

Minimum Flow Monitoring

GLHA has indicated that it is amenable to monitoring minimum flows, as recommended by Maine DEP, but it does not agree that specialized flow monitoring equipment is required to monitor minimum flow releases, as recommended by NMFS. The existing system used by GLHA has been fully adequate for monitoring the minimum flow requirements of the existing license, and would continue to be fully adequate for monitoring minimum flow requirements of any new license issued. Using the existing system, GLHA has been compliant with the existing minimum flow requirements, and there is no reason to believe GLHA would not be compliant under a new license. Because GLHA does not propose any changes in minimum flows, has an existing system that is fully adequate for monitoring minimum flows, and has operated the project without any evidence of deviating from the required minimum flows, there is no basis for installing additional flow monitoring equipment. Further, because GLHA could continue to provide resource agencies with past flow monitoring data upon request and make current and projected flow data available on the National Waterline website,[89] there is no benefit to making the flow data available in another format (e.g., USGS format).

Maine DEP and NMFS both recommend a plan for monitoring impoundment surface elevations and minimum flows, but NMFS recommends two separate plans. We discussed, herein, the potential benefits of two separate plans. However, considering the strong interrelationship of the two issues, it appears to us that they would be best planned together.

Smallmouth Bass Spawning Habitat

Hydropower project operations can create unstable water levels, which can negatively affect smallmouth bass spawning. If the water becomes too shallow after spawning, eggs can be exposed to the atmosphere, and/or abandoned and not guarded by adult bass. In addition, the water around the eggs can become warm and low in oxygen content, as well as exposed to the action of surface waves.

As discussed in section 2.1.3, *Existing Project Operation*, GLHA proposes to continue to operate the project with minimal impoundment surface fluctuations. Interior and NMFS prefer that the impoundment surface elevations be maintained as close to the top of the flashboards as possible under normal conditions, although NMFS specifies a need to limit the impoundment water level within 1 foot of the flashboards, as proposed by GLHA. Maine DMR's recommendation is consistent with GLHA's proposal, but it

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[89] National Waterline website: http://www.h2oline.com/default.aspx?pg=si&op=235118

does not specify the need to maintain impoundment water levels within 1 foot of the flashboards during normal operations.

Our Analysis

To investigate the potential effects of impoundment fluctuations on smallmouth bass nesting habitat, GLHA conducted smallmouth bass spawning surveys in the project impoundment in 2014 (GLHA, 2015). The 2014 study results indicate that adequate smallmouth bass spawning habitat exists in both the shallow (upper 5 feet) and deeper portions (between 5 and 12 feet) of the project impoundment. Based on the estimated number of nests observed within the available shallow water (280 nests) and deepwater habitat (850 nests),[90] it is evident that a greater proportion of smallmouth bass spawning takes place between elevations 228.0 and 235.0 feet in the impoundment.

Based on the study, the shallower water habitat could be affected by the proposed impoundment drawdown limits. Drawdowns of up to 5 feet below the flashboards could negatively affect a large number of nests. Such a drop would eliminate most of the shallow water spawning habitat. However, as indicated in figure 11, these types of drawdowns are rare and only occur about once per year. Under normal operations, the project impoundment is maintained no more than 1 foot below the flashboards, and usually within 0.2 to 0.5 feet of the flashboards. Thus, under normal operation, smallmouth bass nests would be minimally affected. Further, there is no evidence that the smallmouth bass population has been negatively affected by the drawdowns, which have occurred about once per year under the existing license. Consequently, restricting impoundment drawdowns to those limits proposed by GLHA would have little to no effect on smallmouth bass spawning.

Smallmouth Bass and White Sucker Impingement and Entrainment[91]

At the Mattaceunk Project, there are currently two intake openings per generating unit. Each opening is covered by a trash rack with a 1-inch bar spacing that covers the top 16 feet of the water column (at normal impoundment elevation of 240.0 feet) and a 2.63-inch bar spacing covering the lower 36 feet of the water column. To improve downstream passage for eel, shad, and Atlantic salmon, GLHA proposes to install trash

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[90] Given the limited data (seven nests across three locations), we consider the number of deep water nests to be an estimate.

[91] Impingement and entrainment issues for eel, shad, and Atlantic salmon are discussed below in separate sections where downstream passage of those species is analyzed.

racks with 1-inch clear bar spacing to the full depth of the turbine intakes during the fish passage season.

Our Analysis

Water intake structures at hydropower projects can injure or kill fish that are either impinged on intake screens/trash racks, or entrained through turbines. Larger aquatic organisms (typically fish and larger invertebrates) can be trapped against the intake screens or trash racks by the water flowing into a penstock. This process is known as impingement and can cause physical stresses and/or suffocation that lead to the death of some organisms (EPRI, 2003).

If fish are able to pass through screens or trash racks (i.e., are entrained), fish injury or mortality can result from collisions with turbine blades or from exposure to pressure changes, sheer forces in turbulent flows, and water velocity accelerations created by turbines (Rochester *et al*., 1984). The number of fish entrained and at risk of turbine mortality at a hydroelectric project is dependent upon site-specific factors, including physical characteristics of the project, as well as the size, age, and seasonal movement patterns of fish present within the impoundment (EPRI, 1992).

As discussed in the section *3.3.2.1., Affected Environment, Resident Fish,* smallmouth bass and white sucker are two resident fish species found in the Penobscot River. As part of a 2014 fish entrainment and impingement study, GLHA qualitatively evaluated the entrainment risk for the two species at the Mattaceunk Project (GLHA, 2015). Results of the study indicated that many smallmouth bass and white sucker were of sufficient size to be impinged (table 12), but had a low impingement risk, because they have swim speeds greater than the approach velocity (1.7 fps) in front of the trash racks, which would allow them to avoid contact with the trash racks (table 11).

Table 11. Target species burst swimming speeds.

Life Stage	**Target Species**	**Size Range (inches)**	**Burst Swim Speed**	
			fps	**Reference**
Adult	Smallmouth bass	10-15	3.2 – 7.8	Bunt *et al*., 1999
	White Sucker	7-15	4.96	Hunter and Mayor, 1986
Juvenile	Smallmouth bass	4	2.6 - 3.6	Webb, 1998

For fish small enough to pass through the trash racks, entrainment risks were found to be moderate to high, because both smallmouth bass and white sucker were observed in the vicinity of the intake year-round. For smallmouth bass, entrainment risk was predicted to be highest in the summer months when juveniles less than 6 inches in length would be common. However, most sizes of smallmouth bass (i.e., those 4 inches and larger) could avoid entrainment with burst speeds of 2.6 fps or greater (table 11). For white sucker, entrainment risk was predicted to be greatest during the early summer, and fall-winter months when juvenile or sub-adult fish less than 8 inches would be common. Like the smallmouth bass, many white sucker would be able to avoid entrainment with a burst speed of 4.96 fps. The proposed installation of full-depth trash racks with 1-inch bar spacing would further decrease the vulnerability to entrainment by excluding smallmouth bass 8 inches in length or longer and white suckers 7 inches in length or longer (table 12).

Table 12. The minimum lengths of smallmouth bass and white sucker that would be excluded by the upper 1-inch clear spacing trash racks, and lower 2.63-inch clear spacing trash racks.

Target Species	Maximum Size Reported (inches)	Minimum Size (inches) Excluded at Respective Trash rack Clear Spacing	
		1	2.63
Smallmouth bass	25	8	21
White sucker	25	7	18

As described above, the impoundment supports thriving white sucker and smallmouth bass populations, and the project area is known to provide some of the best smallmouth bass fishing in the eastern United States. Given the quality of the existing populations that occur under current and proposed project operations, the qualitative arguments for a low risk of entrainment or impingement under current and proposed operations, and some potential additional benefit from the proposed installation of full-depth trash racks with 1-inch bar spacing, the project would continue to provide adequate protection from impingement and entrainment of smallmouth bass and white sucker.

Upstream Eel Passage

GLHA proposes to develop, install, and maintain (in consultation with Interior and NMFS), on a seasonal basis, an upstream eel passage facility within 2 years of the effective date of the new license. Interior, in its fishway prescription, requires that GLHA design and construct an upstream eel passage ladder at the west abutment of the spillway within 2 years of license issuance, consistent with the FWS's eel passage design criteria.[92] Interior also requires that GLHA's upstream eel ladder be designed to pass 90 percent of the eel entering the ladder within 24 hours (*see* Sweka *et al*., 2014), and operate the eel ladder from June through August. Finally, Maine DMR recommends that

[92] *See* 2017 Fish Passage Engineering Design Criteria Manual (FWS, 2017a).

GLHA install an upstream passage facility for eel at the Mattaceunk Project with 2 years of license issuance, and operate it from June 1 through September 15.

Our Analysis

Currently, upstream fishways for juvenile eel exist at the downstream West Enfield and Milford Dams and at the upstream Medway Dam, but none are provided for juvenile eel at the Mattaceunk Project. Thus, upstream migrating juveniles (elvers and yellow eel) are affected by the presence of the Mattaceunk Project.

Juvenile eel reaching the Mattaceunk Project must climb over or around the project dam. During the 2014 upstream eel passage evaluation, GLHA observed a total of 456 juvenile eel searching for passage over the project dam along the right descending bank (west abutment of the spillway). In addition, juvenile eel have been observed using the existing upstream fishway (designed to pass Atlantic salmon). The presence of adult eel upstream of the project confirms that eel do ascend the project, to some extent. However, while an increasing number of juvenile eel are ascending the West Enfield and Milford Dams downstream, no juvenile eel have ascended the Medway Dam upstream,[93] suggesting that there are some differences in the relative abundance of eel between the upper and lower Penobscot River.

While climbing over or around dams is a well-documented behavior for juvenile eel (GMCME, 2007), the climbing ability of eel declines as they grow longer than 4 inches (Legault, 1988). In its final license application for the Mattaceunk Project, GLHA stated that eel observed during the night-time upstream eel passage survey were primarily between 5 and 8 inches long. However, the eel observed during the night-time surveys ranged in length from 4 to 24 inches, suggesting that the existing route(s) for passage at the project may not be effective for most eel that reach the project dam. A dedicated upstream eel passage facility at the project would increase upstream passage effectiveness and improve access to upstream habitat. Operating the facility from June through September 15 encompasses the time when the majority of the juvenile eel are expected to migrate upstream at the project, and is consistent with the operational period of upstream eel fishways at other mainstem Penobscot River projects.

As part of its proposal, GLHA provided a conceptual design for an upstream eel passage ladder (GLHA, 2015; *see* Appendix F, Attachment F.2). The ladder would be located adjacent to the west abutment of the dam's spillway, along the right descending bank, where the majority of the observed juvenile eel staged and ascended the project dam during the 2014 night-time eel survey. GLHA's conceptual design would enhance the attraction of juvenile eel to this area by providing a more consistent attraction flow than the current leakage flow. In addition, the proposed ramp would provide protection

[93] *See* Interior's Preliminary Fishway Prescription at 16.

from predation and desiccation and would improve the passage effectiveness over current conditions. Thus, locating the eel ladder in this location would provide the best opportunity for improving the ability of eel to migrate upstream of the dam, and enhancing the eel population in the Penobscot River.

GLHA would design, install, and maintain the upstream eel passage facility in consultation with the fisheries agencies. Such consultation would ensure that the plans include effective design concepts and criteria used at other dams, while considering the conditions and constraints at the Mattaceunk Project.

Downstream Eel Passage

GLHA proposes to implement measures for downstream eel passage at the Mattaceunk Project, beginning the first passage season following license issuance. The measures include: (1) implementing annual night-time turbine shutdowns from 8:00 pm to 4:00 am;[94] and (2) opening the project roller gate.[95] In addition, GLHA proposes to install full depth trash racks having 1-inch clear bar spacing (*see* measures included in the Species Protection Plan for Atlantic salmon; section 3.3.4, *Threatened and Endangered Species*).

Interior's fishway prescription, would require that GLHA (a) shut down all generation nightly (8:00 pm to 4:00 am) from August 1 through October 31 to provide out-migrating eel safe and timely downstream passage, and (b) install full-depth trash racks with 1-inch spacing. The condition would also require that GLHA operate the Mattaceunk Project and the downstream eel passage measures such that survival of adult (silver) eel exceeds a minimum downstream survival efficiency criterion of 76 percent.[96]

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[94] The annual schedule for providing downstream eel passage would be developed in consultation with the resource agencies and be based on a predictive model for eel movement through the project. In the interim, GLHA would implement a night-time shutdown period (8 pm to 4 am nightly) for up to 6 weeks, beginning as early as the first significant rain event (1 inch or greater of rain) occurring on or after August 15. The night-time shutdown period, however, would start no later than September 15. This schedule could be modified based on the predictive model, and after consultation with the resource agencies.

[95] The gate setting would be adjusted to maintain stable impoundment levels.

[96] The performance standard is based upon Sweka *et al*. (2014), which indicates that survival of silver eel passing three to four dams (33 percent cumulatively) must exceed a minimum of 76 percent at each dam, and must be higher to rebuild eel populations.

Maine DMR recommends that GLHA, beginning the first passage season following license issuance, institute annual night-time turbine shutdowns (from 8:00 pm to 4:00 am), in combination with opening the project's roller gate and installing full-depth trash racks having 1-inch clear bar spacing. Maine DMR also recommends that downstream passage for eel be provided from August 1 through October 31. The downstream passage season for eel could be modified based on the results of the 2-year effectiveness study.

Our Analysis

In New England, adult eel out-migration typically occurs from mid-August to December (Haro *et al*., 2003; GMCME, 2007). Adult eel often move downstream in pulses with large numbers of eel moving during short periods of activity followed by longer periods with relatively little movement (EPRI, 2001). Peak movements often occur at night during periods of increasing river flow (Richkus and Whalen, 1999). Other environmental cues, such as local rain events and moon phase, may also encourage downstream movement of out-migrating eel (EPRI, 2001; Haro *et al*., 2003).

Under existing project conditions, downstream routes for adult eel migrating through the project area include passing over the spillway when the project spills, through the upstream fish ladder and log sluice when they are being used, or through the turbines during generation. Data collected at USGS gage numbers. 01034500 (located downstream from the project) and 01030500 (located upstream of the project), indicate that the project spills about 7.5, 8.5, 22.5, 20.5, and 21.0 percent of the time in August, September, October, November, and December, respectively. While the license application provides information on the hydraulic capacity of the log sluice (estimated to be 690 cfs, or 9 percent of the station's hydraulic capacity), it does not describe frequency of operation of the structure; therefore, it is unclear how often this route may be available to eel migrating downstream. Regardless, because the turbines have a hydraulic capacity of 7,438 cfs, and GLHA generally passes all river flow through the project turbines when possible, turbine passage is the most likely downstream passage route during the adult eel migration period from August to December.

Estimates of survival for adult eel passing through turbines are highly variable and range from 0 percent to 94 percent (EPRI, 2001). Factors that can influence downstream passage survival include eel size (Richkus and Dixon, 2003) and turbine design (EPRI, 2001).

GLHA conducted a fish entrainment and impingement study for the Mattaceunk Project in 2014 (GLHA, 2015). As part of the study, GLHA evaluated the qualitative entrainment risk for several target species, including eel. Based on this evaluation, GLHA determined that the existing upper trash rack with 1-inch clear bar spacing would exclude an eel with a length of 27 inches or greater from entrainment. The lower portion of the trash rack, which has a clear bar spacing of 2.63 inches, provides no protection, and all eel would be vulnerable to entrainment. Adult eel in the Penobscot River range in size from 24 to 30 inches.

As part of the entrainment and impingement study, GLHA also estimated whole-station survival for target diadromous species, including eel, using parameters that included operations, hydrology, downstream migration periodicity, turbine blade strike survival rates, empirical spillway survival, bypass survival, and bypass effectiveness data. The whole station survival was determined for each month of the eel's out-migration season, then combined for an overall whole-station out-migration survival estimate for the species. Varying inflows representing dry, wet, and normal years were applied to this evaluation, which translated into developing individual estimates for the 75, 50, and 25 percent monthly exceedance flows. The estimated whole-station survival for adult eel (24-30 inches in length; and during flow out-migration months of July-November) was 80.2, 80.6, and 80.3 percent for the 75, 50, and 25 percent exceedance flows, respectively.

Based on the results of entrainment study (GLHA, 2015), the Mattaceunk Project has the potential to adversely affect downstream adult eel (silver eel) passage at the project. Silver eel have a relatively high risk of entrainment at the project because of their benthic-orientation in out-migrating, and their likelihood to pass through the lower trash racks that have a clear bar spacing of 2.63 inches. Empirical entrainment rate information for eel suggest that rates are higher in the late summer to winter time periods, with individuals greater than 10 inches composing the majority of the eel.

GLHA's proposed measures would enhance downstream eel passage effectiveness and minimize potential entrainment of eel at the project. Opening the project roller gate would increase spill during the eel downstream passage period. Because eel tend to exhibit greater attraction to bypasses located near the river bottom (Haro *et al*., 2000; Durif *et al*., 2003; Brown *et al*., 2009), it is likely that the roller gate would be more effective than surface spill, because it has a lower-level release point than the sluice gate or any other surface release structure (e.g., roller gate spill elevation is 221.0, and the surface release elevation is 240.0 feet). However, projects on the Kennebec River typically use surface spill, combined with other measures, to provide interim downstream eel passage. This suggests that a deeper release point may not be critical to providing improved downstream passage survival.

Trash racks with 0.75-inch or 1-inch clear bar spacing, or overlay screens, are used at some hydropower projects during the downstream eel migration season to reduce turbine entrainment of adult eel. The existing trash racks at the Mattaceunk Project have 1-inch clear bar spacing that covers the upper 16 feet of the intake area, and 2.63-inch clear bar spacing that covers the remaining lower portion of the intake area. The 2.63-inch spaced bar racks would not prevent adult eel from passing into the turbines, because adult out-migrating eel are more likely than not to approach the project intake lower in the water column. However, GLHA estimates that eel have low impingement and entrainment risk because the sustained swimming speed of an adult eel exceeds the project's intake velocity. Notwithstanding the swimming speed argument, we would expect that most eel are passing through the project turbines since this is the primary downstream passage route available for most of the August to December period. Installation of new trash racks or overlay screens that have 1-inch clear bar spacing and cover the full depth of the intake would reduce entrainment. This structural enhancement, along with providing a low-level passage route, which GLHA proposes to provide by opening the project's roller gate, would likely enhance the overall survival of downstream migrating eel.[97]

Several hydropower projects in New England and the Mid-Atlantic use temporary shutdowns as a protective measure for eel migrating downstream because the cost of lost generation is less than the cost of building and maintaining permanent downstream eel passage and protection structures. Nightly shutdowns would fully protect eel migrating downstream through the project area from turbine entrainment injury and mortality, although some injuries and mortalities could occur from the corresponding increased spillway passage. In implementing nighttime shutdowns, some projects institute 24-hour shutdowns for the entire migration season, while others only shut down from dusk to dawn during the period of peak migration based on site-specific monitoring or information from upstream projects (Richkus and Whalen, 1999).

GLHA and the resource agencies state that nighttime shutdowns are an effective measure for protecting out-migrating adult eel. FWS, in its section 18 fishway prescription, requires that GLHA shutdown all generation nightly (8:00 pm to 4:00 am) from August 1 through October 31 annually. Maine DMR, in its section 10(j) recommendation, concurs with FWS's seasonal operating schedule. GLHA, however, proposes to develop the seasonal operating schedule in consultation with the agencies, and based on a predictive model for eel movement through the project. In the interim GLHA would implement a night-time shutdown period of up to 6 weeks (8:00 pm to 4:00 am nightly) as early as the first significant rain event (defined as greater than 1 inch of precipitation) occurring on or after August 15, but that the nighttime shutdown period will start no later than September 15 in years that a significant rain event does not occur during the August 15-September 15 time period.

[97] The out-migration of adult eel in the Penobscot River has been enhanced by the installation of downstream passage facilities at the Milford, Orono, and Stillwater Projects that include full-depth trash racks with 1-inch clear bar spacing and downstream bypasses with surface and deep openings. *See* Maine DMR May 16, 2017 Comments at 8.

The protective benefits of shutting generation down, annually, through the entire out-migrating season depends upon the degree to which the eel population (a) migrates downstream at night during the fall, (b) migrates during the specified out-migration period, or (c) migrates at all in a particular year. Studies on the Shenandoah River showed that downstream migration, which predominantly occurred in the fall, may not occur every year (Eyler *et al.*, 2016). Implementing a nightly shutdown, then, may be inefficient at reducing eel mortality, and would cause unnecessary turbine shutdowns and associated generation losses (Eyler *et al.*, 2016).

Downstream eel migration is known to occur largely in episodic events based on environmental cues such as increased river flows following rain events, cooling temperatures, and moon phase. Thus, timing shutdowns based on site-specific eel monitoring data and environmental conditions could substantially reduce project-related eel mortality, while also reducing the cost of lost generation (Haro *et al.*, 2003). Recent studies conducted in the lower Penobscot River, as well as information provided by the Maine DMR appears to support this conclusion. For example, a 2015 qualitative study conducted at the downstream Stillwater Project showed that during the 7 week study period,[98] 86 percent (33 of 36) of the eel observed passed downstream during the week of September 27 – October 3. In fact, 97 percent (30 of 31) of the eel passing the project were observed over a 5-hour period on September 30 during a rain event. In addition, according to Maine DMR's monthly silver eel out-migration data,[99] 80.7 percent of the silver eel in Maine migrate downstream during September and October. An additional 11.6 percent migrated downstream in August. These August eel migrations are likely to occur during the last 2 weeks of the month as the peak migration builds into September.[100] This trend is also supported by multiple silver eel migration studies conducted at the upstream Medway Project, which we described previously in this draft EA.

GLHA proposes to target night-time shutdowns for downstream eel passage based on a predictive model that considers environmental variables that are expected to occur in late August (beginning August 15), September, and/or October. The goal is to protect downstream migrating eel, and to reduce unnecessary lost generation during periods of time when eel are not migrating. The use of a predictive model is an accepted practice

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[98] Downstream passage of adult eel was monitored at the Stillwater Powerhouse B from August 30 to October 17.

[99] *See* Maine DMR's May 22, 2017 Filing at 8 (Figure 1) and Attachment A of Interior's May 23, 2017 Filing at 11 (Figure 2).

[100] *See* GLHA's July 7, 2017 Filing at 30.

that is being used, for example, to protect downstream migrating eel on the Shenandoah River (Smith *et al.*, 2017).[101] FWS suggested the use of a predictive model in the 2015 American Eel Biological Species Report Supplement.[102] Based on available information, implementing such an approach (with the use of a cut-off probability value), along with opening the project's roller gate and the addition of full-depth trash racks with 1-inch clear bar spacing, is expected to reduce mortality of downstream-migrating eel, as well as lost power generation.

GLHA proposes to consult with the resource agencies in developing the predictive eel out-migration model. This consultation would assist in the successful development and implementation of the predictive modeling approach. The cut-off probability value, as well as the environmental triggers for shutting down project operations and for restarting operations should be identified during the consultation. In addition, the mechanism for measuring the success of implementing the predictive model, both in terms of eel passage and lost generation, should be identified.

Finally, GLHA's proposed effectiveness monitoring, which is discussed more fully below, would provide a mechanism for GLHA and the resource agencies to identify the need for model refinements, and determine the period of time the project's generating units would be shut down to aid in downstream eel passage. The goal of such monitoring would be to improve the overall performance of the downstream passage system for eel.

The Penobscot Indian Nation comments that the measures proposed by GLHA and prescribed/recommended by the resource agencies will not be enough to protect the Penobscot River eel population. The Penobscot Indian Nation states that recent out-migrating data from the Shenandoah River in Virginia/West Virginia shows that: (1) only 50 percent of the eel migrated past the dam(s) during the September 15th to December 15th shutdown periods; and (2) eel out-migrate from the system during 11 months of the year. This may be true for the Shenandoah River and the mid-Atlantic

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[101] The predictive model for the Shenandoah River attempts to predict the fraction of the potentially migrating eel moving on a given day, where eel movement is modeled as a function of (a) the time of year, (b) the lunar phase, (c) the discharge rate, and (d) the eel stock (or the population within the river system subject to migrating past the hydropower station). The reduction in eel mortality is dependent upon the cut-off probability value chosen, which is the probability where a decision is made to cut off the generating units.

[102] *See* American Eel Biological Species Report Supplement to: Endangered and Threatened Wildlife and Plants, 12-Month Petition finding for the American eel (*Anguilla rostrata*). Docket No. FWS-HQ-ES-2015-0143.

region, but it does not appear to be the case on the Penobscot River or in New England. For instance, analysis of migration timing data from multiple Maine rivers shows that more than 92 percent of the adult silver eel out-migrated in the months of August, September, and October.

The Penobscot Indian Nation indicates that a predictive model needs to be developed, and the duration of nighttime shutdowns be extended for all months with no spill occurring at the dam, as well as for those months identified by the predictive model.[103] We interpret this to mean that the project would cease generation at night for the entire month for which there would be no spill occurring at the dam for any portion of the month. Based on our review of the project's flow duration curves, this would require GLHA to cease generation at night for all 12 months, as every month there are periods of no spill. Given the substantial reduction in annual generation that would occur under this measure, and that the measure would only protect less than 10 percent of the outmigrating eel population, we do not consider this a reasonable measure and eliminate it from further analysis.

Timing of Downstream Eel Passage Implementation

GLHA proposes to implement downstream eel passage measures beginning the first downstream eel passage season after license issuance, which would involve: (1) seasonally ceasing generation from 8:00 pm to 4:00 am; (2) opening the project's roller gate; and (3) installing, within 2 years after license issuance,[104] full-depth trash racks having a 1-inch clear bar spacing (*see* measures included in the Species Protection Plan for Atlantic salmon; section 3.3.4, *Threatened and Endangered Species*). Interior, in its section 18 fishway prescription, requires that GLHA provide downstream passage for eel, including installing full-depth trash racks with 1-inch clear bar spacing, but does not specify a timeframe for providing the measures. Maine DMR recommends that GLHA provide downstream passage for eel beginning the first passage season following license issuance, including night-time generation shutdowns in combination with opening the project's roller gate and installing full-depth trash racks with 1-inch clear bar spacing.

[103] *See* Penobscot Indian Nation's May 23, 2017 filing at 13.

[104] This timeframe is consistent with that required by NMFS in its fishway prescription.

The actual measures proposed by GLHA and recommended by the agencies for providing downstream eel passage appear to be consistent. However, there are differences as to the timing for when the measures are implemented.[105]

Our Analysis

The number of adult eel upstream of the project dam is unknown, but appears to be low based on the available data. GLHA conducted an eel passage study at the Mattaceunk Project in 2014. A total of about 456 juvenile eel were observed during the study, but the actual number passing the dam is unknown. In addition, passage studies at the upstream Medway Project provided additional insights into the number of adult eel found upstream of Weldon Dam. For example, the Medway upstream eel ladder, which began operation in 2001, passed 69 eel in its first 5 years of operation, and none since 2008. Also, few confirmed out-migrating silver eel have been collected during downstream passage studies at the Medway Project. This information could indicate that the lack of efficient upstream passage at the Mattaceunk Project may contribute to low eel abundance in upstream waters.

The proposed upstream eel ladder, which would be installed within 2 years of license issuance, should improve upstream passage conditions and efficiency of juvenile eel at the Mattaceunk Project, which ultimately would increase the overall eel population upstream of the project. However, the eel passing upstream via the new eel ladder would not migrate back downstream as adult silver eel until at least 2030.[106] Nonetheless, eel presently occupy habitat upstream of Weldon Dam, though numbers are currently low. Given the low numbers, downstream eel passage measures do not appear necessary at the Mattaceunk Project during at least the first year after a new license would be in effect.

The downstream eel passage measures proposed by GLHA may not sufficiently protect downstream migrating adult eel if they are not all implemented in the same passage season. For example, downstream-migrating adult eel tend to migrate low in the water column. Such behavior would result in eel continuing to enter the project's intake should full-depth trash racks not be in place at the same time generation shutdowns and

[105] GLHA proposes to implement downstream eel passage measures beginning the first passage season following license issuance, yet would not install the full-depth trash racks until year 2 of the license. Maine DMR recommends GLHA implement all downstream eel passage measures beginning the first passage season after license issuance, including the trash racks.

[106] The majority of eel in Maine waters (about 95 percent of the females and 70 percent of the males) become mature at 12 years of age and out-migrate to spawn (Oliveira and McCleave, 2000).

opening the project's roller gate are employed. This could potentially result in (a) turbine entrainment and mortality,[107] or (b) migration delays or a complete failure to pass downstream. Thus, implementing the proposed downstream eel protection measures, during the second passage season, as a combined strategy, would be the most biologically beneficial or effective approach to enhancing the eel population in the Penobscot River, while also minimizing the cost of providing downstream eel passage at the project.

Eel Passage Effectiveness Studies

GLHA proposes to: (1) monitor the seasonal upstream eel ladder for use and effectiveness for one eel passage season; and (2) monitor the effectiveness of the annual nighttime turbine shutdowns and roller gate opening for passing downstream migrating silver eel for two passage seasons. Interior, in its fishway prescription, requires that GLHA develop upstream[108] and downstream[109] eel passage effectiveness plans. Maine DMR recommends that GLHA monitor the effectiveness of the installed upstream fish passage facility for 1 year and the downstream eel passage measures for 2 years.[110]

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[107] The effectiveness of the open roller gate would be compromised, since there would not be a protective guidance system in place.

[108] The upstream eel passage effectiveness plan would consist of: (1) evaluating attraction efficiency to the facility; and (2) evaluating effectiveness of passing eel that have entered the upstream eel passage structure. Attraction efficiency would be assessed with night-time observations of migrating eel at the project in comparison to the number of eel passed. Passage effectiveness (targeted at 90 percent) would be based on the number of eel that enter the facility and ultimately pass through the facility within 24 hours.

[109] Downstream eel passage effectiveness would be assessed with radio-telemetry to determine migratory delay, route of downstream passage, immediate survival, and later survival passing the project. The project would be required to meet a 76-percent adult survival rate for downstream passage. If the established survival rate is not met, the plan would include a provision to assess additional passage enhancements (e.g., extended passage season, 0.75-inch trash rack spacing, a deep bypass gate, or new downstream passage facilities that incorporate angled trash racks.

[110] Maine DMR recommends that GLHA implement additional operational and structural modifications and/or habitat enhancement measures, if necessary, to improve eel passage at the Mattaceunk Project. Maine DMR's recommendation is not specific with regards to specific measures to be implemented, and, thus, is premature. Nonetheless, any effectiveness plan(s) developed for eel passage at the project could

Our Analysis

Upstream and downstream eel passage effectiveness studies would verify whether any eel passage measures implemented are providing safe, timely, and efficient passage. Passage effectiveness studies typically evaluate factors such as attraction flows, attraction efficiency, passage efficiency, passage delay, and survival rates. This type of information could help guide modifications to the design or operation of any eel passage measures, and potentially improve upstream or downstream eel passage effectiveness at the project.

Eel Passage Facility Operation and Maintenance Plan

Interior's fishway prescription would require that GLHA develop a fishway operation and maintenance plan for the upstream and downstream passage measures proposed for eel. The condition would also require annual plan updates, reflecting any changes in fishway operation and maintenance planned for the upcoming year. Maine DMR recommends that GLHA develop eel passage operating procedures and an operation and maintenance plan for any upstream and downstream eel fishways or measures implemented at the Mattaceunk Project.

Our Analysis

GLHA has an existing plan that covers the operation and maintenance of the existing fishways for Atlantic salmon. GLHA proposes to continue to implement this plan. However, the plan does not address the operation of eel passage facilities at the project, nor does Great Hydro propose to develop such a plan, or modify the existing plan, for eel passage at the project.

Most fishways require operation and routine maintenance to ensure the fishways operate effectively. An operation and maintenance plan would ensure that routine cleaning and maintenance, including debris removal, are performed so that the eel fishways operate as intended. In addition, the plan would ensure that any eel fishways constructed at the project would be operated during the appropriate times of the day and year, and with an appropriate conveyance flow.

Upstream Shad Passage

Fish passage and associated restoration efforts for diadromous fishes in the Penobscot River Basin are guided by the Maine DMR and Maine DIFW (2008) strategic plan. This plan involves a two-phased approach to restoring runs of diadromous fishes, including shad, on the Penobscot River. The first phase has been completed with the

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include a provision for modifying project facilities/operations to facilitate eel passage at the project, which would ensure that established performance criteria are met.

removal of Great Works and Veazie Dams on the lower river in 2012 and 2013, respectively, and the installation of a fish lift at the Milford Project in 2014. These efforts have increased access to 56 miles of mainstem spawning habitat for shad between the old Veazie Dam and the West Enfield Project. The second phase of the strategic plan (present day through year 2032) involves monitoring the population response of shad to this increased spawning habitat and if needed, installing additional fishways or modifying existing passage facilities at dams located farther upstream, including Weldon Dam at the Mattaceunk Project (*see* Objective 2.2; Maine DMR and Maine DIFW, 2008).

The pool-and-weir fishway at the Mattaceunk Project is unable to effectively pass shad upstream because the fishway was designed for salmon, not shad. Specifically, the fishway has plunging flows created by the 14-inch head drop between pools and a steep gradient (approximately 45 degrees). Because they are weaker swimmers than salmon and not jumpers, shad have difficulty ascending such fishways (Larinier and Travade, 2002). As a case in point, river herring were observed in the project fishway in May and June of 2016, but did not successfully pass upstream as they were not collected in the fish trap above the dam and appeared to have abandoned their migration attempt.[111]

The applicant proposes to continue to operate and maintain the existing pool-and-weir fishway designed to pass Atlantic salmon and also proposes to install and operate an additional (second) upstream fishway that is suitable for passing shad. The shad fishway would be installed in year 15 of any new license issued for the project and would be operational in year 16. Accordingly, under this proposal, starting in year 16 of a new license, there would be two upstream fishways operating at the project: (1) the existing pool-and-weir fishway designed to pass salmon and (2) a fishway designed to pass shad and secondary species, including sea lamprey. NMFS, Maine DMR, and Maine DEP recommend the installation of a shad fishway in year 15 of any new license. NMFS further requires the shad fishway to be operational in year 16 of a license (Maine DMR and Maine DEP do not specify a recommended operational date for the fishway). In addition, NMFS requires, and Maine DMR recommends, that the shad fishway be operational from May 1 through July 31 of each year.

Several participants, including the Penobscot Indian Nation, ASF, and Bruce Haines, recommend that the shad fishway be installed sooner than 15 years after license issuance, because shad are currently present in the project area. However, none of these participants recommended a specific timeline for installation.

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[111] See exhibit E of final license application; see letter filed by NMFS on May 23, 2017.

Our Analysis

The middle portion of the Penobscot River, to which shad now have increased access, can support a considerable number of spawning adults. Specifically, based on a production estimate of 111 American shad per acre (Maine DMR and Maine DIFW, 2008), the 53 miles of mainstem habitat between the Milford and Mattaceunk Projects could support 266,820 adult American shad.[112] Yet, current run sizes of adult shad are only on the order of a few thousand fish per year—between 1,806 and 7,862 shad at Milford from 2015 to 2017 (table 13). These run sizes constitute less than three percent of the production potential of the mainstem spawning habitat between the Milford and Mattaceunk Projects. Therefore, the spawning habitat below Mattaceunk appears underutilized at this time and could support considerably more spawners.

The passage efficiency of shad at the West Enfield Project (located between Milford and Mattaceunk, see figure 1) appears low and likely represents a bottleneck to passage farther upstream. Although quantitative monitoring data are only available for one passage season (May-August 2016[113]), the apparent passage efficiency[114] at this facility is just 1.9 percent—only 149 of the 7,862 shad[115] passing through the Milford fish lift in 2016 successfully passed the vertical slot fishway at West Enfield (HDR, 2017). While some adults may have entered one of the two intervening tributaries to spawn (the

[112] We did not estimate the production potential of blueback herring because there are no production estimates available for that species. Nor did we estimate the production potential of alewives for this portion of the river because they primarily spawn in lake habitats, not in the mainstem.

[113] The current license for West Enfield does not require fish passage monitoring. Rather, this one-year study was conducted by the licensee to support fisheries management and restoration efforts for anadromous fish on the Penobscot River.

[114] We define "apparent passage efficiency" as the number of fish passed upstream through the fishway of interest expressed as a percentage of the total number of fish passed at the next dam downstream.

[115] A portion of the alewife run at Milford likely includes offspring from adults stocked into spawning (lake) habitats downstream of West Enfield. When these offspring return to the river to spawn themselves (~4 years later), they would be expected to migrate only as far upriver as their natal (rearing) habitats (i.e., they would not be motivated to migrate as far upstream as West Enfield). Nor were river herring counts provided at the species level at the West Enfield facility. For these reasons, we did not estimate the passage efficiency of alewife or blueback herring at the West Enfield fishway.

Piscataquis or Passadumkeag Rivers), the apparent passage efficiency at West Enfield is considerably lower than that observed on a similar span of the Connecticut River (i.e., a 20-mile-reach between Turners Falls Dam and Vernon Dam that also contains two intervening tributaries [the Vernon Dam is located at RM 142 and is the third dam on the mainstem]). Specifically, from 2014-2016, the modified ice-harbor-fishway at the Vernon Project (FERC No. 1904) successfully passed 66 to 69 percent of the shad (FWS, 2017b) passing upstream through the Turners Falls Project (FERC No. 2602). Therefore, even if run sizes of shad on the Penobscot were to increase, the low efficiency of the West Enfield fishway, in its current state, would inhibit appreciable numbers of migrating fish from reaching the Mattaceunk Project.

Because of the low run sizes of shad compared to the amount of currently accessible and available spawning habitat on the mainstem Penobscot and the low passage efficiency at the next dam downstream (West Enfield), installing a shad fishway at the Mattaceunk Project at this time would provide minimal benefit to shad. Furthermore, there are many unknowns that make it difficult to predict whether there will be enough fish seeking passage past the Mattaceunk Project 15 years from now that warrants the installation of a shad fishway; these include: (1) the response of the population to the improved access to spawning habitats between Veazie and West Enfield in terms of both population size and spawning distribution within the river, (2) potential changes in the efficiency of fishways at downstream projects including West Enfield, and (3) potential changes in ocean mortality. However, 14 years from now, the need for a shad fishway at the Mattaceunk Project could be re-assessed and based on more current information and population status at that time. If, in 14 years, a shad fishway is deemed necessary and installed at the Mattaceunk Project (in year 15), it would provide American shad and blueback herring access to an additional 30 miles (13 percent) of spawning habitat in the upper Penobscot River Basin (Maine DMR and DIFW, 2008), primarily consisting of the East Branch of the Penobscot River upstream to its confluence with Wassataquoik Stream.[116] However, the installation of a shad fishway would provide little to no benefit to alewives because less than 1 percent of their lake spawning habitat in the Penobscot Basin is located upstream of the Mattaceunk Project.

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[116] Although shad are historically documented to occur in the West Branch of the Penobscot River, this branch is currently inaccessible and not targeted for diadromous fish restoration as the first 15 miles of the West Branch contains five hydropower dams, only one of which, the lowermost at Medway, provides fish passage via an eel ramp, which shad cannot ascend.

Table 13. Annual counts of adult shad passed upstream of the Milford Project via the fish lift that became operational in April 2014.

Year	American shad	Blueback herring	Alewife	Combined River Herring (blueback + alewife)
2014	812	44,597	142,841	187,438
2015	1,806	207,237	382,503	589,740
2016	7,862	697,882	561,502	1,259,384
2017	3,868	N/A	N/A	1,256,061

(Sources: Maine DMR, 2017a; Maine DMR, 2017b).

Although the type of fishway that would be installed at the Mattaceunk Project has not been specified, the situation is similar to the Milford Project, where a second upstream fishway (fish lift) was added to a dam containing an existing fish ladder designed for salmon. The Milford fish lift took approximately 18 months to construct. Therefore, the requirement by NMFS that the new fishway at the Mattaceunk Project be operational within two years of commencing fishway construction appears feasible.

Upon its completion, Maine DMR recommends and NMFS requires that the shad fishway operate from May 1 to July 31 of each year. This period encompasses the reported upstream migration period for shad in this region (Loesch, 1987; Saunders *et al.*, 2006). Therefore, operating the shad fishway for upstream passage from May 1 to July 31 would provide adequate opportunities for shad, particularly American shad and blueback herring, to pass upstream of the project and access additional spawning habitat.

Downstream Shad Passage

The existing downstream fish passage facility—surface bypasses integral with turbine units 3 and 4—is currently operated from April 1 to June 15 and October 17 to December 1 for salmon smolt and kelt passage. To accommodate downstream shad passage upon completion of the shad fishway (expected in year 16 of a license), GLHA proposes to extend the operation period of the existing downstream passage facility to include the period from June 1 through December 1, as needed based on the results of monitoring studies of downstream shad passage. GLHA also proposes to open and provide flows of 225 cfs to 690 cfs down the log sluice from June 1 through December 1, as needed, to accommodate the downstream passage of shad upon completion of the upstream fishway. As discussed in sections above, GLHA proposes to install, within two years of the effective date of a new license, full-depth trash rack overlays with 1-inch clear spacing that would extend to the bottom of the intakes. Although they do not specify dates, GLHA proposes to deploy the full-depth 1-inch trash rack overlays during the ‘downstream fish passage season’.

NMFS and Maine DMR[117] both recommend extending the operation season of the existing downstream passage facility to include the period from June 1 through December 1 and also open the log sluice during this timeframe to accommodate the downstream passage of shad once the upstream shad fishway would be operational. NMFS further states that the period of operation for downstream passage of shad may be modified based on new information and agency consultation. In addition, NMFS and Maine DMR both recommend the installation of full-depth trash racks with 1-inch clear spacing. However, NMFS requires these full-depth trash racks be installed within 2 years of license issuance, while Maine DMR recommends the trash racks be installed during the first downstream passage season after license issuance.

The Penobscot Indian Nation states that the existing downstream passage facility does not protect out-migrating shad or keep them out of the project turbines, but provides no specific recommendations for improvements to the existing downstream passage facility.[118] ASF states that downstream fish passage measures for shad should be implemented sooner than 15 years post-license issuance, because the current lack of dedicated downstream passage for river herring at the Mattaceunk Project will likely preclude stocking efforts above the project, which could start as soon as 2020 based on current population trajectories.[119]

Our Analysis

<u>Downstream Fishway Operations Schedule</u>

In Maine, shad migrate downstream from mid-summer through fall. Most adult shad in this region are repeat spawners, and after spawning, migrate downstream during May and June (alewives) or June and July (American shad and blueback herring) (Saunders et. al, 2006). Meanwhile, juvenile shad migrate downstream from mid-July

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[117] Although Table 2 in Maine DMR's 10(j) letter indicates that downstream passage for shad would be provided from June 1-November 15, its 10(j) recommendation no. 3 states the downstream fishway should be operated from June 1 to November 30 for shad; therefore, we assume throughout this EA that June 1 through November 30 is Maine DMR's recommended operation period for providing downstream passage for shad. Because the November 30 end date for the downstream operation period for shad passage is just one day earlier than that proposed by the applicant and required by NMFS, we assume this difference is negligible and that the December 1 end date incorporates, and is consistent with, Maine DMR's 10(j) recommendation.

[118] See letter filed by The Penobscot Indian Nations on May 23, 2017.

[119] See letter filed by ASF on May 23, 2017.

through the end of October (Saunders *et al.*, 2006). Therefore, GLHA's proposal to extend the operation of the downstream fish passage facility and log sluice to include the period from June 1 through December 1 includes the reported downstream migration period of juvenile and adult shad, and would therefore, accommodate downstream passage of these species. However, there would be no benefit to requiring these measures in any new license until an upstream fishway for shad is operational.

Regarding the comment by the Penobscot Nation on the difficulty of providing downstream passage, this subject is discussed extensively below. ASF's comment is not considered further because alewives are the only shad species currently stocked in the Penobscot River,[120] and waters above the Mattaceunk Project are not targeted for alewife stocking because they contain less than one percent of the historical spawning habitat in the Penobscot Basin for this species, as discussed above (in *Upstream Shad Passage*).

Trash Racks

Most out-migrating juveniles would likely be entrained through the project turbines during their downstream migration. During the low-flow period in which out-migration occurs (mid-July through October), the project would only be spilling approximately 7 to 18 percent of the time.[121] Therefore, the primary downstream passage routes during the juvenile out-migration period would be through the: (1) turbines, (2) surface bypasses, or (3) log sluice.

From July through October, flows into the surface bypasses of turbine units 3 and 4 would compose only 2.8 to 3.7 percent of the median monthly inflow into the impoundment. Proposed surface flows through the log sluice (225 cfs to 690 cfs) would compose a slightly higher fraction of the total inflow—4.5 to 18.2 percent. However, the bulk of the total inflow, 78 to 93 percent, would pass through the turbines during non-spill periods, mostly through units 3 and 4, which are the first units online and last units offline, and have a combined maximum hydraulic capacity of 3,672 cfs. Given their strong attraction to the bulk flow at hydropower projects (Kynard, 1993; Desrorches *et al.*, 1993), reduced swimming abilities compared to adults (table 14), and small, narrow-bodies that would easily fit through the proposed trash racks having 1-inch bar spacing (table 15), most juvenile shad would likely be entrained through the turbines at the

[120] See letter filed by Maine DMR on May 22, 2017.

[121] Calculation of the percent of time the project would be spilling is based on monthly flow duration curves provided in the final license application for the 1996-2015 period of record and the assumption that spill occurs when reservoir inflows exceed 7,593 cfs, which is the sum of the project's maximum hydraulic capacity (7,438 cfs) and existing conveyance flows for upstream (15 cfs) and downstream (140 cfs) fish passage.

Mattaceunk Project during their downstream migration. Nevertheless, entrainment survival is expected to be high for juvenile shad. For the sizes of out-migrating juvenile shad expected at the project (1.5-5.0 inches across species; Richkus, 1975; Pardue, 1983; O'Leary and Kynard, 1986; Weiss-Glanz *et al.*, 1986), the blade strike model of Franke *et al.* (1997) indicates that at least 95 percent of juveniles would survive passage through the turbines (GLHA, 2016a). In addition, Heisey *et al.* (1992) found that 97 to 98 percent of juvenile American shad survived passage through Kaplan units with characteristics similar to those at the Mattaceunk Project.[122] Therefore, even if juvenile shad are found to predominantly pass through the turbines instead of the presumably safer downstream routes (surface bypasses, log sluice, or occasional spill), whole-station survival at the Mattaceunk Project should be high (greater than 95 percent) for out-migrating juvenile shad, and adequate for the protection of the population.

Given their larger body sizes and greater swimming abilities, the entrainment potential of adult shad is lower than that of juveniles. During their post-spawning migration in riverine habitats, adult shad have been found to primarily travel in the bottom-third (shad) or middle portion (blueback herring) of the water column (Witherell, 1987; Witherell and Kynard, 1990). Spawning blueback herring and alewives are generally greater than 10 inches total length (Loesch and Lund, 1977) and spawning American shad are typically greater than 17 inches total length (Leggett and Carscadden, 1978; Limburg *et al.*, 2003). At the Mattaceunk Project, the bottom portions of the existing trash racks (where out-migrating adults would be expected to travel) have a clear spacing of 2.63 inches; therefore, the existing trash racks would not physically exclude blueback herring or alewives of any size, and would only exclude post-spawning American shad greater than 19.6 inches total length (table 15). However, GLHA's proposal to install full-depth trash racks with 1-inch clear spacing to the bottom of the intakes would reduce entrainment of shad at the project because trash racks with this spacing would physically exclude all post-spawning American shad and blueback herring and alewives larger than 11.4 and 11.6 inches, respectively (table 15). Assuming the installation of full-depth trash racks would not increase the approach velocities at the project, the installation of full-depth trash racks with 1-inch clear bar spacing would not be expected to result in impingement of adult shad because their burst swimming speeds (4 to 21 fps, table 14) greatly exceed the existing approach velocities at the Mattaceunk Project (1.7 fps). Therefore, adults would be able to avoid impingement based on their swimming abilities.

Lastly, adult shad have been noted to become more surface-oriented and initiate searching behavior upon reaching obstructions, such as dams, during their downstream

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[122] The Kaplan units in the Heisey *et al.* (1992) study also had 5 runner blades (same as Mattaceunk), but a larger runner diameter (18 feet vs. 9 feet) and lower rotational speed (109 rpm versus 189.5 rpm) than the units at Mattaceunk.

migration (Desrorches *et al.*, 1993; Kynard, 2003). Therefore, given this exploratory behavior, which is afforded by their greater swimming abilities, adult shad may be more adept than juveniles at locating surface outlets that would provide downstream passage past the Mattaceunk Project (i.e., through the surface bypasses, log sluice, or occasional spill). Still, monitoring the downstream passage of adult and juvenile shad would be necessary to conclusively determine the routes used for passage and their associated survival rates.

Table 14. Reported burst swimming speeds in feet per second (fps) of juvenile and adult shad.

Species (total length, inches)	Burst swimming speed (fps)	Source
Juveniles		
American shad (1-3”)	1.8-2.5	Bell (1991)
Alewife (2.5-3.5”)	0.5-3.0	Bell (1991)
Adults		
American shad (12-14”)	8.0-14.0	Bell (1991)
American shad (17”)	11.0-21.0	Castro-Santos (2005)
Blueback herring (9.5”)	5.8-17.4	Castro-Santos (2005)
Alewife (10.6”)	4.0-14.0	Castro-Santos (2005)

(Source: Staff).

Table 15. Minimum sizes of shad (total length, inches) physically excluded from trash racks with 1-inch and 2.63-inch spacing, based on the body width scaling factors in Smith (1985).

Species	1-inch trash racks	2.63-inch trash racks
American shad	7.4 inches	19.6 inches
Blueback herring	11.4 inches	NE[a]
Alewife	11.6 inches	NE

[a] NE indicates none excluded (i.e., all sizes of a given species could pass through the trash racks) because the minimum exclusion size exceeds the maximum reported sizes for these species: 16 inches for blueback herring and 15 inches for alewife (Bigelow and Schroeder, 1953).
(Source: Staff).

Shad Passage Effectiveness Studies

Upon completion of an upstream shad fishway, GLHA proposes to monitor its use for 2 years and also monitor, for 2 years, the use of the existing downstream passage structures by shad. Two years of upstream and downstream monitoring of shad passage is also recommended by Maine DMR and required by NMFS, upon completion of an upstream shad fishway. Furthermore, NMFS requires that study plans for fish passage monitoring studies of all diadromous fishes (Atlantic salmon, eel, and shad) be developed in consultation with the resource agencies and conducted using scientifically accepted practices, and that monitoring begin at the start of the first migratory season after each fishway facility is operational. NMFS also requires a provision that additional protective measures, including structural or operational modifications of fishways, be implemented, if necessary based on monitoring results, to meet any performance standards that are established for shad by the time the shad fishway is operational.

Our Analysis

Although GLHA proposes to monitor upstream and downstream passage of shad for 2 years once the new upstream fishway is operational, they provide no details on the methodology that would be used. Therefore, developing study plans for passage monitoring studies, in consultation with the resource agencies, would help ensure the data collected is sufficient to determine if any operational or structural modifications are necessary to improve the effectiveness of the fishways and meet any passage performance standards established for shad. Nevertheless, there would be no benefit to requiring monitoring studies in any new license until an upstream fishway for shad is operational.

Fish Passage Operation and Maintenance Plan for New Shad Fishway

Maine DMR, in its 10(j) letter, recommends that GLHA develop and maintain, in consultation with the resource agencies, written operating procedures for fishways at the Mattaceunk Project. Specifically, these operating procedures would include general schedules for routine maintenance, procedures for routine operation, procedures for monitoring and reporting on the operation of each fish passage facility or measure, schedules and procedures for annual start-up and shut-down, and procedures for emergencies and project outages significantly affecting fishway operations. Maine DMR recommends that copies of these written operating procedures, and any revisions made during the term of a license, be provided to the resource agencies.

Our Analysis

With regard to an operation and maintenance plan, GLHA has a plan that covers the operation and maintenance of the existing fishways for Atlantic salmon. GLHA proposes to continue to implement this plan. However, the plan does not cover shad, nor does GLHA propose to develop such a plan, or modify the existing plan, for shad passage at the project.

An operation and maintenance plan for the upstream shad fishway**,** including the operation and maintenance aspects recommended above by Maine DMR, would ensure this new structure is operated during the appropriate times of the day/year and with adequate attraction flows. Such a plan would also ensure that routine cleaning and maintenance, including debris removal, are performed so that the new fishway operates as intended. Changes in the operation of the existing downstream passage structures (e.g., extending the operation season) would occur once the shad fishway is operational. Therefore, revising the FPOMP for the existing downstream passage structures to reflect any such changes would be necessary to ensure that the downstream structures are operating during the appropriate times of the day and year with the appropriate conveyance flows, generally functioning as intended, and clear of debris to facilitate passage.

Upstream Passage for Sea Lamprey

Sea lamprey, like the shad discussed above, are an anadromous species that spends most of its life at sea, but must migrate upstream to freshwater to spawn. As discussed in section 3.3.1.1, *Fish Community, Sea Lamprey*, sea lamprey occur in the Penobscot River, including habitats downstream of the Mattaceunk Project. NMFS recommends that the upstream shad fishway proposed by GLHA (discussed above) be designed to ensure safe upstream passage for sea lamprey.

Our Analysis

As discussed in section 3.3.1.1, *Affected Environment*, sea lamprey have been observed passing upstream of West Enfield Dam (first dam immediately downstream of the project) as recently as 2016, and thus are potentially present immediately downstream from the Mattaceunk Project. Sea lamprey could attempt to use the existing pool and weir fishway, if they desired to migrate upstream of the project. However, sea lamprey are poor swimmers[123] and would likely have difficulty moving through the weirs and up successive pools of the existing upstream fishway, which was designed to create flows and turbulence suitable for strong swimmers like salmon. Thus, it is more likely that they would need an alternate upstream passage to successfully migrate upstream of the project.

NMFS recommends that GLHA provide an alternative to the existing pool and weir fishway to enable safe upstream passage for sea lamprey, but does not specify the benefits of providing upstream passage. Historical accounts indicate that sea lamprey were collected upstream of the project in 1832 and 1903 (Kendall, 1914), but the historical abundance of sea lamprey upstream of the project is not known. Further, the relative abundance and importance of upstream habitat to the historical and existing sea lamprey population is not known. Because the abundance and importance of upstream

[123] Sea lamprey have burst swim speeds of about 6 to 7 fps (Bell, 1991), compared to 16.5 to 19.7 fps for Atlantic salmon (Wolter and Arlinghaus, 2003). Their burst speed is at the lower end of the range of that for shad (see table 14).

habitat is not known, the benefit to passing sea lamprey upstream of the project also is not known and cannot be determined based on available information.

Fish Passage Design, Operation, Maintenance, and Monitoring

GLHA proposes that any structural and/or operational modifications of existing upstream and downstream fishways be conducted in consultation with the resource agencies, and that the design of any new fishways would be reviewed with the resource agencies. GLHA also proposes to conduct upstream and downstream fishway effectiveness studies for passage of eel, shad, and Atlantic salmon (*see* details discussed in section 3.3.2.2, *Eel Passage Effectiveness Studies* and *Shad Passage Effectiveness Studies*, and section 3.3.4.2, *Environmental Effects, Atlantic Salmon*). In addition, GLHA proposes to implement the FPOMP, which defines the: (1) operational period of the existing upstream and downstream fishways; (2) annual start-up and shut-down procedures; (3) opening methods; (4) debris management; and (5) safety rules and procedures.

Regarding the design of fishways, NMFS's fishway prescription would require GLHA to: (1) submit design plans to the resource agencies for review and consultation during the conceptual, 30, 60 and 90 percent design stages; (2) provide conceptual designs to the resource agencies no later than 2 years before the anticipated operational date; (3) provide the resource agencies with conceptual designs for the proposed full-depth trash racks with 1-inch bar spacing at least 6 months prior to the first downstream passage season following issuance of any new license; (4) submit final design plans to the Commission for final approval after resource agency approval and prior to the commencement of fishway construction activities, with all unaddressed resource agency comments; and (5) file final as-built drawings with NMFS and FWS that accurately reflect the project as constructed after the fishway is completed.

Regarding evaluation of fish passage effectiveness studies, NMFS has a fishway prescription that includes provisions for GLHA to: (1) develop study design plans in consultation with NMFS and state and federal resource agencies; (2) seek resource agency approval of the study design prior to filing with the Commission for final approval; (3) complete all monitoring with scientifically accepted practices; (4) begin monitoring at the start of the first migratory season after each fishway facility (Atlantic salmon, shad and eel) is operational, and continue monitoring for the time frames proposed, or as otherwise required; (5) provide reports of the monitoring studies to the resource agencies for a minimum 30-day review and consultation, prior to submittal to the Commission for final approval; and (6) include resource agencies' comments in the annual reports submitted to the Commission for final review.

Interior's fishway prescription would require that GLHA to provide information on fish passage operation, and project generating operation that may affect fish passage, upon written request from the FWS. Interior has a second, related fishway prescription that would require GLHA to provide FWS personnel and other FWS-designated representatives, timely access to the fishways at the project and to pertinent project operational records for the purpose of inspecting the fishways to determine compliance with the fishway prescription.

Maine DMR recommends five general provisions for fish passage operations and maintenance.

- The first provision is for GLHA to operate each fish passage facility for a one-season "shakedown" period to ensure that it is generally operating as designed and to make minor adjustment to the facilities and operation. At the end of the “shakedown” period, GLHA would have a licensed engineer certify that the facility is constructed and operating as designed in all material respects. Further, GLHA would provide the Maine DMR, FWS, and NMFS with a copy of the as-built fishway drawings as submitted to the Commission, along with the licensed engineer's letter of certification.
- The second provision is for GLHA to keep the fishways in proper working order and maintain fishway areas clear of trash, logs, and material that would hinder passage. GLHA would perform routine maintenance sufficiently before a migratory period such that fishways can be tested and inspected, and will be operational during the migratory periods.
- The third provision is for GLHA to draft, in consultation with Maine DMR, FWS, and NMFS, and maintain written fishway operating procedures (FOPs) for the Mattaceunk Project. These FOPs would include general schedules of routine maintenance, procedures for routine operation, procedures for monitoring and reporting on the operation of each fish passage facility or measure, and schedules for procedures for annual start-up and shutdown, and procedures for emergencies and project outages significantly affecting fishway operations. Copies of these FOPs, and any revisions made during the term of the license, would be sent to the Maine DMR, FWS, and NMFS.
- The fourth provision is for GLHA to meet with Maine DMR, FWS, and NMFS in March annually to review fish passage operational data from the previous year, draft an annual report, and develop an operational plan for the upcoming year. The fish passage operational data should include the number of fish passed daily (by species), daily water and air temperature data, and other related fishway operational information.
- The fifth and final provision is for GLHA to maintain and operate permanent fish ways during the upstream and downstream migration periods for Atlantic salmon, American shad, blueback herring, alewife, and eel. Any of the operating schedules during these migration periods could be modified during the term of the

license based on migration data, new information, and in consultation with the Maine DMR, FWS, and NMFS. Upon request from GLHA, the actual dates of operation could be varied somewhat in any given year in response to river conditions, maintenance requirements, or annual variability in fish migration patterns, with the approval of Maine DMR, FWS, and NMFS, as appropriate.

Our Analysis

As discussed in several sections above, as well as in section 3.3.4.2, *Environmental Effects, Atlantic Salmon,* below, GLHA is proposing to install fishways (for eel and shad) or improve existing fishways (if necessary, for Atlantic salmon) to provide or enhance fish passage at the project. The installation of fishways, such as the proposed eel ladder and upstream shad fishway would require careful design considerations to ensure the fishways are able to pass fish in a safe, timely, and effective manner. The proposed eel ladder and shad fishway would be new structures at the project that would require considerations such as proper placement along the dam and necessary attraction flows to provide adequate passage for the target species (eel and shad), without negatively affecting the efficiency of the existing fishways for Atlantic salmon. Fishway design would also require consideration of the intended performance standards, such as Interior's fishway prescription that requires GLHA to pass 90 percent of eel that enter the eel ladder. Modifications of the existing upstream fishway and downstream surface bypass may also be necessary at some future date. Any modifications would require similar design considerations regarding potential effects on other fishways, as well as performance standards.[124] GLHA's proposal to consult with the resource agencies on the design of new fishways, and NMFS's fishway prescription that includes general provisions for the design of fishways, would help guide the design process and ensure fishways are constructed to operate effectively.

As-built drawings provide documentation that fishways are constructed as designed. NMFS's fishway prescription would require GLHA to provide as-built drawings to the resource agencies, for any new fishways and Maine DMR recommends that GLHA also provide as-built drawings for modified fishways, along with a licensed engineer's letter of certification. However, because it is the responsibility of the Commission to approve and ensure the proper design of fishways, there would be no benefit to providing certified as-built drawings to the resource agencies. Further, as-built drawings could be accessed by the agencies, through the Commission.

[124] After specific fishway modifications are identified, they can only be implemented upon additional Commission approval in a proceeding separate from this relicensing proceeding.

Maine DMR recommends operating each fishway for a one-season "shakedown" period to ensure that the fishways are generally operating as designed, and if not, to make adjustments. The existing upstream fishway and downstream surface bypass are currently operated and maintained using the FPOMP, and have been monitored several times for passage effectiveness (*see* section 3.3.4.1, *Affected Environment, Atlantic Salmon*). As discussed below and in section 3.3.4.2, *Downstream Passage Operations*, the operation and maintenance of the existing fishways would benefit from additional measures to the FPOMP. Through implementation of the FPOMP, with the additional measures, there is no reason to believe that the existing fishways would not perform as designed. Thus, there would be no benefit to operating the existing fishways for a one-season "shakedown" period.

In contrast to the existing fishways, newly proposed fishway(s) have not been constructed, and therefore there has never been an evaluation to ensure the new fishways are operating as designed. Thus, for any new fishway, there would be a benefit to conducting a one-season "shakedown" period. However, Maine DMR does not specify the timing of the one-season "shakedown" period, and the lack of specificity could result in "shakedown" periods interfering with the migration season or passage effectiveness studies. To prevent interference with the fish passage season or delay of the start of the fish passage effectiveness studies, the "shakedown" period and any necessary adjustments should be timed so that they are completed prior to the relevant fish passage season and pertinent effectiveness studies (see discussion below).

The benefits of fish passage effectiveness studies for eel is discussed above, and effectiveness studies for Atlantic salmon are discussed below in section 3.3.4.2, *Environmental Effects, Atlantic Salmon*. The general provisions for fish passage effectiveness studies that NMFS would require in its fishway prescription, would apply to any effectiveness studies conducted at the project. Implementing these provisions would help to guide the development of effectiveness studies so that the results provide reliable and accurate information regarding fishway effectiveness. Further, the provision to begin monitoring at the start of the first migratory season after each fishway facility is operational, would ensure that studies are conducted in a timely fashion, and so that any needed adjustments could occur quickly, and effectiveness standards could be met as soon as possible. However, NMFS's prescription to begin monitoring at the start of the first migratory season, after each fishway facility is operational, would not be feasible for the upstream passage effectiveness studies for adult Atlantic salmon or downstream passage effectiveness studies for kelts. This topic is discussed in section 3.3.4.2, *Environmental Effects, Atlantic Salmon*.

To maintain proper operation and effectiveness, the fishways need to be properly maintained. GLHA proposes to continue implementing the FPOMP to ensure proper operation and maintenance of fishways. The FPOMP includes maintenance and inspection procedures specifically for the existing upstream fishway and downstream bypass. Maine DMR has five general provisions for fish passage operations and maintenance, which would apply to the existing or new fishways, and would help to ensure proper operation and maintenance of fishways at the project. Some of the recommendations included within Maine DMR's five general provisions are already in the FPOMP for the existing facilities, and thus adding them as conditions to a new license would not provide any additional benefit to upstream or downstream migration of diadromous species in the river. The Maine DMR recommendations that are already in the FPOMP include: (1) maintaining written FOPs for the existing facilities that would include: (a) general schedules for routine maintenance and inspection of the existing facilities; (b) procedures for routine operations of the existing facilities; and (c) procedures for monitoring the existing facilities; (2) maintaining fishway areas clear of debris that would hinder passage; and (3) operation schedules for Atlantic salmon.[125] However, the FPOMP for the existing facilities does not have the following procedures, which are recommended by Maine DMR: (1) perform routine maintenance sufficiently before a migratory period, such that the fishways can be fully operational during the migratory periods; (2) shutdown procedures for the existing facilities; (3) procedures for emergencies and project outages; (4) procedures for reporting annually on the operation of the existing facilities, including providing information upon written request from the resource agencies (as required in Interior's fishway prescription); and (5) a provision to provide copies of the plan to Maine DMR, FWS, and NMFS. Modifying the FPOMP to include items 1 through 4 would help to ensure proper operation and maintenance of the existing fishways. Regarding item 5, copies of plans would be filed publicly with the Commission, and because all public filings are accessible to the public, there would be no benefit to providing copies of the plan to the agencies.

Maine DMR also recommends in its general provisions that GLHA develop an operational plan for fishway operation prior to the beginning of each fish passage season. However, a modified FPOMP would be adequate to ensure proper operation of the existing fishways during each year. Further, new plans would need to be developed for any new fishways, and those plans would need to include, at a minimum, the procedures recommended by Maine DMR, in order to ensure proper maintenance and operation.

Maine DMR also recommends that GLHA meet with Maine DMR, FWS, and NMFS annually in March to review fish passage operational data from the previous year. However, Maine DMR does not identify a specific need or benefit of meeting annually or reviewing fish passage operational data. Further, as discussed above, GLHA would operate and maintain all fishways by following specific operation and maintenance plans that are developed (or modified) in consultation with the resource agencies, and approved

[125] The upstream and downstream fishway operations schedules and potential need for schedule modifications for Atlantic salmon are discussed in section 3.3.3.2, *Environmental Effects, Atlantic Salmon*.

by the Commission. With proper operation and maintenance, there is no reason to believe that the fishways would not perform as designed. Thus, there would be no benefit to meeting annually. For the same reasons, there would also be no benefit to Interior's fishway prescriptions that would require GLHA to provide information on fish passage operations and project generation to FWS upon written request, and to provide FWS personnel access to fishways.

Maine DMR has also indicated in its recommendation that the fish passage operational data should include the number of fish passed daily (by species), daily water temperature, and daily air temperature. GLHA currently counts the number of adult Atlantic salmon that pass through the existing upstream fishway, and they propose to continue to provide these counts under a new license (discussed in detail in section 3.3.3.2, *Environmental Effects, Atlantic Salmon*). Nevertheless, counting Atlantic salmon, or any other migratory species would not protect fishery resources from project effects, mitigate a project effect on fishery resources, or enhance the population. Further, Maine DMR does not provide any justification for counting fish species in the project fishways. Thus, we find no benefit to counting fish species that pass through fishways at the project.

Cumulative Effects

The Mattaceunk Project, in combination with the other existing hydroelectric projects located in the Penobscot River Basin, cumulatively affects water quality, downstream aquatic habitat, and migratory fish species (i.e., Atlantic salmon, American eel, American shad, alewife, and blueback herring). Under existing project operations, water quality at the Mattaceunk Project is consistent with Maine DEP's state water quality standards for Class C aquatic life criteria, and demonstrates that the structure and function of the resident biological community is maintained. With no proposed changes in operation, the project would have minimal cumulative effects on water quality in the Penobscot River.

Under normal project operation, minimal impoundment fluctuations result in relatively stable impoundment and downstream flows, which would continue under any new license. In addition, continuing to provide a year-round continuous minimum base flow, as well as seasonal daily average minimum flows would maintain: (1) the existing, high-quality aquatic habitat in the project area; and (2) an adequate zone of passage for fish migration. Consequently, the project's contribution to cumulative effects on aquatic habitat in the Penobscot River would be minimal.

Cumulative effects occur from multiple hydroelectric developments within the river basin and include injuries and mortality from turbine passage, as well as interference with upstream and downstream fish migrations. GLHA's proposal to provide upstream fish passage for migratory fish species, would: (1) improve upstream passage effectiveness of Atlantic salmon at the project (discussed in section 3.3.4.2, *Operation of the Upstream Fishway*); and (2) improve the passage effectiveness of eel at Weldon Dam and access to habitat upstream of the dam. In addition, GLHA's proposal to enhance downstream passage for Atlantic salmon at the project (discussed in section 3.3.4.2, *Downstream Passage Operations*), and to provide downstream passage measures for eel would limit entrainment and turbine-related mortality of fish moving downstream through the project. Therefore, the proposed protection and enhancement measures are likely to be cumulatively beneficial for diadromous fish in the Penobscot River.

3.3.3 Terrestrial Resources

3.3.3.1 Affected Environment

Botanical Resources

Two types of forested uplands surround the project boundary, a spruce - fir forest and a spruce - northern hardwood forest. The spruce - fir forest is composed primarily of red spruce, with Balsam fir dominating open gaps and younger stands. The ground layer is typically sparse. Shrubs are virtually absent, except for occasional lowbush blueberry, with a ground cover of scattered Canada mayflower, starflower, and bunchberry. The spruce - northern hardwood forest, is characterized by red spruce, yellow birch, sugar maple, red maple and American beech. There is a sapling/shrub layer, with red spruce, striped maple, balsam fir, and paper birch. The shrub species composition varies across sites. The ground layer ranges from vegetatively sparse to dense and is divided between forbs, ferns, and regenerating trees, with few shrubs. Nearly all forests of this type have been harvested in the past, during which the spruce were selectively removed. As a result, the canopy of the harvested forests are often composed of beech, birch, and maples, with spruce and fir appearing more commonly in the understory (Gawler and Cutko, 2010).

Current practices conducted by GLHA include vegetation maintenance around project facilities using mostly mechanical vegetation removal techniques (e.g., mowing). GLHA operations staff conduct periodic inspections for hazard trees near facilities (e.g., power lines) and trim or clear trees when necessary. The designated recreation facilities are kept clear of vegetation through mechanical vegetation removal techniques.

The transmission line right-of-way (ROW) represents a different plant community, an open land or early successional plant community. This community is usually observed in upland areas where the forest has been cleared and dominates upland areas to maintain utility corridors and road edges, or for logging (Anderson *et al.*, 1976). Typically natural succession causes the herbaceous composition and structure to change gradually over time. However, because the ROW is subject to maintenance, the early successional composition is permanent. The maintenance schedule keeps the ROW in a state ranging from herbaceous field to shrub dominated cover. The dominant vegetation within this cover type includes red raspberry, sweet fern, bracken fern, hay-scented fern sheep laurel wintergreen, and bunchberry.

Invasive vegetation

No invasive botanical species have been identified by GLHA within the Project Boundary during routine vegetation management efforts, and continued Project operations are not expected to contribute to the spread of non-native invasive species. As noted above, the botanical resources located within and adjacent to the Project Boundary generally are stable, mature, and well established. GLHA's vegetation management practices typically involve mechanical vegetation removal around Project facilities and the clearing of hazard trees. GLHA is not proposing to conduct additional ground-disturbing activities such as road construction or land-clearing that would facilitate the spread of invasive botanical species within the Project Boundary. There were no comments or recommendations indicating that invasive plant species were problematic at the project. Therefore, we will not analyze invasive plants further in this document.

Wetland Vegetation

Based on satellite imagery, National Wetland Inventory (NWI) wetland data, and riparian and wetland habitat assessments conducted in 2014 and 2015, as part of project relicensing studies, wetland communities are common in and near the project boundary. Wetlands in the project area are generally represented as riverine,[126] lacustrine,[127]

[126] "Riverine" includes all wetlands and deepwater habitats contained within a channel, excluding wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses, or lichens.

[127] "Lacustrine" includes wetlands and deepwater habitats with all of the following characteristics : (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergent vegetation, emergent mosses or lichens with greater than 30 percent areal coverage ; and (3) total area exceeds 8 hectares (20 acres).

palustrine-unconsolidated bottom,[128, 129] palustrine forested, palustrine scrub-shrub, and palustrine emergent wetland types, as defined by Cowardin *et al.* (1979). Based on NWI maps, there are about 1,468 acres of wetlands within the project boundary, including about three acres of wetlands within the project's transmission ROW. The remaining 1,465 acres of wetlands are along the river and in the project boundary. The majority (about 1,426 acres) are classified as lacustrine (or riverine) wetland types. Plant species dominating these wetlands include water horsetail, royal fern, sensitive fern, broad-leaved cat-tail, bur-reed, three-way sedge, spike rush, bulrush, wool-grass, sedge, longhaired sedge, wild calla, skunk-cabbage, sweet flag, pickerelweed, soft rush, blue flag, willow, marsh-cinquefoil, and mountain-holly. True aquatic plants in the project area include pondweed, waterweed, duckweed, fragrant water-lily, water-hemlock, spatterdock, water parsnip, leatherleaf, and bladderwort.

Sensitive Botanical Species

In preparation of its license application, GLHA consulted with federal and state agencies to determine the location of any important natural communities in the vicinity of the project.[130] GLHA reviewed information on rare, threatened, and endangered botanical species, and botanical species of special concern known to occur or to potentially occur in the vicinity of the project. One plant (Orono sedge) was identified as state species of concern.

The Orono sedge is state-listed as rare/threatened and is endemic to Maine. It is found in Aroostook, Penobscot, Hancock, Piscataquis, and Somerset counties and nowhere else in the world. This sedge is found mainly in fields, thickets, forest edges, open woods, and roadsides in the Penobscot and Upper Kennebec watersheds (Arsenault *et al.*, 2013). The Orono sedge flowers in June with fruiting occurring from July through

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[128] "Palustrine" includes all nontidal wetlands dominated by trees, shrubs, persistent emergent vegetation, and emergent mosses or lichens. It also includes wetlands lacking such vegetation, but with all of the following characteristics : (1) area less than 8 hectares (20 acres) ; (2) active wave-formed or bedrock shoreline features lacking ; and (3) water depth in the deepest part of basin less than 6 feet at low water.

[129] "Unconsolidated bottom" includes all wetland and deepwater habitats with at least 25 percent cover of particles smaller than stones, and a vegetative cover less than 30 percent.

[130] The Maine DACF maintains their Biological and Conservation Data system database (Maine BCD) of rare and unusual plant species and natural communities in the state, and tracks the state status (e.g., endangered or threatened) and rank based on a system shared by other state natural heritage programs.

August. This sedge grows in loose clumps, producing sharply angled stems up to 3 feet tall. The leaves are much shorter than the stem and are about 0.5 inches wide. The largest populations are found growing in open sun, while plants growing in the shadiest sites tend to be few, small, and with few reproductive stems. The Orono sedge tends to grow in highly disturbed sites, including roadsides. Often the largest populations are located in hayfields. Records in the Maine BCD database indicate that the project's transmission ROW intersects with several populations of Orono sedge.

Wildlife Resources

The project area supports various wildlife habitats, including those associated with wooded upland and riparian areas. There are over 130 resident and transient bird species, almost 50 species of mammals, and 25 herptile[131] species found in the habitats associated with the Penobscot River corridor.

Mammals common to the state of Maine that could be in the project area include masked shrew, water shrew, smoky shrew, long-tailed shrew, short-tailed shrew, pygmy shrew, hairy-tailed mole, star-nosed mole, little brown myotis, northern myotis, silver-haired bat, Keen's bat, big brown bat, red bat, hoary bat, snowshoe hare, eastern chipmunk, woodchuck, gray squirrel, red squirrel, northern flying squirrel, deer mouse, southern red-backed vole, meadow vole, southern bog lemming, northern bog lemming, Norway rat, house mouse, meadow jumping mouse, woodland jumping mouse, porcupine, coyote, red fox, black bear, raccoon, pine marten, fisher, ermine, long-tailed weasel, striped skunk, lynx, bobcat, white-tailed deer, and moose (DTA, 2002; DeGraaf and Yamasaki, 2001). During the scoping process, Interior recommended an analysis of the effects of project operation on aquatic furbearers such as mink, beaver, river otter, and muskrat.

Herpetiles occupying habitats like those in the project (in Maine) include blue-spotted salamander, spotted salamander, eastern/red-spotted newt, northern dusky salamander, northern redback salamander, four-toed salamander, northern two-lined salamander, eastern American toad, spring peeper, gray tree frog, bullfrog, green frog, mink frog, wood frog, northern leopard frog, pickerel frog, snapping turtle, wood turtle, eastern painted turtle, northern water snake, northern redbelly snake, eastern garter snake, northern ringneck snake, eastern smooth green snake, and eastern milk snake. (Tyning 1990).

There are over 130 species of birds that could possibly be found in the project area including 2 species of tern, 7 species of wading/marsh birds, 12 species of waterfowl, 13

[131] Herptile refers to amphibians and reptiles.

raptors, 6 ground birds, 5 owls, and 85 other assorted perching birds. (DTA, 2002; DeGraaf and Yamasaki, 2001; BNA, 2016.)

Sensitive Bird Species

Marsh Nesting Birds

GLHA conducted surveys for rare marsh nesting birds in the project wetlands. The rare marsh birds include three species listed by the state as endangered, the sedge wren, least bittern, and black tern. The common gallinule is listed as threatened, and two species are listed as of special concern, the common tern, and yellow rail. These birds, if present, could use the wetlands on the margin of the project impoundment as nesting habitat.

The survey used the Standardized North American Marsh Bird Monitoring Protocol, which is a conventional marsh bird survey technique (Conway, 2009). The protocol makes use of call-broadcast surveys, which try to elicit responses from otherwise hard-to-detect birds by increasing the probability of vocalization (Conway and Nadeau, 2006). The surveys collect data on bird response vocalizations, distance to the bird, and habitat occupied. A total of three field surveys were conducted (two surveys during early morning hours on June 11 and 17, 2014, and one survey during early evening hours June 30, 2014) during the marsh-nesting bird season.

During the impoundment field surveys, GLHA did not report detecting any of the target rare marsh-nesting birds listed above. A single American bittern (non-target species) was detected on June 17, 2014, in the wetland southwest of where Route 116 crosses the project boundary, when it responded to a call-broadcast sequence. In addition, during the final survey, a suspected American bittern was visually observed in flight as the biologists approached the survey point. Rare marsh nesting birds will not be discussed further as they were not present in the project area, and any project related effects that might occur to them would be more likely to affect the common loon discussed in the next section.

Common Loon

The common loon is a state threatened species. Common loons tend to occur on inland lakes, larger than 59 acres, where there is little shoreline development, stable water levels, and clear water. Nests are constructed close to the water's edge in dense vegetation). Loons may be found in a wide variety of freshwater aquatic habitats; however, they generally prefer lakes with an abundance of small fish, numerous small islands, and an irregular shoreline that creates coves. Loons have great difficulty walking on land, and must nest right at the water's edge where their reproductive success is susceptible to water level changes. Loons also prefer protection from prevailing winds and waves, overhead vegetation or lateral cover, and a wide viewing angle of their territory (Evers, 2004).

Loon nesting surveys conducted by GLHA in 2014 and 2015 indicate that loons use the project impoundment, but not in large numbers. During the survey observers found one loon pair and no nests during 2014 and two loon pairs and one nest during 2015. The loon pair attempted to nest twice during 2015 but no eggs hatched. GLHA completed an analysis of the impoundment elevations during the 2014 and 2015 nesting period and found that the impoundment maintained elevations within a band of 0.75-feet with a maximum elevation during the nesting of 2015 of 240.40 feet (mean sea level). The loon nest was monitored for impacts from flooding, but there was no evidence that the impoundment elevations rose to a level high enough to reach the nest.

Bald Eagle

Bald eagles tend to locate in proximity to bodies of water where adequate food exists and human disturbance is limited (Wakeley and Wakeley, 1983). Nesting eagles can be sensitive to human intrusions or disturbances, and such activities can compel eagles to abandon a nest. Eagles prefer areas near large lakes and reservoirs, marshes and swamps, or stretches along rivers where they can find open water and their primary food, fish (DeGraaf and Yamasaki, 2001). Bald eagles require breeding habitat with an adequate supply of moderate-sized to large fish, nearby nesting sites, and a reasonable degree of freedom from disturbance during the nesting period (Johnsgard, 1990).

Though bald eagles eat primarily fish, they are highly opportunistic and will consume various items including birds, reptiles, amphibians, crustaceans, and small mammals. They will also consume carrion. While many bald eagles leave Maine in winter, some remain through the winter months. Because ice cover greatly limits food availability in winter, bald eagles that stay in Maine through the frozen months are most likely to occur where open water remains available (e.g., large flowing rivers and coastal areas), or where carrion is available (Maine, DIFW 2014). Several bald eagles were observed at or near the Mattaceunk Project during the 2014 and 2015 field survey seasons. Most of the eagles were observed in the eastern portion of the project impoundment, to the East of the end of Dickey Moore Road. Additionally, a mature bald eagle was observed landing in a known bald eagle nest that is located approximately one and a half miles southeast of the Interstate 95 Bridge crossing of the Penobscot River.

3.3.3.2 Environmental Effects

Wetlands and Riparian Habitat

GLHA proposes to continue to operate the project in a run-of-river mode with pondage, with the impoundment fluctuation limits and minimum flows discussed fully in section 3.3.2.2, *Aquatic Resources, Environmental Effects*. Interior, NMFS, and Maine

DMR recommend GLHA's proposal for impoundment fluctuation limits and minimum flows.

Our Analysis

GLHA's proposal would result in the project being operated in a manner that would minimize changes in impoundment elevations and provide consistency in downstream flows. As discussed in section 3.3.1.2, *Geology and Soils,* the proposed operational protocol should continue to minimize erosion by providing stable conditions along the project shoreline which would protect wetlands in the impoundment, and avoid project-related sedimentation of downstream riparian habitat.

As discussed in the section 3.3.1.2, *Impoundment Levels*, operation of the project as outlined by the applicant would also maintain stable riparian habitats downstream of the dam because of the continued release of relatively stable flows associated with run-of-river operation.

Temporary drawdowns resulting from flashboard failures, could require drawdowns 5 feet below the normal pond elevation, but are typically limited to a period of less than three days. Further, based on recorded data of impoundment elevations from 2008 to 2015, these types of drawdowns occur on average, less than once per year (GLHA, 2016). Thus, the drawdowns required for flashboard repair are infrequent and short in duration, and unlikely to cause any substantial affects to wetlands.

Terrestrial Habitats and Wildlife

Current practices used by GLHA for vegetation maintenance around project facilities and the ROW include using mostly mechanical vegetation removal techniques (e.g., mowing). GLHA operations staff periodically inspect project facilities for hazard trees which are trimmed or cleared periodically as necessary. Recreation facilities are kept clear of vegetation through mechanical vegetation removal techniques. GLHA proposes to continue these current vegetation management practices for the term of a new license.

Interior, on behalf of FWS, states that uplands, wetlands, and associated wildlife are not likely to be adversely affected by continued project operation. No recommendations have been filed regarding altering the vegetation management practices used by GLHA at the project.

Our Analysis

Orono sedge is considered an early successional species and GLHA's current maintenance activities in the ROW permanently keep the successional stage in this early state. This management is likely conducive to the success of the Orono sedge in the

ROW. Therefore, continued maintenance of the ROW, as proposed by GLHA, would provide a constant open habitat for the Orono sedge, and would support the continued existence of the present populations under a new license.

Wildlife Resources

Bald Eagles

The bald eagle was listed as federally-endangered on March 11, 1967, partially due to the significant population declines attributed to the use of DDT. On July 9, 2007, FWS issued a final rule (Final Delisting Rule effective on August 8, 2007) removing the bald eagle from the list of endangered and threatened wildlife.[132] The eagle however is still protected under the Bald and Golden Eagle Protection Act, as amended,[133] and the Migratory Bird Treaty Act, as amended[134].

Bald eagles have been documented at the Mattaceunk Project using foraging habitat that can be found within the project boundary. There are four historical locations for nests around the project, but none are currently active (FWS, 2012). No measures for bald eagle protection have been proposed or recommended.

Our Analysis

Given current population trends for the species, future use of the project area by bald eagles is likely, as suitable habitat is widespread throughout the Penobscot River Basin. Human activities that can disturb eagles, such as construction of roads, trails, canals, or power lines, or alteration of shoreline or wetlands, are not occurring or proposed for the relicensing of the project. Continued operation and maintenance of the Mattaceunk Project as proposed would not disturb bald eagles or associated habitats.

Common Loons

There were no comments or recommendations indicating that project operation would negatively affect loon habitat in in the project impoundment.

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[132] Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife. Final Rule. 72 Fed. Reg. 37346 (July 9, 2007).

[133] 16 U.S.C. §§ 668-668d.

[134] 16 U.S.C. §§ 703-712.

Our Analysis

Fluctuating water levels that can occur in impoundments can cause Loon nest failure by flooding or stranding nests, reducing nest accessibility, and increasing vulnerability to predation. Continued operation of the project in a run-of-river mode with pondage with minimal fluctuation in impoundment surface elevation for the installation and operation of the project flashboards, would maintain the reservoir elevation within 1.0 foot of the normal full pond elevation of 240.0 feet.

Impoundment drawdowns would only occur when flashboard repairs are needed, generally early in the year, and repairs completed in less than three days. The short timing of flashboard loss and repair would avoid causing impacts to the loon nesting season by returning the reservoir to normal operational levels quickly and not allowing loons to build a nest in normally submerged areas. Therefore, loons nesting success is unlikely to be affected by continued project operation under a new license.

Aquatic Furbearers

During the scoping process, Interior recommended an analysis of the effects of project operation on aquatic furbearers.

Our Analysis

Although dens are constructed to allow for changes in water levels, a consistent water levels during prime birthing periods is preferred during this critical life stage. Maintaining the impoundment levels by not fluctuating levels more than 1 foot between late May and mid-July, would limit negative impacts on breeding and/or brooding activities.

During winter months, entrances to beaver dens must be inundated to maintain an open den entrance below the ice. When water levels fall below the entrance, ice can form a barrier to the den. Because of the project's relatively stable reservoir operation, furbearers are unlikely to be affected by project operations under a new license.

3.3.4 Threatened and Endangered Species

3.3.4.1 Affected Environment

The federally endangered Gulf of Maine Distinct Population Segment (GOM DPS) of anadromous Atlantic salmon (*Salmo salar*) currently occupies the Penobscot River. In addition, two federally listed threatened species, the Canada lynx (*Lynx canadensis*) and northern long-eared bat (*Myotis septentrionalis*), could occur in Somerset County, Maine.

Atlantic Salmon

Listing Status

The initial listing (issued in 2000) for anadromous Atlantic salmon defined the Gulf of Maine Distinct Population Segment (GOM DPS) as including tributaries of the lower Kennebec River to, but not including, the mouth of the St. Croix River at the U.S.-Canada border, but excluded fish that inhabit the mainstem and tributaries of the Penobscot River upstream of the former Bangor Dam, near Bangor, Maine.[135] In 2009, a final rule was issued for the GOM DPS which expanded the listing to encompass the freshwater range of salmon associated with the Penobscot River (figure 12).[136] The GOM DPS range for Atlantic salmon on the Penobscot River extends from Penobscot Bay to impassible falls including Big Niagara Falls on Nesowadnehunk Stream in the West Branch Penobscot Basin, Grand Pitch on Webster Brook in the East Branch Penobscot Basin, and Grand Falls on the Passadumkeag River.[137] Critical habitat within the main stem of the Penobscot River, was designated for the GOM DPS, and extends from the estuarine habitat of Penobscot Bay up into the East and West Branches. The Mattaceunk Project falls within the designated critical habitat, which is located in the Penobscot Bay salmon habitat recovery unit (SHRU)[138] for Atlantic salmon (figures 13 and 14).

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[135] 74 Fed. Reg. 29344 (June 19, 2009).

[136] *Id.*

[137] *Id.*

[138] SHRUs are separate geographic units within the GOM DPS. The GOM DPS is separated into three SHRUs to ensure that Atlantic salmon are well distributed across the GOM range. The separation is based on life history characteristics, as well as demographic and environmental variation. This type of separation is designed to buffer the DPS from adverse demographic and environmental events that could negatively affect recovery of the GOM DPS.

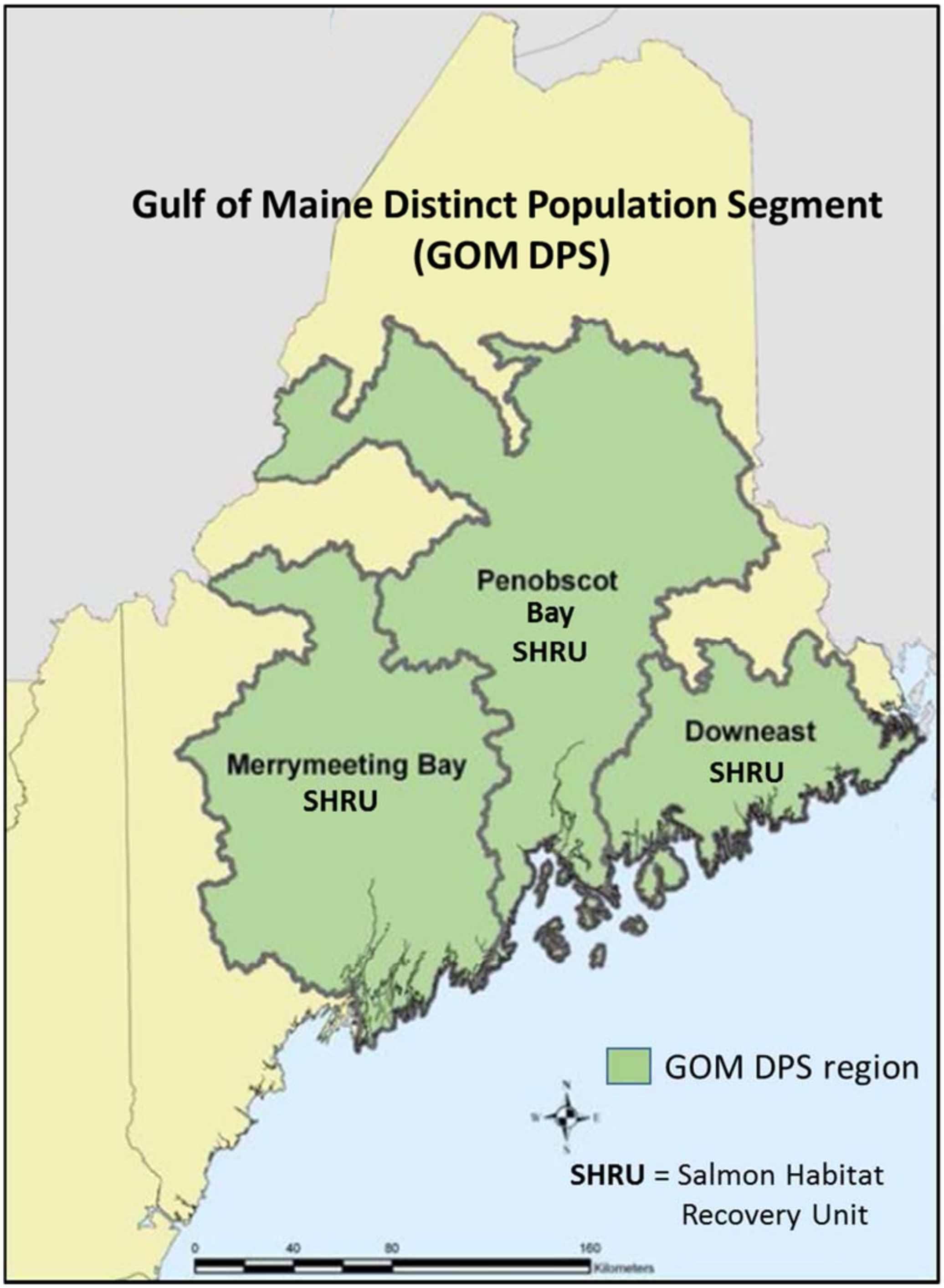

Figure 12. The freshwater population range of the Gulf of Maine Distinct Population Segment (GOM DPS) of endangered Atlantic salmon. (Source: NMFS, 2016a, as modified by staff).

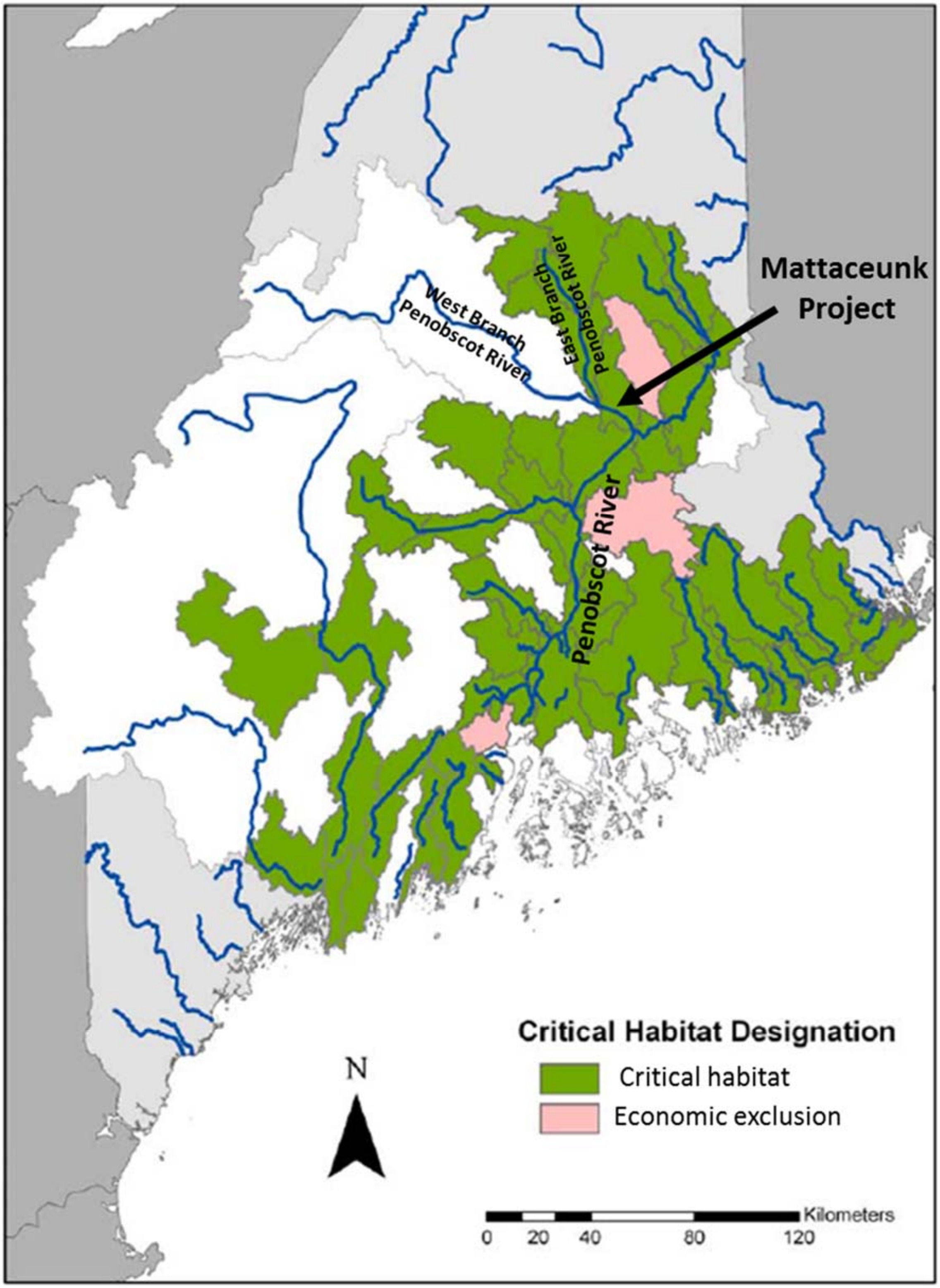

Figure 13. Atlantic salmon critical habitat in Maine.
(Source: NASCO, 2009, as modified by staff).

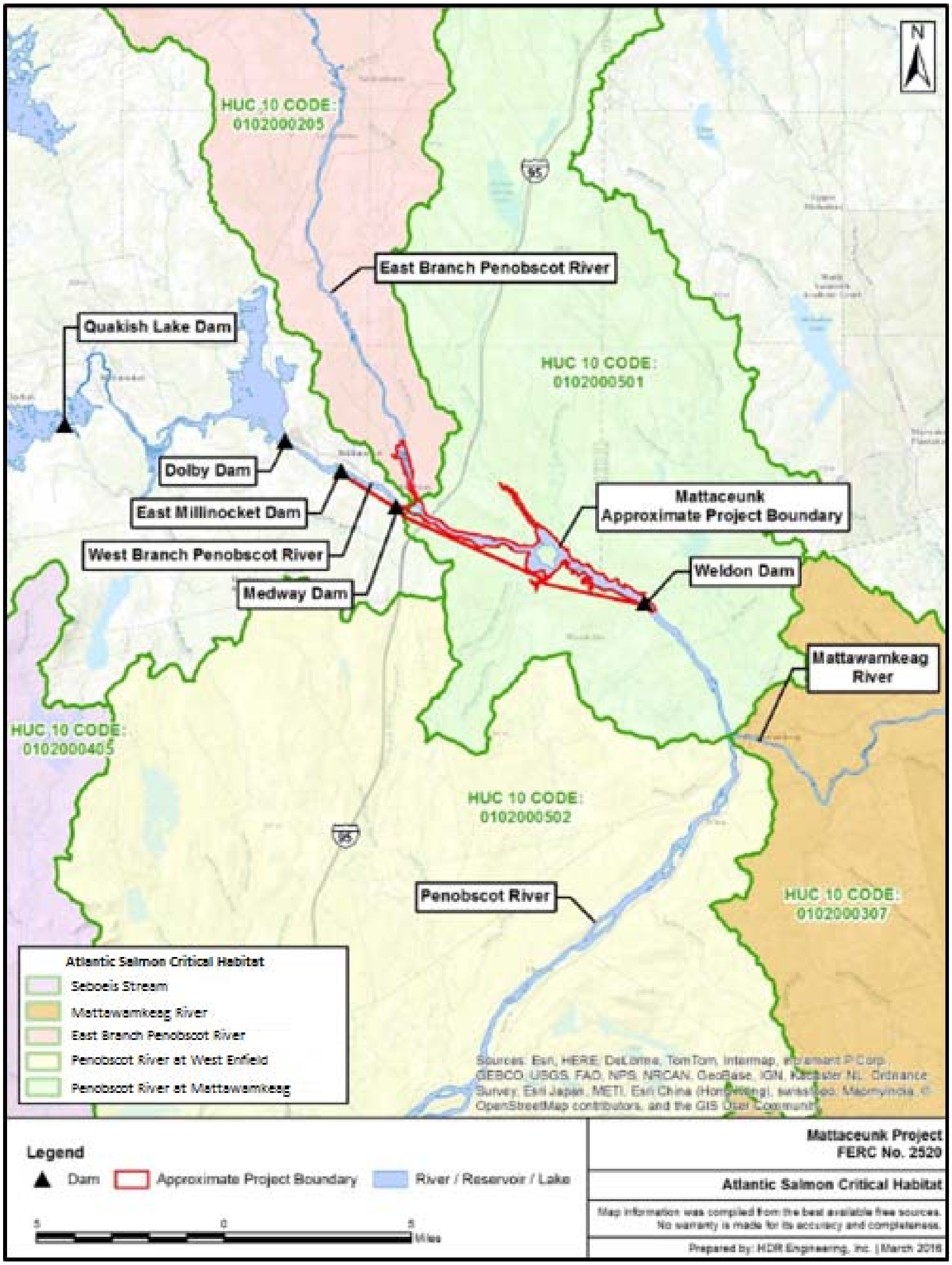

Figure 14. Atlantic salmon critical habitat near the Mattaceunk Project. (Source: GLHA, 2016a, as modified by staff).

<u>Life History</u>

Anadromous Atlantic salmon typically spend 2 to 3 years in the ocean before returning to their natal rivers to spawn. Approximately 86 percent of adults return after 2 years, about 10 percent (primarily males) return after 1 year, and the remaining 4 percent are repeat spawners, or spend 3 years at sea (NMFS, 2009). Most adult Atlantic salmon enter Maine rivers during the spring and early summer (May-July), but upstream migrations can occur from April to early November (Baum 1997). In the Penobscot River, upstream migrating adult Atlantic salmon are most common in June (Maine DMR 2007 and 2008; NMFS, 2009). Daily monitoring at the Mattaceunk Project from 1983 to 2012 indicates that upstream migration past the project peaks during July and in late September, with limited movement occurring in early June, August, and mid-late October (figure15).

Upstream migrating adult Atlantic salmon will return (or home) to their natal river or stream (i.e., habitat where they reared as young salmon) where they will spawn. Adults are able to return to their natal habitat using olfactory cues (i.e., odors) that they imprinted on while rearing in natal habitat, especially during the smolt stage (McCormick *et al.*, 1998). Returning adults will spawn in clear, coldwater streams and rivers having relatively unobstructed passage to the ocean. Suitable spawning habitat is characterized by coarse gravel or rubble bottom with suitable well-oxygenated, clean water. Anadromous Atlantic salmon spawn in October and November (Fay *et al.*, 2006). After spawning, some adults, known as kelts during the downstream migration, survive, journey back to the ocean, and return again to spawn after at least one year in the ocean. From 1967 to 2003, approximately 3 percent of the wild and naturally reared adult anadromous Atlantic salmon returning to U.S. rivers were repeat spawners (USASAC, 2004).

Kelts have been observed in the lower Penobscot River in November, while some kelts wait until the following spring (April or May) to migrate back downstream (USASAC, 2007). Five years of data collected at the Mattaceunk Project demonstrate a spring migration period between April 25 and June 25, and a fall migration in October and November (GNP, 1993, 1994). Kelts tended to move downstream with higher flows in early spring.

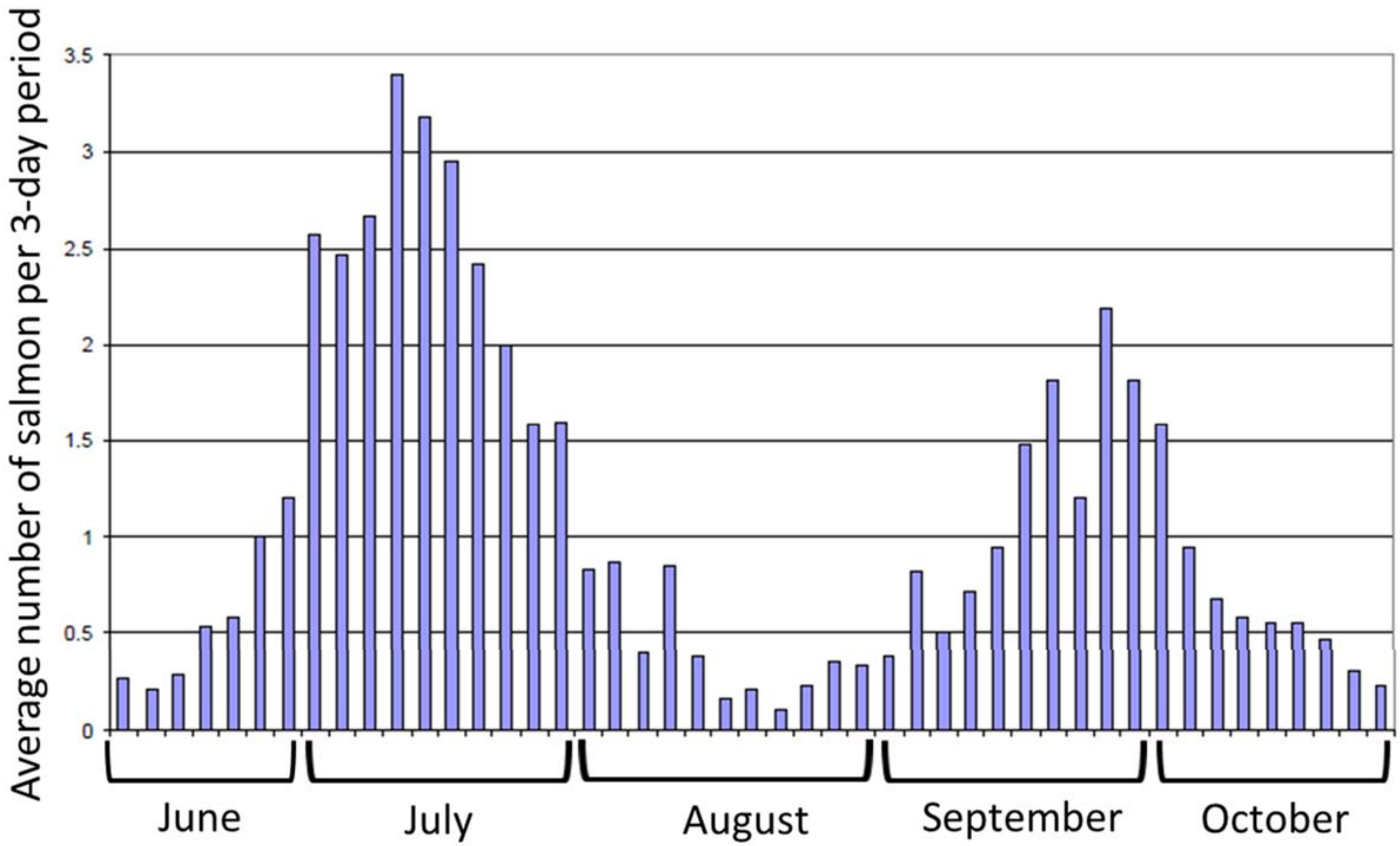

Figure 15. Average number of salmon per 3-day period (i.e., each bar is a 3-day period) counted in the upstream fishway at the Mattaceunk Project from 1983 to 2012.
(Source: GLHA, 2016a, as modified by staff).

The early life stages of Atlantic salmon begin with eggs that hatch during March and April (Fay *et al.*, 2006). The newly hatched alevins (larvae with yolk-sacs) remain in the gravel for about six weeks. Alevins emerge from the gravel in mid-May. Juvenile salmon (parr) remain in rivers 1 to 3 years (until approximately 5 inches or greater in length) at which point they begin a transformation of color, shape, internal salt balance, and energy storage, and become smolts that migrate downstream to the ocean in the spring (Fay *et al.*, 2006).

Smolt population surveys conducted from 2000 to 2005, demonstrate that smolts migrate from the Penobscot River between late April and early June with a peak in early May (Fay *et al.*, 2006). Based on an aggregate of 6 years of monitoring data collected between 1988 and 1995, smolts migrate through the Mattaceunk Project from late-April to mid-June, with peak migration (80 percent of smolts) occurring in May (GNP, 1995). The same studies also demonstrate that the majority of the smolt migration takes place over a 2- to 3-week period after water temperatures rise to about 50° F. The peak of movement shifts 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[139] cues (Bourgeois and O'Connell, 1986). Smolt survival during the downstream migration is generally highest at temperatures between 50° F and 68° F, and at intermediate river flows (Stich *et al.*, 2015a).

<u>Habitat</u>

Atlantic salmon habitat is quantified in the GOM DPS by mapping habitat within hydrologic units.[140] The Penobscot River consists of 314,314 historic habitat units, with 207,955 units currently characterized as accessible to returning adults, which indicates that 66 percent of the historic habitat units are currently accessible to Atlantic salmon (NASCO, 2009). Atlantic salmon habitat quality also is measured in the same hydrologic units based on the suitability of several parameters, which include temperature, biological

[139] For fish, rheotaxis generally refers to the tendency to orient swimming movement in the direction of oncoming current.

[140] Specifically, the GOM DPS is mapped for habitat quantity and quality at the hydrologic unit code 10 (HUC 10; ten representing the number of digits in the code that represents the hydrologic unit) scale. The U.S. is divided and sub-divided into successively smaller hydrologic units. The HUC 10 level represents a level of subdivision that usually results in a hydrologic unit of 40,000 to 250,000 acres.

communities, water quality, substrate, and cover. Medium-low and medium quality habitat scores have been assigned throughout most of the Penobscot River, with scores increasing from the mouth to the headwaters (figure 16; NASCO, 2009). Most of the Mattaceunk Project boundary is located in a hydrologic unit that has medium habitat quality, but the portion of the project boundary located in the East Branch Penobscot River occurs in a habitat unit classified as high quality (figure 16).

Fine scale mapping data within the hydrologic units nearest the project indicate the presence of both spawning and juvenile rearing habitat upstream and downstream of the project (FWS, 2016). The nearest mapped spawning and rearing habitat upstream of the project is located in Wassataquoik Stream, a tributary of the East Branch of the Penobscot River, the confluence of which is located approximately 31 miles upstream of Weldon Dam (figure 17) and approximately 22 miles upstream of the project boundary. Mapped spawning and rearing habitat in the mainstem of the East Branch occurs approximately 29 miles upstream of the project boundary. The nearest downstream mapped spawning and rearing habitat is in the Mattawamkeag River, a tributary that flows into the Penobscot River approximately 4.3 miles downstream from Weldon Dam (FWS, 2016). As indicated by NMFS,[141] and as discussed in section 3.3.2.1, *Aquatic Habitat*, habitat mapping conducted in the project tailrace indicates that the tailrace is suitable for spawning and rearing of Atlantic salmon given the presence of run, riffle, and gravel bar habitat.

Because the project operates in run-of-river mode with pondage, flows upstream and downstream of the project are similar, and thus outflow generally mimics inflow. Average flows during the peak upstream migration of adults and peak downstream migration of smolts is 5,366 cfs and 9,664 cfs, respectively (table 16). Flows at the project rarely fall below 2,943 cfs and 3,409 cfs during the peak upstream migration of adults and peak downstream migration of smolts, respectively (i.e., 90 percent exceedance; table 16).

Table 16. Flows in cfs at the project during the peak upstream and downstream migration of Atlantic salmon.

Life stage	Migratory period	Average flow	Minimum flow	90 percent exceedance	10 percent exceedance	Maximum flow
Adult (upstream)	early June to late October	5,366	1,726	2,943	8,714	45,108
smolt (downstream)	May	9,664	1,673	3,409	18,807	69,936

(Source: GLHA, 2016a, as modified by staff).

141 *See* letter filed by NMFS on May 23, 2017.

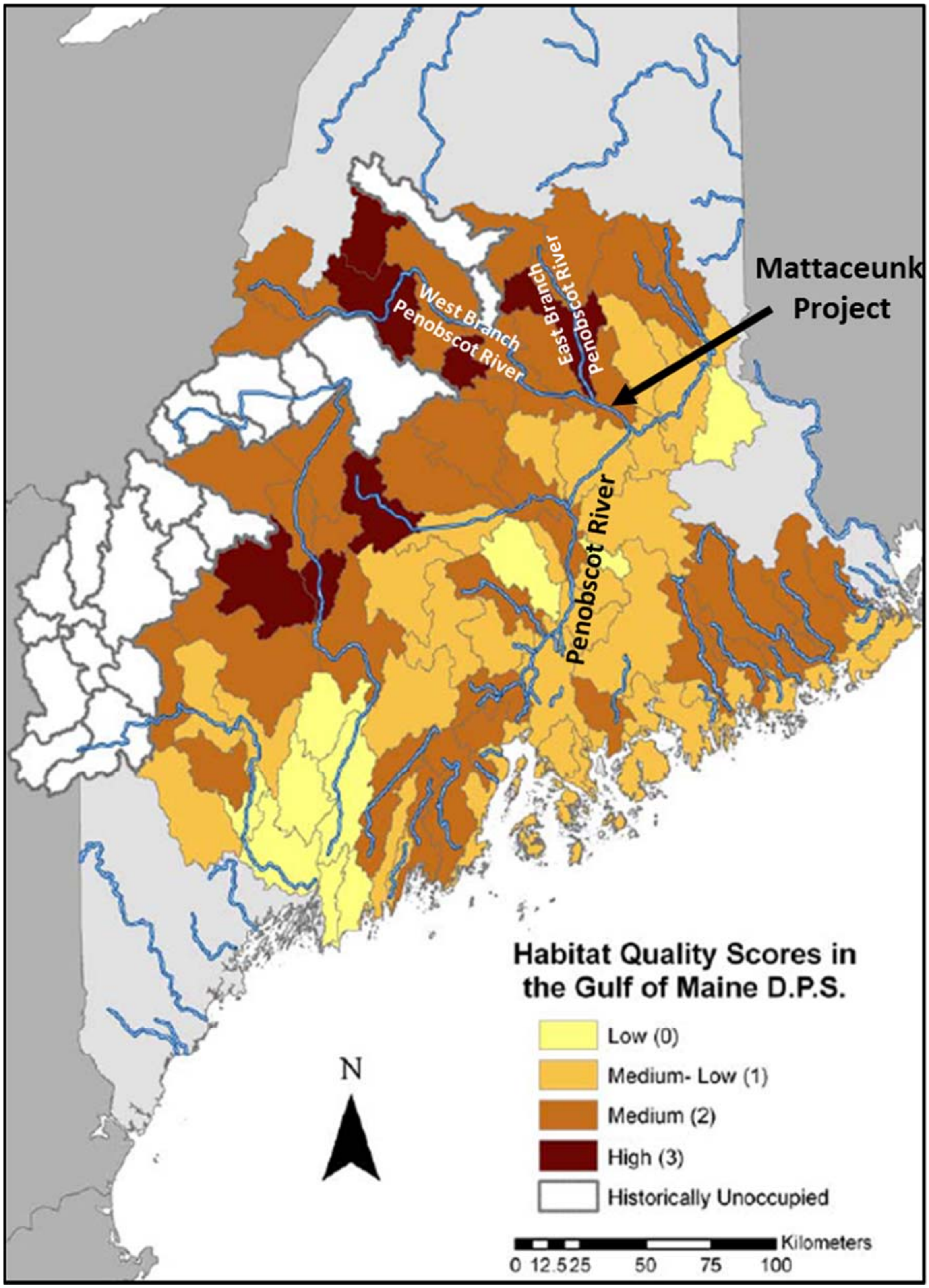

Figure 16. Atlantic salmon habitat quality.
(Source: NASCO, 2009).

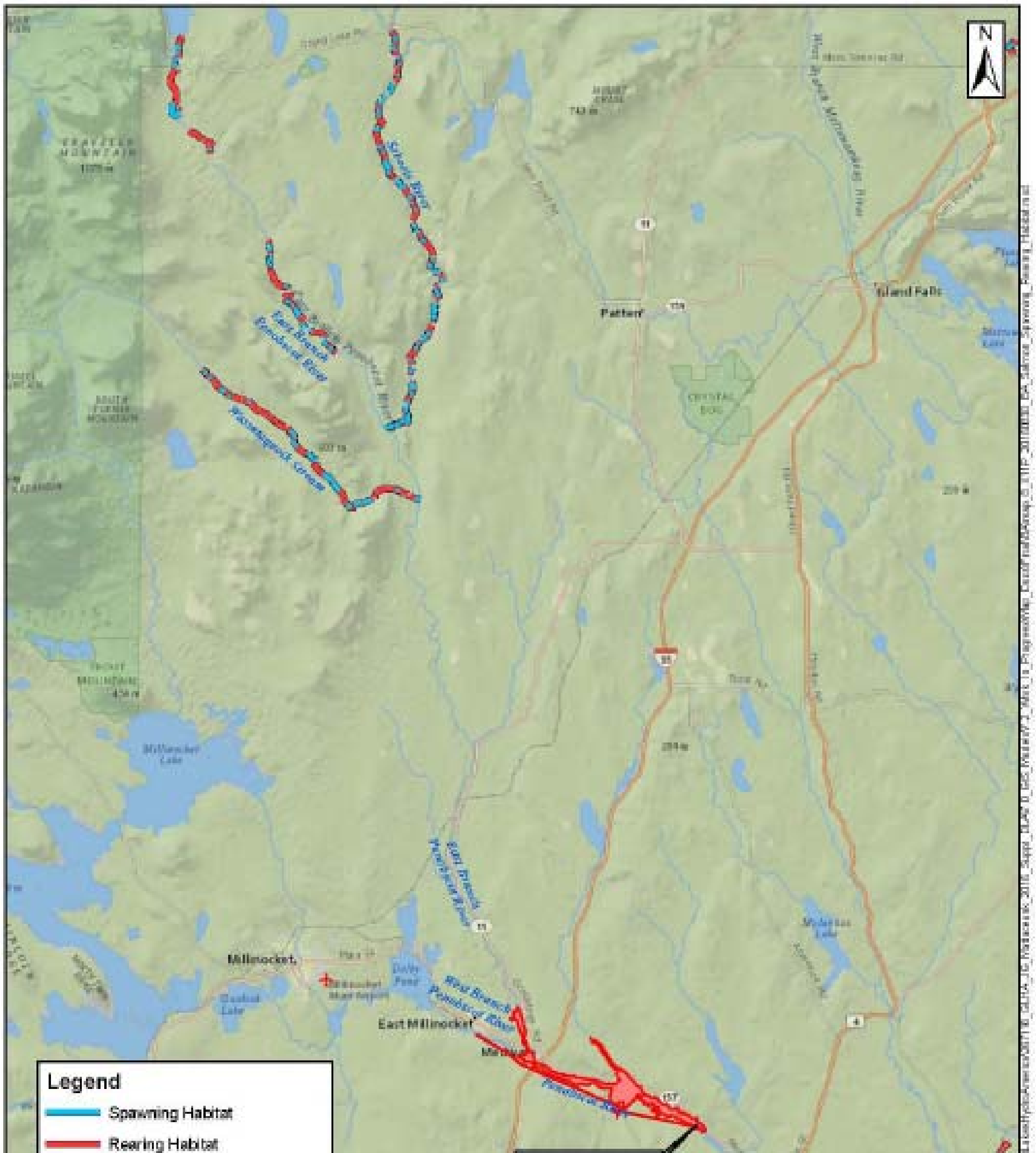

Figure 17. Atlantic salmon habitat.
(Source: FWS, 2016).

Abundance

Historically, high abundances of Atlantic salmon were reportedly present in the Penobscot River, but adult returns and native stocks of Atlantic salmon have decreased dramatically in the Penobscot River watershed (NMFS, 2009). Atkins and Foster (1867) estimated that the Penobscot alone had 100,000 returning adults annually (as cited in Fay *et al*., 2006). Currently, adult Atlantic salmon returning to the Penobscot River each year are recorded at the Milford Dam fish lift, which began operation in 2014 following its construction and the removal of the Great Works (2012) and Veazie (2013) dams. Adult Atlantic salmon were previously recorded at the Veazie Dam fishway, until it was removed in 2013. Numbers of returning adult Atlantic salmon to the Penobscot River are substantially higher than all other GOM DPS salmon rivers (USASAC, 2015). Over the past decade, adult Atlantic salmon returns have ranged from a low of 261 in 2014 to 3,125 in 2011 (figure 18). The 2011 Atlantic salmon returns were the highest since 1991 (USASAC, 2015).

Upstream migrating adult Atlantic salmon are also counted at the Mattaceunk Project. The number of adults counted at the Mattaceunk Project is lower than at Milford Dam or Veazie Dam, because many of the fish counted at Milford Dam or Veazie Dam would have migrated to tributaries and spawning habitat located downstream of Mattaceunk, and because some adults were used for broodstock and other research activities and were not released upstream of Milford or Veazie (figure 18). Nevertheless, the abundance patterns are similar to those at Milford and Veazie and show a declining trend since 1983.

To increase the number of returning adult Atlantic salmon in the Penobscot River, Maine DMR stocks approximately 1 million fry annually in the Penobscot River Basin, with about 50 percent stocked upstream of the project in the East Branch Penobscot River. In addition to stocking 1 million fry, Maine DMR also stocks smolts in the lower Penobscot River, to reduce cumulative mortality during the downstream migration, and thereby maximize the number of smolts that enter the ocean.

The smolt population in the Penobscot River mostly consists of individuals that were stocked in the river as fry. On the Penobscot River, out of a total of 1,614 smolts captured during a survey in 2004, 1.7 percent were naturally reared smolts and the remainder were hatchery-origin smolts (Fay *et al*., 2006). More recently, the smolt population in a tributary located downstream from the project (i.e., upper Piscataquis River[142]) was estimated at 4,576 individuals ± 1,307, 9,304 individuals ±1,213, 5,209 individuals ± 1,312, and 4,278 individuals ± 272 in 2009, 2010, 2011, and 2015, respectively (Dube *et al*., 2012; USASAC, 2015). However, from 2009 to 2011, the majority of smolts produced in the Piscataquis River were stocked in the river as fry and not produced from returning adults (Dube *et al*., 2012).

[142] The Piscataquis River is a large tributary that enters the Penobscot River downstream from the Mattaceunk Project near the town of Howland.

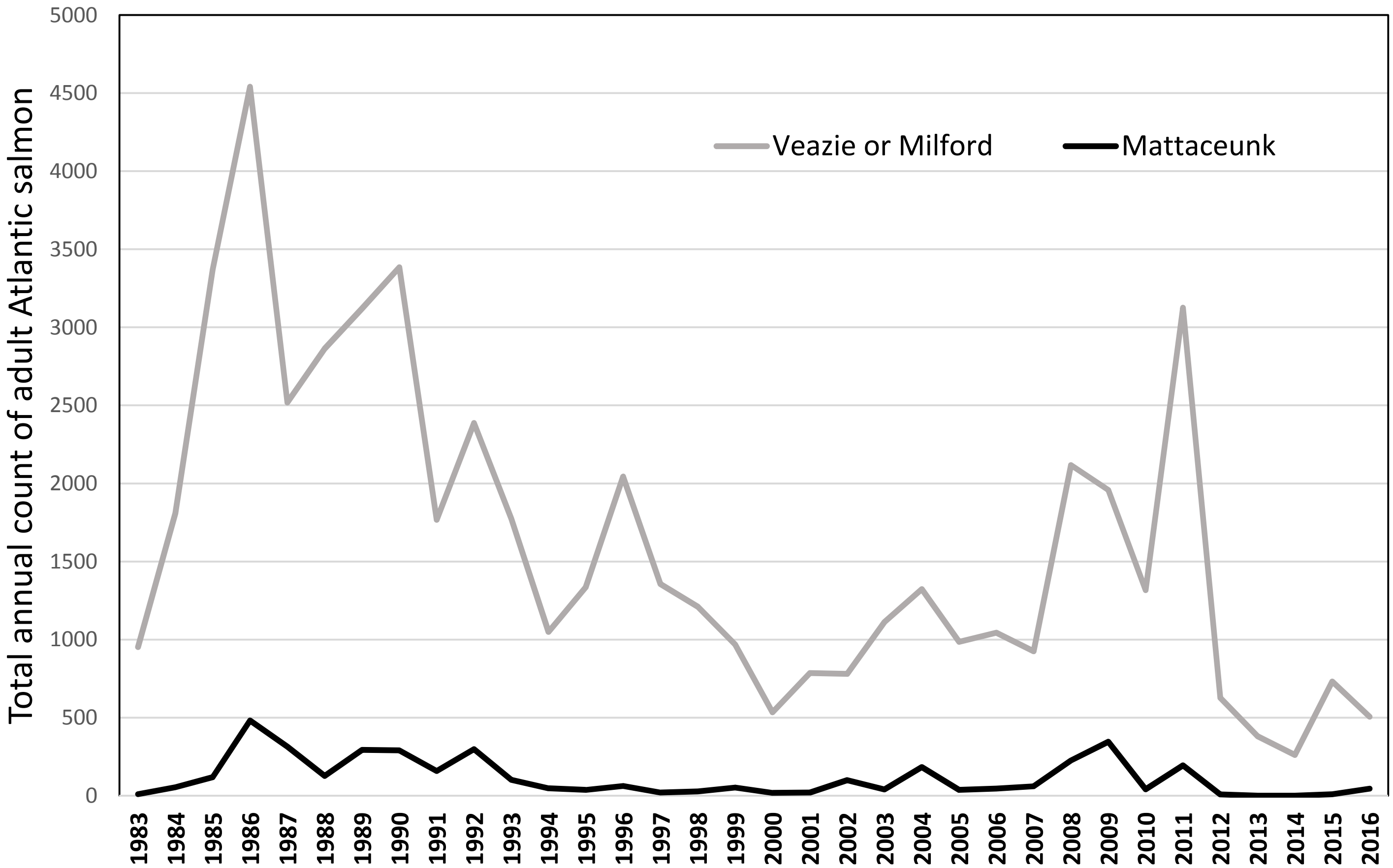

Figure 18. Adult Atlantic salmon counts at the Mattaceunk Project and at Veazie dam (1983-2013) or Milford dam (2014-2016).
(Source: Maine DMR (2016), as modified by staff).

Upstream Passage

From 1983 to 2016, 3,859 adult Atlantic salmon have passed the upstream fishway at the Mattaceunk Project. Since the 1980s, a few upstream Atlantic salmon passage efficiency studies have been conducted at the Mattaceunk Project. In 1986, upstream passage efficiency of the existing upstream fishway was evaluated using radio telemetry,[143] following a series of fishway modifications that were made in support of relicensing (GNP, 1986). During the study, adult salmon that were stocked in the East Branch of the Penobscot River as smolts, were captured at the Veazie Dam fish trap and radio-tagged (or untagged as controls), and released 1.5 miles downstream from the Mattaceunk Project. The study indicated that 71 percent[144] of radio-tagged salmon, and 89 percent[145] of control salmon (externally tagged without a radio), successfully passed upstream of the project using the upstream fishway.[146]

More recently, GLHA has been cooperating with USGS and the University of Maine on an upstream Atlantic salmon monitoring study involving the use of PIT

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[143] Radio telemetry is a method used to track fish by inserting a radio-tag which transmits a high frequency radio signal that can be detected when a radio-tagged fish swims near an instrument capable of receiving the signal (i.e., receiver).

[144] Fourteen radio-tagged Atlantic salmon that reached the tailwaters immediately downstream from the Mattaceunk Project were included in the analysis. Ten of the 14, or 71 percent, successfully passed upstream using the upstream fishway. The remaining four salmon that did not successfully pass upstream of the fishway, but rather moved downstream after reaching the project tailwaters.

[145] Sixteen of 18 (89 percent) control salmon released downstream from the project were observed to successfully pass upstream using the upstream fishway. However, because the control salmon were not tagged, it is not known whether the two salmon that did not pass upstream ever migrated to the project tailwaters.

[146] The Atlantic Sea Run Salmon Commission also conducted a study that included 10 unmarked Atlantic salmon released about 24 miles downstream from the project (near South Lincoln, Maine). The results were reported in the GNP (1986) report, which indicated that 9 of 10 (90 percent) unmarked salmon were observed to have passed through the upstream fishway. However, distinguishing unmarked study salmon from wild salmon that were not part of the study would have been difficult. Because the GNP (1986) report does not provide details on how the unmarked salmon were identified as study fish, we do not include this study in any further discussion or analysis.

(passive integrated transponder) tag[147] detection arrays at nine dams in the Penobscot River, including the Mattaceunk Project (Maine CFWRU and University of Maine, 2011). In 2012, eight PIT-tagged Atlantic salmon that reached the Mattaceunk Project all successfully passed upstream using the existing fishway. No tagging occurred in 2013 because of the Veazie Dam removal construction activities, and in 2014 and 2015 due to the low numbers of Atlantic salmon available downstream of Weldon Dam resulting from low returns and hatchery broodstock collection.

Downstream Passage

Smolt Passage Past the Dam

As discussed in section 2.1.1, *Existing Project Facilities*, the downstream bypass facility includes single surface inlets at intakes 3 and 4. The bypass has been tested a number of times using smolts since 1993, when it was installed. From 1993 to 1999 (excluding 1996 when no studies were conducted), the collection efficiency[148] of the existing bypass was evaluated using radio-tagged smolts released upstream of the project. During the studies, bypass testing conditions varied using different combinations of strobe light depth in forebay #1 and #2 (i.e., forebays without surface bypasses) and turbine flow through forebays #3 and #4 (i.e., where the surface bypasses are located). Based on these studies, collection efficiency ranged between 17 and 59 percent.[149] In 2004, the downstream bypass was tested with no strobe lights and under typical turbine flow conditions, resulting in a passage efficiency of 41 percent.[150] Given the irregular success of the strobe light system in directing smolts to the bypass, it is no longer used. None of these studies evaluated passage survival.

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[147] The PIT tag is an electronic tag measuring 0.5 inches long and less than 1/8 inches in diameter. Fish injected with this tag can be automatically recognized by detecting/recording devices located within collection facilities at hydroelectric dams.

[148] Collection efficiency represents the proportion of study smolts that successfully pass the dam using the bypass system relative to the total number of smolts that pass the dam successfully.

[149] Collection efficiencies were 59 percent (1993), 45 percent (1994), 52 percent (1995), 41 percent (1997), 22 percent (1998), and 17 percent (1999). No studies were conducted in 1996. *See* GLHA's Biological Assessment filed with the final license application on August 31, 2016.

[150] *See* GLHA's Biological Assessment filed with the final license application on August 31, 2016.

In 2014 and 2015, GLHA conducted studies to evaluate passage route selection, collection efficiency, and survival past the dam for downstream migrating smolts that were radio-tagged and released upstream of the project.[151] In 2015, GLHA also studied passage survival in the project impoundment. In both years, the most common route of passage for smolts was through the turbines (2014: 70.1 percent; 2015: 78.5 percent). In 2014, the bypass and spillway were used equally (14.9 percent) by downstream migrating smolts. In 2014, the log sluice was not open for passage. In 2015, when the log sluice was open for passage, the bypass was used by 8.1 percent of smolts, and the spillway and log sluice were each used by 6.7 percent of smolts.

Bypass collection efficiency was 17.5 percent in 2014 and 9.4 percent in 2015. In 2015, following completion of the study, GLHA observed that the bypass was blocked with debris during maintenance activities, which might have affected the bypass collection efficiency.

Using the same study of smolts described above, GLHA estimated minimum survival rates of smolts through each passage route in 2014 and 2015.[152] Minimum survival estimates are shown in table 17 and indicate that smolt survival through the downstream bypass and log sluice was 100 percent, while survival through the turbines and other spill routes (where the majority of smolts passed downstream) was between about 85 and 93 percent.

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[151] In 2014, GLHA radio-tagged and released 151 smolts; GLHA released 102 (treatment) fish upstream of Weldon Dam and 49 (control) fish downstream from the dam to account for natural mortality not associated with the project (i.e., paired-release study design). GLHA did not use the paired-release model in 2015, but instead released 100 tagged test smolts about 1,300 feet upstream of the project, and 49 tagged test smolts at the upper end of the impoundment to evaluate impoundment mortality and delay. GLHA evaluated natural mortality by smolts that were detected between two arrays downstream from the project.

[152] Minimum survival rates were estimated without accounting for and removing background mortality that naturally occurs in the river and false mortalities that could occur when a surviving smolt passes a downstream receiver, but is not detected by the receiver.

Table 17. Study results of downstream smolt passage studies.

Year	Passage route	Number of smolts using route	Percent of smolts using route	Percent of smolts surviving route
2014	Spillway	10	14.9	90
	Bypass	10	14.9	100
	Powerhouse	47	70.1	85.1
	Total	67	100	
2015	Spillway	9	6.7	88.9
	Bypass	11	8.1	100
	Powerhouse	106	78.5	92.5
	Log sluice	9	6.7	100
	Total	135	100	

(Source: GLHA, 2016a, as modified by staff).

Total survival past the dam (i.e., combined survival through all passage routes) was also estimated in 2014 and 2015. In 2014, GLHA used a paired-release study design, which allowed GLHA to include a control group released downstream from the dam for estimating background mortality.[153] In 2014, the total survival past the dam was estimated to be 95.8 percent (point estimate) with a 95 percent confidence interval between 83 and 100 percent.[154] In an effort to increase the number of smolts released upstream of the project for estimating impoundment mortality, GLHA did not use a

[153] Background mortality is the mortality that occurs in a natural free-flowing section of river, and is unrelated to the dam.

[154] Point estimates are single value estimates for survival. However, because there are inherent uncertainties (e.g., some surviving fish may not be detected by arrays) when calculating survival using telemetry, there is some uncertainty or error with a point estimate. Therefore, true survival may be larger or smaller than the point estimate. To capture the range of potential true values of survival, GLHA estimated a 95 percent confidence interval for the 2014 and 2015 survival estimates. The 95 percent confidence interval represents a range of survival values, within which there is a 95 percent probability of including the true survival estimate.

paired-release design in 2015, but, instead released all smolts upstream of the project.[155] In 2015, total survival past the dam was estimated to be 95.9 percent (point estimate) with a 95 percent confidence interval between 89.3 and 100 percent.

The downstream smolt passage studies also evaluated migration timing and delay. Based on the timing of tag detections, once smolts approached the project dam (within 656 feet), they typically moved through quickly. The median migration time was 0.24 hours (range between 0.01 and 29.03 hours) in 2014, and 0.3 hours (range between 0.01 and 297.5 hours) in 2015. In both years, movement rates increased from early May to late May.

In response to a request from NMFS, GLHA also determined the proportion of smolts that did not pass the dam within 24 hours of reaching a location 1,300 feet upstream of the dam (i.e., enter the forebay).[156] In 2014, two of the 69 smolts (2.9 percent) took slightly longer than 24 hours (27.3 and 29.0 hours) to pass the project after being detected in the forebay. In 2015, 12 of 137 (8.8 percent) of smolts detected in the forebay took longer than 24 hours to pass the project.

In addition to the onsite studies above, GLHA also included an analysis of whole station survival of smolts past the dam in its desktop entrainment and impingement study conducted during the pre-filing period of this relicensing proceeding. The results of the desktop study estimated that 97.4 percent, 96.6 percent, and 96.6 percent of smolts would survive passage past the dam at 25 percent, 50 percent, and 75 percent exceedance flows, respectively.

Smolt Survival Through the Impoundment

In 2015, GLHA also estimated smolt survival through the project impoundment by releasing 49 radio-tagged smolts about 7.8 miles upstream of the project dam. All 49 reached the first monitoring station about 984 feet downstream from the release site. A total of 42 smolts reached the dam, yielding an impoundment survival rate of 85.7 percent, or a mortality rate of 1.8 percent per mile (the distance from the release location

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[155] In 2015, background mortality was estimated from smolts released upstream of the project and detected at monitoring stations located at 4.7 and 6.7 miles downstream from the dam.

[156] In a letter filed on March 10, 2015, NMFS requested that GLHA calculate survival past the dam by assuming that only smolts that pass the project within 24 hours of approaching the trash racks can be counted as possible survivors. This 24-hour performance standard is currently a condition of other FERC-licensed projects on the Penobscot River (i.e., West Enfield, Milford, Stillwater, Orono).

to the dam is about 7.8 miles). In 2015, a mortality rate representative of background mortality unrelated to dam passage was estimated using tag detections from receivers located about 2.9 miles and 4.2 miles downstream from the dam, which equated to 4.8 percent mortality between the receivers, or about 3.8 percent mortality per mile based on the distance between the two stations.

In a separate study, Stich *et al.* (2015b) estimated mortality rates in the project impoundment, and in free-flowing reaches of the Penobscot River. Stich *et al.* (2015b) observed that mortality was higher in the project impoundment (average mortality rate for hatchery smolts: 2.7 percent per mile; and average mortality rate for wild smolts: 1.6 percent per mile)[157] than in free-flowing sections (average mortality rate for hatchery smolts: 0.64 percent per mile; and average mortality rate for wild smolts: 1.34 percent per mile) of the Penobscot River.

Downstream Passage of Kelts

Studies have been conducted at the project to evaluate passage of kelts and the collection efficiency of the existing downstream bypass. During the fall of 1992, a radio telemetry study indicated that among eight radio-tagged kelts, six survived passage downstream (five used the bypass, one passed through the turbines), one died or regurgitated its tag upstream of the dam, and one died downstream from the dam (GNP, 1993). In the spring of 1993, a larger-scale study involving 71 post-spawn broodstock kelts from the Craig Brook National Fish Hatchery was conducted under spill conditions, in which 30 kelts were radio-tagged and 41 served as controls.[158] Among the radio-

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[157] Stich *et al.* (2015b) provide estimates of smolt mortality in table S2 of the supplementary material provided with the article (http://nrcresearchpress.com/doi/suppl/10.1139/cjfas-2014-0573). We estimated the average mortality rates in the project impoundment based on the reaches labeled, "Weldon Head Pond" in table S2. Table S2 provides three estimates of mortality in the impoundment for hatchery and three estimates for wild smolts. Our estimate of average mortality in the impoundment is based on those three estimates, respectively, for hatchery and wild smolts. We estimated the average mortality rates in free-flowing reaches based on the reaches in table S2 that are in the Penobscot River and not labelled. Table S2 provides six estimates of mortality in free flowing reaches for hatchery and six estimates for wild smolts. Our estimate of average mortality in free-flowing reaches is based on those six estimates, respectively, for hatchery and wild smolts.

[158] The control kelts were Floy-tagged (i.e., small plastic external tag inserted just below the scales and skin) to identify the fish as part of the experiment, and identify whether the radio-tags affected kelt behavior or survival. Floy tags are less intrusive than

tagged kelts, three did not pass the dam (10 percent), three (10 percent) used the bypass, one passed through the turbines (3.3 percent), and 20 (66.7 percent) passed downstream via spill (GNP, 1993). The kelt that passed through the turbines died; however, the remaining 26 kelts survived, indicating that passage survival was 96.3 percent. Among the control kelts, 13 (31.7 percent) used the bypass. The passage route of the remaining control kelts was unknown, but based on the radio-tagged kelts, they likely passed via spill.

Bypass collection efficiency for kelts was also analyzed using the data collected during the 1992 and spring 1993 studies above, as well as a fall 1993 study that provided limited information on survival.[159] Data collected during these studies indicated that 11 radio-tagged kelts migrated downstream of the project dam using non-spillage routes during project operation. Nine of the kelts were collected in the downstream bypass, resulting in a collection efficiency of 82 percent (GNP, 1994).

In addition to the onsite studies above, GLHA also included an analysis of whole station survival of kelts past the dam in its desktop entrainment and impingement study. The results of the desktop study estimated that 96.6 percent, 94.2 percent, and 93.9 percent of kelts would survive passage past the dam at 25 percent, 50 percent, and 75 percent exceedance flows, respectively.

Recovery Plans

The 2005 Final Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon for the originally-listed GOM DPS (NMFS and FWS, 2005) presented a strategy for recovering Atlantic salmon listed as endangered under 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 (NMFS and FWS, 2016a).

The 2016 Draft Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon plan 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

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the radio-tags (which were inserted into the stomach) and are unlikely to affect behavior and survival.

[159] During 1993, 13 radio-tagged adult salmon were radio-tagged and released after successfully passing upstream via the upstream fishway. In the fall of 1993, only one of these kelts returned to the project after spawning, and it used the downstream bypass.

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 (NMFS and FWS, 2016a). The main objective 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 (NMFS and FWS, 2016a).

This recovery plan includes a table that generally identifies the priority, timing, and involved parties for the various actions, and states that annual decisions made about recovery priorities will be formulated in SHRU-level workplans (NMFS and FWS, 2016b). SHRU-level workplans 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 (NMFS and FWS, 2016a).

Recovery actions are also outlined in the workplan (NMFS and FWS, 2016b) to address these threats. Those actions potentially relevant to the Mattaceunk Project include:

- Complete a SPP plan at Weldon Dam to establish upstream and downstream fish passage efficiency standards required to ensure the survival and recovery of Atlantic salmon.

- Evaluate and modify operation of the Weldon Project[160] as needed until operations meet or exceed the specified standards. Standards must be met within ten years of the completion of any final SPP.
- Assess whether artificial lighting increases opportunities for predation at dams, particularly by cormorants, and implement measures to minimize these impacts.
- Identify and document sources of cool water that could serve as refuge for adult and juvenile salmon and ensure that all areas of cool water along the mainstem Penobscot are protected from activities that degrade water quality and limit accessibility for both adults and juveniles.
- Assess the feasibility of conducting a large wood/boulder project in the East Branch of the Penobscot River, develop a study design, and if deemed feasible and appropriate, implement according to the study design.
- Improve conductivity within the watershed through the modification of culverts within the project vicinity.

Atlantic Salmon Critical Habitat

Critical habitat was designated for Atlantic salmon on June 19, 2009.[161] The critical habitat designation includes 45 specific areas occupied by the GOM DPS of Atlantic salmon that comprise approximately 12,161 miles of perennial river, stream, and estuary habitat and 197,437 acres of lake habitat. Within the occupied areas there are known physical and biological features (i.e., primary constituent elements [PCEs]) that are essential to the conservation of the species. Within the occupied range of the GOM DPS, Atlantic salmon PCEs include sites for spawning, incubation, and juvenile rearing, (i.e., spawning and rearing PCE) and sites for migration (i.e., migration PCE). Physical and biological features of the spawning and rearing PCE include:

- PCE 1: deep, oxygenated pools and cover (e.g., boulders, woody debris, and vegetation), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall;
- PCE 2: 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;
- PCE 3: 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;
- PCE 4: freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr;

[160] The Weldon Project is the Mattaceunk Project.

[161] 74 Fed. Reg. 29300-29341 (June 19, 2009).

- PCE 5: 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;
- PCE 6: freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr; and
- PCE 7: freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.

Physical and biological features of the migration PCE include:

- PCE 8: 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;
- PCE 9: 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;
- PCE 10: freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation;
- PCE 11: freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment;
- PCE 12: freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration; and
- PCE 13: freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

Atlantic Salmon Critical Habitat in the Project Area

Critical habitat within the main stem Penobscot River extends from the estuarine habitat of Penobscot Bay up into the East and West Branches. Therefore, the Mattaceunk Project falls within the designated critical habitat of the Penobscot Bay SHRU for Atlantic salmon. Section 3.3.2.1, *Aquatic Resources*, *Affected Environment* contains a description of aquatic habitat conditions upstream of and downstream from the project, which are within designated critical habitat.

Essential Fish Habitat

Essential fish habitat (EFH) refers to those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity and covers a species' full life cycle.[162] EFH for Atlantic salmon has been defined as, "all waters currently or historically accessible to Atlantic salmon within the streams, rivers, lakes, ponds, wetlands, and other water bodies of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut", which includes the project area. A description of EFH for each Atlantic salmon life stage can be found in the New England Fishery Management Council (NEFMC) Essential Fish Habitat Amendment (NEFMC, 1998) as follows:

- Eggs: Bottom habitats with a gravel or cobble riffle above or below a pool in rivers. Generally, the following conditions exist in the egg pits (redds): water temperatures below 50°F, and clean, well-oxygenated fresh water. Atlantic salmon eggs are most frequently observed between October and April.
- Larvae: Bottom habitats with a gravel or cobble riffle (redd) above or below a pool in rivers. Generally, the following conditions exist where Atlantic salmon larvae, or alevins/fry, are found: water temperatures below 50°F, and clean, well-oxygenated fresh water. Atlantic salmon alevins/fry are most frequently observed between March and June.
- Juveniles: Bottom habitats of shallow gravel/cobble riffles interspersed with deeper riffles and pools in rivers and estuaries. Generally, the following conditions exist where Atlantic salmon parr are found: clean, well-oxygenated freshwater, water temperatures below 77°F, water depths between 10 cm and 61 cm (3.9 to 24.0 inches), and water velocities between 30 and 92 cm per second (1 to 3 feet per second). As they grow, parr transform into smolts. Atlantic salmon smolts require access downstream to make their way to the ocean. Upon entering the sea, "post-smolts" become pelagic and range from Long Island Sound north to the Labrador Sea.
- Adults: For adult Atlantic salmon returning to spawn, habitats with resting and holding pools in rivers and estuaries. Returning Atlantic salmon require access to their natal streams and access to the spawning grounds. Generally, the following conditions exist where returning Atlantic salmon adults are found migrating to the spawning grounds: water temperatures below 73°F, and DO above 5 parts per million (ppm). Oceanic adult Atlantic salmon are primarily pelagic and range from the waters of E-5-65 the continental shelf off southern New England north throughout the Gulf of Maine.
- Spawning Adults: Bottom habitats with a gravel or cobble riffle (redd) above or below a pool of rivers. Generally, the following conditions exist where spawning Atlantic salmon adults are found: water temperatures below 50°F, water depths between 30 cm and 61 cm (11.8 to 24 inches), water velocities around 61 cm per second (2 feet per second), and clean, well-oxygenated fresh water. Spawning Atlantic salmon adults are most frequently observed during October and

[162] 50 CFR 600.10.

November. Atlantic salmon EFH includes all aquatic habitats in the watersheds of the identified rivers, including all tributaries, to the extent that they are currently or were historically accessible for salmon migration. Atlantic salmon EFH excludes areas upstream of longstanding naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

As discussed above, spawning and rearing habitat has been identified both upstream of and downstream from the project boundary. Further, NMFS has indicated that the habitat mapping conducted in the project tailrace by GLHA indicates that the tailrace is suitable for spawning and rearing of Atlantic salmon given the presence of run, riffle, and gravel bar habitat.[163]

Canada Lynx

Canada lynx are medium-sized cats that inhabit boreal forests and feed almost exclusively on snowshoe hare. In the United States they are found primarily in the Northeast, western Great Lakes, northern and southern Rockies, and northern Cascades, in the southern-most extent of its range. The Canada lynx was listed as threatened under the ESA on March 24, 2000 (FWS, 2000). Canada lynx are a state species of special concern in Maine (Maine DIFW, 2013).

Canada lynx habitat is widespread throughout northern Maine and includes large areas of young, dense stands of spruce and fir, approximately 12 to 30 years old, which have dense understory vegetation that support high densities of snowshoe hares. Areas of prime habitat shift with time as stands mature and new stands are cut. Populations of snowshoe hare have a direct effect on local lynx populations, which fluctuate in response to its prey.

The FWS designated five units of critical habitat for the Canada lynx in November 2005. In Maine 10,123 square miles of forestland in western and northern Maine (FWS, 2014) was proposed for critical habitat (Unit 1). Unit 1 includes portions of Aroostook, Franklin, Penobscot, Piscataquis, and Somerset counties. According to the FWS this area is important for lynx conservation, because it is the only area in the northeastern region of the lynx's range that is within the contiguous United States, and that currently supports a resident breeding population. Thus, Unit 1 likely acts as a source or provides connectivity with Canada for more peripheral portions of the lynx's range in the Northeast.

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[163] *See* letter filed by NMFS on May 23, 2017.

The Mattaceunk Project exists outside of Unit 1 and thus there is no designated critical habitat within the project boundary. No agency recommendations were received regarding the Canada lynx.

Northern Long-eared Bat

The Northern long-eared bat (NLEB) was listed as a federally threatened species under the ESA on May 4, 2015 and is also a species of special concern in Maine. In January 2016, the FWS finalized the 4(d) rule for this species which focuses on preventing effects on bats in hibernacula associated with the spread of white-nose syndrome[164] and effects of tree removal on roosting bats or maternity colonies (FWS, 2017b). As part of the 4(d) rule, FWS proposes that take incidental to certain activities conducted in accordance with three specific habitat conservation measures, as applicable, would not be prohibited. Those habitat conservation measures are that the activity: (1) occurs more than 0.25 mile from a known, occupied hibernacula; (2) avoids cutting or destroying known, occupied maternity roost trees during the pup season (June 1 – July 31);[165] and (3) avoids clearcuts within 0.25 mile of known, occupied maternity roost trees during the pup season (June 1 - July 31). The 4(d) rule provides flexibility to landowners, land managers, government agencies, and others as they conduct activities in areas that could be NLEB habitat.

NLEB emerge at dusk and use upland and lowland forested habitats and tree-lined corridors to feed on insects while in flight and using echolocation. In summer, natural roosts are under loose tree bark and in other tree cracks, crevices, and cavities (ESI, 2002). Non-reproductive females and males also sometimes roost in cooler places, such as caves or mines. NLEB roost in a variety of habitats. The species also sometimes uses man-made structures such as abandoned buildings, dilapidated barns, park pavilions, sheds, window shutters, utility poles, and bat houses (FWS, 2017b). NLEB 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 (FWS, 2015). No critical habitat has been designated for this species; however,

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[164] Hibernacula are locations where bats hibernate over the winter, such as caves. White-nose syndrome is a fungal infection that agitates hibernating bats, causing them to rouse prematurely and burn fat supplies. Mortality results from starvation or, in some cases, exposure. (FWS, 2014b)

[165] Pup season refers to the period when bats birth their young.

the project is located within the white-nose syndrome buffer zone for the northern long-eared bat.[166]

3.3.4.2 Environmental Effects

Atlantic Salmon

Operational Effects on Atlantic Salmon Habitat

As discussed previously, GLHA proposes to continue to operate the project in a run-of-river mode with pondage, with the impoundment fluctuation limits and minimum flows discussed fully in section 3.3.2.2, *Aquatic Resources, Environmental Effects*. Interior, NMFS, and Maine DMR recommend GLHA's proposal for impoundment fluctuation limits and minimum flows.

In addition to the operational recommendations, Maine DEP recommends that GLHA develop an operation and monitoring plan that specifies the methods that would be used to monitor the project and maintain minimum flows and impoundment water levels. NMFS recommends that GLHA develop a plan to monitor impoundment water levels, with specific provisions discussed in section 3.3.2.2, *Aquatic Resources, Environmental Effects*. NMFS also recommends that GLHA install flow monitoring equipment in the project tailrace to confirm minimum flow requirements, and this recommendation also is discussed in more detail in section 3.3.2.2, *Aquatic Resources, Environmental Effects.*

Our Analysis

Atlantic Salmon Critical Habitat

As discussed in section 2.1.3, *Existing Project Operation*, GLHA operates the project in run-of-river mode with pondage, with impoundment fluctuations that are minimal and maintained within 1 foot or less of the top of the flashboards, except when repairs are needed, in which case drawdowns are maintained within 2 feet of the flashboards, or within 1 foot of the crest of the dam when the flashboards are being repaired or installed. Thus, other than when drawdowns are needed, the project is operated as a run-of-river facility with inflow equal to outflow. This mode of operation, which GLHA proposes to continue under a new license, prevents rapid fluctuations in the impoundment, and thus prevents migrating salmon from being stranded along the shore. Run-of-river conditions with minimal fluctuation of the impoundment also helps to

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[166] The white-nose syndrome buffer zone encompasses counties within 150 miles of a U.S. county or Canadian district in which white-nose syndrome or the fungus that causes white-nose syndrome is known to have infected bat hibernacula.

maintain submerged aquatic vegetation along shallow water areas of the impoundment, which can serve as temporary holding and resting areas during the upstream migration of adult salmon (i.e., PCE 9 discussed above). The continuation of these project operations would maintain the existing conditions, and as discussed in section 3.3.2.2, *Environmental Effects* and below, an operation compliance monitoring plan would ensure that GLHA consistently maintains the impoundment elevation and downstream minimum flows at levels that are protective of Atlantic salmon.

As discussed in section 3.3.2.2, *Water Quality*, the water quality study conducted by GLHA demonstrates that water quality in the project impoundment is very good and consistent with Maine's water quality levels specified for Class C waters. The study also indicates that the impoundment does not stratify and that water temperature and DO are relatively uniform throughout the water column. Further, operating the project in run-of-river mode, which would provide nearly natural flows and maintain cool water temperatures, would help provide the diurnal cues to stimulate smolt migration (i.e., PCE 12), and support the migration of other native diadromous species (i.e., eel, shad, and sea lamprey), which serve as protective buffers against predation (i.e., PCE 10). All of the conditions discussed above would be maintained under proposed operations, and are generally consistent with the recommendations from NMFS, Interior, and Maine DMR. Further, as discussed in section 3.3.2.2, *Operations Compliance Monitoring*, the development and subsequent implementation of an operations compliance monitoring plan to monitor impoundment water levels, as recommended by Maine DEP and NMFS, would ensure that the good habitat conditions under existing conditions would be maintained under a new license.

Project operation also maintains good water quality downstream from the project (water temperature of 69° F and DO of 8.6 mg/L in mid-August), as discussed in section 3.3.2.1, *Water Quality*, and run-of-river flows allow the physical habitat to be maintained and biological productivity to be sustained. This habitat consists of runs, riffles, and pools, with bottom substrates consisting mostly of gravel, cobble, and boulders (see section 3.3.2.1, *Downstream Habitat*). These water quality, flow, and bottom substrate conditions (particularly gravel in runs and riffles) create habitat that is potentially suitable for spawning and rearing of Atlantic salmon (i.e., PCE 1 through PCE 7 as discussed above).[167]

Existing run-of-river operation with pondage prevents rapidly fluctuating water levels from occurring downstream of the project, which prevents stranding of Atlantic

[167] Habitat downstream of the project has not been documented (i.e., mapped or formally described) as spawning and rearing habitat for Atlantic salmon. The habitat conditions in the project tailrace, however, are suitable for spawning and rearing (see letter filed by NMFS on May 23, 2017).

salmon that migrate upstream or downstream, or dewatering of spawning habitat that may be present downstream of the project. Run-of-river operation also allows flows that average 5,366 cfs and 9,664 cfs to move through habitats downstream of the project during the upstream migration of adults and the downstream migration of smolts, respectively (GLHA, 2016a). However, as discussed above, if minimum flow releases are needed during impoundment drawdowns, the minimum flow study conducted by GLHA indicates that the proposed minimum flow of 1,674 cfs would maintain suitable aquatic habitat and a provide connectivity of habitats with water depths that exceed the 4 inches to 10 inches of water needed for passage of adult Atlantic salmon to reach the project (Maine DOT, 2004), and thus the downstream habitat would not be a barrier to upstream or downstream migration (i.e., PCE 8 as discussed above). Further, water velocities along the shoreline passage zones were less than the burst swim speeds of smolts (6 fps) and adults (16.5 to 19.7 fps), and therefore would not be a barrier to passage.

As discussed in detail below, GLHA is proposing to maintain upstream and downstream fishways for Atlantic salmon and ensure the fishways meet performance standards of 95 percent effectiveness for upstream migrating adults and 96 percent survival for downstream migrating smolts and kelts. Maintaining a rate of passage at the level of the proposed performance standards would provide necessary passage requirements for the GOM DPS, and improve migration habitat for Atlantic salmon migrating through the project area, and reduce passage delay (i.e., PCE 11 as discussed above).

Atlantic Salmon Essential Fish Habitat

Essential fish habitat for Atlantic salmon is present both upstream of and downstream from the Mattaceunk Project, and Atlantic salmon use habitat in the immediate vicinity of the project for migration and potentially for spawning and rearing downstream from the dam. As the discussion above on critical habitat indicates, proposed project operation would maintain the good quality habitat in the project vicinity, which currently allows passage of all life stages of Atlantic salmon, and the water quality, flow, and habitat conditions capable of supporting spawning and rearing downstream from the project. Further, as discussed in detail below, GLHA is proposing to maintain upstream and downstream fishways for Atlantic salmon, and to ensure the fishways meet performance standards of 95 percent effectiveness for upstream migrating adults and 96 percent survival for downstream migrating smolts and kelts. As discussed below, maintaining passage at the proposed performance standards would provide necessary passage requirements for the GOM DPS and would improve migration habitat for Atlantic salmon migrating through the project area. Therefore, over the term of the license, aquatic habitat and EFH would be enhanced under the applicant's proposal. The additional staff modifications and measures discussed in section 5.1, *Comprehensive*

Development and Recommended Alternative, which are supported in section 3.3.2.2, *Aquatic Resources,* and in sections below, would further support EFH.

Operation of the Upstream Fishway

To improve upstream passage of Atlantic salmon at the Mattaceunk Project, an upstream pool and weir fishway was constructed in the late 1930s, and the current configuration has been used since the spring of 1986, when it was improved after agency consultation. The current upstream fishway has 36 pools with a drop of approximately 14 inches between pools, which is described fully in section 2.1.1, *Existing Project Facilities*.

To provide the necessary upstream passage for Atlantic salmon, GLHA proposes to continue to maintain and operate[168] the existing upstream fishway annually from May 1 to November 10, including continuing to use a 7 cfs attraction flow at the fishway entrance. In addition, GLHA proposes to implement the FPOMP, which defines the: (1) operational period of the existing upstream and downstream fishways; (2) annual start-up and shut-down procedures; (3) opening methods; (4) debris management; and (5) safety rules and procedures.

NMFS's fishway prescription would require, and Maine DMR recommends, GLHA's proposal to maintain and operate the upstream fishway.[169] NMFS's fishway prescription would also require GLHA to open the upstream fishway prior to May 1 if the fish lift at Milford Dam begins capturing adult Atlantic salmon earlier than May 1. Maine DMR recommends including a provision in any new license to allow modification of the upstream fishway operating schedule during the term of the license, and in consultation with Maine DMR, Interior, and NMFS, based on new information or migration data. Maine DMR also recommends that, with approval from Maine DMR,

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[168] In operating the upstream fishway, GLHA is required to provide flows through the fishway that consist of 6 to 8 cfs transport flow, with an additional attraction flow of 7 cfs.

[169] NMFS includes a comment in Attachment B to the preliminary fishway prescription filed on May 23, 2017, which states that NMFS currently recommends a minimum attraction flow of 5 percent of station capacity, with design flexibility for attraction flow up to 10 percent station capacity. However, NMFS's preliminary prescription does not include this language, and instead indicates that they support GLHA's proposal to continue to maintain the existing upstream fishway, which includes a 7 cfs attraction flow and 6 to 8 cfs transport flow (for a total of about 13 to 15 cfs attraction flow [i.e., less than 1 percent of station capacity, which is 7,438 cfs]). Because of this conflict, we default to analyzing the preliminary prescription, rather than the recommendation included in the comments.

Interior, and NMFS, GLHA have the ability to request changes in the upstream fishway operating schedule in any given year in response to river conditions, maintenance requirements, and annual variability in migration patterns.

NMFS also recommends that GLHA determine the minimum impoundment elevation necessary to operate the upstream fishway.

Our Analysis

Existing Upstream Passage Facility Effectiveness

GLHA's proposal to operate the existing fishway, which is supported by NMFS and Maine DMR, would allow upstream migrating adult Atlantic salmon that reach the project to continue ascending the river to access spawning habitat upstream of the project. As discussed above, studies conducted in 1986 and 2012 indicate that the passage efficiency of the existing upstream fishway is capable of passing adult Atlantic salmon, but the effectiveness is variable. Among three separate groups of tagged adult salmon, the percent that successfully passed upstream through the fishway was 71 percent (1986, radio-tagged), 89 percent (1986, externally tagged control), and 100 percent (2012, PIT tagged).

Although the existing upstream fishway is capable of passing adult Atlantic salmon, improvements may be needed. As discussed above, passage effectiveness is estimated to be between 71 percent and 100 percent. The effectiveness of the existing upstream fishway has never consistently met the performance standard of 95 percent that is proposed by GLHA, recommended by Bruce Haines and the Atlantic Salmon Federation, and currently supported by NMFS (see additional discussion of the performance standard below in section titled, *Upstream Passage Performance Standard and Effectiveness Testing*).

Upstream Passage Operation Schedule

As discussed in section 3.3.4.1, *Affected Environment*, daily monitoring at the Mattaceunk Project from 1983 to 2012 indicates that the peaks in upstream migration past the project occur during July and in early September, with limited movement occurring in early June, August, and mid-late October (*see* figure 15). Thus, GLHA's proposal, Maine DMR's recommendation, and NMFS's fishway prescription to maintain and operate the existing upstream fishway from May 1 to November 10, represents an appropriate operational window that would afford all adult Atlantic salmon that reach the Mattaceunk Project an opportunity to migrate to upstream habitats. However, since 2012, there are now two fewer impediments to upstream passage (i.e., the removal of Great Works and Veazie Dams), and there is improved upstream passage at the Milford Project (i.e., new fish lift began operations in 2014). With fewer potential causes of upstream passage delay in habitats downstream of the Mattaceunk Project, adult Atlantic salmon may reach the project sooner than historical records indicate. Thus, it may be necessary to begin operating the upstream fishway earlier than May 1, if monitoring data at the Milford Project, or other sources of information indicate that adult Atlantic salmon are migrating to the Mattaceunk Project earlier than historical observations. It is also possible that upstream migratory delays could occur as a result of environmental factors. As discussed above, river flow and extremes in temperature can cause adult Atlantic salmon to delay their upstream migration.

With respect to modifying the fishway operations schedule, Maine DMR recommends that the Commission allow (a) the operating schedule for the upstream fishway to be modified during the term of the license, and (b) GLHA to request changes to the operating schedule, if data (i.e., migration timing, river flow, river temperature) and consultation with resource agencies, support the need to modify the operating schedule. In addition, NMFS's fishway prescription would require GLHA to open the upstream fishway prior to May 1 if the Milford fishway begins capturing fish earlier. Both Maine DMR and NMFS indicate that there should be flexibility in the operating schedule for the upstream fishway to allow the fishway to operate beyond the window of May 1 to November 10. However, neither Maine DMR's recommendation, nor NMFS's prescription includes limits regarding the number of days earlier or later that the fishway should operate outside the May 1 to November 10 schedule. In the absence of such limits to the operational window, we have no information to determine whether a particular schedule modification would or would not provide benefits to the GOM DPS of Atlantic salmon. Therefore, we are unable to identify any benefits to implementing unspecified modifications to the upstream fishway operating schedule.

Effects of Impoundment Elevation on Upstream Passage Operation

The upstream fishway is operational when the flashboards are in place, and under normal operating conditions, which allow fluctuations of up to 2 feet from the top of the flashboards (impoundment elevation with the flashboards in place is 240.0 feet, thus 2 feet below flashboards is 238.0 feet), although fluctuations are typically less than 1 foot below the flashboards. Under these conditions, water from the impoundment flows into the fishway and serves as a source of water and attraction flow at the fishway entrance. When high flows or other events cause flashboard failure, resulting in a need for replacement or repair, the impoundment is drawn down up to 1 foot below the permanent crest (impoundment elevation is 236.0 feet) of the dam and the fishway is not operational, because no flows from the impoundment can pass into the fishway.

The upstream fishway is operational under normal operating conditions, which could can include impoundment fluctuations down to an impoundment elevation of 238.0 feet. The upstream fishway is not operational at an impoundment elevation of 236.0 feet. However, there is an unknown impoundment elevation between 236.0 feet and 238.0 feet at which the upstream fishway becomes non-operational. NMFS recommends that

GLHA determine this elevation for future fishway operation, and any new fishway construction.

Knowing the elevation at which the upstream fishway becomes non-operational is irrelevant to the operation of the upstream fishway, because under existing and proposed project operations, the impoundment elevations are always at or above 238.0 feet when the flashboards are in place (i.e., normal operations), or between 235.0 feet and 236.0 feet, when the flashboards are down for repair or because of flashboard failure. An impoundment elevation between 236.0 feet and 238.0 feet would never occur under normal operations. Thus, the existing upstream fishway would be operational under the proposed normal operating conditions, which are the same as existing operations, and therefore it is not necessary to identify the impoundment elevation at which the existing fishway can no longer operate.

Upstream Passage Performance Standard and Effectiveness Testing

Despite the presence of an upstream fishway, existing studies indicate that its effectiveness varies, ranging between 71 percent and 100 percent. GLHA is proposing to meet a performance standard of 95 percent passage effectiveness for upstream migrating adults. Thus, upstream fishway improvements may be needed. To evaluate the need for upstream passage improvements, GLHA proposes in the SPP to conduct up to 3 years of upstream fishway effectiveness studies for Atlantic salmon using the methods in the existing approved study plan.[170] GLHA's proposed study would include coordination with resource agencies to stock uniquely marked Atlantic salmon smolts upstream of the Mattaceunk Project in the first 3 years after relicensing to serve as a source of imprinted adult fish that can be used for studying upstream passage of adults.[171] GLHA also proposes, as part of the SPP, to implement an adaptive management approach, in consultation with the resource agencies that would include additional operational, structural, and/or habitat enhancement measures, if necessary, to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon. Specifically, if the upstream fishway is able to meet GLHA's proposed performance standard of 95 percent effectiveness during the first year of any new license, GLHA would evaluate upstream passage at the project once every 10 years to verify continued achievement of the performance standard. If the project does not achieve the proposed

[170] GLHA's existing study plan (Upstream Salmon Passage – Interim Species Protection Plan) was filed on December 11, 2013 as part of GLHA's revised study plan for relicensing the Mattaceunk Project.

[171] Stocked smolts would migrate downstream, through the project area, and out to sea. They would then spend about 2 years at sea before returning to the Penobscot River, where they would be collected at the Milford Project fishlift, inserted with a telemetry tag, and released to be part of the upstream passage effectiveness study.

95 percent performance standard for upstream passage in the first year, GLHA would begin an adaptive management approach to meeting the performance standard that would include consulting with the resource agencies and Penobscot Indian Nation to make any modifications to the upstream fishway deemed appropriate, followed by additional study.

Bruce Haines and the Atlantic Salmon Federation also recommend upstream passage effectiveness that meets a 95 percent performance standard for adult Atlantic salmon migrating to spawning habitats upstream of Weldon Dam.

NMFS's fishway prescription would require, and Maine DMR recommends, GLHA's proposal to conduct up to 3 years of upstream fishway effectiveness studies. In addition, NMFS's fishway prescription would require, and Maine DMR recommends, GLHA's proposal to implement additional operational and structural modifications, and/or habitat enhancement measures, if necessary, to address performance standard deficiencies for upstream migrating Atlantic salmon adults. If modifications to the upstream fishway are needed, Maine DMR recommends that GLHA operate the fishway for a one season "shakedown" period (i.e., evaluation period), as discussed in section 3.3.2.2, *Aquatic Resources, Environmental Effects*, to ensure it is generally operating as designed and to make minor adjustments to the facilities and operation. Further, Maine DMR recommends that at the end of the "shakedown" period, GLHA have a licensed engineer certify that the facility is constructed and operating as designed. NMFS's fishway prescription would require GLHA to operate the upstream fishway in a way that complies with any incidental take statement.[172] NMFS also recommends, as proposed in the SPP, that GLHA's adaptive management for upstream and downstream passage be developed in consultation with the resource agencies.

Our Analysis

Under existing conditions, passage effectiveness of the upstream fishway has never consistently exceeded GLHA's proposed performance standard of 95 percent (*see* section 3.3.4.1, *Upstream Passage*), and has been more than 20 percent lower (i.e., 71 percent in 1986) than the proposed performance standard. A performance standard of 95 percent effectiveness for upstream passage is already a requirement at the West Enfield and Milford Projects,[173] which are the only two dams downstream from the Mattaceunk Project on the mainstem of the Penobscot River. Thus, increasing passage effectiveness

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[172] In a letter filed on May 23, 2017, NMFS indicated that a performance standard of 95 percent effectiveness, as proposed by GLHA, is consistent with other performance standards in the Penobscot River, but that standard could be modified in the incidental take statement of its future biological opinion.

[173] 146 FERC ¶ 62,224 (2014).

at the Mattaceunk Project to 95 percent would increase the cumulative passage through the river from what could be as low as 64 percent under existing conditions to about 86 percent.[174] The increase in upstream passage effectiveness at the project would benefit the GOM DPS of Atlantic salmon by allowing more individuals to locate suitable spawning habitat upstream of the project, and thereby improve the reproductive potential of the population.

Additional monitoring would be needed to verify whether the 95 percent performance standard is currently being met. Conducting up to 3 years of upstream fishway effectiveness testing, as proposed by GLHA, recommended by Maine DMR, and required by NMFS's fishway prescription, would ensure that the existing fishway is either meeting the 95 percent performance standard, or if it is not meeting the standard, the study results would provide documentation of a need for additional measures to improve passage effectiveness. Further, GLHA's proposed use of the existing study plan, which was previously developed in consultation with the resource agencies and Penobscot Indian Nation, and approved by the Commission, includes scientifically acceptable methods, such as the use of telemetry tagged adult Atlantic salmon. However, because some aspects of the methodology, such as the choice of telemetry tag (e.g., radio-tag, acoustic tag), have not been finalized in the existing study plan, GLHA would need to consult with the resource agencies and Penobscot Indian Nation before filing any final study plans on upstream passage effectiveness.

For the proposed upstream passage study to accurately determine the effectiveness of the upstream fishway, telemetry tagged adult Atlantic salmon must be motivated to migrate to spawning habitat upstream of the project (i.e., imprinted to habitat upstream of the project), otherwise failure to pass upstream could be caused by lack of motivation and not an ineffective fishway. To increase the chances that adults would be motivated to migrate upstream of the dam, GLHA proposes, Maine DMR recommends, and NMFS would require in its fishway prescription, stocking uniquely marked Atlantic salmon

[174] The cumulative passage through the mainstem of the Penobscot River under existing conditions would be the product of passage effectiveness at the Milford Project (95 percent), the West Enfield Project (95 percent), and the Mattaceunk Project (71 percent, assuming the lowest reported effectiveness for the upstream fishway), which is 64 percent. If passage effectiveness at Mattaceunk were increased to 95 percent, the product of effectiveness at all three dams would increase to 86 percent.

smolts upstream of the project,[175] to serve as a source of imprinted adult fish that would be used to study upstream passage of adults.[176]

The use of adult fish imprinted to spawning habitat upstream of the project is necessary to ensure that the fish used in the study are motivated to migrate upstream of the project. If non-imprinted adults are used, they may not migrate upstream of the project simply because there are no cues motivating them to migrate to upstream spawning habitat (Shepard, 1995). Any unsuccessful passage caused by the absence of motivation would reduce the percent of successfully passing adults, even though the cause of unsuccessful passage may not be caused by the upstream fishway. Using imprinted adults would remove motivation as a factor that could cause unsuccessful upstream passage, and would allow the study to more accurately evaluate passage success as a function of operational or structural upstream fishway conditions.

NMFS's fishway prescription would require that the effectiveness studies begin at the start of the first migratory season after fishways are operational. However, as discussed above, upstream migrating adult Atlantic salmon would not be available for study until at least 2 years after they are stocked as smolts upstream of the project. Thus, NMFS's requirement would not be feasible for the Atlantic salmon upstream passage effectiveness studies.

NMFS has indicated,[177] with respect to the upstream passage effectiveness studies, that its incidental take statement may include a condition stating that the performance standard of 95 percent effectiveness would be considered achieved if 75 percent of adult study fish pass the project area within 48 hours of approaching the dam (i.e., 656 feet downstream), and the remaining 20 percent of study fish pass the project within 96 hours. Thus, any adults that exhibit migratory delays beyond the 48- or 96-hour thresholds, would be considered as failed passage attempts in evaluating whether the performance standard is achieved. Delays in migration are a concern because they can result in prolonged exposure to disease and parasites, cause delay in reproduction which may

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[175] Stocking of smolts upstream of the project is required, because natural reproduction upstream of the project is currently very low. Thus, there are very limited numbers of adult Atlantic salmon that are both imprinted to habitats upstream of the dam and that are returning to the project. For numbers of recent returning adults Atlantic salmon, see section 3.3.4.1, *Affected Environment, Atlantic Salmon*.

[176] The marked smolts would migrate downstream, and most would spend 2 years at sea before returning to the Penobscot River. Any marked adults captured at the Milford Project fish lift would be identified as being stocked upstream of the Mattaceunk Project, and included in the upstream fish passage study.

[177] See letter from NMFS filed on May 23, 2017.

negatively affect egg and sperm quality, or cause depletion in overall energy reserves – all of which could negatively affect reproduction and survival (Geist *et al.*, 2000; Hari *et al.*, 2006; Hinch *et al.*, 2012; Fenkes *et al.*, 2016).

Although dams are known to delay upstream passage of salmonids (Caudill *et al.*, 2007), a 48-hour and 96-hour passage requirement implicitly assumes that delay is exclusively caused by the dam or ineffective upstream passage. However, other factors, including extreme high or low water temperatures (Alabaster, 1990; Shepherd 1995) and river flow (Jensen *et al.*, 1986; Trepanier *et al.*, 1996) can also delay migration. Further, we have been unable to identify any studies that would indicate that delays beyond 48 hours, 96 hours, or any time period would negatively affect reproduction or survival. Thus, NMFS's potential requirement for adult salmon to pass upstream of the project within a specific 48-hour or 96-hour threshold is without scientific justification.

The upstream effectiveness studies may show that the existing upstream fishway does meet the 95-percent performance standard for upstream passage after 1 year of study. Under this scenario, GLHA proposes to operate the existing fishway without structural or operational changes and evaluate upstream passage once every 10 years to verify continued achievement of the performance standard. The ability to meet the 95-percent performance standard after 1 year of study would indicate that the upstream fishway is effective at passing adults upstream, and if the upstream fishway is maintained in accordance with the FPOMP (discussed in section 3.3.2.2, *Fish Passage Design, Operation, Maintenance, and Monitoring*) it should continue to meet the 95 percent standard. However, because GLHA is proposing to stock uniquely tagged smolts during the first 3 years after relicensing, GLHA could conduct an additional 1 or 2 years of upstream passage effectiveness studies to provide additional verification of effectiveness. The need for an additional 1 or 2 years of study could be determined in consultation with the resource agencies, with final approval from the Commission.

Once the upstream fishway meets the 95 percent effectiveness standard, GLHA proposes to reevaluate of the upstream fishway effectiveness every 10 years to provide additional assurance that upstream passage effectiveness is maintained at a high level throughout the duration of any license issued. However, if the upstream fishway meets the 95 percent performance standard and is properly operated and maintained, as discussed in section 3.3.2.2, *Fish Passage Design, Operation, Maintenance, and Monitoring*, there would be no benefit to conducting additional effectiveness monitoring every 10 years.

Evaluating the upstream fishway effectiveness may show that the upstream fishway does not meet the 95 percent performance standard. Under this scenario, GLHA proposes, Maine DMR recommends, and NMFS's would require GLHA to consult with the resource agencies and Penobscot Indian Nation, and make any structural or operational modifications that are deemed appropriate, followed by additional study.

Although additional measures may be needed to meet a 95 percent performance standard, specific structural and/or operational modifications have not been proposed, because a need for such measures cannot be determined at this time. Without specific structural and/or operational modifications to analyze, we are unable to determine whether such measures would benefit the Atlantic salmon GOM DPS. Nevertheless, if specific structural and/or operational modifications are identified as necessary at a future date, implementation could occur, but would require final Commission approval.

GLHA is only proposing to stock smolts for 3 years, which would allow them to conduct up to 3 years of upstream effectiveness monitoring. A fourth year of study would not be feasible under GLHA's proposal, and stocking additional smolts for the purposes of additional study may not be consistent with the restoration objectives for Atlantic salmon.[178] Therefore, 3 years of monitoring could end without meeting the 95 percent performance standard and without an ability to conduct additional monitoring. Under this scenario, GLHA could develop additional adaptive management provisions, but implementation of any future provisions would require final Commission approval. This would provide GLHA a mechanism to continue efforts to meet the 95 percent performance standard, which would benefit the GOM DPS.

Counting Atlantic Salmon in the Upstream Fish Trap

Atlantic salmon that pass through fishways can be counted, with the data being used to determine current population status and historical trends, which can inform management decisions. Since 1983, the licensee of the Mattaceunk Project has voluntarily operated a fish trap located at the upstream exit of the fishway, where fish enter the trap through a funnel-like opening after negotiating the fishway. The trap is tended daily during the migration season by GLHA, and any Atlantic salmon captured are

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[178] For the study to succeed, GLHA would need to stock tens of thousands of smolts each year of the upstream passage study, in order to get at least 20 adult salmon returning to the Penobscot River and Milford Project fishlift, where they would be collected, telemetry tagged, and released as study fish. Kocik and Sheehan (2006) indicate that adult return rates of hatchery smolts released in the Penobscot River in 2005 was 0.17 percent. Based on a 0.17 percent return rate alone, GLHA would need to stock a minimum 11,765 smolts to have the possibility of 20 adult returns. However, GLHA may need to stock thousands more smolts to improve the chances of collecting and tagging 20 adult salmon each year. Stocking smolts upstream of the project for the purposes of the study could impede restoration efforts, which are currently focused on stocking smolts downstream of all Penobscot River hydropower projects in order to maximize the number of smolts that reach the ocean (*see* GLHA's Updated Study Report Meeting Summary filed on February 5, 2016 for discussion on current stocking efforts in the Penobscot River).

counted and classified by size and allowed to passively swim out of the trap by opening a hinged door. GLHA proposes to monitor the upstream fishway and count the number of adult Atlantic salmon passing upstream of the project, using a methodology developed in consultation with the resource agencies. GLHA indicated, in its letter filed July 7, 2017, that the counts may or may not involve using the existing fish trap. NMFS's fishway prescription would require GLHA to maintain the existing fish trap for counting adult Atlantic salmon. Maine DMR recommends that GLHA provide counts of adult Atlantic salmon that exit the upstream fishway to resource agencies, but does not specify a need to continue using the existing fish trap.

Our Analysis

For over three decades, adult Atlantic salmon have been counted in the fish trap at the Mattaceunk Project. The count data provide resource managers with information on the number of spawning capable salmon that successfully pass the project, and are within access to spawning grounds in the East Branch of the Penobscot River. The abundance estimates derived from the counts can help determine whether the population is increasing or decreasing. Nevertheless, there is no benefit to counting Atlantic salmon (in the fish trap or by other means), as it relates to project effects on the GOM DPS. More specifically, counting Atlantic salmon does not protect adult salmon from project effects, mitigate a project effect on adult salmon, or provide information that would allow GLHA to enhance the GOM DPS through changes in its operations.

Downstream Passage Operations

GLHA proposes to continue to maintain and operate the existing downstream fish passage facility at its maximum flow capability (140 cfs) to provide downstream passage for Atlantic salmon smolts and kelts from April 1 to June 15 and only kelts from October 17 to December 1. Continued operation also includes operating the project such that turbines 3 and 4 are the first units on and the last units off whenever the downstream fishway is operational. GLHA also proposes a new measure to open the project's log sluice between 3 percent and 9 percent of the station's hydraulic capacity, or between approximately 225 cfs and 690 cfs. This measure would start during the first passage season following license issuance, in order to support downstream Atlantic salmon smolt outmigration for a 3 week period during the spring. The dates of the three-week period would be determined in consultation with resource agencies (measure in SPP).[179] In addition, GLHA proposes to install trash rack overlays having 1-inch clear spacing to the

[179] As discussed in section 3.3.1.2, *Environmental Effects*, GLHA is proposing to extend the seasonal operation of the log sluice beyond the 3 week period once the new upstream fishway for shad is operational.

full depth of the turbine intakes. The trash racks would be installed within two years after license issuance, and thereafter would be deployed annually during the fish passage season, from April 1 to June 15 [smolts and kelts] and October 17 to December 1 [kelts] (measure in SPP).[180] Finally, as discussed previously, GLHA proposes to implement adaptive management that would include additional operational, structural, and/or habitat enhancement measures, if necessary, to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon (measure in SPP).

NMFS filed five fishway prescriptions relevant to downstream passage structures and operation, exclusive of effectiveness testing and maintenance (the latter issues are detailed in sections below). These preliminary prescriptions state that:

(1) downstream passage structures shall be operational within 2 years after issuance of a new license, and consist of a protective barrier leading to a bypass system,[181] with the bypass system consisting of (a) a surface entrance leading to a pipe or sluice to convey fish around the project and discharge to flowing water below the project, such as the tailrace with sufficient depth (at least 4 feet) to avoid injury, and (b) increased spill through an opening (e.g., log sluice) adjacent to the powerhouse discharging to flowing water below the project with sufficient depth (at least 4 feet) to avoid injury;

(2) the downstream fishway shall be operational for Atlantic salmon smolts and kelts from April 1 to June 15 and Atlantic salmon kelts from October 17 to December 1;

(3) the log sluice shall be open (between 3 percent and 9 percent of station hydraulic capacity, or between approximately 225 cfs and 690 cfs) starting the first passage season following relicensing in support of downstream Atlantic salmon smolt outmigration for a 3 week period during the spring that would be determined in consultation with resource agencies;

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[180] As discussed in section 3.3.1.2, *Environmental Effects, Downstream Eel Passage*, GLHA also proposes to provide downstream passage for eel during downstream eel migrations, which GLHA expects to occur from September to October, but would be determined in consultation with the resource agencies and based on a predictive model for eel movement.

[181] We assume that a protective barrier is analogous to the proposed trash rack overlays having 1-inch clear spacing to the full depth of the turbine intakes.

(4) within 2 years of license issuance, GLHA shall deploy during the fish passage season, trash racks having 1-inch clear spacing to the full depth of all turbine intakes; and

(5) develop and implement an adaptive management plan that would include additional operational, structural, and/or habitat enhancement measures, if necessary, to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon.[182]

NMFS also recommends real-time monitoring of the downstream fishway to ensure safe and effective operation for downstream migrating fish.

Maine DMR recommends GLHA's proposals, as discussed above, to maintain and operate the existing downstream fish passage facility from April 1 to June 15 and Atlantic salmon kelts from October 17 to December 1, open the project's log sluice, and develop and implement an adaptive management plan. Maine DMR also recommends GLHA's proposal to install trash racks having 1-inch clear spacing to the full depth of the turbine intakes. Unlike GLHA's proposal, however, Maine DMR recommends that the trash racks be installed within the first fish passage season following license issuance, and thereafter deploy the trash racks during the downstream fish passage season (i.e., April 1 to June 15, and August 1 to December 31).[183]

Bruce Haines recommends that the downstream bypass include attraction flows of 5 percent of the station's hydraulic capacity, and that the attraction flows should be provided 24 hours per day, 365 days per year.

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[182] GLHA's proposed SPP includes two adaptive management measures to: (1) implement an adaptive management plan to address performance criteria for downstream passage, should the proposed measures be inadequate; and (2) implement additional operational and structural modifications and/or habitat enhancement measures, if necessary, to address outmigrating Atlantic salmon smolts and kelts and upstream migrating Atlantic salmon adults. Because of the similarity in these two measures, we combined them into this single adaptive management measure that captures the intent of the two measures proposed by GLHA.

[183] The downstream fish passage season was defined by Maine DMR in its May 22, 2017, filing with the Commission. Maine DMR's recommended downstream fish passage season incorporates the downstream migration periods defined by Maine DMR for Atlantic salmon smolts and kelts (i.e., April 1 to June 15 [smolts and kelts], October 15 to December 31 [kelts]), and August 1 to October 31 [eel]).

Our Analysis

Downstream Passage Survival Under Existing Bypass Operation

The existing downstream passage structures (i.e., surface bypass inlets with a designed maximum flow capability of 140 cfs [2 percent of station hydraulic capacity] and trash racks) at the project are designed to reduce entrainment and provide the only source of safe downstream passage when no water is spilling over the dam, and to reduce entrainment and enhance downstream passage when the project is spilling water over the dam. As discussed in section 3.3.4.1, *Affected Environment, Atlantic Salmon*, the downstream bypass facilities do function to reduce entrainment through the turbines and enhance passage past the project. In fact, studies conducted in 2014 and 2015 resulted in point estimates of 95.8 percent and 95.9 percent survival past the dam, respectively, with a 95 percent probability that survival was between 83 percent and 100 percent in 2014, and 89.3 percent and 100 percent in 2015.[184] These results are consistent with the estimates of smolt survival (96.6 percent [at 50 and 75 percent exceedance flows], 97.4 percent [at 25 percent exceedance flow]), calculated in GLHA's desktop entrainment and impingement analysis. Thus, a large majority of smolts that approach the project survive passage past the project, and in 2014 and 2015, all smolts that used the surface bypass system survived passage to 8.3 and 4.2 miles downstream, respectively.

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[184] Point estimates are single value estimates for survival. However, because there are inherent uncertainties (e.g., some surviving fish may not be detected by arrays) when calculating survival using telemetry, there is some uncertainty or error with a point estimate. Therefore, true survival may be larger or smaller than the point estimate. To capture the range of potential true values of survival, GLHA estimated a 95 percent confidence interval for the 2014 and 2015 survival estimates. The 95 percent confidence interval represents a range of survival values, within which there is a 95 percent probability of including the true survival estimate.

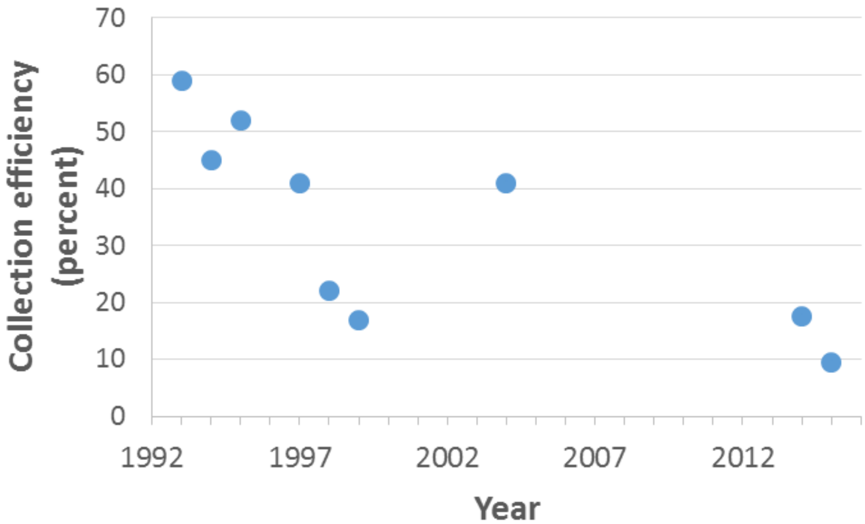

Figure 19. Smolt collection efficiency of the existing bypass at the Mattaceunk Project.
(Source: staff).

Although downstream survival of smolts using the bypass is good, the collection efficiency[185] of the surface bypass system is low. Among nine studies conducted between 1993 and 2015, the average collection efficiency of the bypass system was 33.8 percent, with the minimum of 9.4 percent occurring most recently (2015)[186] and the maximum of 59 percent occurring just after the permanent bypass system was installed (October 1992). Although study conditions varied from 1993 to 2015, the general trend in study results was a decline in bypass collection efficiency over time (figure 19). The studies occurring between 1993 and 1999 were conducted during low flow conditions, when the only two passage routes were the bypass system and the turbine intakes. Under such conditions, spill and the log sluice were not an option for downstream passage, and thus the majority of smolts were entrained through the turbine intake. Even when spill and/or the log sluice is an option for downstream passage, as in 2014 and 2015, 70.1 percent and 78.5 percent of smolts, respectively, were entrained through the turbines. Further, those smolts that are entrained through the turbines exhibit lower rates of

[185] Collection efficiency represents the proportion of study smolts that successfully pass the dam using the bypass system relative to the total number of smolts that pass the dam successfully. Collection efficiency provides an estimate of the proportion of smolts that pass downstream that are using the bypass system, which is considered the safest route downstream.

[186] As discussed in section 3.3.3.1, *Affected Environment*, GLHA discovered after completing the 2015 study that the bypass was blocked with debris, and might have affected the collection efficiency.

survival (2014: 85.1 percent, 2015: 92.5 percent) compared to smolts that use the bypass (2014: 100 percent, 2015: 100 percent) or the log sluice (2015: 100 percent) for downstream passage.

The information above indicate that smolts can pass the project under existing conditions at close to 96 percent survival. As discussed above, the existing condition includes a bypass system that is generally ineffective at attracting smolts to a safe passage route and a turbine intake that is highly effective at entraining smolts through a less safe route. The ineffectiveness of the bypass compared to the turbine intakes is most likely a result of the relative location of the bypass and the limited flow capability of the bypass. Specifically, the bypass openings are positioned directly above the turbine intakes, and have a maximum flow capacity of 140 cfs, which is only 2 percent of the station's hydraulic capacity (i.e., 7,438 cfs).

To be effective, safe passage routes, like the bypass, must create hydraulic signals that are capable of attracting fish to the safe route. If flows coming from the bypass are not discernable from competing flows coming from the turbine intakes, fish will be attracted toward the turbine intakes. Thus, the greater passage of smolts through the turbines could be the result of a greater hydraulic signal coming from the turbine intake, compared to the signal coming from the bypass that is positioned in the same path as the turbine intakes. Additional improvements to smolt survival at the project could be possible by providing more discernable flows through a safe passage route (*see* below, *Opening the Log-sluice for Smolt Passage*). Such improvements could allow GLHA to exceed the 96 percent performance standard and/or more consistently meet the standard, allowing more smolts to survive passage past the project, which would benefit the GOM DPS.[187] The specific improvements supported by the analysis above, which are proposed by GLHA, recommended by Maine DMR and Bruce Haines, and would be required by NMFS, are discussed in sections below.

Available information on downstream passage of kelts is based on studies conducted in the early 1990s, and the desktop entrainment study discussed in section 3.3.4.1, *Affected Environment, Atlantic Salmon*. In the spring of 1993, a large-scale study involving 71 post-spawn broodstock kelts from the Craig Brook National Fish Hatchery

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[187] A performance standard of 96 percent smolt survival is currently a requirement at the Orono, Stillwater, Milford, and West Enfield Projects, and is based on NMFS's recommendations for those projects (*see* 142 FERC ¶ 62,118 (2013)). All projects are located downstream of the Mattaceunk Project. West Enfield and Milford are located on the Penobscot River and Orono and Stillwater are located on the Stillwater River, which is a tributary of the Penobscot River. Thus, passing smolts downstream from the Mattaceunk Project with 96 percent survival meets the survival standard determined by NMFS to be protective of smolts migrating downstream in the Penobscot River.

was conducted under spill conditions, in which 30 kelts were radio-tagged and 41 served as controls. Among the radio-tagged kelts, three did not pass the dam (10 percent), three (10 percent) used the bypass, one was entrained through the turbines (3.3 percent), and 20 (66.7 percent) passed downstream via spill (GNP, 1993). The kelt that was entrained through the turbines died. The remaining 26 kelts survived, indicating that passage survival was 96.3 percent, which is relatively consistent with the results from the desktop entrainment analysis (i.e., 93.9 percent to 96.6 percent survival depending on inflow). Among the control kelts, 13 (31.7 percent) used the bypass. The passage route of the remaining control kelts was unknown, but based on the radio-tagged kelts, they likely passed via spill. These results indicate that under existing conditions, entrainment of kelts is relatively low and survival past the dam meets the 96 percent survival performance standard proposed by GLHA. Like smolts, a performance standard of 96 percent for kelt survival is currently a requirement at the Orono, Stillwater, Milford, and West Enfield Projects, and is based on NMFS's recommendations for those projects.[188] Thus, under existing conditions, kelts are able to pass downstream of the Mattaceunk Project with 96 percent survival, which meets the survival standard determined by NMFS to be protective of kelts migrating downstream past other projects on the Penobscot River.

Bypass Operations Schedule

As discussed in section 3.3.4.1, *Affected Environment*, *Atlantic Salmon*, smolt population surveys conducted from 2000 to 2005, demonstrate that smolts migrate from the Penobscot River between late April and early June with a peak in early May (Fay *et al.*, 2006). In addition, 5 years of data collected on downstream migrating kelts at the Mattaceunk Project demonstrate a spring migration period between April 25 and June 25, and fall migration in October and November (GNP, 1993, 1994).

The downstream bypass was historically operated from October 17 to December 1 for Atlantic salmon kelts, as well as from April 25 to June 25 for smolts and kelts. To enhance passage, the spring operational period for the downstream bypass was modified in 2013 to begin on April 1 and end on June 15 each year. Operating the bypass earlier in the spring provides improved passage for kelts, which have been shown to occasionally migrate soon after ice-out occurs; and NMFS[189] indicates that operation of the bypass after June 15 for smolts and kelts during the spring migration is unnecessary. Thus, based on the aforementioned information, GLHA's proposal to operate the downstream bypass from April 1 to June 15 for smolts and kelts, and from October 17 to December 1

[188] *See* 142 FERC ¶ 62,118 (2013).

[189] *See* letter filed by NMFS on June 28, 2015.

for kelts would allow smolts and kelts to use the downstream bypass when they are most likely to be migrating downstream of the project.

Bruce Haines recommends operating the downstream bypass 365 days per year. As shown by the existing data above, smolts and kelts migrate downstream during specific periods of the year. Thus, there is no additional benefit to operating the bypass all year long, and beyond the period proposed by GLHA.

Trash Racks

At the Mattaceunk Project, there are currently two intake openings per generating unit, and each opening is covered by a trash rack with 1-inch clear bar spacing that covers the top 16 feet of the water column (at normal impoundment elevation of 240 feet) and 2.63-inch clear bar spacing covering the lower 36 feet of the water column. Approach velocities in front of the trash racks are estimated to be 1.7 fps. Under these conditions, smolts could volitionally pass (i.e., by choice) through either the 1-inch or 2.63-inch trash racks and become entrained because of their small size (table 18), but because they have burst swim speeds of about 6.0 fps, smolts have the potential to avoid entrainment (table 19). Thus, for smolts there is a risk of entrainment, but little to no risk of impingement. Kelts are larger than smolts, and all kelts are too wide to be entrained through the existing 1-inch clear bar spacing (table 18). Most kelts are also too wide to be entrained through the existing 2.63-inch clear bar spacing. Although their large size makes them more susceptible to impingement than entrainment, kelts have burst swim speeds high enough to overcome impingement and entrainment (table 19).

GLHA proposes to begin using seasonally installed (i.e., during the fish passage season for smolts, kelts, and eel [April 1 to June 15 and September 1 to December 1]) trash racks having 1-inch bar spacing to the full depth of the turbine intakes (i.e., from surface to about 36 feet below normal impoundment elevation) within 2 years after license issuance, with the intention of reducing entrainment of smolts and kelts. Maine DMR recommends, and NMFS's and Interior's fishway prescriptions would require, GLHA's proposed measures.

The information immediately above, as well as the downstream passage studies discussed earlier in this section, indicate that among salmon life-stages, smolts are most likely to be entrained under existing conditions, which include trash rack bar spacing of 1 and 2.63 inches. However, as indicated above, reducing the existing 2.63-inch bar spacing in the lower water column, to 1-inch bar spacing, would not reduce entrainment, because smolts could still pass through either the 1-inch or 2.63-inch bar spacing. Further, smolts are surface oriented swimmers that primarily use the upper 33 percent of the water column (Wagner and Ingram, 1973; Dunn, 1978, Eicher, 1988). The existing trash racks with 1-inch bar spacing already covers the top 24 percent of the water column,[190] which is 73 percent of the water column generally used by smolts. Thus, for the purposes of protecting smolts from entrainment, there is no apparent benefit to installing 1-inch bar spacing to the full depth of the turbine intakes.

Narrowly spaced trash rack bars do have the potential to deter fish from passing between the bars (Coutant and Whitney, 2000). However, the difference in deterrence between trash racks with 1-inch spacing compared to 2.63-inch spacing is not known. Nevertheless, GLHA could explore the potential deterrence effect of adding of 1-inch bar spacing to the full depth of the turbine intakes during the downstream passage season for smolts, if the downstream effectiveness studies indicate that the project is unable to meet the performance standard of 96 percent survival without the 1-inch bar spacing to the full depth of the turbine intakes. Thus, adding trash racks with 1-inch bar spacing could be a component of GLHA's adaptive management strategy (discussed in more detail below), if necessary, to protect downstream passage of smolts. There would be no benefit of adding the 1-inch bar spacing for the protection of kelts, because most kelts are already protected by the existing trash rack configuration. However, as discussed in section 3.3.2.2, *Downstream Eel Passage*, installing 1-inch bar spacing to the full depth of the turbine intakes during the downstream eel passage season would be protective of larger eel, which swim in deeper water.

Table 18. Minimum length of Atlantic salmon excluded by trash racks with 1.0-inch and 2.63-inch bar spacing.

Species	Life-stage	Scaling factor for body width	Length range (inches)	Minimum length (inches) excluded	
				1.0 inch bar spacing	2.63 inch bar spacing
Atlantic salmon	juvenile (smolt)	0.104	5 - 8	Not excluded	Not excluded
	adult (kelt)	0.104	25-32	10	25

(Source: GLHA, 2016a, as modified by staff).

[190] The estimated depth of the dam forebay is 66 feet at normal impoundment elevation, based on exhibit F-2 drawings included in the final license application. The existing 1-inch bar spacing extends down to 16 feet below normal impoundment elevation.

Table 19. Burst swim speeds of Atlantic salmon.

Species	Life-stage	Length range (inches)	Burst swim speed
Atlantic salmon	juvenile (smolt)	5 - 8	6.0[a]
	adult (kelt)	25 - 32	16.5 - 19.7[b]

[a] Wolter and Arlinghaus, 2003
[b] Peake *et al.*, 1997
(Source: GLHA, 2016a, as modified by staff).

Approach Velocity

The approach velocities at powerhouse intakes are generally defined as the average water velocity measured a few inches in front of the trash racks taken in the same direction as inflow (EPRI, 2000). This definition of approach velocity describes the velocity experienced by the fish as it swims freely near the front of the trash racks (EPRI, 2000). Approach velocities can be estimated by dividing the maximum hydraulic capacity by the total intake area of the powerhouse (EPRI, 2000). Using this approach, GLHA estimated the average approach velocity at the project to be 1.7 fps. As discussed above, an approach velocity of 1.7 fps is lower than the burst swim speeds of smolts and kelts (table 19), and therefore reduces entrainment and impingement risk during the downstream migration.

NMFS's fishway prescription would require GLHA to take annual point measurements of approach velocities immediately upstream of the project trash racks (i.e., 6 to 12 inches), and ensure that point measurements do not exceed 2.0 fps within a 2-foot-square grid. However, the benefit of measuring approach velocities, as required by NMFS's prescription, is not clear, as approach velocities would not deviate substantially from the estimated 1.7 fps (which is less than the prescribed 2.0 fps), because there are no proposed changes to the size of the turbine intake or the maximum hydraulic capacity.

In contrast to approach velocities, through-screen velocities[191] could increase with debris accumulation on the trash racks. GLHA proposes to continue implementing the

[191] Through-screen velocity represents the velocity of the water as it passes between the bars of a trash rack (EPRI, 2000).

FPOMP, which includes provisions for utilizing a trash rake[192] to clear debris from the intakes of units 3 and 4. GLHA has indicated that the intakes are cleared prior to opening the downstream fishway at the beginning of the season. However, the frequency of debris removal is not identified in the plan.[193] Further, there is no indication that the intakes of units 1 and 2 are also cleared of debris. To maintain through-screen velocities, GLHA could use the trash rake to routinely clear debris from the trash racks in front of all four intakes during the downstream migration season. Debris loads in a river can vary seasonally (e.g., leaf drop) and with weather events (e.g., rain and thawing events that can transport debris to a river and increase flow causing suspension and transport of settled debris on the riverbed). Consequently, the frequency of debris clearing would be best determined in consultation with the resource agencies most familiar with the nature of debris loads in the Penobscot River, with final approval from the Commission. Implementation of these additional debris clearing measures would ensure that the through-screen velocities do not increase.

Through-screen velocities could also change if there are structural changes that could modify the trash rack configuration. GLHA is proposing to install trash racks with 1-inch bar spacing to the full depth of the turbine intakes within 2 years of license issuance, which as discussed above, is not needed to protect Atlantic salmon, but as discussed in section 3.3.2.2, *Downstream Eel Passage*, would help protect eel during their downstream migration. The addition of these full depth trash racks could increase the through-screen velocity, because the 1-inch bar spacing would decrease the amount of open space at depths greater than 16 feet where trash bar spacing is currently 2.63 inches. However, the through-screen velocity would be experienced only when a fish is right at the face of the trash rack, or passing through the trash rack, and is not likely to be as important a factor in whether a fish becomes impinged or entrained as is the approach velocity (EPRI, 2000). More importantly, and to the merits of NMFS's prescription, there would be no change to the approach velocities as a result of adding 1-inch bar spacing to the full depth of the turbine intakes.[194] Therefore, there would be no benefit to taking point measurements of approach velocities immediately upstream of the project trash racks for the purpose of ensuring that point measurements do not exceed 2.0 fps.

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[192] GLHA operates a trash rake that is operated by an electrical hoist on a trolley beam.

[193] *See* letter filed by GLHA on July 7, 2017.

[194] Approach velocity is the velocity in front of the trash racks, which is estimated as the intake flow divided by the intake cross-sectional area (EPRI, 2000).

Opening the Log-sluice for Smolt Passage

GLHA proposes, Maine DMR recommends, and NMFS's fishway prescription would require, opening the project's log sluice (at between 3 percent and 9 percent of station's hydraulic capacity, or between approximately 225 cfs and 690 cfs)[195] starting the first passage season following license issuance to facilitate downstream Atlantic salmon smolt outmigration for a 3-week period during the spring that would be determined in consultation with resource agencies.

Sluiceways are typically used to bypass ice and debris at hydropower projects, but they can also provide an adequate and generally successful means of downstream passage if fish are able to locate them. This type of passage may work well for surface or near-surface oriented fish (i.e., shad, salmon, and some resident riverine species), but may not work as well for fish distributed elsewhere in the water column (OTA, 1995). Currently, the log sluice is used for debris management, and since 2013, has been used as the first opened and last closed gate for passing excess flows[196] during the downstream migration seasons for Atlantic salmon. Thus, the log sluice is currently operated to pass smolts when the project is spilling. GLHA's proposal would expand the operating window of the log sluice to occur during a 3-week window of peak smolt migration, even if the project is not spilling. The proposed change would also increase downstream passage flows from 140 cfs (2 percent of the station's hydraulic capacity) through the bypass system, to between 365 cfs (5 percent) and 830 cfs (11 percent), with the addition of passage flows through the log sluice.

Prior to filing its fishway prescriptions,[197] Interior indicated that the project's log sluice is too far from the bulk flow through the turbine intakes to be an effective route for passage, and it cites the few existing studies conducted at the Mattaceunk Project to support its conclusion.[198] The first studies to evaluate the effectiveness of the log sluice were conducted in 1991 and 1992 before the downstream bypass system was installed.

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[195] The log sluice has a gated capacity of 690 cfs.

[196] The roller gate is used to pass excess flows once the inflows exceed the hydraulic capacity of the turbines, fishways, and log sluice.

[197] The memorandum from Bryan Sojkowski (Regional Fish Passage Engineer, FWS), with the subject title, "Downstream Passage Design Alternatives for the Mattaceunk Hydroelectric Project (FERC No. 2520)" was included in the FWS's administrative record that was filed on May 23, 2017, with FWS's fishway prescriptions.

[198] In comments filed on May 23, 2017, the Atlantic Salmon Federation and Penobscot Indian Nation agreed with FWS's conclusion.

During the studies, 140 cfs (2 percent of the station's hydraulic capacity) was passed through the log sluice, and among 26 tagged smolts, 16 passed through the turbines, and none passed through the log sluice (GNP, 1992). GLHA is proposing to pass flows of between 225 cfs and 690 cfs through the log sluice. Thus, the 1991 and 1992 studies may not be representative of the capacity of the log sluice to effectively pass smolts when flows through the log sluice are greater than 2 percent of the station's hydraulic capacity.[199] Further, a more recent telemetry study conducted in 2015 indicated that 9 of 135 radio-tagged smolts used the log sluice, and all of them survived passage to 4.2 miles downstream. The 2015 results indicate that the log sluice is a safe passage route and has the potential to be effective at reducing entrainment. Also, NMFS states that the log sluice is a safe route of passage given its smooth hydraulic transition into the tailrace.[200]

Smolt population surveys conducted from 2000 to 2005, demonstrate that smolts migrate from the Penobscot River between late April and early June with a peak in early May, and that the majority of the smolt migration takes place over a 2- to 3-week period after water temperatures rise to 50°F (Fay *et al.*, 2006). Thus, GLHA's proposal to open the log sluice continuously during the peak 3-week smolt migration period (determined in consultation with resource agencies), would ensure that the log sluice is able to pass smolts during the most opportune time of the migration season. GLHA has indicated that the log sluice opening would likely be based on water temperatures or other environmental factors, but the timing would ultimately be determined in consultation with the resource agencies, and could be altered to coincide with the stocking of hatchery reared smolts upstream of the project. GLHA's approach to timing the opening of the log sluice would be based on evidence and consultation with resource experts, and would help ensure maximum downstream passage of smolts.

Existing information at the project indicates that the log sluice is a safe passage route, and its use during the peak downstream migration could improve the passage of smolts. Existing information also indicates the potential for the log sluice to be effective when used in combination with the existing bypass system. However, the proposed operation of the log sluice and installation of full depth trash racks with 1-inch bar spacing would change the flow dynamics that currently occur in the project forebay, and these changes could affect how smolts and kelts move downstream through different passage routes (i.e., bypass, log sluice, spillway). Changing the flow characteristics (i.e.,

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[199] The flow passing through the log sluice during the 2015 study has not been reported. Thus, staff do not know whether the flow is within the 225 cfs to 690 cfs proposed. However, even if the flow passing through the log sluice was the same as in the 1991 and 1992 studies, the 2015 results still indicate that the log sluice is a safe route, and that it has the potential to be effective.

[200] *See* the letter filed by NMFS on May 23, 2017.

more water flowing toward and through the log sluice) and potentially the passage route could alter downstream passage survival of smolts and kelts, relative to the survival that occurs under existing conditions. Post-licensing downstream passage effective studies for smolts and kelts would help to determine whether the proposed operation of the log sluice and trash rack installation are able to maintain or improve downstream passage survival, or whether additional measures may be necessary.

Attraction Flows

Successfully passing fish downstream of hydroelectric projects is dependent upon attracting the fish to the appropriate bypasses or sluiceways (Castro-Santos and Haro, 2010). Salmon smolts are surface oriented swimmers (Giorgi and Stephenson, 1995) and generally follow higher flow patterns as they approach dams (Coutant and Whitney, 2000). Thus, surface oriented bypasses and log sluices, such as those at the Mattaceunk Project, can effectively draw smolts to these routes if there is sufficient attraction.

GLHA proposes to continue operating the downstream bypass at its maximum flow capability of 140 cfs (2 percent of station hydraulic capacity) to safely pass smolts downstream. However, as described above (*Downstream Passage Survival Under Existing Bypass Operation*), the downstream bypass may not be effective based on low bypass collection efficiencies (i.e., between 17 and 59 percent). As a result, smolt survival downstream of the project may not be able to meet the proposed performance standard of 96 percent survival without additional enhancements for downstream passage. Because GLHA operates the bypass at its maximum flow capability, it is unable to enhance downstream passage through the bypass by increasing attraction flows. However, GLHA proposes to operate the log sluice, as described above, to provide between 225 cfs and 690 cfs of safe passage flows downstream of the project. The log sluice flows by themselves would provide between 3 percent and 9 percent of the station's hydraulic capacity, which is near or greater than the 5 percent design criteria recommended for each fishway by FWS (2017a). Further, when the two fishways (i.e., log sluice and bypass) are combined, there would be between 5 percent and 11 percent of safe passage flows provided for smolts. Thus, operating the log sluice would increase the volume of safe passage flows during the peak smolt migration. These enhancements, should reduce entrainment and increase downstream passage survival for smolts, but if studies (discussed below) indicate they do not allow downstream passage to meet the performance standard, additional enhancements and studies could be conducted, as discussed below, until the performance standard is met.

Bruce Haines recommends that GLHA redesign the existing bypass to meet the 5 percent design criteria recommended by FWS (2017a). FWS (2017a) indicates that the attraction flows per fishway should be equal to 5 percent of the total station hydraulic capacity, or a flow of 50 cfs, whichever is greater. Based on these general design criteria, which are not specific to the Mattaceunk Project, attraction flows to the bypass would need to be 372 cfs to be effective.[201] However, the 5 percent design criteria is a general engineering recommendation not specific to the Mattaceunk Project. As discussed above, the maximum flow capability of the existing bypass is 2 percent of the station's hydraulic capacity, and thus the 5 percent criteria has never been tested and is not known to be effective at the Mattaceunk Project. Like all other potential passage enhancement options, meeting the 5 percent design criteria would not guarantee improved passage downstream. In addition, redesigning the existing bypass would require structural changes to the project.

GLHA's proposed opening of the log sluice, installation of full depth trash racks with 1-inch bar spacing, and continued operation of the bypass, would occur in the first passage season following license issuance. Like Bruce Haines recommended design changes, there is no certainty that the GLHA's proposed log sluice operations and trash-rack installation would provide the necessary enhancements to existing operation to increase smolt survival past the project. However, the effectiveness of the proposed log sluice operations and trash-rack installation could be studied in the first passage season, which would allow a determination of whether additional enhancements are needed. As discussed below, GLHA proposes to study the effectiveness of downstream passage and improve passage as necessary using an adaptive management strategy, if survival past the project does not meet the performance standard. An adaptive management strategy may eventually lead to design changes similar to those recommended by Bruce Haines; however, GLHA should explore operational changes (e.g., operation of the log sluice), which can occur quickly, before exploring structural changes, which are more timing consuming, could be more costly, and cannot be easily reversed if they are not successful.

Real-time Monitoring of the Downstream Fishway

The existing downstream bypass is capable of minimizing entrainment and safely passing smolts and kelts downstream, and the proposed continued operation of the bypass would offer the same benefits if the bypass is maintained and fully functional during the migration season. However, as indicated by FWS,[202] the downstream bypass pipe is a

[201] In an internal FWS memorandum with the subject title, "Downstream Passage Design Alternatives for the Mattaceunk Hydroelectric Project (FERC No. 2520)" Bryan Sojkowski (Regional Fish Passage Engineer, FWS) referred to the 5 percent design criteria and indicated that the target bypass flow should be 372 cfs. The memorandum was included in the Interior's administrative record that was filed on May 23, 2017 with its fishway prescriptions. However, Interior did not include the 5 percent criteria as a recommendation or fishway prescription in the May 23, 2017 filing.

[202] *See* the internal FWS memorandum with the subject title, "Downstream Passage Design Alternatives for the Mattaceunk Hydroelectric Project (FERC No. 2520)"

closed system and therefore is difficult to clean or know when clogging occurs. GLHA does conduct daily visual inspections of the outflow from the bypass pipe, which should help determine whether blockage is preventing 140 cfs from flowing through and out of the bypass pipe. However, a blockage incident in 2015 indicates that visual inspection is not adequate for detecting debris blockages, which could cause decreased bypass outflow.

To ensure safe and effective operation of the bypass, NMFS recommends that GLHA conduct real-time monitoring of the downstream bypass. Although NMFS recommendation for real-time monitoring lacks detail, we assume that real-time monitoring would require the installation of a flow meter at the outflow of the bypass pipe, along with a data logger, and a wireless system to transmit data for real-time monitoring. The use of real-time flow monitoring would allow GLHA to quickly identify decreases in flow through the bypass, as well as the need for additional inspection and possible debris removal.

The daily visual inspections of the bypass outflow pipe that occur at the project in accordance with the FPOMP were not sufficient to identify the debris blockage that occurred in 2015. One possible reason is that the FPOMP does not provide details on how outflows from the bypass would be verified, when during each day data would be collected, or how data on outflows would be collected and made available to the Commission and resource agencies. To prevent future debris blockages and ensure the effectiveness of the bypass in passing smolts and kelts safely downstream, GLHA could modify the FPOMP, in consultation with the resource agencies, to at a minimum, establish a detailed approach, that is approved by the Commission, to monitor outflows from the bypass. If well designed, monitoring methods that are less sophisticated than the real-time monitoring recommended by NMFS, may suffice to ensure optimal bypass function. During modification of the plan, and through consultation, it may be determined that real-time monitoring is necessary. In either case, it is important that the final FPOMP include a viable strategy to ensure proper function of the downstream bypass.

Downstream Smolt Passage Performance Standard and Effectiveness Testing with Adaptive Management

As discussed above, existing project facilities and operations during the downstream migration have the potential to safely pass smolts and kelts at a survival rate that is at or near the proposed 96 percent survival, but the overall effectiveness of the existing bypass as a passage route for smolts can be very low (i.e., 9.4 percent). Because

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Bryan Sojkowski (Regional Fish Passage Engineer, FWS), which was included in the Interior's administrative record filed on May 23, 2017 with its fishway prescriptions.

of the low effectiveness of the bypass in passing smolts, and to improve downstream passage of smolts and kelts, GLHA is proposing to open the log sluice for 3 weeks during the migration season and install trash racks with 1-inch bar spacing to the full depth of the turbine intakes. To determine whether these additional downstream passage measures allow smolts to pass downstream of the project with at least 96 percent survival, GLHA proposes in the SPP to conduct a minimum of 3 years of Atlantic salmon smolt downstream passage studies to determine if the existing and proposed downstream passage operations and facilities meet a performance standard of 96 percent survival for smolts.[203] The studies would begin during the first spring outmigration season after installing the trash racks with 1-inch bar spacing. GLHA proposes to follow the existing study plan,[204] along with any additional modifications deemed appropriate during consultation with the resource agencies and Penobscot Indian Nation. Maine DMR recommends and NMFS prescribes GLHA's proposed effectiveness monitoring.[205]

NMFS's fishway prescription does not specify a performance standard of 96 percent survival for smolts. However, NMFS's prescription does state that the fishways must operate in a way that complies with any incidental take statement issued as part of the biological opinion, and NMFS indicates that a performance standard of 96 percent for downstream passage is consistent with other performance standards in the Penobscot River. NMFS also states in its fishway prescription that during the downstream passage

[203] In the SPP, GLHA indicates that it would conduct up to 3 years of downstream passage studies for smolts. However, in a letter filed on July 7, 2017, GLHA states that it would conduct a minimum of 3 years of downstream passage studies for smolts, until a total of 3 years meet the proposed performance standard of 96 percent survival.

[204] GLHA's existing study plan (Downstream Salmon Passage – Interim Species Protection Plan) was originally filed on December 11, 2013 as part of GLHA's revised study plan for relicensing the Mattaceunk Project. However, modifications to the study plan were made in 2015 to accommodate a request from NMFS to study smolt mortality in the project impoundment. The methods of the revised plan are included in the 2015 Atlantic Salmon Passage Study Report, filed on March 31, 2016.

[205] In letters filed on May 23, 2017 and May 22, 2017, NMFS prescribed and Maine DMR recommended, respectively, GLHA's original proposal in the final license application to conduct up to 3 years of effectiveness studies for downstream passage of smolts. However, because GLHA's current proposal to conduct a minimum of 3 years of study ensures that more years of study would be completed, we assume that NMFS and Maine DMR would support GLHA's most recent proposal.

studies, smolts must pass the project forebay area[206] within 24 hours to be considered a successful passage attempt that can be applied toward calculation of downstream passage survival.

There is uncertainty as to whether the existing upstream fishway, or the existing downstream bypass with the additional measures would be capable of meeting the proposed performance standard of 96 survival for smolts. Consequently, GLHA proposes, Maine DMR recommends, and NMFS prescribes,[207] the development and implementation adaptive management that would include additional operational, structural, and/or habitat enhancement measures determined in consultation with the resource agencies, to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon, if it is needed.[208]

GLHA describes its adaptive management approach in the SPP. Specifically, if the downstream bypass, together with the proposed structural and operational enhancements (i.e., full depth trash racks with 1-inch bar spacing, opening the log sluice for 3 weeks), meet smolt performance criteria during 3 years of study, GLHA proposes to evaluate downstream passage for smolts at the project once every 10 years, thereafter to verify continued achievement of the performance standard of 96 percent survival. However, if the project does not achieve the 96 percent performance standard for downstream passage of smolts, GLHA proposes to consult with the resource agencies and

[206] NMFS defines the project forebay area as 200 meters upstream of the trash racks to approximately 1 mile downstream of the powerhouse.

[207] In addition to requiring GLHA's proposed adaptive management plan, NMFS has an additional section 18 preliminary prescription requiring additional protective measures or alternative actions (e.g., additional fishway entrances, increased attraction flow) that may be necessary based on monitoring, to address performance standard deficiencies for upstream migrating salmon. However, because this preliminary prescription includes the types of measures that could be included in an adaptive management plan and because it fully overlaps with GLHA's proposal, we treat these two items as one preliminary prescription for adaptive management.

[208] In the final license application, GLHA specifically proposes to: (1) implement an adaptive management plan to address performance criteria for downstream passage, should the proposed measures be inadequate; and (2) implement additional operational and structural modifications and/or habitat enhancement measures, if necessary, to address outmigrating Atlantic salmon smolts and kelts and upstream migrating Atlantic salmon adults. However, because both proposals are analogous and include an adaptive approach to addressing passage for Atlantic salmon, staff have combined the two proposals into one proposal for adaptive management.

Penobscot Indian Nation to determine appropriate modifications, make any modifications that are deemed appropriate, and then reevaluate the downstream fish passage structures until the performance standard is met. If modifications are not feasible, GLHA proposes to initiate phased spill measures. The first phase would involve increasing spill to between 20 percent and 50 percent of river flow from 8 pm to 4 am for 3 weeks during the smolt outmigration period, and evaluate the ability of this measure to meet the performance standard during a minimum of 3 years of study. If the 20 percent to 50 percent spill phase meets the performance standard during 3 years of study, then GLHA would operate the project using that spill measure. If the 20 percent to 50 percent spill phase does not allow the project to meet the performance standard, GLHA would increase spill to between 50 percent and 75 percent of river flow, and evaluate the ability of this measure to meet the performance standard during a minimum of 3 years of study. If the 50 percent to 75 percent spill phase meets the performance standard during 3 years of study, then GLHA would operate the project using that spill measure. If the 50 percent to 75 percent spill phase does not allow the project to meet the performance standard, GLHA would increase spill to 100 percent of river flow, and evaluate the ability of this measure to meet the performance standard during 1 year of study. If the final spill measure does not achieve the performance standard, GLHA proposes that the Commission reinitiate formal consultation with NMFS.

Our Analysis

Passage Effectiveness Studies

To successfully reach the ocean, Atlantic salmon smolts spawned upstream of the project must survive a variety of natural causes of mortality (e.g., predation, disease, water temperature), as well as passage downstream of powerhouses and dams at the Mattaceunk, West Enfield, and Milford Projects. Once Atlantic salmon leave the riverine environment, and enter the estuarine environment, mortality rates increase, primarily because of high predation risk (Hawkes *et al.*, 2013) and physiological stress in transitioning to a salt water environment (Handeland *et al.*, 1997). If Atlantic salmon survive the freshwater and estuarine environment, they must then survive the marine environment, which has become an increasingly difficult challenge, as indicated by recent precipitous declines in marine survival, possibly caused by changing ocean conditions (ICES, 2011; Miller *et al.*, 2012). Improving smolt passage survival at the project would help reduce the mortality that occurs in freshwater, and thereby increase the proportion of smolts that migrate out to marine environment.

As discussed above, passage effectiveness of the downstream bypass is low, and although smolt survival studies conducted in 2014 and 2015 indicate relatively high passage survival, passage improvements could be made to provide consistently high downstream survival of smolts. GLHA is proposing to continue operating the existing bypass, and improve passage with new measures to operate the log sluice and install full depth trash racks with 1-inch bar spacing. To evaluate the effectiveness of these proposed measures, and the potential need to improve downstream smolt survival at the project, GLHA is proposing to conduct a minimum of 3 years of Atlantic salmon smolt downstream passage studies to determine if the existing and proposed downstream passage operations and facilities meet a performance standard of 96 percent survival for smolts. Such studies would help to determine whether the project is able provide passage that meets the 96 percent survival standard for smolts, subsequent to the implementation of the proposed log sluice operations and installation of full depth trash racks. Passing smolts downstream of the Mattaceunk Project with 96 percent survival would meet the survival standard determined by NMFS to be protective of smolts migrating downstream in the Penobscot River.[209] A minimum of three years of studies would inform whether the project consistently passes smolts at the proposed and recommended 96 percent survival rate, which would help in the recovery of the GOM DPS.

GLHA proposes that the performance standard of 96 percent survival be considered achieved, if in each of 3 years of studies, the lower and upper 75 percent confidence limits include 96 percent survival.[210] A confidence limit is needed to address the inherent uncertainties surrounding estimates of downstream passage survival (e.g., some surviving fish may not be detected by telemetry arrays, some surviving radio-tagged fish may lose their tags), and a 75 percent limit, provides a reasonable amount confidence that survival is close to the desired rate of 96 percent.[211]

NMFS states in its fishway prescription that during the downstream passage studies, smolts and kelts must pass the project forebay area within 24 hours to be considered a successful passage attempt that can be applied toward calculation of downstream passage survival. To support its conclusion, NMFS suggests that a study conducted by Stich *et al.* (2015a) indicates that downstream passage delay of more than 24 hours at each dam in freshwater habitat of the Penobscot River causes increased

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[209] A performance standard of 96 percent smolt survival is currently a requirement at the Orono, Stillwater, Milford, and West Enfield Projects, and is based on NMFS's terms and conditions for those projects. *See* 142 FERC ¶ 62,118 (2013)

[210] The 75 percent confidence limit for smolt survival estimates represents a range of survival values, within which there is a 75 percent probability of including the true survival estimate.

[211] The performance standard of 96 percent smolt survival, within the lower and upper 75 percent confidence limits is currently a requirement at the Orono, Stillwater, Milford, and West Enfield Projects, and would be adequate for the Mattaceunk Project.

mortality in the Penobscot River estuary.[212] It is true, that delayed downstream migration can be problematic for smolts. Smolts that are delayed can experience predation, elevated energetic costs, and decreased migration speed (McCormick *et al.*, 1998; Antolos *et al.*, 2005; Norrgård *et al.*, 2012). In addition, an increase in time spent migrating can lead to loss of migratory motivation, reversion of physiological adaptations for life in the seawater, lost feeding opportunities, and mistimed arrival in relation environmental conditions in the ocean (McCormick *et al.*, 1999; Muir *et al.*, 2006; Tétard *et al.*, 2016).

Despite evidence supporting the negative effects of delay, in general, the specific duration of delay (e.g., 24-hours) that can lead to negative consequences for smolts is not well understood. Specifically, there is no evidence to indicate that smolts that do not pass a dam within 24-hours will experience excessive mortality. In fact, Stich *et al.* (2015a) indicate that smolt survival in the Penobscot River estuary was unrelated to movement rate (i.e., a means to measure potential delay) of smolts in the Penobscot River. This specific observation suggests that if there is delay that is caused by dams in the Penobscot River, it does not affect survival of smolts in the estuary. Consequently, neither the Stich *et al.* (2015a) study, nor any other source provides evidence that passage delay affects survival in the Penobscot River estuary. Further, the Stich *et al.* (2015a) study provides no specific justification that would support NMFS's requirement for a 24-hour passage criteria.

In addition to the lack of support for a 24-hour passage criteria, in general, there also is little information to suggest that downstream passage delay is problematic at the project. In 2014, two of the 69 smolts (2.9 percent) took slightly longer than 24 hours (27.3 and 29.0 hours) to pass the project after being detected in the forebay. In 2015, 12 of 137 (8.8 percent) smolts detected in the forebay took longer than 24 hours to pass the project. Further, all of the smolts that did not pass the dam within 24 hours were detected at downstream arrays (located 3 to 4 miles downstream of the dam) and determined to have survived passage past the dam. Thus, under existing conditions, there is little indication that downstream passage delay is excessive at the project, and given the proposed improvements for downstream passage, there is no reason to believe that passage delay would be problematic under a new license.

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[212] NMFS also cites Stich *et al*. (2015a) when stating in its May 23, 2017 filing, that smolts have more than 20 percent lower probability of survival in the estuary based on a 44 hour delay. However, staff were unable to verify NMFS calculations based on the available information in Stich *et al*. (2015a).

Adaptive Management

An adaptive management approach for managing downstream passage survival of Atlantic salmon, as discussed in the sections above, could help address uncertainty as to whether or not the existing downstream bypass with additional measures would allow the project to meet the proposed performance standards. If the downstream bypass, together with the proposed structural and operational enhancements (i.e., full depth trash racks with 1-inch bar spacing, opening the log sluice for 3 weeks), meet smolt performance criteria during 3 years of study, GLHA proposes that it would evaluate downstream passage for smolts at the project once every 10 years thereafter to verify continued achievement of the performance standard of 96 percent survival.

The ability to meet the 96 percent performance standard during each of 3 years of study would indicate that the downstream passage structures are effective at passing smolts downstream, and if the downstream passage structures are maintained (discussed in section 3.3.2.2, *Fish Passage Design, Maintenance, and Monitoring*) they would likely meet the 96 percent standard indefinitely. Further, if the 96 percent performance standard is met during each of 3 years of study, there would be no justification for reevaluating downstream passage survival for smolts every 10 years, as proposed by GLHA, because there are no proposed or anticipated changes that would cause smolt survival to change every 10 years. If passage effectiveness for smolts does not achieve the 96 percent performance standard, GLHA could consult with the resource agencies and Penobscot Indian Nation on the need for additional operational or structural modifications, followed by additional study, and implement additional measures upon Commission approval until a 96-percent performance standard is met.

If the existing bypass with additional proposed measures does not allow GLHA to meet the proposed performance standard for downstream survival of migrating smolts, then GLHA could implement additional measures to improve downstream passage of smolts and help meet the performance standard of 96 percent survival. GLHA proposes that if the existing bypass with additional proposed measures do not allow smolts to pass downstream with 96 percent survival, it would consult with the resource agencies and Penobscot Indian Nation to determine appropriate structural or operational modifications, make any modifications that are deemed appropriate, and then reevaluate the downstream passage structures until the performance standard is met. Implementing structural or operational modifications may be necessary to meet the performance standard and allow smolts to pass downstream with 96 percent survival. However, at this time, there are no specific structural or operational modifications to analyze. Thus, there are currently no known benefits to implementing unspecified structural or operational measures. Nevertheless, if specific structural and/or operational modifications are determined to be necessary at some future date, implementation could occur, but only after Commission approval.

GLHA proposes that if operational or structural modifications are not feasible, it would move to the phased spill approach outlined above. Spill can be a benign means of passing smolts downstream of hydroelectric projects, and has been used to mitigate the negative effects of hydroelectric dams on downstream migrating fish (Noonan *et al*., 2012; Adams *et al*., 2014). A positive relationship between spill and smolt survival has been observed (Cada *et al*., 1997; Stich *et al*., 2014). As discussed in section 3.3.4.1, *Affected Environment, Atlantic Salmon*, studies conducted at the project in 2014 and 2015 indicate that smolts do use spill, although survival by spill was lower than it was through the bypass. GLHA's proposed, phased spill measures would increase spill incrementally, as needed, beginning with spill that is equal to a minimum of 20 percent of river flow and increase it to 100 percent of river flow from 8 pm to 4 am for 3 weeks during the smolt outmigration period. Based on the information above, the phased spill approach could improve downstream passage of smolts and allow the project to provide 96 percent survival for smolts. However, like operation of the log sluice, determining the 3 week period of spill in consultation with the resource agencies would help maximize the likelihood of matching spill with the smolt outmigration. Approval from the Commission would also be needed.

GLHA's proposal does not clearly define when the phased spill measures would be implemented. The implementation of phased spill measures could begin at a time determined in consultation with the resource agencies and Penobscot Indian Nation, with approval from the Commission. However, implementation of the phased spill approach would need to occur after at least 1 year of study shows that implementing the proposed log sluice operations with the new full depth trash racks does not meet the 96 percent survival performance standard for smolts. In addition, to prevent a continuous loop of study followed by structural and/or operational modification(s), implementation of the phased spill measures would need to begin, after a maximum of 3 years of downstream passage studies and modifications that show non-achievement of meeting the 96 percent performance standard.

Kelt Passage Performance Standard and Effectiveness Testing

GLHA is proposing to open the log sluice for 3 weeks during the migration season and install trash racks with 1-inch bar spacing to the full depth of the turbine intakes to provide additional passage and passage protection for kelts. To confirm that these additional downstream passage measures allow kelts to pass downstream of the project with at least 96 percent survival, GLHA proposes in the SPP to conduct up to 3 years of Atlantic salmon kelt downstream passage studies, using the same returning, imprinted adult salmon that would be used during the upstream passage study (discussed above in this section, *Upstream Passage Performance Standard and Effectiveness Testing*). Maine DMR recommends adopting GLHA's proposal. GLHA also proposes to develop and implement adaptive management to address performance criteria for downstream passage, but does not provide any specific provisions to implement for passage of kelts.

NMFS's fishway prescription would require and Maine DMR recommends adopting GLHA's proposal to study passage effectiveness for kelts. However, neither the fishway prescription nor Maine DMR's recommendation include a performance standard of 96 percent survival for kelts. Nevertheless, NMFS's prescription does state that the fishways must operate in a way that complies with any incidental take statement issued as part of the biological opinion, and NMFS indicates that a performance standard of 96 percent for downstream passage is consistent with other performance standards in the Penobscot River. NMFS also states in its prescription that during the downstream passage studies, a kelt must pass the project within 24 hours of entering the forebay area to be considered a successful passage attempt that can be applied toward calculation of downstream passage survival. NMFS defines the project forebay area as 200 meters upstream of the trash racks to approximately 1 mile downstream of the powerhouse.

Our Analysis

Although few adult Atlantic salmon will return to the ocean after spawning, their successful downstream migration and return upstream can provide additional reproductive contributions to the population. As discussed above, studies conducted in the early 1990s indicated that the survival of kelts migrating downstream of the project can be quite high (96.3 percent) and the collection efficiency of the existing bypass is good (82 percent). Thus, under existing conditions, the bypass is effective at attracting kelts. Further, survival past the dam meets the 96 percent survival performance standard determined by NMFS to be protective of kelts migrating downstream past other hydropower project in the Penobscot River Basin. However, GLHA is proposing additional measures to operate the log sluice for 3 weeks during the spring and to install trash racks with 1-inch bar spacing to the full depth of the turbine intakes.[213] Thus, there would be a benefit to conducting more studies to determine whether the project is still able to pass kelts downstream with 96 percent survival after implementation of additional measures.

To evaluate the effectiveness of the downstream passage structures for kelts, GLHA proposes, Maine DMR recommends, and NMFS's fishway prescription would require up to 3 years of kelt downstream passage studies, using returning, imprinted adult

[213] As discussed in this section, the proposed trash racks would provide no benefit to the downstream passage of Atlantic salmon, but as discussed in section 3.3.2.2, *Downstream Eel Passage*, the full depth trash racks would help to prevent entrainment of large eel that migrate downstream. GLHA's proposed opening of the log sluice for 3 weeks during the spring has the potential to benefit downstream migrating smolts and kelts; however, the intended purpose of opening the log sluice is to enhance downstream passage for smolts.

salmon (discussed above in this section, *Upstream Passage Performance Standard and Effectiveness Testing*), to determine if the proposed operations and facilities are able to pass kelts with 96 percent survival. As discussed above, the use of imprinted adult Atlantic salmon is needed for the upstream passage studies. However, these same fish can be, and are, proposed to be used to study the effectiveness of the downstream passage structures, if they return downstream after spawning upstream of the project.[214]

The proposed performance standard of 96 percent survival of kelts would represent a high rate of survival past the project dam, and would be consistent with other projects in the basin.[215] In addition, for the same reasons discussed above for smolts, considering the performance standard of 96 percent survival for kelts achieved, if the lower and upper 75 percent confidence limits include 96 survival, would provide a reasonable amount of confidence that survival is close to the desired level of 96 percent. Further, like smolts, there is no evidence to support NMFS's prescription that would require kelts to pass the project forebay area and move downstream within 24 hours to be considered a successful passage attempt during the effectiveness study.

Although GLHA proposes to conduct up to 3 years of study to evaluate whether the downstream passage structures are able to meet the 96 percent performance standard for kelts, GLHA does not propose, nor does anyone recommend, specific provisions that would be implemented if, after one year of study, the downstream passage structures do or do not meet the 96 percent performance standard. Nevertheless, because the studies for downstream kelt passage effectiveness would require the use of the same study fish (i.e., the stocked smolts) used in the upstream passage effectiveness studies, similar provisions for additional study and adaptive management should apply after one year of study. Specifically, one year of study may be adequate if the study shows that the downstream passage structures are able to meet the 96 percent performance standard. However, because GLHA is proposing to stock uniquely tagged smolts during the first 3 years after license issuance for the purposes of the adult passage studies, GLHA could conduct an additional 1 or 2 years of upstream passage effectiveness studies to provide additional verification of effectiveness. The need for an additional 1 or 2 years of study would need to be determined in consultation with the resource agencies, and approved by

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[214] As discussed in section 3.3.3.1, *Affected Environment, Atlantic Salmon*, few returning Atlantic salmon are repeat spawners (most die after spawning). Thus, only a small percentage of adults are expected to migrate back downstream and out to sea.

[215] A performance standard of 96 percent survival for kelts also is currently a requirement at the Milford and West Enfield Projects, which are located downstream of the Mattaceunk Project and represent the second and third dams that kelts would have to pass to reach the ocean after spawning upstream of the Mattaceunk Project. *See* 146 FERC ¶ 62,224 (2014).

the Commission. After it is determined that the upstream fishway meets the 96 percent effectiveness standard, there would be no benefit to reevaluating the effectiveness of the downstream fishway effectiveness for kelts every 10 years, as proposed, because there are no proposed or anticipated changes that would cause kelt survival to change every 10 years.

Evaluating the effectiveness of the downstream fishway may show that the downstream passage structures do not meet the 96 percent performance standard for kelts. Under this scenario, GLHA could consult with the resource agencies and Penobscot Indian Nation to identify the need for, and type of additional measures that might be necessary. Currently, there is no known benefit to implementing structural or operational modifications, because no specific modifications have been proposed or recommended. However, if in the future, specific structural or operational measures are determined to be necessary, and benefits to the measures are apparent, then modifications could be implemented, but only after Commission approval.

As discussed previously, NMFS's prescription requires that the effectiveness studies begin at the start of the first migratory season after fishways are operational. However, as discussed above, upstream migrating adult Atlantic salmon would not be available for study until at least 2 years after tagged smolts are stocked for the purposes of the study. Thus, NMFS's requirement would not be feasible for the downstream passage effectiveness studies for kelts.

Smolt Mortality in the Impoundment

To evaluate smolt mortality in the project impoundment, GLHA proposes to use the existing study plan,[216] with additional modifications for conducting a more rigorous evaluation of the sources of impoundment mortalities, along with any additional modifications deemed appropriate during agency consultation. Further, GLHA proposes to develop an adaptive management plan, if necessary, to address impoundment mortality.[217]

[216] GLHA's existing study plan (Downstream Salmon Passage – Interim Species Protection Plan) was originally filed on December 11, 2013 as part of GLHA's revised study plan for relicensing the Mattaceunk Project. However, modifications to the study plan were made in 2015 to accommodate a request from NMFS to study smolt mortality in the project impoundment. The methods of the revised plan are included in the 2015 Atlantic Salmon Passage Study Report, filed on March 31, 2016.

[217] GLHA does not include this proposal in the SPP. However, in a letter filed on July 7, 2017, GLHA states that it is committed to developing an adaptive management

Maine DMR recommends that GLHA conduct up to 3 years of studies to assess the sources of impoundment mortality. NMFS does not recommend a study, but does recommend that GLHA develop a mitigation plan, in consultation with NMFS and resource agencies, for the loss of Atlantic salmon smolts as a result of maintaining the project impoundment. The mitigation plan would: (1) be developed after completion of the downstream smolt survival studies; (2) include an implementation schedule; (3) include measures to reduce the number of smolts that die in the impoundment (potential measures could include predator control, flow manipulations to move smolts through the area faster, etc.); and/or increase the number of smolts in the project area such that a "no net loss" standard is achieved; and (4) be provided in draft form to resource agencies within 6 months of the completion of the smolt survival studies, and in final form ready for implementation within one year of the smolt survival studies.

Our Analysis

As discussed in section 3.3.4.1, *Affected Environment, Atlantic Salmon*, GLHA and Stich *et al.* (2015b) investigated smolt mortality in the project impoundment on separate occasions. The GLHA study demonstrated that the mortality rate in the impoundment (1.8 percent per mile) was lower than in a free-flowing section of river downstream of the project dam (3.8 percent per mile). The Stich *et al.* (2015b) study demonstrated that for hatchery smolts, the mortality rate in the impoundment (average mortality of 2.7 percent per mile) was higher than in free-flowing sections of the Penobscot River (average mortality of 0.64 percent per mile), but for wild smolts the mortality rates were similar between the impoundment (average mortality of 1.6 percent per mile) and free-flowing sections of the river (average mortality of 1.34 percent per mile). The impoundment mortality results from the GLHA and Stich *et al.* (2015b) studies are not consistently higher or lower than in free-flowing sections, and thus provide no consistent evidence for a project effect.

The GLHA and Stich *et al.* (2015b) studies also provide no information to indicate that mortality in the project impoundment is excessive. Further, there are no specific survival performance standards, or otherwise acceptable levels of impoundment mortality that would suggest that mortality in the impoundment is excessive. Without specific information to indicate whether or not mortality in the impoundment is excessive either today, or in the future, there is no means to determine whether environmental measures would be needed, or the type of environmental measures that would be beneficial. In addition, without a means to determine whether mortality in the impoundment is

plan if necessary, based on the results of the study of smolt mortality in the impoundment.

excessive, and thus whether environmental measures are needed, there is no benefit to conducting an impoundment mortality study.

Even if performance standards for smolt mortality in the impoundment were identified, the proportion of mortality in the impoundment caused by the project would be difficult to identify because estimates of mortality in the impoundment could be the result of multiple sources that may or may not be related to the project. For example, mortality could result from parasites or poor feeding conditions that could exist in the 8.5-mile-long project impoundment (McCormick *et al.*, 1998, Larsson *et al.*, 2011). Mortality could also be caused by any number of freshwater fish (e.g., brook trout, American eel, chain pickerel, smallmouth bass) or bird predators (e.g., common mergansers, red-breasted mergansers, osprey) found in the upper Penobscot River (Dube *et al.*, 2012; Fay *et al.*, 2006). Smallmouth bass, in particular: (1) are very effective predators on both Pacific and Atlantic salmon smolts (Van den Ende, 1993, Fayram *et al.*, 2000); (2) are present in the project impoundment; and (3) could have a negative effect on smolt survival in the impoundment. Further, the presence of smallmouth bass is actively supported in the Penobscot River through fisheries management, which is unrelated to project effects, but could nonetheless affect smolt mortality in the project impoundment. Removing the effect of managing for smallmouth bass would be necessary to begin to identify the proportion of mortality in the impoundment caused by the project.

Based on the information discussed above, there is: (1) no consistent evidence for a project effect on smolt mortality in the impoundment; (2) no indication that smolt mortality in the impoundment is excessive; and (3) no means to determine whether smolt mortality is excessive. In addition, identifying a project effect on smolt mortality in the impoundment would be difficult. For these reasons, there is no justification for conducting a post-licensing impoundment mortality study, or implementing environmental measures to reduce mortality in the project impoundment.

Consistency with Atlantic Salmon Recovery Plan

GLHA’s proposed, and the agencies’ recommended or required, environmental measures would be consistent with the 2016 Draft Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (NMFS and FWS, 2016a). This is because the proposal and recommendations include: (1) measures to maintain accessible upstream and downstream passage to suitable habitat; (2) measures to maintain water quality conditions that support a recovered population, including water quality that supports Atlantic salmon spawning, incubation, rearing, and migration; (3) measures to provide adequate instream flow conditions to support Atlantic salmon spawning, incubation, rearing, and migration; and (4) measures to allow co-evolved diadromous species to be restored to the extent possible to support a recovered GOM DPS.

Based on our analysis throughout the sections above on Atlantic salmon, we conclude that GLHA's proposed SPP with additional modifications, would minimize many adverse effects of the project on the GOM DPS of Atlantic salmon. Nevertheless, project operation would result in the take of some Atlantic salmon smolts, and therefore continued operation may affect, and is likely to adversely affect Atlantic salmon. Designated critical habitat for the GOM DPS of Atlantic salmon does occur in the project area, and the PCEs of critical habitat include sites free from physical and biological barriers that delay or prevent upstream (PCE 8) and downstream migration (PCE 11) of Atlantic salmon. However, with GLHA's proposed SPP, along with additional modifications, including proposed improvements to upstream and downstream passage to meet specific 95 percent upstream passage effectiveness and 96 percent downstream survival, we conclude that operating the project may affect, but is not likely to adversely affect the designated critical habitat for the GOM DPS of Atlantic salmon.

Cumulative Effects

The cumulative effects of relicensing the Mattaceunk Project have been previously discussed in section 3.3.2.2, *Cumulative Effects*, with respect to fishery resources. The cumulative effects discussed in that section also apply to Atlantic salmon. Here we discuss the specific cumulative effects on passage of Atlantic salmon.

The Mattaceunk Project is the third hydroelectric project on the mainstem of the Penobscot River upstream from where it enters the sea. Upstream passage is currently maintained at all three dams, as discussed in section 3.3.2.1, *Affected Environment, Fish Community*. License requirements at Milford and West Enfield require that each project maintain a 95 percent upstream passage effectiveness for adult Atlantic salmon. Under existing conditions, upstream passage effectiveness ranges between 71 percent and 100 percent at the Mattaceunk Project. Thus, under current license conditions for all three projects, the cumulative passage effectiveness could be as low as 64 percent (assuming 71 percent effectiveness at the Mattaceunk Project) for adults that are motivated to spawn upstream of the Mattaceunk Project. However, GLHA is proposing to maintain the existing upstream fishway and meet an upstream performance standard of 95 percent. Thus, under a new license, the cumulative upstream passage effectiveness would improve to 85.7 percent, or as much as 21.7 percentage points higher for adults motivated to spawn upstream of the Mattaceunk Project. Thus, there would be an overall positive cumulative effect on upstream migration for Atlantic salmon.

The three hydroelectric projects on the mainstem of the Penobscot River also act to cumulatively effect the GOM DPS of Atlantic salmon by reducing downstream passage survival of smolts and kelts. As discussed in section 3.3.2.1, *Affected Environment, Fish Community*, downstream passage is currently maintained for Atlantic salmon at all three projects. License requirements at Milford and West Enfield require that each project maintain 96 percent downstream passage survival for adult Atlantic salmon smolts and kelts. Under existing conditions, and best available information, the Mattaceunk Project maintains about 96 percent passage survival for both smolts and kelts. Thus, under current license conditions for all three projects, there is a cumulative passage survival of about 88 percent for smolts and kelts that originate upstream of the Mattaceunk Project. GLHA is proposing to maintain the existing upstream fishway and make any operational or structural modifications that are necessary to be able to maintain a downstream performance standard of 96 percent survival. Under a new license, the cumulative downstream passage survival would not necessarily improve with GLHA's proposal, because available information indicates that downstream survival of smolts and kelts is already about 96 percent survival. However, current license conditions do not require that GLHA maintain 96 percent survival for downstream passage. Requiring GLHA's proposal would ensure that the cumulative survival of smolts and kelts would be maintained at a high level, and thereby improve the chances of recovery for the GOM DPS of Atlantic salmon.

Canada Lynx and Northern Long-Eared Bat

GLHA does not propose any measures for the protection of the Canada lynx, or northern long-eared bat, and no agency recommendations were received regarding the Canada lynx or northern long-eared bat.

Our Analysis

Canada lynx from the eastern part of its range (Maine) have distinctly different habitat preferences from the western populations of lynx (everything west of Maine) that favor boreal spruce-fir forest (FWS, 2014). The eastern populations prefer areas of open early successional vegetation where their prey (snowshoe hares) are located. This type of habitat is more common in the western and northern sections of Maine and is not common in the project area. The ROW, while maintained in an early successional state, is a narrow corridor through the forest, and is not the open habitat preferred by snowshoe hares and Canada lynx in the eastern part of their ranges. Since this habitat is sparse in the project area, it is both unlikely the snowshoe hare and lynx would be present, and that the project would have any impact on this species. Based on this information, we conclude that relicensing the Mattaceunk Project with any of the measures considered in this draft EA would have no effect on the Canada lynx.

Northern long-eared bat hibernacula sites are not known to occur in the project vicinity; however, because the project vicinity is largely forested, it should supply suitable habitat for summer roosting and foraging activities. If the northern long-eared bat is present in the project vicinity, project operation and maintenance would not affect its habitat or food availability because the applicant does not propose any ground disturbing activities or tree clearing activities as part of relicensing. Based on this information, we conclude that relicensing the Mattaceunk Project with any of the measures considered in this draft EA would have no effect on the northern long-eared bat.

3.3.5 Land Use and Recreation

3.3.5.1 Affected Environment

Land Use

Lands in the project vicinity are largely undeveloped. State Routes 157 and 115 run adjacent to the project on the north and south sides of the impoundment and Interstate 95 crosses the upper impoundment downstream of the confluence of the East and West Branches. Several homes and businesses are located along the roadways near the shoreline of the impoundment.

Generally, the Mattaceunk Project boundary follows the 240 foot elevation contour around the impoundment and islands; portions of islands above the 240 foot elevation are not included in the project boundary, and GLHA does not consider them to be part of the project. GLHA maintains all rights necessary for flowage within the project boundary but does not implement shoreline management policies that direct land use along the impoundment. Zoning along the impoundment is regulated by municipal zoning ordinances as required by the State of Maine. All land within 250 feet of the impoundment is controlled by each municipality's Shoreline Zoning Ordinance. The impoundment shoreline is zoned as "resource protection," which is defined as areas in which development would adversely affect water quality, productive habitat, biotic systems, or scenic or natural values. Non-intensive recreation use is allowed within areas zoned "resource protection."

The project boundary deviates from the 240 foot elevation to enclose all project facilities, including the dam, powerhouse, switchyard, and transmission line corridor. The project boundary also encloses the Downstream Angler Access Area and a portion of the canoe portage. Under a new license, GLHA proposes to enclose the entirety of the canoe portage within the project boundary. Downstream from the dam, the project boundary extends along the shoreline to meet the upper extent of the downstream Medway Project boundary. Other than the lands specifically needed for project operation and project recreation, GLHA owns little land within the project boundary.

No portions of the East Branch, West Branch or mainstem Penobscot River are designated as wild and scenic; however, portions are listed on the National Park Service's Nationwide Rivers Inventory (NRI). The NRI, which was created in 1982 and amended in 1993, identifies river segments in the United States that are believed to possess one or more "outstandingly remarkable" natural or cultural values judged to be of more than local or regional significance. The NRI classifies 21 miles of the West Branch upstream from the project[218] as outstandingly remarkable for its scenic and fish resources. The NRI also classifies 16 miles of the mainstem Penobscot River downstream from the project[219] as outstandingly remarkable for its geologic and hydrologic values, specifically for the unique characteristics of the islands in the river. Several tributaries of the Penobscot River are also listed on the NRI, but none are in the immediate project vicinity (NPS, 2009).

Statewide-Recreation Outlook

The Maine State Comprehensive Outdoor Recreation Plan (SCORP), 2014-2019 identifies outdoor recreation as central to the state's economic, environmental and community values. The SCORP identifies broad goals of using outdoor recreation to improve health and drive economic development. In terms of water-based activity, the SCORP identifies strong growth both nationally and regionally for this form of recreation. The SCORP recommends expanding identification, signage, and branding of resources like water trails as a way of connecting both local users and tourists to the state's many existing resources for water-based recreation (Maine DACF, 2015).

Regional Recreation Opportunities

The Penobscot River Basin contains numerous opportunities for recreation, including fishing, hunting, river and lake boating, camping, hiking, snowmobiling, and picnicking. Baxter State Park, a 200,000-acre recreation area located just north of the project, contains the northern terminus of the Appalachian National Scenic Trail at Mount Katahdin. In 2016, President Obama designated 87,500 acres of land in Penobscot County, Maine as Katahdin Woods and Waters National Monument. The National Monument designation preserves the area's outdoor recreation, wildlife, and scenic resources (NPS, 2016). Other regionally-significant recreation areas in the project vicinity include the Penobscot River Corridor public lands and Allagash Wilderness Waterway. Commercial outfitters provide opportunities for rafting and whitewater kayaking.

Recreation at the Project

As discussed previously, the project impounds both the East and West Branches of the Penobscot River, as well as the mainstem Penobscot River below the confluence. On the impounded portion of the East Branch, the Town of Medway owns and operates a

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[218] The classified reach includes the segment of the West Branch from Ripogenus Dam to Ambajejus Lake.

[219] The classified reach includes the segment of the mainstem Penobscot River from Passadunkeag to Socks Island.

recreation complex. The complex includes sports facilities (baseball, tennis, and basketball) and a playground, as well as a swimming beach, picnic facilities, a boat ramp, and parking. The boat ramp is accessible and provides the only direct access for motorized boats to the project's impoundment.

Downstream from the project's dam, there is a fishery for landlocked salmon, brook trout, and smallmouth bass. More information about the project's fishery resources is located in section 3.3.2.1, *Affected Environment, Fish Community*.

Project Recreation Facilities

GLHA owns and operates two recreation facilities at the project: (1) a canoe portage; and (2) a recreation site downstream with angler access and picnic facilities (figure 20).

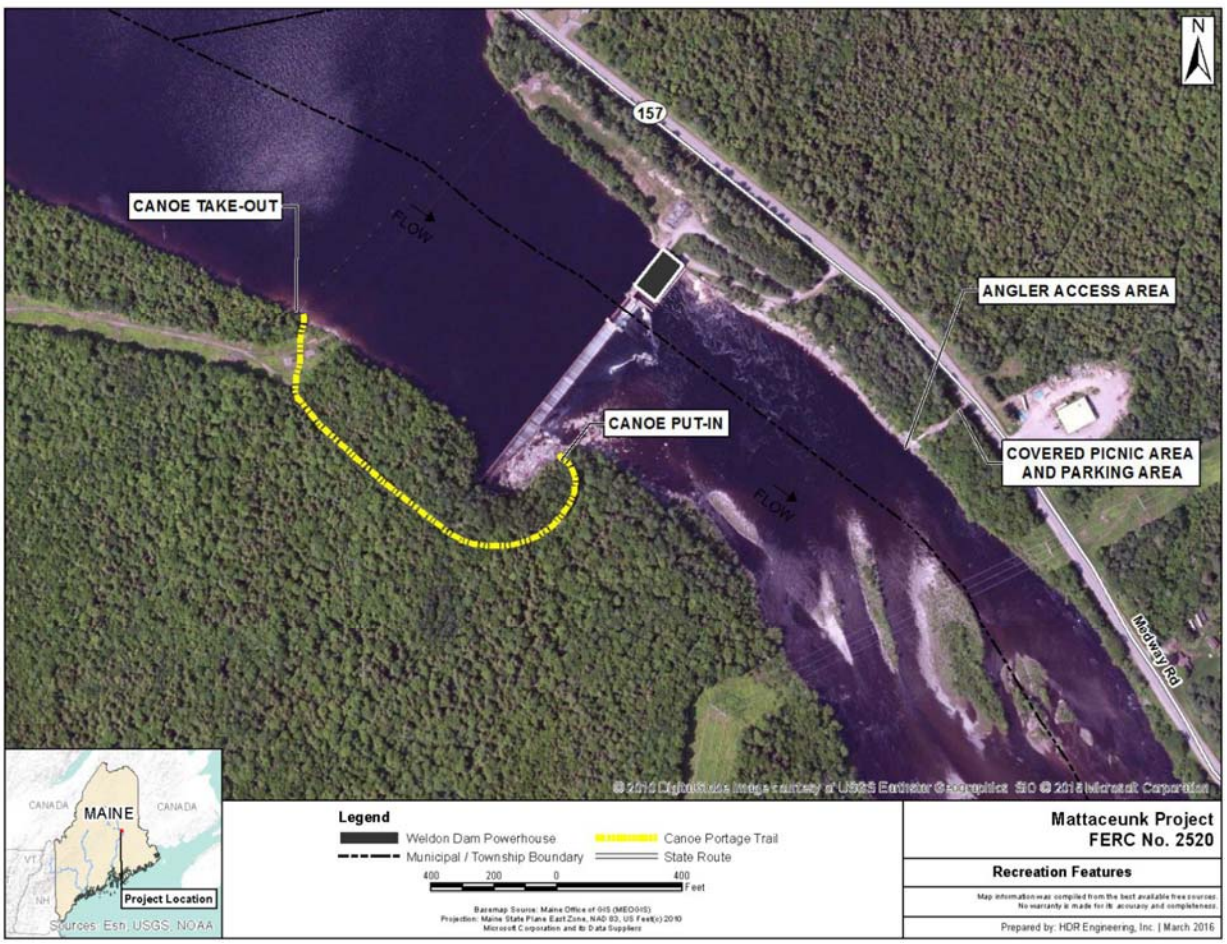

Figure 20. Recreation sites at the Mattaceunk Project.
(Source: GLHA, 2016a).

The canoe portage take-out is located on the western shore of the impoundment approximately 650 feet upstream from the dam. The portage trail follows a compacted gravel road that is approximately 9 feet wide and used only occasionally by the licensee to access the west side of the dam. The canoe put-in is located on the western shore of the project, downstream from the dam. Signage associated with the portage trail includes signs indicating the put-in and take-out locations, as well as signs to guide trail users and information related to public safety. Signs are periodically inspected and maintained as needed.

On the east bank of the river, GLHA owns and operates a recreation site that provides angler access, a picnic area, and parking for six to eight vehicles. The facility is located adjacent to State Route 157, approximately 1,000 feet downstream from the dam. The angler access consists of a set of wooden stairs that lead from the top of the bank to the river's edge. A picnic table with shelter is located at the top of the bank, adjacent to the compacted gravel parking area. Signage associated with the recreation area includes public safety signs that are routinely inspected and maintained.

Recreational Use

Use of the project's recreation facilities is estimated at 3,696 recreation days[220] during the peak recreation season from Memorial Day to Labor Day. This rate of use is very low compared to the capacity of the facilities (use was estimated at 4.5 percent of capacity). Recreational observations recorded during the 2014 recreation season showed no use of the portage trail and very limited use of the angler access/picnic area (three total observations). The primary source of recreation at the project is from the Town of Medway's recreation complex, which received significantly higher rates of vehicular traffic than GLHA's facilities. Although the Town of Medway does not keep records of recreation use at the complex, they estimate approximately 40 users per day at the swim beach on weekends during the peak recreation season. Motorized boats, likely originating from the town's boat ramp, were observed infrequently. No non-motorized boats were observed.

3.3.5.2 Environmental Effects

Special Designation Lands and Waters

Both the Atlantic Salmon Federation and the Penobscot Indian Nation request that the Commission analyze the effects of the project on special-designation lands and waters, specifically the Katahdin Woods and Waters National Monument. However, neither the Atlantic Salmon Federation nor the Penobscot Indian Nation provide specific recommendations for protection, mitigation, or enhancement measures relating to Katahdin Woods and Waters National Monument although both state that restoration of

[220] Recreation days are defined as each visit by a person to the project for recreational purposes during any portion of a 24-hour period.

Atlantic salmon to the East Branch of the Penobscot River would benefit the National Monument's mission.

Our Analysis

Katahdin Woods and Waters National Monument, which was designated for the protection of both the "historic and scientific objects" within its boundary, encompasses 87,000 acres, including areas of the East Branch of the Penobscot River just upstream from the project (NPS, 2016). As discussed previously, in section 3.3.2.1, *Affected Environment, Fish Community* and section 3.3.4.1*, Affected Environment, Atlantic Salmon*, the East Branch of the Penobscot River has historically been home to high-quality habitat for diadromous fish species, including spawning and rearing habitat for Atlantic salmon. As the Atlantic Salmon Federation and Penobscot Indian Nation assert, areas within Katahdin Woods and Waters National Monument are ecologically linked with areas downstream, including the Mattaceunk Project. Protection measures for diadromous fish species, as part of any new license issued for the project (discussed in section 3.3.2.2, *Aquatic Resources*, *Environmental Effects* [i.e., eel and shad] and section 3.3.4.2, *Threatened and Endangered Species, Environmental Effects* [i.e. Atlantic salmon]), would minimize the effects of the project on habitat, and upstream and downstream migration of such species and would cause no adverse effects on the current natural resource values of Katahdin Woods and Waters National Monument.

<u>Recreation Use and Access</u>

Over the term of a new license, GLHA proposes to continue to operate and maintain the existing project recreation sites.

In response to stakeholder comments about the need for improved amenities at the Downstream Angler Access Area, GLHA also proposes to implement recreation facility improvements within 3 years of license issuance, including installation of: (1) a pulley system to assist boaters with moving car top boats and other small watercraft up and down the existing stairs at the angler access area, located on the east side of the Penobscot River, downstream from the project's powerhouse; and (2) a ramp adjacent to the existing recreation pavilion to provide wheel chair access to the pavilion and its associated picnic table.

Interior provided comments recommending that GLHA develop a portage plan for improvements to the project's existing portage trail in consultation with the Penobscot Indian Nation stating that Mattaceunk (Weldon) Dam currently impedes downstream travel by canoe and that passage around the dam is difficult through the woods.

Our Analysis

The existing project facilities provide an appropriate level of recreation access for this portion of the Penobscot River, which receives relatively low recreation use.

The canoe portage, which GLHA proposes to continue to operate and maintain, provides necessary downstream access for boaters paddling the Penobscot River. Interior provides no support for the statement that there is no easy way to portage a boat around the project. Photos of the existing portage trail provided by GLHA in the final license application indicate that the trail is maintained and signed. During site visits to discuss recreation access at the project, no comments were raised about the condition of the trail.

The Downstream Angler Access Area provides access to a fishery for brook trout, smallmouth bass, and landlocked salmon. The facility is not at or near capacity, according to studies conducted during relicensing. GLHA's proposed recreation improvements would further enhance the existing recreation facilities by improving the usability of the Downstream Angler Access Area. Installing a pulley system to help boaters transport canoes down the steep stairs between the parking area and water would provide better access to the Penobscot River downstream of the project. Minor enhancements to the Downstream Angler Access Area's picnic facilities would improve access for the disabled on the project's east side, while consultation with Maine DIFW indicated that the Town of Medway's Recreation Complex provided adequate access for persons with disabilities to the project's western and upstream reaches.

3.3.6 Cultural Resources

3.3.6.1 Affected Environment

<u>Area of Potential Effect</u>

Under section 106 of the NHPA of 1966, as amended, the Commission must take into account whether any historic properties within a project's APE could be affected by the project. The Advisory Council on Historic Preservation defines an APE as the geographic area or areas in which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE for the project includes: (1) lands enclosed by the project boundary; and (2) lands or properties outside the project boundary where 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. By letter dated August 27, 2015 and filed October 13, 2017, the Maine SHPO concurred with the proposed definition of the APE.

Cultural History Overview

The archaeological record in Maine begins over 11,000 years before present (B.P.). This section provides an overview of the cultural context of the region.

Pre-contact Period

The earliest inhabitants of the region and throughout North America were Paleoindian people, who rapidly colonized the continent in pursuit of large game (Martin, 1973). The hallmark of the Paleoindian tradition is the fluted spear point, which was presumably used to hunt large game. In Maine, the Paleoindian period dates from approximately 11,500 to 9,500 B.P. when much of the landscape was still vegetated in tundra and/or woodlands. Paleoindian people living in the region are characterized as highly mobile hunters and gatherers reliant mainly on caribou that were abundant in the environment of that time. They crafted their tools out of fine-grained, colorful rocks obtained from a limited number of sources in the region, and they camped in locations typically removed from present day water bodies (Spiess *et al.*, 1998).

The Archaic period (ca. 9,500 - 3,000 B.P.) represents the longest cultural period in the region, spanning around 6,500 years. This timeframe is indicative of persistent cultural adaptations over several millennia. This period is subdivided into the Early, Middle, and Late Archaic period. Although Early and Middle Archaic people probably continued a nomadic hunter and gatherer lifestyle, their subsistence and settlement patterns were different from those of the Paleoindian people. This distinction is suggested by the location of most Early and Middle Archaic sites along present-day water bodies and the presence of food remains of aquatic species, particularly beaver, muskrat, and fish. Tools were typically produced from local stone, and lack the finely crafted, chipped stone spear points that characterize the Paleoindian period. In addition, a new technology using pecking and grinding techniques appears for the first time in the archaeological record (Robinson, 1992). This new technology produced a suite of groundstone tools that became more elaborate through time. During the Middle Archaic period, chipped stone spear points became increasingly more abundant. Increased ceremonialization is represented in the record by the presence of cemetery sites which reveal mortuary practices that included the sprinkling of graves with red ocher and the offering of grave goods (Willoughby, 1898; Moorehead, 1922; Robinson, 1992; Will and Cole-Will, 1996).

The close of the Late Archaic period is characterized by a transition to the Susquehanna Tradition, which is widespread in Maine and New England (Sanger, 1979; Bourque, 1995). The people of the Susquehanna Tradition appear to have been more focused on a terrestrial economy than a marine economy. They also largely abandoned the use of red ocher in their graves and often cremated their corpses rather than buried them intact. Diagnostic tool forms include large, broad-bladed chipped stone spear points.

The introduction of pottery manufacture and use in Maine defines the onset of what Maine archaeologists call the Ceramic period, but is known more widely as the Woodland period in other parts of the Northeast. Ceramics first appear in the archaeological record of Maine around 3,000 years ago, and they persist until contact with Europeans when clay pots were replaced in favor of iron and copper kettles that were traded for beaver pelts and other animal furs. Ceramic period sites are abundant in Maine, along both the coast and in the Maine interior (Bourque, 1971; Sanger, 1979). Sites in the interior are most common along waterways, especially rivers, ponds, and lakes. The presence and nature of artifact forms, and certain types of stone recovered from Ceramic period sites, indicate trade and communication with peoples far to the north, south, and west. By the end of the period, historical and archaeological evidence suggests horticulture was practiced in southern Maine. The Ceramic period ends with European contact around 450 years ago. At this time, most of the artifacts attributable to Pre-contact inhabitants of Maine disappear from the archaeological record.

Post-contact Period

At the time of European contact, a number of tribal groups were living in the region of Maine and the maritime Canadian provinces. Collectively, these groups identified as the Wabanaki, meaning "people of the land of the dawn." The term generally applies to the Passamaquoddy, Penobscot, Maliseet, Abenaki of western Maine and the Abenaki of Quebec, although there is no consensus on use of the term Wabanaki and the peoples who identify as Wabanaki (AFSC, 1989).

Throughout the sixteenth century, European fishing vessels frequently made contact with the Wabanaki as they traveled through the Gulf of St. Lawrence; but, it was not until the first years of the seventeenth century that Europeans permanently began to settle in Wabanaki territory and provide written records of these societies. In 1600, the population of Wabanaki in Maine and maritime Canada is estimated to have been 32,000 people. Villages ranged in size from a half-dozen houses to over 100 and they were built at the coast, along the estuaries of rivers, and near lakes, rivers and streams. As European settlement increased, the native populations experienced sudden and catastrophic population change due to disease epidemics. In the span of a few years, the native population in the region was reduced by as much as 75 percent (AFSC, 1989).

European settlement also changed Wabanaki society in other ways. Extensive trade grew between European settlers and Wabanaki peoples. These trading relationships reduced traditional subsistence practices and increased the Wabanaki's reliance on European goods. European settlement patterns resulted in significant changes in the landscape as timbering and farming became more prevalent in the region. As the traditional social structure changed, the Wabanaki peoples allied with the French, with whom they had significant trading relationships, to reduce English encroachment into their territory. However, after the French and Indian War, England claimed the lands in Maine and Maritime Provinces. Treaties with both the British government and, subsequently, the state of Massachusetts, further reduced the tribes' territories within the region (AFSC, 1989).

Surveys of the area in 1820, by Joseph Treat and his Penobscot guide John Neptune, documented Penobscot families camping both on reservation lands, consisting of the "upper four townships" and islands in the Penobscot River. According to Treat's survey, there were two Penobscot townships and six identified Native American encampment villages located within the Mattaceunk Project's APE. These villages and encampments were located near rapids and falls in the river, which were important for sustenance fishing. The locations of these settlements now lay below the Mattaceunk impoundment's surface (letter from K. Francis, Tribal Chief, Penobscot Indian Nation, Indian Island, ME to K. Bose, Secretary, FERC, Washington, D.C. filed May 23, 2017).

Europeans began settling towns near the present-day location of the Mattaceunk Project in the early-to-mid nineteenth century. Medway, then known as "Nicatou" (The Forks - referring to its location at the confluence of the East and West Forks of the Penobscot River) and Mattawamkeag were first settled in the 1820s as rail and stage lines were constructed into the region. These towns, along with Woodville and Molunkus were both strongly affected by the growth and development of the timber industry in Maine. In Medway, which was officially incorporated in 1865, the town boasted a number of water-powered sawmills along the Penobscot River with dense settlement along both sides of the river. Use of the river by sawmills and for power production, continued into the late twentieth century (Wheeler and Marlatt, 2015).

Cultural Resource Investigations

Pre-contact Archaeological Resources

In 2015, GLHA retained TRC Environmental Solutions (TRC) to conduct a Phase IA pre-contact archaeological review and assessment of the project's APE (Phase IA Pre-Contact Study). The goal of the study was to identify previously reported archaeological sites within the project's APE and to support development of a sensitivity model to guide subsequent field investigations within the APE. The study indicated that the shoreline of the project's impoundment was sensitive for pre-contact cultural resources (Will, 2015).

As a result of the findings from the Phase IA Pre-contact study, six archeologically-sensitive areas, as well as seven sites with previously-identified archaeological resources, were examined as part of a Phase IB Pre-Contact Study (Will and Clark, 2016). The investigators used subsurface testing to document the presence of pre-contact archaeological sites. In total, the Phase IB Pre-Contact Study included the excavation of 175 test holes within the project's APE. No evidence of the seven previously-reported archaeological sites was encountered during the Phase IB Pre-Contact Study; however, one new pre-contact archaeological site was discovered and is being further evaluated as part of a Phase II Archaeological Site Evaluation, in consultation with the Maine SHPO.

Post-Contact Archaeological Resources

In 2015, GLHA retained Independent Archaeological Consulting, LLC (IAC) to conduct a desktop post-contact archaeological review and assessment of the project's APE (Desktop Post-Contact Study). The Desktop Post-Contact Study included a site file search at the Maine SHPO to learn of any recorded sites proximate to the project, as well as a cartographic analysis to identify the location of areas sensitive for post-contact archaeological resources. Based on the Desktop Post-Contact Study, IAC identified 40 areas in the project's APE considered sensitive for post-contact archaeological resources (Wheeler and Marlatt, 2015).

In September 2015, IAC conducted a Phase 0 walkover survey of the previously-identified locations within the APE identified as sensitive for Post-Contact archaeological resources. During the walkover, IAC identified three archaeologically sensitive areas requiring further study (Wheeler and Marlatt, 2015). IAC conducted a Phase IB archaeological field reconnaissance survey (Phase IB Post-Contact Survey) of these areas.

In total, IAC identified five post-contact archaeological resources through inspection of the project's APE by pedestrian and boat surveys, the Phase IB Post-Contact Survey, and additional consultation with Penobscot Indian Nation's Tribal Historic Preservation Officer (THPO) (Wheeler and Marlatt, 2016). A description of these resources, and IAC's recommendation for further study are included in table 20, below. Two resources were under water during the investigations. In those instances, IAC recommends additional archaeological investigations should a project drawdown of more than 24 feet occur in the future.

Table 20. Post-contact archaeological investigations within the project's APE.

Resource	Site Number	Recommendation
W. Wait Homestead	ME 275001	No further archaeological investigations.
Medway Village Sawmill Complex Earthen Dam Mill Foundation	ME 275002	No further archaeological investigation of earthen dam. If impoundment is drawn down 24 feet or more,

Resource	Site Number	Recommendation
		consult with the MHPC and conduct additional Phase IB Archaeological Investigations of Mill Foundation.
G.H. Baker Homestead	ME 275003	No further archaeological investigations.
W. Reed Homestead	ME 275004	No further archaeological investigations.
Medway Unidentified Foundation	ME 275005	If impoundment is drawn down 24 feet or more, consult with the MHPC and conduct additional Phase IB Archaeological Investigations.

(Source: Wheeler and Marlatt, 2016; as modified by staff).

Historic Architectural Resources

In 2015, TRC conducted an architectural survey to identify historic architectural resources (above-ground structures) within the project boundary that are listed in or eligible for listing in the National Register. Background research conducted by TRC confirmed that no properties currently listed on the National Register are located within the project boundary. Two resources, the Weldon Dam and powerhouse,[221] were previously surveyed in 2010 and determined to be eligible for the National Register by the Maine SHPO under Criteria A and C[222] (Henry, 2015).

[221] The Architectural Survey and Findings of Effects Report (Henry, 2015) refers to the dam as Mattaceunk Dam and powerhouse as the Roy V. Weldon Power Station. For consistency, we refer here to the name of the dam as "Weldon Dam" and use the term "powerhouse" to refer to the Roy V. Weldon Power Station.

[222] Resources eligible for listing on the National Register under criterion A are those that are associated with events that have made a significant contribution to the broad patterns of our history. Resources eligible for listing on the National Register under criterion C are those that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction (NPS, 2002).

The National Register-boundary for the project includes the dam and powerhouse, a small part of the tailrace to the south, as well as that part of the upstream impoundment which conveys the historic purpose and effect of the dam's construction. The National Register boundary does not include that part of the impoundment not visible from the two NRHP-eligible resources, including Salmon Stream and the confluence of the East and West Branches located some distance away from the eligible structures (Henry, 2015). The project, and its contributing resources, remain operable and in good condition and have been continuously used for hydropower generation since their construction.

Traditional Cultural Properties

By letter dated September 11, 2012, Commission staff initiated consultation with the Aroostook Band of Micmacs, Houlton Band of Maliseet Indians, Passamaquoddy Tribe, and Penobscot Indian Nation regarding the effects of relicensing the Mattaceunk Project on issues of tribal concern.

By letter filed July 17, 2013, the Penobscot Indian Nation provided comments on GLHA's PAD and the Commission's SD1, expressing the tribe's interests in participating in the relicensing proceedings for the project. Throughout pre-filing and post-filing consultation, the Penobscot Indian Nation has asserted its interest in the Penobscot River basin as both the ancestral home of the tribe as well as sustenance fishery for current tribal members. As described previously, lands of historic and current interest to the tribe are located within and adjacent to the project boundary, including submerged islands within the project's impoundment.[223]

3.3.6.2 Environmental Effects

Historic Properties

Project-related effects on cultural resources within the APE can result from modifications to project facilities or project operations; project-related ground-disturbing activities; construction, modification, or maintenance of project recreation facilities and use of such facilities by visitors; project-induced shoreline erosion;[224] and vandalism. GLHA does not propose to modify project operation; however, GLHA and resource

[223] The boundaries of the Penobscot Reservation and the Penobscot Indian Nation's hunting, fishing, and gathering rights in the waters of the Penobscot River are currently the subject of federal court litigation. At this time the BIA has provided no documentation of federal reservation lands within the project boundary.

[224] Project-induced shoreline erosion does not include shoreline erosion attributable to flood flows or phenomena, such as wind-driven wave action, erodible soils, and loss of vegetation due to natural causes.

agencies have proposed modifications to the project facilities to improve fish passage. GLHA also proposes some minor improvements to the Downstream Angler Access Area, including installation of a pulley system for moving car-top boats from the recreation site's parking area to the river and construction of a ramp to provide wheelchair access to the covered picnic shelter. These activities, and other maintenance activities associated with routine operation of the project, have the potential to adversely affect resources eligible for listing on the National Register, including the National Register-eligible dam and powerhouse.

To avoid, minimize, or mitigate for adverse effects on historic properties that may be affected by relicensing the project, GLHA proposes to develop an HPMP which directs the management of historic properties within the project's APE. The HPMP would be developed in consultation with the Maine SHPO and Penobscot Indian Nation THPO. The HPMP would address the following items: (1) any additional measures necessary to assist in the identification or management of historic properties within the project's APE; (2) Phase IB archaeological investigations of the Medway Village Sawmill Complex when the impoundment is lowered 24 feet or more; (3) potential effects on historic properties resulting from the continued operation and maintenance of the project; (4) management and treatment measures for historic properties; (5) procedures for the review of proposed future ground-disturbing activities or other activities within the project's APE which would have the potential to adversely affect historic properties; (6) protection of historic properties threatened by direct or indirect project-related activities, including routine project maintenance; (7) resolution of unavoidable adverse effects on historic properties; (8) treatment and disposition of any human remains that may be discovered within the project's APE; (9) provisions for unanticipated discoveries of previously unidentified cultural resources within the project's APE; (10) a dispute resolution process; (11) a list of categorical exclusions from further review of effects; (12) project-specific measures and a schedule for implementing the HPMP; (13) roles and responsibilities for the licensee, Maine SHPO, Penobscot Indian Nation THPO, and other individuals and organizations in regards to implementation of the HPMP; and (14) coordination with the Maine SHPO, Penobscot Indian Nation THPO and other consulting parties during implementation of the HPMP.

The Maine SHPO and Penobscot Indian Nation acknowledged GLHA's proposal for developing a HPMP to address adverse effects on historic properties within the project's APE. Development of the HPMP would require additional consultation with these entities.

Our Analysis

An HPMP, with measures for continued use and maintenance of historic properties and treatment of historic properties affected by project-related activities, developed in consultation with the Maine SHPO and Penobscot Indian Nation, GLHA would ensure that continued operation and maintenance of the project would either have no effect on known historic properties or that any unavoidable effects would be minimized and appropriately mitigated. The HPMP would also provide guidance specific to the maintenance and upkeep of the dam and powerhouse with respect to the project facilities' historic character. Additionally, the HPMP would also establish consultation protocols for non-routine activities occurring at the project as well as treatment of previously unidentified historic properties discovered at the project over the term a license.

To meet the requirements of section 106, the Commission intends to execute a PA with the Maine SHPO and Penobscot Indian Nation THPO for the proposed project to protect historic properties that would be affected by the continued operation and maintenance of the project. The terms of the PA would require GLHA to address all historic properties identified within the project's APE through the development of an HPMP in consultation with the Maine SHPO and Penobscot Indian Nation THPO.

Gathering of Indigenous Plants

Under any license issued by the Commission, GLHA would be required to maintain public access to project lands and waters. In comments filed in response to the Commission's REA notice, BIA requested that tribal members be provided unrestricted access to lands within the project boundary for collecting indigenous plants.

Our Analysis

As discussed previously, the Penobscot River basin is the ancestral home of the Penobscot Indian Nation and serves an important role in the tribe's culture today. To the extent possible, the Commission requires licensees to provide public access to project lands and waters, which would include access for the gathering of indigenous plants. However, the Commission also has an obligation to protect public safety and requires licensees to enact public safety measures at their projects. Therefore, the Commission cannot ensure unrestricted access to areas of the project that contain the project facilities or other safety hazards. It is important that any access to the project for gathering of indigenous plants not conflict with any public safety plan for the project or otherwise interfere with project operation. Further, the Commission has no jurisdiction to require access across private property to reach remote areas within the project boundary, unless such access is deemed necessary for project purposes.

4.0 DEVELOPMENTAL ANALYSIS

In this section, we look at the project's use of the Penobscot River for hydropower purposes to see what effects various environmental measures would have on the project's costs and power generation. Under the Commission's approach to evaluating the economics of a hydropower project, as articulated in *Mead Corp.*,[225] the Commission compares the current project cost to an estimate of the cost of obtaining the same amount of energy and capacity using a likely alternative source of power for the region (cost of alternative power). In keeping with Commission policy as described in *Mead Corp*, our economic analysis is based on current electric power cost conditions and does not consider future escalation of fuel prices in valuing the hydropower project's power benefits.

For each of the licensing alternatives, our analysis includes an estimate of: (1) the cost of individual measures considered in the EA for the protection, mitigation, and enhancement of environmental resources affected by the project; (2) the cost of alternative power; (3) the total project cost (i.e., operation, maintenance, and environmental measures); and (4) the difference between the cost of alternative power and total project cost for the project. If the difference between the cost of alternative power and total project cost is positive, the project helps to produce power for less than the cost of alternative power. If the difference between the cost of alternative power and total project cost is negative, the project helps to produce power for more than the cost of alternative power. This estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license. However, project economics is only one of many public interest factors the Commission considers in determining whether, and under what conditions, to issue a license.

4.1 POWER AND ECONOMIC BENEFITS OF THE PROJECT

Table 21 summarizes the assumptions and economic information we use in our analysis for the project. This information was provided by GLHA in its license application or estimated by staff. We find that the values provided by GLHA are reasonable for the purposes of our analysis. Cost items common to all alternatives include: taxes and insurance costs, net investment, estimated future capital investment required to maintain and extend the life of facilities, relicensing costs, normal operation and maintenance cost, and Commission fees.

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[225] See *Mead Corporation, Publishing Paper Division*, 72 FERC ¶ 61,027 (July 13, 1995). In most cases, electricity from hydropower would displace some form of fossil-fueled generation, in which fuel cost is the largest component of the cost of electricity production.

Table 21. Parameters for economic analysis of the Mattaceunk Project.

Parameters	Values (2017 dollars)	Sources
Period of analysis	30 years	Staff
Term of financing	20 years	Staff
Escalation rate	0 percent	Staff
Alternative energy value	$40.00/MWh	GLHA
Federal tax rate	Included in O&M[a]	GLHA
local tax rate	Included in O&M[a]	GLHA
Interest rate	7 percent	Staff
Discount rate	7 percent [b]	Staff
Net remaining investment	$26,318,288[c]	GLHA
Annual operation and maintenance cost	2,572,427[d]	GLHA

[a] All taxes were included in the project's O&M.
[b] Assumed by staff to be the same as the interest rate.
[c] Based on GLHA's remaining undepreciated net investment and cost to develop the license application for the project.
[d] GLHA's value for the project's operation & maintenance cost includes fees, insurance, overhead, depreciation, local, state and Federal taxes.

4.2 COMPARISON OF ALTERNATIVES

Table 22 summarizes the installed capacity, annual generation, cost of alternative power, estimated total project cost, and difference between the cost of alternative power and total project cost for each of the alternatives considered in this draft EA: no-action, GLHA's proposal, the staff alternative and staff alternative with mandatory conditions.

Table 22. Summary of the annual cost of alternative power and annual project cost for the four alternatives for the Mattaceunk Project.

	No Action	GLHA's Proposal	Staff Alternative	Staff Alternative with Mandatory Conditions
Installed capacity (megawatts)	19.2	19.2	19.2	19.2
Annual generation (MWh)	123,334	116,339	112,759	112,759
Annual cost of alternative power ($ and $/MWh)	$5,874,303 47.63	$5,874,303[a] 47.63	$5,874,303[a] 47.63	$5,874,303[a] 47.63
Annual project cost ($ and $/MWh)	$4,848,180 39.31	$7,491,186 60.74	$5,981,602 48.50	$6,643,895 53.87
Difference between the cost of alternative power and project cost ($ and $/MWh)	$1,026,122 8.32	($1,616,882)[b] (13.11)	($107,299)[b] (0.87)	($770,825)[b] (6.25)

[a] The loss of generation is reflected as a higher project cost, rather than a lower power value.

[b] Numbers in parenthesis are negative.

4.2.1 No-Action Alternative

Under the no-action alternative, the project would continue to operate as it does now. The project would have an installed capacity of 19.2 MW, and generate an average of 123,334 MWh of electricity annually. The average annual cost of alternative power would be $5,874,303, or about $47.63/MWh. The average annual project cost would be $4,848,180, or about $ 39.31/MWh. Overall, the project would produce power at a cost that is $1,026,122, or $8.32 /MWh, less than the cost of alternative power.

4.2.2 GLHA's Proposal

Table 23 lists all environmental measures, and the estimated cost of each, considered for the Mattaceunk Project. Under GLHA's proposal, the Mattaceunk Project would have an installed capacity of 19.2 MW, and generate an average of 116,339 MWh of electricity annually. The average annual cost of alternative power would be $5,874,303, or about $47.63/MWh. The average annual project cost would be $7,491,186, or about $60.74/MWh. Overall, the project would produce power at a cost that is $1,616,882, or $13.11/MWh, more than the cost of alternative power.

4.2.3 Staff Alternative

The staff alternative is based on GLHA's proposal with staff modifications and additional measures. The staff alternative would have an installed capacity of 19.2 MW and an average annual generation of 112,759 MWh, the cost of alternative power would be $5,874,303, or about $47.63/MWh. The average annual project cost would be $5,981,602, or about 48.50/MWh. Overall, the project would produce power at a cost that is $107,299, or about $0.87/MWh, more than the cost of alternative power.

4.2.4 Staff Alternative with Mandatory Conditions

Under the staff alternative with mandatory conditions the Mattaceunk project would have an installed capacity of 19.2 MW and an average annual generation of 112,759 MWh, the cost of alternative power would be $5,874,303, or about $47.63/MWh. The average annual project cost would be $6,643,895, or about $53.87/MWh. Overall, the project would produce power at a cost that is $770,825, or about $6.25/MWh, more than the cost of alternative power.

4.3 COST OF ENVIRONMENTAL MEASURES

Table 23. Cost of environmental mitigation and enhancement measures considered in assessing the effects of operating the Mattaceunk Project.

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
General				
Operate in a run-of-river mode, such that outflow approximately equals inflow, and impoundment water levels are maintained within 1.0 foot of the top of flashboard crest elevation (240.0 feet) during normal operations, and within 2.0 feet of the flashboard crest elevation (240.0 feet) for irregular circumstances (i.e., to allow adequate margin for debris loads, ice loads, or sudden pool increases that might cause flashboard failure), and up to 1.0 foot of the crest of dam elevation (236.0 feet) when replacing the flashboards.	GLHA, NMFS,[d] Interior,[d] Maine DMR,[d] Staff	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Develop an operation monitoring plan that specifies the methods that will be used at the project to monitor the project and maintain minimum flows and impoundment water levels within licensed limits.	GLHA, Maine DEP, NMFS,[d] Staff	$5,000[f]	$0	$432
Aquatic Resources				
Continue to provide a year-round continuous minimum base flow of 1,674 cfs or inflow, whichever is less. Continue to provide a daily average minimum flow of 2,392 cfs from July 1 through September 30 and 2,000 cfs from October 1 through June 30, or average inflow, whichever is less.	GLHA, NMFS,[d] Maine DMR,[d] Staff	$0	$0	$0
Develop a plan to monitor flows as proposed in the operations monitoring plan, with the addition of measures to: (1) install flow monitoring equipment in the project tailrace; and (2) make flow data electronically accessible consistent with USGS website format.	NMFS[d]	$6,000[g]	$200[g]	$719

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Conduct continuous stream temperature monitoring downstream of the dam between April 1 and October 31 to assure that the dam and its operations do not intensify the effects of climate change that can affect smolt emigration, adult immigration, and juvenile development in nursery habitats downstream of the dam.	NMFS[d]	$2,800[h]	$200[h]	$442
A plan to monitor water temperature in the impoundment for multiple years to determine project effects on impoundment water temperature.	Penobscot Indian Nation	$5,000[f]	$0	$432
Install trash racks with 1-inch clear bar spacing to the full depth of the turbine intakes during the downstream migration seasons for eel, and Atlantic salmon (a measure proposed in the SPP).	GLHA, Interior,[e] NMFS,[e] Maine DMR[d]	$1,000,000	$787,500	$873,962
Install trash racks with 1-inch clear bar spacing to the full depth of the turbine intakes during the downstream migration seasons for eel.	Staff	$1,000,000	$330,750[w]	$417,212

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Begin installing the seasonal trash racks with 1-inch clear bar spacing to the full depth of the turbine intakes within 2 years (a measure proposed in the SPP).	GLHA, NMFS,[e] Staff	$0	$0	$0
Begin installing the seasonal trash racks with 1-inch clear bar spacing to the full depth of the turbine intakes during the first passage season for Atlantic salmon and eel.	Maine DMR[d]	$0	$0	$0
Estimate approach velocities, annually using point measurements immediately upstream of the intakes and trash racks to ensure that velocities do not exceed 2.0 fps.	NMFS[e]	$0	$3,000	$3,000
Install and maintain, seasonally, an upstream eel ladder within 2 years of the effective date of the new license and operate the facility from June 1 to September 15 each year.	GLHA, Maine DMR,[d] Interior,[e] Staff	$50,000	$10,000	$14,323

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Monitor the upstream eel ladder for use and effectiveness for one passage season.	GLHA, Maine DMR,[d] NMFS,[e] Staff	$15,000	$0	$1,297
Develop a plan to monitor the efficiency and effectiveness of the upstream eel passage measures.	Interior,[e]	$5,000[f]	$0	$432
Develop a plan to monitor the efficiency and effectiveness of the upstream eel passage measures, as required my Interior's prescription, with specific provisions (see section 2.4, *Staff Alternative* for list of provisions).	Staff	$5,000	$0	$432
Provide downstream passage up to 6 weeks each year for eel by implementing annual nighttime turbine shutdowns, in combination with opening the project's roller gate and installing full-depth 1-inch-spaced trash rack [capital cost provided above].	GLHA, Staff	$0	$313,000	$313,000

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Provide downstream passage, as proposed, except every night for 12 weeks from August 1 through October 31 each year.	Maine DMR,[d] Interior[e]	$0	$626,000[k]	$626,000
Conduct two years of monitoring to determine the effectiveness of the nighttime shutdowns, coupled with installation of the full-depth trash racks with 1-inch clear spacing and water releases from the roller gate for passing eel downstream in a safe, timely, and effective manner.	GLHA, NMFS,[e] Maine DMR,[d] Staff	$0	$36,000 for 2 years[l]	$5,245
Develop a plan to monitor the effectiveness of the downstream eel passage measures.	Interior,[e]	$5,000[f]	$0	$432
Develop a plan to monitor the effectiveness of the downstream eel passage measures, as required my Interior's prescription with specific provisions (see section 2.4, *Staff Alternative* for list of provisions)	Staff	$5,000	$0	$432

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Develop a Fishway Operation and Maintenance Plan, within 12 months, covering all maintenance and operation of the upstream and downstream fishways provided for eel.	Interior,[e] Staff	$5,000[f]	$0	$432
Install, in year 15 of a new license, an upstream fishway for shad.	GLHA, NMFS,[e] Maine DMR,[d] Maine DEP	$7,000,000	$100,000[m]	$233,981
Install upstream and downstream passage for shad as soon as possible.	Bruce Haines	$7,000,000	$100,000	$705,233
Operate the new upstream fishway for shad from May 1 through July 31 of each year.	NMFS,[e] Maine DMR[d]	$0	$179,000[n]	$47,619

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Monitor the upstream and downstream passage of shad for two years once a new upstream fishway is operational (expected in year 16 of a license).	GLHA, NMFS,[d] Maine DMR[d]	$113,000[i]	$80,000[o]	$7,033
Develop a study plan, in consultation with the resource agencies, for monitoring upstream and downstream passage effectiveness of fishways for shad.	NMFS[e]	$5,000[f]	$0	$432

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Provide downstream passage for shad after a new upstream fishway for shad is operational (expected in year 16), by: (1) extending the operation of the existing downstream fish bypass such that it operates continuously from April 1 to December 1; and (2) by opening the log sluice (and releasing between 3 percent [225 cfs] and 9 percent [690 cfs] of station hydraulic capacity) from June 1 to December 1, as needed for shad, based on monitoring results.	GLHA, NMFS,[e] Maine DMR[d]	$0	$342,000	$342,000
Re-assess the need for shad passage at the project 14 years from license issuance.	Staff	$5,000[i]	$0	$146
Develop an operation and maintenance plan for the new upstream shad fishway.	Maine DMR[d]	$5,000[f]	$0	$432
Design the new upstream fishway to provide safe passage for sea lamprey.	NMFS[d]	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Modify the fishway operating schedules during the term of the license based on migration data, new information, and in consultation with the Maine DMR, FWS, and NMFS. Upon request of licensee, the actual dates of operation may be varied in any given year in response to river conditions, maintenance requirements, or annual variability in fish migration patterns, with the approval of Maine DMR, FWS, and NMFS, as appropriate.	Maine DMR,[d] NMFS[e]	$0	$0	$0
Implement additional operational and structural modifications and/or habitat enhancement measures, if necessary, to provide effective eel and shad passage (passage criteria for eel and shad shall be based on a review of the performance of comparable fish passage measures in New England).	GLHA, NMFS,[e] Maine DMR[c]	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Use the following general provisions for monitoring the effectiveness of all fishways: (1) monitoring plans will be developed in consultation with NMFS and state and federal resource agencies. The monitoring plan to be approved by the agencies prior to filing with the Commission for final approval; (2) all monitoring will be completed with scientifically accepted practices; (3) monitoring shall begin at the start of the first migratory season after the each fishway facility is operational, except for upstream Atlantic salmon and downstream kelt studies, and shall continue to be conducted for the time frames proposed or as otherwise required; (4) reports of the monitoring studies shall be provided to the resource agencies for a minimum 30-day review and consultation prior to submittal to the Commission for final approval; and (5) the Licensee shall include resource agencies' comments in the annual reports submitted to the Commission for final review.	Staff	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Use the general provisions for studying the effectiveness of fishways as recommended by staff, except monitoring shall begin at the start of the first migratory season, without exception.	NMFS[e]	$0	$0	$0
Continue to implement the FPOMP, which defines the: (1) operational period of the existing upstream and downstream fishways; (2) annual start-up and shut-down procedures; (3) opening methods; (4) debris management; and (5) safety rules and procedures.	GLHA, Staff	$0	$10,000	$10,000
Modify the FPOMP to include additional provisions (see section 2.4, *Staff Alternative* for list of provisions)	Maine DMR,[d] Interior,[e] Staff	$3,000[p]	$0	$259

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Operate each fishway for a “shakedown” period subsequent to any new fishway construction, or operational or structural modifications to existing fishways, and prior to the relevant fish passage season and pertinent effectiveness studies to ensure it is operating as designed and to make minor adjustments to facilities and operations, as needed.	Maine DMR[d]	$0	$0	$0
Operate the upstream eel ladder for a “shakedown” period subsequent to installation, and prior to the passage season and pertinent effectiveness studies to ensure it is operating as designed and to make minor adjustments to facilities and operations, as needed.	Staff	$0	$0	$0
Have a licensed engineer certify that fishways are constructed and operating as designed at the end of each shakedown period.	Maine DMR[d]	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Provide the Maine DMR, FWS, and NMFS with a copy of the as-built fishway drawings for any new or modified fishways as submitted to the Commission, along with the licensed engineer's letter of certification.	Maine DMR[d]	$0	$0	$0
Prepare an annual report to include all available fish passage operations data.	Staff	$3,000[i]	$0	$259
Prepare an annual report, as recommended by staff, except include in the report the number of fish passed daily (by species), daily water temperature, and air temperature.	Maine DMR[d]	$3,000[i]	$0	$259
Meet annually in March with the resource agencies to review fish passage operations data.	Maine DMR[d]	$0	$0	$0
Prepare a fishway operations plan for all fishways each year following the annual meeting to review fish passage operations.	Maine DMR[c]	$0	$3,000[i]	$3,000

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Provide FWS personnel and other FWS-designated representatives, timely access to the fishways and to pertinent project operational records for the purpose of inspecting the fishways to determine compliance with the fishway prescription.	Interior[e]	$0	$0	$0
Conduct real-time monitoring of the downstream bypass fishway to ensure safe and effective operation.	NMFS	$8,000[r]	$200[r]	$892
Redesign the downstream bypass to provide 5 percent attraction flow.	Bruce Haines	$2,000,000[i]	$0	$172,924
Provide 5 percent attraction flows through the downstream bypass 365 days per year.	Bruce Haines	$0	$190,095[s]	$190,095

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Design fishways using the following provisions: (1) submit design plans to the resource agencies for review and consultation during the conceptual, 30, 60 and 90 percent design stages; (2) provide conceptual designs to the resource agencies no later than two years before the anticipated operational date; (3) provide the resource agencies with conceptual designs for the proposed full-depth trash racks with 1-inch bar spacing at least six months prior to the first downstream passage season following issuance of any new license; (4) submit final design plans to the Commission for final approval after resource agency approval and prior to the commencement of fishway construction activities, with all unaddressed resource agency comments; and (5) file final as-built drawings with NMFS and FWS that accurately reflect the project as constructed after the fishway is constructed.	NMFS,[e] Staff	$0	$0	$0
Threatened and Endangered Resources				

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Continue to maintain and operate the upstream fishway annually from May 1 to November 10 for adult Atlantic salmon, including a 7 cfs attraction flow at the fishway entrance.	GLHA, NMFS,[e] Maine DMR,[d] Staff	$0	$25,000	$25,000
Continue to maintain and operate the downstream fish bypass to provide downstream passage for Atlantic salmon smolts from April 1 to June 15 and Atlantic salmon kelts from October 17 to December 1.	GLHA, NMFS,[e] Maine DMR,[d] Staff	$0	$25,000	$25,000
Monitor the upstream fishway and count the number of adult Atlantic salmon passing upstream of the project, using a methodology developed in consultation with resource agencies, to provide resource managers with data to estimate the size of the spawning population upstream of the project.	GLHA, Maine DMR[d]	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Maintain and monitor the existing fish trap at the exit of the existing upstream fishway for counting adult Atlantic salmon.	NMFS[e]	$0	$5,000[i]	$432
Coordinate with resource agencies to stock uniquely marked Atlantic salmon smolts upstream of Weldon Dam in the first three years after relicensing to serve as a source of imprinted adult salmon (i.e., fish homing to areas upstream of Weldon Dam) used for studying upstream passage of adults and downstream passage of kelts (a measure in the proposed SPP).	GLHA, Maine DMR,[d] Staff	$45,000	$15,000[t]	$7,063
Conduct up to three years of upstream fishway effectiveness monitoring for adults and up to three years of downstream passage monitoring for kelts, using the returning imprinted adult salmon (a measure in the proposed SPP).	GLHA, NMFS,[e] Maine DMR,[d] Staff	$60,000	$45,000[u]	$14,705

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Open the project's log sluice (between 3 percent [225 cfs] and 9 percent [690 cfs] of station hydraulic capacity) starting the first passage season following relicensing to provide additional passage for downstream Atlantic salmon smolts for a 3-week period during the spring that would be determined in consultation with resource agencies (a measure in the proposed SPP).	GLHA, NMFS,[e] Maine DMR,[d] Staff	$0	$37,250	$37,250
Conduct a minimum of 3 years of monitoring to evaluate the effectiveness of existing passage operations and additional measures (operation of the log sluice and installation of the 1-inch clear spacing full-depth trash racks), in passing Atlantic salmon smolts downstream past the dam (a measure in the proposed SPP).	GLHA, NMFS,[e] Maine DMR,[d] Staff	$110,000	$75,000[v]	$25,372
Evaluate smolt mortality in the project impoundment (a measure in the proposed SPP).	GLHA	$110,000[x]	$25,000[y]	$11,270

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Conduct up to 3 years of studies to assess the sources of impoundment mortality for Atlantic salmon smolts.	Maine DMR[d]	$110,000[x]	$75,000[z]	$25,372
Develop a mitigation plan, in consultation with NMFS and resource agencies, for the loss of Atlantic salmon smolts as a result of maintaining the project impoundment.	NMFS[d]	$5,000[f]	$0	$432
Implement adaptive management that would include additional operational, structural, and/or habitat enhancement measures, if necessary, to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon (a measure in the proposed SPP).	GLHA, NMFS,[e] Maine DMR,[d]	$0	$0	$0
Modify the SPP to include at minimum, the existing provisions in the existing SPP and additional measures.	Staff	$5,000[p]	$0	$432

Enhancement/Mitigation Measures	Entity	Capital cost [a]	Annual cost [a, b]	Levelized annual cost [c]
Recreation and Land Use Resources				
Maintain existing project recreation facilities including: (1) a canoe portage trail, and (2) a downstream angler access area.	GLHA, Staff	$0	$1,000	$1,000
Implement recreation facility improvements at the existing downstream angler access area.	GLHA, Staff	$3,000	$300	$559
Develop a portage plan in consultation with the Penobscot Indian Nation.	Interior	$5,000[f]	$500	$932
Cultural Resources				
Develop an HPMP.	GLHA, Staff	$10,000	$2,000	$2,865

a Costs provided by the applicant unless otherwise noted.
b Annual costs typically include operational and maintenance costs and any other costs which occur on a yearly basis.
c All capital and annual costs are converted to equal annual costs over a 30-year period to give a uniform basis for comparing all costs.
d 10(j) recommendation.
e Section 18 preliminary fishway prescription.
f Staff estimated cost for the development of the plan.
g Staff estimated $6,000 for a flow gauge and installation, and $200 per year to maintain the gauge.
h Staff estimated $2,800 in capital costs for one temperature sensor and a back-up sensor, and a data logger. Staff estimated $200 in annual costs for maintenance and repair.

[i] Staff estimated cost.
[j] Staff estimate the cost to be $3,000 during the first 3 years of any new license.
[k] Staff estimated cost based on 12 weeks of spill and an estimated 12,520 MWh in lost generation.
[l] Staff estimated the cost to be $36,000 per year for 2 years.
[m] Based on GLHA's cost estimate of $100,000 per year in additional expenditures for the upstream fishway, beginning in year 16 of any new license.
[n] Based on GLHA's cost estimate of $179,000 per year in lost generation beginning in year 16 of any new license.
[o] Staff estimate an annual cost of $80,000 per year for 2 years of monitoring.
[p] Staff estimated cost to modify the plan.
[q] Staff estimate the cost of implementing the plan to be the same as GLHA's proposed plan.
[r] Staff estimated $8,000 for a flow gauge, telemetry system for real-time monitoring, and installation, and $200 per year to maintain the gauge.
[s] Staff estimated this cost based known information (i.e., the existing bypass operates at 2 percent of station hydraulic capacity, 120 days per year, which reduces generation by 886 MWh and costs $25,000 per year). This information was used to extrapolate costs using 5 percent flows at 365 days per year.
[t] Based on GLHA's cost estimate of $15,000 for 3 years of stocking smolts.
[u] Based on GLHA's cost estimate of $45,000 for 3 years of studies.
[v] Based on GLHA's cost estimate of $75,000 for 3 years of studies.
[w] Staff estimated this cost based on the reduced number of days that the 1-inch trash rack overlays would be installed if the overlays are only installed during the downstream migration for eel. If the trash rack overlays are installed during the downstream passage seasons for eel (August 15 to October 31 [or 78 days]), smolts (April 1 to June 15 [76 days]), and kelts (October 17 to December 1 [31 total days beyond the end of the eel passage season], they would be in place for 185 days. However, if the trash rack overlays are only installed during the downstream eel passage season, they would only be in place for 78 days, or 42 percent less time than if they are also in place during the smolt and kelt passage seasons. Staff estimated that annual costs would be reduced 42 percent, or from $787,500 to $330,750.
[x] Staff estimated this cost, assuming that the capital costs associated with estimating smolt mortality in the impoundment would be the same as the capital costs associated with estimating mortality past the dam (i.e., $110,000).

[y] Staff estimated this cost, assuming that the annual cost of conducting 1 year of study to estimate smolt mortality in the impoundment would be a third of the annual cost associated with estimating mortality past the dam (i.e., $75,000).

[z] Staff estimated that this annual cost would be the same as the annual cost associated with estimating mortality past the dam (i.e., $75,000).

(Source: staff).

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a) of the FPA require the Commission to give equal consideration to the power development purposes and to the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife; the protection of recreational opportunities; and the preservation of other aspects of environmental quality. Any license issued shall be such as in the Commission's judgment will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses. This section contains the basis for, and a summary of, our recommendations for relicensing the project. We weigh the costs and benefits of our recommended alternative against other proposed measures.

Based on our independent review of agency and public comments filed on the project and our review of the environmental and economic effects of the proposed project and project alternatives, we selected the staff alternative as the preferred alternative. We recommend this alternative because: (1) issuing a major license for the project would allow GLHA to continue to operate its project as a dependable source of electrical energy; (2) the 19.2 MW of electric capacity comes from a renewable resource that does not contribute to atmospheric pollution; (3) the public benefits of the staff alternative would exceed those of the no-action alternative; and (4) the proposed and recommended measures would protect and enhance fish and wildlife resources and would improve public recreation opportunities at the project.

In the following section, we make recommendations as to which environmental measures proposed by GLHA or recommended by agencies or other entities should be included in any license issued for the project. In addition to GLHA's proposed environmental measures listed below, we recommend additional staff-recommended environmental measures to be included in any license issued for the project.

5.1.1 Measures Proposed by GLHA

Based on our environmental analysis of GLHA's proposal in section 3.0, *Environmental Effects,* and the costs presented in section 4.0, *Developmental Analysis,* we conclude that the following environmental measures proposed by GLHA would protect and enhance environmental resources and would be worth the cost. Therefore, we recommend including these measures in any license issued for the project.

To protect or enhance aquatic habitat, fish and wildlife habitat, and recreation at the project, GLHA proposes to:

- Continue to operate the project in a run-of-river mode with pondage with year-round use of 4-foot-high flashboards;
- Continue to operate the impoundment with fluctuation limits that consist of maintaining the impoundment surface elevation: (1) within 1.0 foot of the flashboard crest elevation (240.0 feet) on a regular basis when the flashboards are in place; (2) no lower than 2.0 feet below the flashboard crest elevation when needed for maintenance, to allow an adequate margin for wave action, debris loads, ice loads, or sudden pool increases that might cause flashboard failure when the flashboards are in place; and (3) no lower than 1.0 foot below the dam crest elevation of 236.0 feet when the flashboards are not in place;
- Continue to provide a year-round continuous minimum flow of 1,674 cfs or inflow, whichever is less, downstream from the project, and continue to provide a daily average minimum flow of 2,392 cfs from July 1 through September 30 and 2,000 cfs from October 1 through June 30, or average inflow, whichever is less, to protect aquatic resources downstream of the project;
- Install and maintain, on a seasonal basis, an upstream eel ladder within 2 years of the effective date of the new license;
- Monitor the upstream eel ladder for use and effectiveness for one eel passage season;
- Provide downstream passage for eel by implementing annual nighttime turbine shutdowns (8:00 pm to 4:00 am), in combination with opening the project's roller gate and installing full-depth trash racks with 1-inch bar clear spacing (see measures included in the SPP for Atlantic salmon), beginning the first passage season following license issuance;[226]

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[226] GLHA would develop the annual schedule in consultation with the resource agencies based on a predictive model for eel movement through the project. GLHA refined its proposed window for downstream passage events as follows: "until such time that a predictive model is developed, GLHA would implement a night-time shutdown period of up to 6 weeks (8 pm to 4 am nightly) as early as the first significant rain event (defined as greater than 1 inch of precipitation) occurring on or after August 15, but that the nighttime shutdown period will start no later than September 15 in years that a significant rain event does not occur during the August 15-September 15 time period."

- Monitor, for two passage seasons, the effectiveness of the downstream eel passage measures;[227]

- Continue to implement the FPOMP, as modified below;

- Continue to maintain and operate the upstream fishway annually from May 1 to November 10 for adult Atlantic salmon, including the 7-cfs attraction flow at the fishway entrance;

- Continue to maintain and operate the downstream surface bypass to provide downstream passage for Atlantic salmon smolts from April 1 to June 15 and Atlantic salmon kelts from October 17 to December 1;

- Implement an SPP for the federally endangered Atlantic salmon, as modified below;

- Continue to operate and maintain the project recreation facilities;

- Implement recreation facility improvements at the existing downstream angler access area within 3 years of license issuance, including installation of: (1) a pulley system to assist boaters with moving car top boats and other small watercraft up and down the stairs; and (2) a ramp adjacent to the existing recreation pavilion to provide wheel chair access to the pavilion and associated picnic table; and

- Develop an HPMP for the protection of historic properties within the project's APE.

5.1.2 Additional Measures Recommended by Staff

In addition to GLHA's proposed measures noted above, we recommend including the following additional and modified measures in any license that may be issued for the Mattaceunk Project.

- Develop an operation compliance monitoring plan to document compliance with the proposed operations described above (i.e., run-of-river mode with pondage, limited impoundment fluctuations, and minimum flows) for the protection of aquatic resources in the impoundment and downstream of the dam;

[227] The schedule for nighttime shutdowns within the 6-week period could be reduced based on the predictive model, and after consultation with the resource agencies.

- Develop individual monitoring plans for upstream and downstream eel passage, as required by FWS's fishway prescription, that include:
  (1) the goals and objectives of the monitoring;
  (2) performance criteria for determining the success of the eel passage measures;
  (3) the methodology used to monitor the effectiveness and efficiency of the upstream and downstream passage measures to pass eel;
  (4) provisions for reporting the results of the monitoring (i.e., development of a report) and consulting with the agencies regarding the results (including an annual meeting); and
  (5) a provision to identify and implement (upon Commission approval): (a) additional monitoring studies, or (b) operational and structural modifications and/or habitat enhancement measures to provide eel passage, if after 1 year of upstream monitoring and 2 years of downstream monitoring, the proposed passage measures for eel are ineffective at achieving the upstream and downstream effectiveness and survival performance criteria.

- Re-assess the need for shad passage at the project 14 years after license issuance;

- Modify the FPOMP to include additional provisions for:
  (1) performing routine maintenance before the migration season, such that the existing fishways would be fully operational during the migratory period;
  (2) clearing debris from the trash racks of all turbine intakes prior to the migration season, and identify, with final Commission approval, the frequency of debris clearing during the migration season;
  (3) monitoring outflows from the downstream bypass pipe, to detect debris blockages using a method approved by the Commission;
  (4) procedures for filing with the Commission for informational purposes, an annual report on the operation of the existing fishways and on project generation;
  (5) developing shutdown procedures for the existing fishways; and
  (6) developing procedures for operation and maintenance of the existing fishways during emergencies and project outages;

- Operate the proposed upstream eel ladder for a "shakedown" period subsequent to installation, and prior to the passage season and pertinent effectiveness studies to ensure it is operating as designed and to make minor adjustments to facilities and operations, as needed;

- Revise the SPP to include the following additions and modifications:

(1) remove the provision to seasonally install trash racks with 1-inch clear bar spacing to the full depth of the turbine intakes for the purpose of protecting smolts and kelts;

(2) revise, with final approval from the Commission, the upstream passage effectiveness study methodology to include the type of telemetry tag to be used on upstream migrating adults and the appropriate timing for stocking tagged smolts, and refile the SPP with the revised study plan;

(3) include the proposed passage effectiveness study plans as attachments to the SPP;

(4) determine the need for an additional 1 or 2 years of effectiveness studies, with final approval from the Commission, if the upstream fishway meets the 95 percent performance standard after the first year;

(5) determine the need for future effectiveness studies or measures, with final approval from the Commission, if after 3 years of upstream passage effectiveness studies, the upstream fishway does not meet the 95 percent effectiveness performance standard;

(6) revise the number of downstream passage effectiveness studies for smolts to indicate that a minimum of 3 years of study would be conducted;

(7) revise the criteria for achieving the downstream performance standard for smolts to state that the standard would be considered achieved if a total 3 years of effectiveness studies for smolts demonstrate that the downstream passage structures meet a 96 percent survival performance standard;

(8) determine, with final approval from the Commission, when to begin implementation of phased spill measures for downstream passage of smolts, with the restriction that phased spill measures would be implemented after a minimum of 1 year and a maximum of 3 years of conducting downstream passage survival studies for smolts, and non-spill passage measures;

(9) determine, with final approval from the Commission, the 3-week period during which any phased spill measures would occur for downstream passage of smolts;

(10) determine the need for an additional 1 or 2 years of downstream passage effectiveness studies for kelts, with final approval from the Commission, if the downstream passage structures meet the 96 percent survival performance standard for kelts after the first year;

(11) determine the need to conduct at least 1 year of additional effectiveness study, with final approval from the Commission, if the downstream passage

structures do not meet the 96 percent survival performance standard for kelts after the first year;

(12) determine the need for future effectiveness studies, and/or downstream passage measures, with final approval from the Commission, if after 3 years of downstream passage effectiveness studies, the downstream passage structures do not meet the 96 percent survival performance standard for kelts;

(13) remove the provision to conduct a study to evaluate smolt mortality in the project impoundment;

(14) remove the provisions requiring reevaluation of upstream and downstream passage effectiveness every 10 years;

(15) add a provision to file an application to amend the license and get Commission approval prior to implementing any future, and currently unspecified operational, structural, and/or habitat enhancement measures that may be used to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon.

In addition, we are recommending all of the preliminary fishway prescriptions, with the exception of those discussed in section 5.1.3, *Measures Not Recommended*.

Below, we discuss the basis for the staff-recommended measures and modifications.

Operation Monitoring Compliance Plan

Impoundment Fluctuations and Minimum Flows

As discussed in section 2.1.3, *Existing Project Operation*, GLHA proposes to continue to operate in a run-of-river mode with pondage, while maintaining impoundment fluctuations: (1) within 1.0 foot or less of the top of the flashboard crest during normal project operation, or within 2.0 feet of the flashboard crest when necessary (i.e., to allow an adequate margin for debris, or sudden pool increases that might cause flashboard failure); and (2) within 1.0 foot of the dam crest when the flashboards are down for repair or installation. Additionally, GLHA proposes to continue supplying a continuous minimum flow of the less of 1,674 cfs or inflow, and maintaining a daily average minimum flow of the less of 2,392 cfs or average inflow, from July 1 through September 30 and the less of 2,000 cfs or average inflow, from October 1 through June 30. Interior, NMFS, and Maine DMR all recommend GLHA's proposed operations, impoundment fluctuation limits, and minimum flows.

Operating the project in a run-of-river mode with pondage, minimizes impoundment fluctuations, maintains a stable shoreline, and protects shoreline and riparian habitat used by wildlife upstream of the dam. Additionally, the run-of-river operation provides the diurnal cues to stimulate fish migration. The current and proposed minimum flows also support aquatic life and habitat below Weldon Dam, while providing a zone of passage suitable for upstream and downstream fish migration. Therefore, we recommend that GLHA continue the current project operation and minimum flows, which would not add any additional cost.

Operation and Minimum Flow Compliance

GLHA uses an existing monitoring system that monitors project operation and minimum flows by measuring impoundment water levels directly, and records both impoundment water levels and flow through the individual turbines. Additionally, GLHA maintains and stores mean daily and hourly data for inflow to the impoundment, outflow from the project, and water levels in the project impoundment. GLHA also supplies these data to the agencies within 30 days of a request. Maine DEP and NMFS recommend that GLHA develop a plan or plans that specify the methods used to monitor and maintain impoundment elevation levels and minimum flows within the licensing limits. NMFS also recommends that any minimum flow monitoring plan include measures to install flow monitoring equipment in the project tailrace and make the flow data electronically accessible, consistent with USGS website format to confirm that minimum flow requirements are met.

As discussed in section 3.3.2.2, *Operation Compliance Monitoring,* developing a formal project operation and monitoring plan would provide a mechanism for reporting operational data and deviations, facilitate administration of the license, and ensure the protection of resources sensitive to impoundment surface elevation fluctuations. Additionally, developing such a plan would provide a better understanding of the flow releases, and would ensure that the minimum flows required in any license issued for the project are met and monitored effectively and efficiently.

As discussed in section 3.3.2.2, *Operation Compliance Monitoring*, GLHA has an existing system that is fully capable of monitoring project operation and minimum flows under any new license issued. For reasons discussed above, we recommend that GLHA develop an operation compliance monitoring plan with measures to monitor minimum flows and impoundment elevation levels using the existing system, document compliance, provide a mechanism for reporting operational data and deviations, and facilitate administration of the license. We estimate that the annual levelized cost of developing a monitoring plan would be $432, and conclude that the benefits of the plan outweigh the cost.

NMFS recommends that the required project operation and monitoring plan include measures to make the flow data electronically accessible, consistent with USGS website format. However, because GLHA does not propose any changes in minimum flows, has an existing system that is fully capable of monitoring minimum flows, and has operated the project without any evidence of deviating from the required minimum flows, there is no basis for installing additional flow monitoring equipment. In addition, because GLHA would continue to provide resource agencies with flow monitoring data upon request and make flow data available on the National Waterline website, there is no benefit to making the flow data available in another format (e.g., USGS format). Therefore, we do not recommend that GLHA install additional flow monitoring equipment in the project tailrace, consistent with the USGS website, and conclude it is not worth the levelized annual cost of $719.

Eel Passage Effectiveness Studies

GLHA proposes to: (1) monitor the seasonal upstream eel ladder for use and effectiveness for one eel passage season; (2) monitor the effectiveness of the proposed downstream eel passage measures (i.e., annual nighttime turbine shutdowns, roller gate opening, and full-depth trash racks with 1-inch bar spacing) for passing downstream migrating silver eel for two passage seasons; and (3) implement additional operational and structural modifications and/or habitat enhancement measures to provide eel passage, if the proposed passage measures for eel are ineffective. Interior, in its fishway prescription, requires that GLHA develop upstream and downstream eel passage effectiveness plans. Maine DMR recommends that GLHA monitor the effectiveness of the installed upstream fish passage facility for 1 year and the downstream eel passage measures for 2 years.

As discussed in section 3.3.2.2, *Eel Passage Effectiveness Studies*, upstream and downstream eel passage effectiveness studies are necessary to verify whether the eel passage measures implemented are providing safe, timely, and efficient passage. In addition, the studies would inform the need for additional monitoring or structural and/or operational modifications, which may be necessary if the project is unable to meet the upstream and downstream performance criteria.[228] However, neither GLHA's proposal nor Interior's prescription provide any detail as to what is to be included in the monitoring plans.

To ensure the studies are designed to accurately assess upstream passage effectiveness and downstream passage survival, GLHA would need to develop the upstream and downstream eel passage effectiveness plans required in Interior's prescription. Because the specific provisions of the plans have not been provided, we recommend that the plans include, at a minimum: (1) goals and objectives of the monitoring; (2) performance criteria for determining the success of the eel passage

[228] Interior's fishway prescription includes a targeted upstream passage effectiveness of 90 percent and a downstream adult survival rate of 76 percent.

measures; (3) methodology used to monitor the effectiveness and efficiency of the upstream and downstream passage measures; (4) provisions to report the results of the monitoring (i.e., development of a report) and consulting with the agencies regarding the results (including an annual meeting); and (5) a provision to identify and implement (upon Commission approval): (a) additional monitoring studies, or (b) operational and structural modifications and/or habitat enhancement measures to provide eel passage, if after 1 year of upstream monitoring and 2 years of downstream monitoring, the proposed passage measures for eel are ineffective at achieving the upstream and downstream effectiveness and survival performance criteria. We conclude that the benefits of developing plans to monitor the effectiveness of the upstream and downstream eel passage measures is worth the annual levelized cost of $864.

Upstream Shad Passage

Shad restoration in the Penobscot River is ongoing, and in 2016 shad were observed in the Mattaceunk pool and weir fishway for the first time since the removal of Great Works (2012) and Veazie Dams (2013), and the installation of a fish lift at Milford (2014). Currently, shad are unable to migrate upstream of the Mattaceunk Project because the existing pool and weir fishway is ineffective at passing shad. GLHA proposes to install a fishway for shad in year 15 of the license. This measure is also required in NMFS's fishway prescription and recommended by Maine DMR and Maine DEP.

As discussed in section 3.3.2.2., *Upstream Shad Passage,* shad spawning habitat located downstream of the Mattaceunk Project is currently underutilized, and passage efficiency at West Enfield (i.e., the first dam downstream of the Mattaceunk Project) appears low. Thus, based on current available information, there would be minimal benefit to providing access at this time to shad habitat upstream of the Mattaceunk Project by installing a shad fishway. In addition, many factors make it difficult to predict, with any certainty at this point in time, the run sizes of shad on the Penobscot River 15 years into the future, and whether the number of fish seeking passage past the Mattaceunk Project would warrant the installation of an additional fishway at the dam. Given this uncertainty, we do not recommend the installation of a shad fishway in year 15, and conclude that it would not be worth the levelized annual cost of $233,981.

Because upstream shad passage is not needed at this time, we also do not recommend any of the following proposed and recommended measures that are contingent on the installation of the upstream shad fishway: (1) extending the operation season of the existing downstream fish passage facilities to accommodate shad passage, as proposed by GLHA and recommended by NMFS and Maine DMR; (2) developing a study plan to monitor the effectiveness of shad passage, as proposed by GLHA and recommended by NMFS and Maine DMR; (3) conducting 2 years of effectiveness monitoring of upstream and downstream passage structures for shad, as proposed by

GLHA and recommended by NMFS and Maine DMR; and (4) developing an operation and maintenance plan for the upstream shad fishway, as recommended by Maine DMR.

As described in section 3.3.2.2, the restoration of shad would continue through year 2032 and the term of any new license. Although requiring upstream passage for shad at this time is not warranted, empirical data on the run sizes and restoration of shad over the next 10 to 15 years could provide the necessary information to establish the need for upstream passage in year 15 of any new license. Compared to the information available today, such a re-assessment in year 14 of any new license issued for the project would provide a more accurate evaluation of the need to install a fishway for shad at the project in year 15, as run size and distribution of American shad and blueback herring in the Penobscot River would likely change over that time period. If shad passage were deemed necessary at that time, the licensee could file a non-capacity related amendment and/or NMFS could exercise its reservation of authority. Therefore, we recommend that the need for shad passage at the project be re-assessed in year 14 of any new license issued for the project. The annual levelized cost of $146 to re-assess the need for shad passage at the project is worth the benefit of having better information to determine, with more certainty, whether upstream passage for shad in year 15 of the license is warranted.

Fish Passage Operation and Maintenance Plan

GLHA proposes to implement the existing FPOMP, which defines the: (1) operational period of the existing upstream and downstream fishways; (2) annual start-up and shutdown procedures; (3) opening-methods; (4) debris management; and (5) safety rules and procedures. Maine DMR recommends five general provisions for fish passage operations and maintenance, which are outlined in detail in section 3.3.2.2, *Environmental Effects, Fish Design, Maintenance, and Monitoring*. In summary, Maine DMR's five provisions include: (1) implementing a "shakedown" period to ensure proper fishway operation after any modification; (2) keeping fishways in proper working order; (3) drafting and maintaining written FOPs; (4) meeting with the resource agencies annually to review fish passage operational data; and (5) maintaining and operating the fishways during the upstream and downstream migration periods for Atlantic salmon.[229] To ensure proper operation of the upstream fishway, NMFS recommends that GLHA determine the specific elevation at which the upstream fishway becomes non-operational. NMFS also recommends that GLHA conduct real-time monitoring of the downstream bypass to ensure it is clear of debris. NMFS's fishway prescription would require GLHA to take point measurements of approach velocities immediately upstream of the project

[229] Maine DMR's recommendation also includes maintaining and operating fishways during the upstream and downstream migration periods for eel and shad. We discuss Maine DMR's recommendation for general fish passage provisions as it relates to these species in section 3.3.2.2, *Eel Passage Facility Operation and Maintenance Plan*.

trash racks (i.e., 6 to 12 inches), and ensure that point measurements do not exceed 2.0 fps, and make the data available annually. Finally, Interior has a fishway prescription that would require GLHA to provide information on fish passage operations and generation upon written request from FWS.

GLHA's FPOMP includes maintenance and inspection procedures specifically for the existing upstream fishway and downstream bypass. However, the FPOMP lacks some important details that would improve GLHA's ability to properly maintain, operate, and report on the existing fishways. Maine DMR's recommendation includes several provisions that would help to ensure proper operation and maintenance of fishways at the project. However, some of the recommendations included within Maine DMR's five general provisions are already in the FPOMP for the existing facilities (see section 3.3.2.2, *Environmental Effects, Fish Design, Maintenance, and Monitoring*), and thus adding them as conditions to a new license would not provide any additional benefit to upstream or downstream migration of diadromous fish. The FPOMP does not have the following procedures, which are recommended by Maine DMR, and would ensure proper operation and maintenance of the existing fishways: (1) perform routine maintenance sufficiently before a migratory period, such that the fishways can be fully operational during the migratory periods; (2) shutdown procedures for the existing facilities; (3) procedures for emergencies and project outages; and (4) procedures for reporting annually on the operation of the existing facilities. Maine DMR also recommends a provision to provide copies of the plan to Maine DMR, FWS, and NMFS. With respect to this latter provision, copies of the FPOMP would be filed publicly with the Commission. Because all public filings are accessible to the agencies, there is no need for GLHA to provide copies of the plan directly to the agencies.

Maine DMR also recommends that GLHA meet with Maine DMR, FWS, and NMFS annually in March to review fish passage operational data from the previous year. However, Maine DMR does not identify a specific need or benefit of meeting annually, or reviewing the fish passage operational data. Further, GLHA would operate and maintain all fishways by following the proposed FPOMP (with staff modifications, discussed below). With proper operation and maintenance, there is no reason to believe that the fishways would not perform as designed. Thus, there would be no benefit to meeting annually. For the same reasons, there would also be no benefit to Interior's fishway prescriptions that would require GLHA to provide information on fish passage operations and project generation to FWS upon written request, and to provide FWS personnel access to fishways.

Maine DMR also recommends in its general provisions that annually, prior to the beginning of each fish passage season, GLHA develop a plan for fishway operations. However, the FPOMP already is an operational plan and our recommended modification to the plan (discussed below) would be adequate to ensure proper operation of the existing fishways during each year. Further, if future modifications to the FPOMP are needed, they could be made, but would require final approval from the Commission.

The trash racks in front of the turbine intakes are designed to reduce entrainment of fish and river debris. However, some debris can accumulate on the trash racks, forcing the same volume of water to pass through a smaller area and causing the through-screen velocity between the trash rack bars to increase. As discussed in section 3.3.4.2, *Approach Velocity*, through-screen velocities are not as important as approach velocities in determining whether a fish becomes impinged or entrained. Nevertheless, with regular debris removal, the trash racks can remain mostly clear, and prevent through-screen velocities from increasing. GLHA proposes to continue implementing the FPOMP, which includes provisions for using a trash rake[230] to clear debris from the intakes of units 3 and 4. GLHA has indicated that the intakes are cleared prior to opening the downstream bypass at the beginning of the season. The frequency of debris removal, however, is not stated in the plan.[231] Further, there is no indication that the intakes of units 1 and 2 are also cleared of debris. To maintain approach velocities at 1.7 fps,[232] GLHA would need to use the trash rake to routinely clear debris from the trash racks in front of all four intakes during the downstream migration season, and this procedure would need to be included in a modified FPOMP.

River debris can also enter into the downstream bypass pipe and cause blockages that could reduce downstream passage efficiency for smolts and kelts. In fact, operators at the Mattaceunk Project observed that the bypass was blocked with debris in 2015 subsequent to the downstream smolt passage effectiveness studies, which as discussed in section 3.3.4.2, *Environmental Effects*, appeared to cause a very low bypass efficiency (9.4 percent) for smolts during the study. GLHA does conduct daily visual inspections of the outflow from the bypass pipe in accordance with the FPOMP, which should help determine whether blockage is preventing 140 cfs (i.e. maximum flow capability of the bypass) from flowing through and out of the bypass pipe. However, the blockage incident in 2015 indicates that visual inspections are not adequate for detecting debris blockages, which would cause decreased bypass outflow. NMFS recommends that

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[230] GLHA operates a trash rake that is operated by an electrical hoist on a trolley beam.

[231] See letter filed by GLHA on July 7, 2017.

[232] As discussed in section 3.3.2.2, *Environmental Effects,* GLHA estimated the approach velocity in front of the trash racks to be 1.7 fps, which is protective of eel, shad, smallmouth bass, and white sucker, and as discussed in section 3.3.4.2, *Environmental Effects*, these approach velocities are protective of Atlantic salmon.

GLHA conduct real-time monitoring of the downstream bypass.[233] The use of real-time flow monitoring would allow GLHA to quickly identify decreases in flow through the bypass, and the need for additional inspection and possible debris removal. However, other less sophisticated and potentially less costly monitoring, such as daily visual inspection of the outflow from the bypass pipe should also be adequate. Although daily visual inspections of bypass outflow is currently a provision in the FPOMP, the plan does not provide details on how and when data on outflows from the bypass would be collected, verified, and made available to the Commission and resource agencies. Consequently, there is a need to file a modified FPOMP for Commission approval with a detailed approach to monitoring outflows from the bypass.

Therefore, we recommend that GLHA modify the existing FPOMP to add, at a minimum, procedures to: (1) perform routine maintenance before the migration season, such that the existing fishways would be fully operational during the migratory period; (2) clear debris from the trash racks of all turbine intakes prior to the migration season, and identify, with final Commission approval, the frequency of debris clearing during the migration season; (3) monitor outflows from the downstream bypass pipe, to detect debris blockages, using a method approved by the Commission; (4) include procedures for filing with the Commission for informational purposes, an annual report on the operation of the existing fishways and on project generation; (5) develop and include shutdown procedures for the existing fishways; and (6) develop and include procedures for operation and maintenance of the existing fishways during emergencies and project outages. We estimate that the levelized annual cost of modifying the FPOMP would be $259, and conclude that the benefits of the measure outweigh the cost.

Fishway "Shakedown" Period

Maine DMR recommends operating each fishway for a one-season "shakedown" period to ensure that the fishways are generally operating as designed, and if not, to make adjustments. The existing upstream fishway and downstream surface bypass are currently operated and maintained using the FPOMP. With GLHA's implementation of a modified FPOMP (discussed above), there is no reason to believe that the existing fishways would not perform as designed. Thus, there would be no benefit to operating the existing fishways for a one-season "shakedown" period.[234]

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[233] NMFS recommendation for real-time monitoring lacks detail, thus we assume that real-time monitoring would require installation of a flow meter at the outflow of the bypass pipe, a data logger, and a wireless telemetry system to monitor real-time data.

[234] As discussed below in this same section (i.e., *Species Protection Plan for Atlantic Salmon*) passage effectiveness studies for adult Atlantic salmon, smolts, and kelts may indicate that additional measures are needed to meet the passage performance

In contrast to the existing fishways, newly installed fishway have not been constructed and therefore there has never been an evaluation to ensure the new fishways are operating as designed. As discussed below (section 5.1.3, *Measures Not Recommended*), we do not recommend installation of a shad fishway in year 15, but we do recommend installation of an upstream eel ladder. Thus, for the upstream eel ladder, there would be a benefit to conducting a one-season "shakedown".

Maine DMR's recommendation would ensure proper eel ladder operation and design (see in section 3.3.2.2, *Fish Passage Design, Operation, Maintenance, and Monitoring*). However, Maine DMR does not specify the timing of the one-season "shakedown" period, and the lack of specificity could result in "shakedown" periods interfering with the migration season or passage effectiveness studies. To prevent interference with the fish passage season and delay in conducting fish passage effectiveness studies, the "shakedown" period, and any necessary adjustments, should be timed so that they are completed prior to relevant fish passage seasons and pertinent effectiveness studies.

To ensure the eel ladder is operating as designed and to make minor adjustments to facilities and operations, as needed, we recommend that GLHA operate the eel ladder for a "shakedown" period that would occur prior to the relevant upstream passage season and associated effectiveness studies. We estimate that the levelized annual cost of the "shakedown" would be included in routine operation and maintenance, and thus the cost would be negligible. Therefore, the benefits of the measure outweigh the cost.

Species Protection Plan for Atlantic Salmon

Measures for Upstream Passage of Adult Atlantic Salmon

To evaluate ability of the upstream fishway to meet a performance standard of 95 percent passage effectiveness for upstream migrating adult Atlantic salmon, GLHA proposes in the SPP to conduct up to 3 years of upstream fishway effectiveness studies for Atlantic salmon using the methods in the existing approved study plan. GLHA's proposed study would include coordination with resource agencies to stock uniquely marked Atlantic salmon smolts upstream of the Mattaceunk Project in the first 3 years after relicensing to serve as a source of imprinted juvenile fish that can be used for studying upstream passage as returning adults. GLHA proposes in the SPP to implement

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standards. The additional measures may include future modifications to the upstream fishway or downstream passage structures, which could necessitate a "shakedown" subsequent to any modifications. However, if modifications are determined to be necessary at a future date, GLHA would need to file an application to amend the license and get Commission approval prior to implementing any modifications and any "shakedowns" subsequent to modifications.

an adaptive management approach, in consultation with the resource agencies that would include additional operational, structural, and/or habitat enhancement measures, if necessary, to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon. Specifically, if the upstream fishway is able to meet the performance standard of 95 percent effectiveness during the first year, GLHA proposes to evaluate upstream passage at the project once every 10 years to verify continued achievement of the performance standard. If the project does not achieve the 95 percent performance standard for upstream passage, GLHA proposes to begin an adaptive management approach to meeting the performance standard, which would include consulting with the resource agencies and the Penobscot Indian Nation to make any modifications to the upstream fishway deemed appropriate, followed by additional study.

NMFS's fishway prescription would require, and Maine DMR also recommends GLHA's proposal to conduct up to 3 years of upstream fishway effectiveness studies. In addition, NMFS's fishway prescription would require, and Maine DMR recommends, GLHA's proposal to implement additional operational and structural modifications and/or habitat enhancement measures, if necessary, to address performance standard deficiencies for upstream migrating Atlantic salmon adults. NMFS also recommends, as proposed in the SPP, that GLHA's adaptive management for upstream passage be developed in consultation with the resource agencies.

As discussed in section 3.3.4.2, *Upstream Passage Performance Standard and Effectiveness Testing*, increasing upstream passage effectiveness from rates as low as 71 percent under existing conditions to the proposed performance standard of at least 95 percent would allow more spawning-capable salmon to reach spawning grounds upstream of the project, which could advance the recovery of the GOM DPS. GLHA's proposed effectiveness studies would be necessary to determine whether or not the 95 percent effectiveness standard was met. If the existing upstream fishway does not meet the 95 percent effectiveness standard, the proposed adaptive management and additional effectiveness studies may be needed to improve upstream passage and meet the standard. The proposed studies and adaptive management approach are supported by NMFS[235] and Maine DMR. Nevertheless, the SPP lacks adequate detail with respect to the study design, the number of years of study, and the need and timing of additional studies not proposed. Specifically, the upstream passage effectiveness study, which was previously developed in consultation with the resource agencies and Penobscot Indian Nation, and

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[235] NMFS's fishway prescription requires that all passage effectiveness studies for eel, alosines, and Atlantic salmon, begin at the start of the first migratory season after fishways are operational. However, as discussed in detail below in section 5.1.3, *Measures Not Recommended*, this requirement would not be feasible for the upstream passage effectiveness studies for adult Atlantic salmon.

approved by the Commission, includes scientifically acceptable methods, such as the use of telemetry tagged adult Atlantic salmon. However, because some methodology, such as the choice of telemetry tag (e.g., radio-tag, acoustic tag) has not been finalized in the existing study plan, GLHA would need revise the study plan in consultation with the resource agencies and the Penobscot Indian Nation, and file a revised plan for final approval from the Commission. In addition, because the existing study plans are not currently included in the SPP,[236] the existing study plans and any revisions will need to be included as attachments to the SPP subsequent to GLHA receiving any new license.

Regarding the number of years of study, GLHA is proposing to conduct up to 3 years of effectiveness studies. Because GLHA is proposing to stock uniquely tagged smolts during the first 3 years after relicensing (discussed in detail in section 3.3.4.2, *Upstream Passage Performance Standard and Effectiveness Testing*), GLHA could conduct an additional 1 or 2 years of upstream passage effectiveness studies to provide additional verification of effectiveness. The need for an additional 1 or 2 years of study would need to be determined in consultation with the resource agencies, with final approval from the Commission.

After the upstream fishway meets the 95 percent effectiveness standard, GLHA proposes to reevaluate its effectiveness every 10 years. However, if the upstream fishway meets the 95 percent performance standard and is properly operated and maintained by following the proposed FPOMP with staff modifications (discussed above), there is no known benefit to conducting additional effectiveness monitoring every 10 years, and thus there is no need for additional monitoring. Therefore, we do not recommend that GLHA conduct additional upstream effectiveness monitoring every 10 years.

As stated above, GLHA is proposing to conduct up to 3 years of effectiveness studies. However, GLHA does not include any additional adaptive management provisions in the SPP if the 95 percent performance standard is not met after 3 years of study. Further, for the purposes of this study, GLHA is only proposing to stock smolts for 3 years. Thus, a fourth year of study would not be feasible under GLHA's proposal,

[236] GLHA's existing study plan for upstream passage (Upstream Salmon Passage – Interim Species Protection Plan) was filed on December 11, 2013, as part of GLHA's revised study plan for relicensing the Mattaceunk Project. GLHA's existing study plan for downstream passage (Downstream Salmon Passage – Interim Species Protection Plan) was originally filed on December 11, 2013, as part of GLHA's revised study plan for relicensing the Mattaceunk Project. However, modifications to the study plan were made in 2015 to accommodate a request from NMFS to study smolt mortality in the project impoundment. The methods of the revised plan are included in the 2015 Atlantic Salmon Passage Study Report, filed on March 31, 2016.

and stocking additional smolts for the purposes of additional study may not be consistent with the restoration objectives for Atlantic salmon. Consequently, the SPP needs an additional provision requiring GLHA to determine the need for future effectiveness studies or measures, in consultation with the resource agencies and the Penobscot Indian Nation, and with final approval from the Commission, that could be implemented if after three years of study the upstream fishway does not meet the performance standard.

Therefore, we recommend that GLHA modify the existing SPP to include additional provisions to: (1) revise the upstream passage effectiveness study methodology, in consultation with the resource agencies and with final approval from the Commission, to include the type of telemetry tag to be used on upstream migrating adults and the appropriate timing for stocking tagged smolts, and refile the SPP with the revised study plan; (2) include the proposed passage effectiveness study plans as attachments to the SPP; (3) determine the need for an additional 1 or 2 years of effectiveness studies, with final approval from the Commission, if the upstream fishway meets the 95 percent performance standard after the first year; and (4) determine the need for future effectiveness studies or measures, with final approval from the Commission, if after 3 years of upstream passage effectiveness studies, the upstream fishway does not meet the 95 percent performance standard.

Downstream Passage of Smolts

Because of the low effectiveness of the existing bypass in passing smolts, GLHA is proposing to open the log sluice for 3 weeks during the migration season and to install trash racks with 1-inch bar spacing to the full depth of the turbine intakes. To determine whether these additional downstream passage measures allow smolts to pass downstream of the project with at least 96 percent survival, GLHA proposes in the SPP to conduct a minimum of 3 years of Atlantic salmon smolt downstream passage studies to determine whether the existing and proposed downstream passage operations and facilities meet a performance standard of 96 percent survival for smolts. Maine DMR recommends and NMFS's fishway prescription would require GLHA's proposal.

As part of the SPP, GLHA proposes, Maine DMR recommends, and NMFS's fishway prescription would require the installation of trash racks with 1-inch bar spacing to the full depth of the turbine intakes to cover the existing trash racks with 2.63-inch bar spacing during the downstream passage seasons for smolts, kelts, and eel. However, as discussed in section 3.3.4.2, *Trash Racks*, reducing the existing 2.63-inch bar spacing in the lower water column, to 1-inch bar spacing, would not reduce entrainment, because smolts could pass through the 1-inch bar spacing and the 2.63-inch bar spacing. Thus, for the purposes of protecting smolts from entrainment, there is no apparent benefit to installing 1-inch bar spacing to the full depth of the turbine intakes. However, narrowly spaced trash rack bars have the potential to deter fish from passing between the bars, but the difference in deterrence between trash racks with 1-inch spacing compared to 2.63-

inch spacing is not known. Nevertheless, GLHA could explore the potential deterrence effect of adding 1-inch bar spacing to the full depth of the turbine intakes, if the downstream effectiveness studies for smolts indicate that the project is unable to meet the performance standard of 96 percent survival without the 1-inch bar spacing to the full depth of the turbine intakes. Thus, adding trash racks with 1-inch bar spacing could be a component of GLHA's adaptive management strategy (discussed in more detail below) to protect downstream passage of smolts, if necessary. There would be no benefit to the 1-inch bar spacing for kelts, because most kelts are already protected by the existing trash rack configuration.[237]

GLHA proposes the development and implementation of adaptive management that would include additional operational, structural, and/or habitat enhancement measures determined in consultation with the resource agencies to improve passage and/or address performance criteria downstream migrating Atlantic salmon, if such measures are needed. GLHA describes its adaptive management approach in the SPP, which includes the implementation of phased spill measures, and we discuss the adaptive management fully in section 3.3.4.2, *Smolt Passage Performance Standard and Effectiveness Testing*. Although the overall concept of the studies and adaptive management approach proposed in the SPP are required and recommended by NMFS and Maine DMR, respectively, the SPP needs to be updated to be consistent with GLHA's current proposal to conduct a minimum of 3 years of downstream passage studies for smolts.[238] Three years of studies that demonstrate a downstream passage survival rate of 96 percent would engender confidence that the project can consistently pass smolts that survive at that rate, and help in the recovery of the GOM DPS of Atlantic salmon.

The SPP also lacks adequate detail with respect to the timing of proposed measures and the need and timing of additional studies not proposed. With respect to the timing of proposed measures, GLHA proposes that if downstream passage effectiveness studies demonstrate that the downstream bypass with log sluice operations is unable to meet the performance standard of 96 percent survival for smolts, and operational or structural modifications of the bypass and log sluice are not feasible, it would move to a phased spill approach that would occur from 8:00 pm to 4:00 am for 3 weeks during the

[237] As discussed in section 3.3.2.2, *Downstream Eel Passage*, installing 1-inch bar spacing to the full depth of the turbine intakes during the downstream eel passage season would be protective of larger eel.

[238] In the SPP (filed with the final license application on August 31, 2016), GLHA indicates that it would conduct up to 3 years of downstream passage studies for smolts. However, in a letter filed on July 7, 2017, GLHA stated that it would conduct a minimum of 3 years of downstream passage studies for smolts, until a total of 3 years meet the proposed performance standard of 96 percent survival.

smolt out-migration period. However, the timing of the 3-week period during out-migration is not specified in the SPP. Like operation of the log sluice, the 3-week period of spill should be determined in consultation with the resource agencies and with final approval from the Commission, to maximize the likelihood of matching spill with the smolt out-migration. The SPP also does not clearly define when the phased spill measures would or could be implemented, other than to state that spill would be implemented if the downstream fishway with log sluice operations is unable to meet the performance standard of 96 percent survival for smolts, and operational or structural modifications of the bypass and log sluice are not feasible. The timing for implementing phased spill measures would be best determined through consultation, with final approval from the Commission. To prevent the establishment of a continuous loop of study and structural and/or operational modification without a finite limit, GLHA should begin implementing the phased spill measures after a maximum of 3 years of downstream passage studies and modifications show that the 96 percent performance standard has not been achieved. It may be determined, in consultation with the resource agencies and with final approval from the Commission, that the phased spill measures should be implemented prior to reaching a maximum of 3 years. However, at least 1 year of study should be conducted prior to implementing the phased spill measures to at least determine the effectiveness of the new log sluice operations, and thus determine whether phased spill is needed.

The SPP also requires additional measures that are not proposed by GLHA. If the downstream bypass, together with the proposed structural and operational enhancements (i.e., full depth trash racks with 1-inch bar spacing, opening the log sluice for 3 weeks), meet smolt performance criteria during 3 years of study, GLHA proposes to evaluate downstream passage for smolts at the project once every 10 years thereafter to verify continued achievement of the performance standard of 96 percent survival. As discussed in section 3.3.4.2, *Smolt Passage Performance Standard and Effectiveness Testing*, the ability to meet the 96 percent performance standard during each of 3 years of study would indicate that the downstream passage structures are effective at passing smolts downstream, and if the downstream passage structures are maintained by following the proposed FPOMP with staff modifications (discussed above), GLHA should meet the 96 percent standard indefinitely. Further, if the 96 percent performance standard is met during each of 3 years of study, there is no need for reevaluating the downstream passage survival for smolts every 10 years, as proposed by GLHA, because there are no proposed or anticipated changes that would cause smolt survival to change every 10 years. Thus, we do not recommend that GLHA conduct additional monitoring every 10 years to verify that a 96 percent survival performance standard is being met for smolts.

Therefore, we recommend that GLHA modify the existing SPP to include additional provisions to: (1) revise the number of downstream passage effectiveness studies for smolts to indicate that a minimum of 3 years of study would be conducted; (2) revise the criteria for achieving the performance standard to state that the performance standard would be considered achieved if a total 3 years of downstream passage effectiveness studies for smolts demonstrate that the downstream passage structures meet a 96 percent survival performance standard; (3) determine, with final approval from the Commission, when to begin implementation of phased spill measures for downstream passage of smolts, with the restriction that phased spill measures would be implemented after at least 1 year of conducting downstream passage effectiveness studies for smolts, but after no more than 3 years of downstream passage effectiveness studies and non-spill passage modifications; and (4) determine, with final approval from the Commission, the 3-week period during which any phased spill measures would occur for downstream passage of smolts.

Measures for Downstream Passage of Smolts Through the Impoundment

To evaluate smolt mortality in the project impoundment, GLHA proposes in the SPP to use the existing study plan[239] with additional modifications for conducting a more rigorous evaluation of the sources of impoundment mortalities, along with any additional modifications deemed appropriate during agency consultation. Further, GLHA proposes to develop an adaptive management plan, if necessary, to address impoundment mortality. GLHA does not state in the SPP, the number of studies it would conduct, but Maine DMR recommends that GLHA conduct up to 3 years of studies to assess the sources of impoundment mortality. NMFS did not recommend a study, but did recommend that GLHA develop a mitigation plan, in consultation with NMFS and the resource agencies, for the loss of Atlantic salmon smolts as a result of maintaining the project impoundment.

As discussed in section 3.3.4.2, *Smolt Mortality in the Impoundment*, GLHA and Stich et al. (2015b) estimated smolt mortality in the project impoundment. The results from those studies demonstrate that mortality in the project impoundment is not consistently higher or lower than in free-flowing sections of the Penobscot River, and provide no consistent evidence for a project effect. Further, there is no information from those studies or other sources (e.g., performance standards, or otherwise acceptable levels of mortality) to suggest that mortality in the impoundment is excessive. In addition, because there are no performance standards, or otherwise acceptable levels of mortality for the project impoundment, future studies also would not be able to identify whether mortality in the impoundment is excessive. Without specific information to indicate

[239] GLHA's existing study plan (Downstream Salmon Passage – Interim Species Protection Plan) was originally filed on December 11, 2013, as part of GLHA's revised study plan for relicensing the Mattaceunk Project. However, modifications to the study plan were made in 2015 to accommodate a request from NMFS to study smolt mortality in the project impoundment. The methods of the revised plan are included in the 2015 Atlantic Salmon Passage Study Report, filed on March 31, 2016.

whether or not mortality in the impoundment is excessive either today, or in the future, there is no means to determine whether environmental measures would be needed, or the type of environmental measures that would be beneficial. In addition, without a means to determine whether mortality in the impoundment is excessive, and thus whether environmental measures are needed, then there is no benefit to conducting an impoundment mortality study. Further, and as discussed in section 3.3.4.2, *Smolt Mortality in the Impoundment,* even if performance standards for smolt mortality in the impoundment were identified, the proportion of mortality in the impoundment caused by the project would be difficult to identify because estimates of mortality in the impoundment could be the result of multiple sources that may or may not be related to the project. Isolating those non-project sources of mortality from project effects would be necessary, and difficult.

Because there is no need to conduct a post-licensing impoundment mortality study, or implementing environmental measures to reduce mortality in the project impoundment, we conclude that conducting between 1 year (as proposed by GLHA) and 3 years (as recommended by Maine DMR) of impoundment mortality studies is not worth the annual levelized cost of $11,270 to $25,372, respectively. Further, because available evidence provides no indication that mortality in the project impoundment is excessive, we also do not recommend NMFS's recommendation for GLHA to develop a mitigation plan for the loss of smolts in the impoundment, and conclude that the mitigation plan is not worth the annual levelized cost of $432.

Downstream Passage of Kelts

GLHA proposes in the SPP to conduct up to 3 years of Atlantic salmon kelt downstream passage studies, using the same returning, imprinted adult salmon that would be used during the upstream passage study (discussed above). In these studies, GLHA would determine if the proposed operations and facilities meet a performance standard of 96 percent survival for kelts. Maine DMR recommends GLHA's study proposal. GLHA also proposes to develop and implement adaptive management to address performance criteria for downstream passage, but does not provide any specific provisions to implement for passage of kelts. NMFS's fishway prescription would require and Maine DMR recommends GLHA's proposal to study passage effectiveness for kelts.

Although GLHA proposal has support from NMFS and Maine DMR, the proposal lacks details. In particular, GLHA does not propose, nor does anyone recommend, specific provisions that would be implemented if after 1 year of study the downstream passage structures do or do not meet the 96 percent survival performance standard. Because the studies for downstream kelt passage effectiveness would require the use of the same study fish used in the upstream passage effectiveness studies and are thus confined to the same restrictions of using stocked smolts to begin the study, we conclude that the similar provisions for additional study and measures should apply after 1 year of study. Specifically, 1 year of study may be adequate if the study shows that the downstream passage structures are able to meet the 96 percent performance standard. However, because GLHA is proposing to stock uniquely tagged smolts during the first 3 years after relicensing for the purposes of the adult passage studies, GLHA could conduct an additional 1 or 2 years of downstream passage effectiveness studies to provide additional verification of effectiveness regarding kelts. The need for an additional 1 or 2 years of study would best be determined in consultation with the resource agencies, and with final Commission approval.

Evaluation of the downstream passage structure effectiveness may show that the downstream passage structures do not meet the 96 percent survival performance standard for kelts. Under this scenario, GLHA would determine the need to conduct an additional 1 or 2 years of study, in consultation with the resource agencies and Penobscot Indian Nation, with final approval from the Commission. However, if the performance measure is not met after a total of 3 years of studying downstream passage effectiveness for kelts using the salmon originally stocked as smolts, then GLHA would need to determine the need for additional effectiveness studies and/or measures, in consultation with the resource agencies and Penobscot Indian Nation, with final approval from the Commission. Use of this adaptive management approach described above would ensure that kelts would be able to pass the project with at least 96 percent survival, and help in the recovery of the GOM DPS.

Therefore, we recommend that GLHA modify the existing SPP to include additional provisions to: (1) determine the need for an additional 1 or 2 years of downstream passage effectiveness studies for kelts, with final approval from the Commission, if the downstream fishway meets the 96 percent survival performance standard for kelts after the first year; (2) determine the need to conduct at least 1 year of additional effectiveness study, with final approval from the Commission, if the downstream fishway does not meet the 96 percent survival performance standard for kelts after the first year; and (3) determine the need for future effectiveness studies and/or downstream passage measures, with final approval from the Commission, if after 3 years of downstream passage effectiveness studies, the downstream passage structure does not meet the 96 percent survival performance standard for kelts.

GLHA proposes in the SPP to implement an adaptive management approach, in consultation with the resource agencies that would include additional operational, structural, and/or habitat enhancement measures, if necessary, to meet the performance standards for upstream and downstream migrating Atlantic salmon. NMFS's fishway prescription would require, and Maine DMR recommends, GLHA's proposal. Implementing structural or operational modifications may be appropriate at some future date, if a need is identified.[240] At this time, specific structural or operational modifications have not been proposed, recommended, or prescribed, because the proposed monitoring (discussed above) has not been conducted. Thus, there is currently no information to indicate a need or benefit for modifications. Because there is no identified need or benefit of implementing structural or operational modifications, there is no justification for authorizing the implementation of such measures in this proceeding. In addition, it would be inconsistent with Commission policy to authorize implementation of an unspecified measure, because such a measure is without limitations.[241] Because the Commission cannot exercise its oversight authority on measures without limits, the Commission cannot approve such measures. Therefore, prior to implementing any future, and currently unspecified operational, structural, and/or habitat enhancement measures that may be used to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon, GLHA must file an application to amend the license and get Commission approval.

We estimate that the levelized annual cost of modifying the SPP with all of the additional provisions discussed above would be $432 and conclude that the benefits of the measure outweigh the cost. We do not recommend that the SPP include a provision to install trash racks with 1-inch bar spacing to the full depth of the turbine intakes during the downstream migration season for smolts and kelts. Installing the trash racks during the downstream season for smolts and kelts would increase the levelized annual cost from $417,212 that would be incurred by only installing the trash racks during the downstream passage season for eel, to $873,962 for installing the trash racks during the downstream passage season for smolts, kelts, and eel. We conclude that the benefits of installing the trash racks during the downstream passage season for smolts and kelts is not worth the additional levelized annual cost of $86,462.

5.1.3 Measures Not Recommended

Continuous Stream Temperature Monitoring

NMFS recommends that GLHA develop continuous stream temperature monitoring downstream of the dam from April 1 through October 31. NMFS argues that project operation could intensify the potential effects of climate change on stream temperature below the dam, and thus influence smolt emigration, adult immigration, and

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[240] If a need for specific structural and/or operational modifications were to be identified at a future data, the licensee would have to file an amendment application with the Commission, seeking authority to alter the terms of the license.

[241] *See* 116 FERC ¶ 61,270 (2006).

juvenile development in nursery habitats downstream of the dam. GLHA does not propose water quality monitoring.

As discussed in section 3.3.2.2, *Water Quality*, monitoring conducted in 2012 indicates that water temperature in the project impoundment and tailwaters did not deviate substantially from unimpounded waters upstream of the project impoundment. Maine's water quality standards do not include water temperature limits, but as discussed in section 3.3.2.2, *Environmental Effects*, data collected in the impoundment in 2014 show that the impoundment does not stratify by temperature and that the impoundment has a short residence time. Together, these findings support the conclusion that there are no substantial project-related temperature issues under current and proposed operation.

In addition, NMFS does not explain a clear relationship between climate change and water temperature in the project tailrace, or how project operation would interact with a changing climate change and impact smolt emigration. Further, the existing fish population within the project vicinity is diverse, self-sustaining, and healthy – suggesting that there are no project-related water quality issues (including temperature). Finally, because there is no indication that the project alters water temperature downstream of the tailrace in a way that would negatively affect aquatic resources during operation, there is no need to monitor continuously for stream temperature. Consequently, NMFS's recommendation lacks a nexus to any project effect. Therefore, we do not recommend the measure be included in any new license issued for the Mattaceunk Project.

Finally, the Penobscot Indian Nation comments that GLHA's temperature monitoring for about 4.5 months of 2012 does not adequately characterize the water temperature for the project. The Penobscot Indian Nation believes that a plan for monitoring for multiple years is necessary. Based on existing water quality data, as discussed in 3.3.2.2, *Environmental Effects*, data collected upstream, in the impoundment, and in the tailwater, although limited in sample size, indicate that there is no significant temperature deviation between the three habitats. Therefore, we do not recommend a plan for monitoring temperature.

Trash Rack Installation Schedule

GLHA proposes to implement downstream eel passage measures beginning the first downstream eel passage season after license issuance, which include: (1) seasonally ceasing generation from 8:00 pm to 4:00 am; (2) opening the project's roller gate; and (3) installing full-depth trash racks with 1-inch clear bar spacing. GLHA, however, would install the trash racks within 2 years of license issuance. The proposed trash rack schedule is consistent with the schedule required by NMFS in its fishway prescription.[242] Interior, in its fishway prescription, requires the night-time shutdowns and installation of a full-depth trash rack with 1-inch clear bar spacing, but provides no implementation schedule. Maine DMR recommends that GLHA provide downstream passage for eel beginning the first passage season following license issuance, including installing trash racks with 1-inch clear bar spacing,

GLHA proposes measures to protect out-migrating adult (silver) eel, as well as for Atlantic salmon and shad that are generally consistent with protection measures recommended by the resources agencies. However, GLHA and the resource agencies differ as to when to initially install/deploy the new full-depth trash racks with 1-inch clear bar spacing.

The number of adult eel upstream of the project dam is unknown, though available data suggests the numbers are low. While the new upstream eel ladder, which will be installed at the project within 2 years of license issuance, is expected to improve upstream passage efficiency of juvenile eel and increase the number of eel upstream of the project, these eel will not migrate downstream as adults until at least 2030. With regard to Atlantic salmon, and as discussed above, downstream migrating smolts and kelts would not substantially benefit from trash racks with 1-inch bar spacing to the full depth of the turbine intakes. Thus, only eel would be affected by trash rack installation schedule.

In order for GLHA to implement the downstream passage measures in a way that meets all requirements of the resources agencies, and efficiently protects eel, the proposed measures (i.e., turbine shut-down, full-depth trash rack with 1-inch bar spacing, and roller gate opening) need to be implemented using a comprehensive approach. As discussed in section 3.3.2, *Aquatic Resources – Environmental Analysis*, implementing the nighttime shutdown and opening the roller gate may not provide sufficient protection

[242] *See* NMFS's Fishway Prescription at A-63 (Condition 7.3.2.a). Condition 7.3.5 of NMFS's Fishway Prescription, however, requires that GLHA provide conceptual designs for the proposed full-depth trash racks with 1-inch clear bar spacing at least 6 months prior to the first downstream passage season following license issuance. Based on our interpretation, there appears to be a discrepancy between these two conditions. For example, Condition 7.3.2.a indicates that NMFS is adopting GLHA's proposal to install the new trash racks within 2 years of license issuance, while Condition 7.3.5 requires conceptual designs to be provided at least 6 months prior to the first downstream passage season, which implies installation potentially occurring prior to the first downstream passage season. We ask that NMFS, in any modified fishway prescription filed with the Commission, clarify its schedule for installing/deploying the new, full-depth trash racks at the project.

to out-migrating adult eel, without the full-depth trash racks being in place. The more biological beneficial approach to protecting downstream migrating eel at the project would be to implement the downstream eel passage measures in a coordinated and combined fashion. Therefore, we do not recommend that the proposed trash racks be installed prior to the first downstream passage season, but rather recommend that the trash racks be installed within 2 years of license issuance. This timing is consistent with the other downstream passage measures proposed and recommended for the project and represents a schedule that would most effectively and efficiently protect downstream migrating eel.

Approach Velocities

NMFS's fishway prescription would require GLHA to take point measurements of approach velocities immediately upstream of the project trash racks, and ensure that point measurements do not exceed 2.0 fps within a 2-foot-square grid. As discussed in section 3.3.4.2, *Approach Velocity*, approach velocities can be estimated by dividing the maximum hydraulic capacity by the total intake area of the powerhouse (EPRI, 2000). Using this approach, GLHA estimated the average approach velocities at the project to be 1.7 fps, which is lower than the burst swim speeds of smolts and kelts (table 19), and therefore reduces entrainment and impingement risk during the downstream migration. Approach velocities would not deviate substantially from 1.7 fps, because there are no proposed changes to the size of the turbine intake or the maximum hydraulic capacity. Through-screen velocities could increase with debris accumulation on the trash racks, but through implementation of the proposed FPOMP with staff recommended modifications discussed above, GLHA would regularly clear debris from the trash racks during the migration season and velocities would not increase.

Based on the information above, approach velocities at the project are already known, would not change under proposed operations, and are protective of downstream migrating fish. Further, through-screen velocities would not change with implementation of the FPOMP with staff recommended modifications. Therefore, there would be no benefit to measuring approach velocities, as required by NMFS's fishway prescription, or measuring other velocities (e.g., through-screen) near the trash racks.

Therefore, we do not recommend NMFS's fishway prescription to take point measurements annually, and conclude that it is not worth the levelized annual cost of $3,000.

Downstream American Eel Passage Operational Period

Under existing project conditions, downstream routes for adult (silver) eel migrating through the project area include either passing over the spillway when the project spills, through the upstream fish ladder and log sluice when they are being used, or through the turbines during generation. However, turbine passage is the most likely downstream passage route during the adult eel migration period from August to December because GLHA generally passes all river flow through the project turbines when possible.

GLHA conducted a fish entrainment and impingement study for the Mattaceunk Project in 2014 (GLHA, 2015). The results indicate that the project has the potential to adversely affect downstream-migrating adult (silver) eel. Adult eel have a relatively high risk of entrainment at the project because of their benthic orientation when out-migrating and their likelihood to pass through the lower trash racks that have a clear bar spacing of 2.63 inches. Empirical entrainment rate information for eel suggests that rates are higher in the late summer to winter time periods, with individuals longer than 10 inches composing the majority of the eel.

GLHA proposes, and the resource agencies recommend, the same measures to protect downstream migrating adult eel (e.g., implementing night-time shutdowns, opening the project's existing roller gate to provide a low-level passage route, and installing full-depth trash racks with 1-inch clear bar spacing). However, GLHA and the resource agencies differ in regards to the operational period for the night-time turbine shutdowns. For instance, GLHA proposes to implement annual night-time shutdowns from 8:00 pm to 4:00 am, with the schedule being developed in consultation with the resource agencies and being based on a predictive model for eel movement through the project. In the interim, GLHA would implement a night-time shutdown period of up to 6 weeks (8:00 pm to 4:00 am nightly), beginning as early as the first significant rain event (1 inch or greater of rain) occurring on or after August 15. The night-time shutdown period, however, would start no later than September 15. Interior's fishway prescription would require GLHA to shut down all generation nightly (8:00 pm to 4:00 am) from August 1 through October 31. Maine DMR, similarly, recommends that GLHA institute annual night-time turbine shutdowns (8:00 pm to 4:00 am) from August 1 through October 31.

Night-time shutdowns[243] are commonly used at hydropower projects to protect eel migrating downstream. Such nightly shutdowns would fully protect eel migrating downstream through the project area from turbine entrainment injury and mortality, though some injuries and mortalities could occur from the corresponding increased spillway passage.

[243] Shutdowns can take the form of 24-hour shutdowns for the entire eel migration season, or can be implemented nightly from dusk to dawn during the period of peak migration based on site-specific monitoring or information from upstream projects (Richkus and Whelan, 1999; Smith *et.al*., 2017).

As we found in section 3.3.2, *Aquatic Resources – Environmental Analysis*, shutting generation down, annually, through the entire out-migrating season, or even longer, would provide the greatest level of protection for adult eel passing through the project. However, available evidence indicates that such shutdowns may not be efficient at reducing eel mortality, and would result in unnecessary turbine shutdowns with associated generation losses. For example, downstream eel migration is known to occur largely in episodic events based on environmental cues such as increased river flows following rain events, cooling temperatures, and moon phase. Thus, timing shutdowns based on site-specific eel monitoring data and environmental conditions could substantially reduce project-related eel mortality, while also reducing the cost of lost generation (Haro *et al*., 2003). Recent studies conducted in the lower Penobscot River as well as information provided by the Maine DMR support this conclusion (*see* section 3.3.2, *Aquatic Resources – Environmental Analysis*,).

Consistent with the strategy to protect eel on the Shenandoah River (Smith *et al.*, 2017), in West Virginia, and FWS's 2015 American Eel Biological Species Report Supplement, GLHA proposes to target night-time shutdowns for downstream eel passage based on a predictive model that considers environmental variables that are expected to occur in late August (beginning August 15), September, and/or October.[244] Implementing such an approach (with the use of a cut-off probability value), along with opening the project's roller gate and the addition of full-depth trash racks with 1-inch clear bar spacing, is expected to reduce mortality of downstream-migrating eel, as well as minimize lost power generation. GLHA's proposed effectiveness monitoring would provide a mechanism for GLHA and the resource agencies to refine both the model and ultimately the period of time the project's generating units are shut down to aid in downstream eel passage.

GLHA's proposal for a 6-week shutdown would result in a loss of 6,260 MWh of generation at an annual levelized cost of $313,000, annually. In contrast, FWS's and Maine DMR's approach to shut down all generation every night (from 8:00 pm to 4:00 am) from August 1 through October 31 would result in an estimated loss of 12,520 MWh of generation, at an annual levelized cost of $626,000, annually. The agencies' recommended 12-week shutdown, therefore, would double the amount of lost generation and annual cost associated with downstream eel passage at the project, when compared to GLHA's proposal. GLHA's proposal and the agencies' recommendation, however, are

[244] GLHA proposes to consult with the resource agencies in developing the predictive eel out-migration model. The cut-off probability value, as well as the environmental triggers for shutting down project operations and for restarting operations should be identified during the consultation. In addition, the mechanism for measuring the success of implementing the predictive model, both in terms of eel passage and lost generation, should be identified.

likely to protect a similar number of out-migrating eel, though the additional 6 weeks is likely to protect a small, though unknown, number of additional eel. Thus, the additional cost of the agencies' recommended measure would not be worth the benefit derived. Therefore, we recommend GLHA's proposed schedule for ceasing generation be included in any new license issued for the Mattaceunk Project.

Upstream Passage for Sea Lamprey

Sea lamprey are an anadromous species that currently pass upstream of the West Enfield Dam, and are potentially present immediately downstream of the project. Sea lamprey could attempt to use the existing pool and weir fishway to pass upstream, but because sea lamprey are poor swimmers, they are unlikely to successfully move through the weirs and up successive pools because the fishway was designed for strong swimmers like salmon. NMFS recommends that GLHA design the proposed upstream shad fishway to provide sea lamprey with a safe passage route upstream of the project.

As discussed in section 3.3.2.2, *Upstream Passage for Sea Lamprey*, the need for sea lamprey to pass safely upstream of the project is not evident. Although sea lamprey were historically present upstream of the project, the relative abundance and importance of upstream habitat to the historical and existing sea lamprey population is not known. Because the abundance and importance of upstream habitat is not known, a benefit to passing sea lamprey upstream of the project cannot be identified. Therefore, we do not recommend that GLHA provide upstream passage for sea lamprey.

Impoundment Elevations and Upstream Passage Operation

As discussed in section 3.3.4.2, *Effects of Impoundment Elevation on Upstream Passage Operation*, the existing upstream fishway is operational under normal operating conditions, which could can include impoundment fluctuations down to an impoundment elevation of 238.0 feet (i.e., 2 feet below the top of the flashboard elevation of 240 feet). The upstream fishway is not operational at an impoundment elevation of 236.0 feet, which occurs when the 4-foot-high flashboards are down. However, there is an unknown impoundment elevation between 236.0 feet and 238.0 feet at which the upstream fishway becomes non-operational. NMFS recommends that GLHA determine the specific elevation at which the upstream fishway becomes non-operational to inform future fishway operations and any new fishway construction. However, knowing the elevation at which the upstream fishway becomes non-operational would provide no benefit to the operation of the upstream fishway and upstream passage of Atlantic salmon, because under existing and proposed project operations, the impoundment elevations are always at or above 238.0 feet when the flashboards are in place (fishway is operational), or between 235.0 feet and 236.0 feet, when the flashboards are down (fishway is not operational). An impoundment elevation between 236.0 feet and 238.0 feet would never occur under normal operations. Therefore, because the existing upstream fishway would be operational under the proposed normal operating conditions (i.e., with the 4-foot-high flashboards in place), which are the same as existing operations, we do not recommend that GLHA identify the impoundment elevation at which the existing upstream fishway can no longer operate.

Fishway Design

GLHA is proposing to install new fishways to provide passage for eel and shad, and to consult with the resource agencies on the design of new fishways. As-built drawings are an important component of the fishway design process, because they provide documentation that fishways are designed properly. NMFS's fishway prescription would require GLHA to provide as-built drawings to the resource agencies, for any new fishways and Maine DMR recommends that GLHA to also provide as-built drawings for modified fishways, along with a licensed engineer's letter of certification. However, because it is the responsibility of the Commission to approve and ensure proper design of fishways, there would be no benefit to providing certified as-builts drawings to the resource agencies. Further, as-built drawings would be filed with the Commission and accessible to the resource agencies from the Commission. Therefore, we do not recommend requiring GLHA to provide certified copies of as-builts to the resource agencies.

Upstream Fishway Fish Trap

NMFS's fishway prescription would require GLHA to maintain the existing fish trap for counting adult Atlantic salmon as they exist the existing upstream fishway. Maine DMR recommends that GLHA provide counts of adult Atlantic salmon that exit the upstream fishway to resource agencies, but does not specify a need to continue using the existing fish trap. GLHA proposes to monitor the upstream fishway and count the number of adult Atlantic salmon passing upstream of the project using a methodology developed in consultation with resource agencies. As discussed in section 3.3.4.2, *Environmental Effects, Counting Atlantic Salmon in the Upstream Fish Trap*, count data collected at the project can be used to help estimate Atlantic salmon population abundance. Nevertheless, there is no benefit to counting Atlantic salmon (in the fish trap or by other means), as it relates to project effects on the GOM DPS. More specifically, counting Atlantic salmon does not protect Atlantic salmon from project effects, mitigate a project effect on Atlantic salmon, or enhance the GOM DPS. Although NMFS's fishway prescription would require GLHA to count Atlantic salmon in the fish trap, for the reasons stated above, we do not recommend that continued use of the existing fish trap to count Atlantic salmon be a necessary requirement in a new license.

Modifications to Atlantic Salmon Passage Operating Schedules

GLHA proposes, Maine DMR recommends, and NMFS would require operation of the upstream fishway from May 1 to November 10, and the downstream bypass from

April 1 to June 15 [smolts and kelts] and October 17 to December 1 [kelts]. In addition to the specified operating schedules, NMFS has a fishway prescription that would require GLHA to open the existing upstream fishway prior to May 1 if the fish lift at Milford dam begins capturing adult Atlantic salmon earlier than May 1. Maine DMR recommends including a provision in any new license to allow modification of the permanent upstream and downstream fishway operating schedules for Atlantic salmon during the term of the license. Such modification would occur in consultation with Maine DMR, FWS, and NMFS, based on new information or migration data. Maine DMR also recommends that, with approval from Maine DMR, FWS, and NMFS, GLHA have the ability to make changes in the operating schedules in any given year in response to river conditions, maintenance requirements, and annual variability in migration patterns.

Both Maine DMR and NMFS are in agreement that there should be flexibility to modify the fishway operating schedules for Atlantic salmon based on environmental or passage data. However, neither Maine DMR's recommendation nor NMFS's prescription includes limits regarding the number of days earlier or later that the fishways should be able to operate beyond the proposed schedules. In the absence of recommended or prescribed limits on operating schedule modifications, we have no information to analyze, and therefore no information to determine whether a particular schedule modification would or would not provide benefits to the GOM DPS of Atlantic salmon. More directly, we are unable to determine whether the schedule modifications would be in the public interest. Therefore, we are unable to identify any benefits to implementing unspecified modifications to the upstream fishway operating schedule. Thus, we do not recommend a license requirement that allows GLHA to modify, without limits, the operating schedules of the upstream fishway and downstream bypass used by Atlantic salmon.[245]

Downstream Bypass Attraction Flows

As discussed in section 3.3.4.2, *Downstream Passage Operations*, the existing bypass is not effective at passing smolts downstream. To improve passage of Atlantic salmon smolts migrating downstream at the project, GLHA proposes to continue operating the downstream bypass at its maximum flow capacity of 140 cfs (2 percent of station hydraulic capacity), and to implement an added measure to provide additional safe downstream flows of 225 cfs to 690 cfs (between 3 percent and 9 percent of station hydraulic capacity) through the log sluice. Bruce Haines recommends that GLHA redesign the existing bypass to provide an attraction flow of 5 percent, which meets the 5 percent design criteria recommended by FWS (2017).

[245] *See* 116 FERC ¶ 61,270 (2006).

To be effective, safe passage routes, like the bypass or log sluice, must pass flows (i.e., attraction flows) that are capable of attracting fish to these safe routes. If the attraction flows are not discernable from competing flows (e.g., turbine intakes), fish could be attracted toward an unsafe route, such as the turbine intakes. In general, higher attraction flows are better (NMFS, 2011) and FWS recommends a minimum attraction flow of 5 percent of station hydraulic capacity.

Increasing the bypass flows from 2 percent of hydraulic capacity under existing conditions to 5 percent of hydraulic capacity would increase attraction flows, which should be more discernable, and thereby improve attraction and passage through the bypass. Nevertheless, the existing bypass pipe has a maximum flow capacity of 2 percent of station hydraulic capacity, and cannot be increased to provide a 5 percent attraction flow without structural changes, which have not occurred and are not proposed. Consequently, the ability of a 5 percent attraction flow to improve downstream passage through the bypass has not been tested at the Mattaceunk Project. Therefore, the exact benefit of increasing attraction flow to 5 percent through the bypass is not known.

GLHA proposes, Maine DMR recommends, and NMFS requires in its fishway prescription, opening the project's log sluice (at between 3 percent and 9 percent of station hydraulic capacity, or between approximately 225 cfs and 690 cfs)[246] starting the first passage season following relicensing to facilitate downstream Atlantic salmon smolt outmigration for a 3-week period during the spring (determined in consultation with resource agencies). This measure represents an alternative to providing a 5 percent attraction flow through the bypass that would not require structural changes. Like Bruce Haines' recommendation, providing log sluice flows that are between 3 and 9 percent of station hydraulic capacity would increase the amount of safe passage flows above 2 percent. However, log sluice flows could increase to 9 percent of station hydraulic capacity – which is nearly double the 5 percent flows recommended by Bruce Haines and FWS (2017). Thus, operating the log sluice has the potential to be effective at increasing attraction of smolts toward a safe route, compared to existing conditions. However, the increased attraction flows through the log sluice have not been tested, and thus like Bruce Haines recommendation, the benefits are not known.

Compared to Bruce Haines' recommendation, GLHA's proposed log sluice operations has the potential to provide equally effective attraction, yet equally unknown benefits to the downstream passage of smolts. However, the levelized cost of redesigning the bypass to provide a bypass attraction flow of 5 percent would be $172,924.[247]

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[246] The log sluice has a gated capacity of 690 cfs.

[247] This levelized cost only includes the cost to redesign the bypass to provide a 5 percent attraction flow, and does not include additional costs to operate and maintain a

Conversely, the levelized cost of implementing the proposed log sluice operations would be $37,250. Because of the higher cost of providing a 5 percent attraction flow through the bypass, and the potential to be equally effective and beneficial as the log sluice operations, we do not recommend that GLHA redesign the bypass to provide an attraction flow of 5 percent.

Operating Period for the Downstream Bypass

Bruce Haines recommends operating the downstream bypass with 5 percent attraction flows, 365 days per year for Atlantic salmon smolts and kelts. However, based on existing information on the downstream migration of smolts and kelts (discussed in section 3.3.4.2, *Environmental Effects, Downstream Passage Operations*), GLHA's proposal to operate the downstream bypass from April 1 to June 15 for smolts and kelts, and from October 17 to December 1 for kelts covers the timeframe when smolts and kelts are most likely to be migrating downstream of the project. Because most smolts and kelts are not migrating outside of the proposed timeframe, providing passage outside of this timeframe would not provide a substantial benefit to the passage success of smolts or kelts. Further, the levelized annual cost of operating the bypass with 5 percent attraction flows, 365 days per year would be $190,095. Operating the downstream bypass when most smolts and kelts are likely to be migrating would be $25,000. Because there is no substantial benefit to operating the bypass 365 days per year, and because the levelized annual cost is $165,095 greater than the cost of GLHA's proposed bypass operations, we do not recommend that GLHA operate the downstream bypass year-round.

Timing of Atlantic Salmon Passage Effectiveness Studies

NMFS's fishway prescription would require that all passage effectiveness studies for eel, shad, and Atlantic salmon, begin at the start of the first migratory season after fishways are operational. The existing upstream fishway and downstream bypass are currently operational, and thus the effectiveness studies for the Atlantic salmon that use those fishways could, in theory, be conducted during the start of the first migratory season. However, as discussed in detail in section 3.3.4.2, *Upstream Passage Performance Standard and Effectiveness Testing* and *Kelt Passage Performance Standard and Effectiveness Testing*, the studies on upstream migrating adult Atlantic salmon and downstream migrating kelts would require salmon that are imprinted to habitats upstream of the project, and thus motivated to migrate upstream of the

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bypass that is capable of providing 5 percent attraction flows. Bruce Haines recommends operating the bypass with 5 percent attraction flows, 365 days per year. The levelized cost of operating the bypass with 5 percent attraction flows, 365 days per year would be $190,095. We discuss this specific component of Bruce Haines recommendation below in the section title, *Operating Period for the Downstream Bypass*.

Mattaceunk Project. This requirement necessitates stocking smolts upstream of the project, which would be imprinted to those habitats, migrate out to sea, and return on average, 2 years later to be telemetry tagged and used in the effectiveness studies. Thus, effectiveness studies for upstream migrating adult Atlantic salmon and downstream migrating kelts could not occur within the time constraints of NMFS's prescription. Consequently, NMFS's prescription lacks substantial evidence as to its need. Therefore, we do not recommend that there be a requirement in any new license to begin the upstream adult or downstream kelt effectiveness studies at the start of the first migratory season after the fishways are operational.

Time Standard for Downstream Passage of Atlantic Salmon

As discussed in section 3.3.4.2, *Smolt Passage Performance Standard and Effectiveness Testing* and section 3.3.4.2, *Kelt Passage Performance Standard and Effectiveness Testing,* GLHA proposes to conduct studies to evaluate downstream passage survival for smolts and kelts. NMFS states in its fishway prescription that during the downstream passage survival studies, smolts and kelts must pass the project forebay area within 24 hours to be considered as a successful passage attempt that can be applied toward calculation of downstream passage survival. To support the 24-hour passage criteria for smolts, NMFS cites Stich et al. (2015a). NMFS states that the results from Stich et al. (2015a) indicate that downstream passage delay of more than 24 hours at each dam in freshwater habitat of the Penobscot River causes increased mortality in the Penobscot River estuary. As discussed in detail in section 3.3.4.2, *Smolt Passage Performance Standard and Effectiveness Testing,* there is evidence that delays at dams can reduce survival of smolts (but not kelts). However, there is no evidence attributing a specific duration of delay to excessive smolt or kelt mortality, and thus there is no evidence to indicate that smolts or kelts that do not pass a dam within 24-hours will experience excessive mortality. Based on the evidence available, there would be no benefit to including a 24-hour passage criteria in the study designs used to estimate downstream passage survival of smolts and kelts. Therefore, we do not recommend including a requirement, in any new license, for smolts or kelts to pass downstream of the project within a specific 24 hour threshold to be considered as a successful passage attempt.

Portage Plan

GLHA operates and maintains an existing portage around Weldon Dam. Interior recommends that GLHA consult with the Penobscot Indian Nation to develop a plan for the canoe portage around the project. Interior states that there is no good way for boaters to portage through the woods around the dam. However, Interior does not explain why the existing portage trail is not a feasible route for portaging canoes around the dam, and no clarity is provided about whether improvements to the existing trail are needed because of the existing portage's condition or some other factor.

As discussed in section 3.3.5, *Land Use and Recreation*, the portage is located on the west bank of the river, and follows a 9-foot-wide gravel road that is periodically used by GLHA for maintenance. GLHA inspects and maintains the signage associated with the trail, including signs at the take-out, put-in, and directional signs along the route. Photos provided by GLHA of the canoe portage indicate that it is clear and maintained, and no other comments have been filed indicating issues with the existing route. Therefore, we do not recommend inclusion of a portage plan for the project as a license requirement.

5.1.4 Conclusion

Based on our review of the agency and public comments filed on the project and our independent analysis pursuant to sections 4(e), 10(a)(1), and 10(a)(2) of the FPA, we conclude that licensing the Mattaceunk Project, as proposed by GLHA with the additional staff-recommended measures, would be best adapted to a plan for improving the Penobscot River Basin.

5.2 UNAVOIDABLE ADVERSE IMPACTS

Some entrainment mortality is likely unavoidable for Atlantic salmon and adult eel migrating downstream even with upstream and downstream passage for these species. Entrainment also is likely unavoidable for some resident fish species like smallmouth bass and white sucker. Most adult fish could avoid involuntary entrainment, but entrainment of some small fish could still occur. Additionally, some dewatering of shallow water nests is likely unavoidable for species that spawn in shallow water, such as smallmouth bass, when the 4-foot-high flashboards are not in place.

5.3 SUMMARY OF SECTION 10(J) RECOMMENDATIONS

Under the provisions of section 10(j) of the FPA, each hydroelectric license issued by the Commission shall include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project.

Section 10(j) of the FPA states that whenever the Commission finds that any fish and wildlife agency recommendation is inconsistent with the purposes and the requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of the agency.

In response to our March 24, 2017, notice accepting the application to relicense the project and soliciting motions to intervene, protests, comments, recommendations, preliminary terms and conditions, and preliminary fishway prescriptions, Interior filed one section 10(j) recommendation on May 23, 2017, NMFS filed eight section 10(j) recommendations on May 23, 2017, and Maine DMR filed 39 section 10(j) recommendations on May 22, 2017. Table 24 lists the recommendations filed pursuant to section 10(j), and indicates whether the recommendations are included under the staff alternative, as well as the basis for our preliminary determinations concerning measures that we consider inconsistent with section 10(j). Environmental recommendations that we consider outside the scope of 10(j) have been considered under section 10(a) of the FPA and are addressed in the specific resource sections of this document.

Table 24. Analysis of fish and wildlife agency recommendations for the Mattaceunk Project.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Operate in a run-of-river mode, such that outflow approximately equals inflow, and impoundment water levels are maintained within 1.0 foot of the top of flashboard crest elevation (240.0 feet) during normal operations, and within 2.0 feet of the flashboard crest elevation (240.0 feet) for irregular circumstances (i.e., to allow adequate margin for debris loads, ice loads, or sudden pool increases that might cause flashboard failure), and up to 1.0 foot of the crest of dam elevation (236.0 feet) when replacing the flashboards.	NMFS, Interior, Maine DMR	Yes.	$0	Yes.
Develop plans to monitor impoundment water levels. The applicant shall consult with the resource agencies and USGS in developing these plans, and shall respond to agency comments and include their correspondence in future filings with the Commission. The applicant shall provide the resource agencies a minimum of 30 days to respond to draft plans before filing for Commission approval.	NMFS	Yes.	$432	Yes. Staff recommend the development of an operations monitoring plan, which would include plans to monitor impoundment water levels.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Continue to provide a year-round continuous minimum base flow of 1,674 cfs or inflow, whichever is less. Continue to provide a daily average minimum flow of 2,392 cfs from July 1 through September 30 and 2,000 cfs from October 1 through June 30, or average inflow, whichever is less.	NMFS, Maine DMR	Yes.	$0	Yes.
Develop a flow monitoring plan, in consultation with the resource agencies and USGS, that includes measures to: (1) install flow monitoring equipment in the project tailrace to confirm that minimum flow requirements are being met; and (2) make flow data electronically accessible consistent with USGS website format. The applicant shall provide a minimum of 30 days to respond to draft plans before filing for Commission approval.	NMFS	 Yes. No.[b]	$719	No. Staff recommend the development of an operations monitoring plan, which would include monitoring for minimum flows.
Conduct continuous stream temperature monitoring between April 1 and October 31 to assure that the dam and its operations do not intensify the effects of climate change that can affect smolt emigration, adult immigration, and juvenile development in nursery habitats downstream of the dam.	NMFS	No.[a]	$200	No. No nexus.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Operate each fishway for a “shakedown” period subsequent to any new fishway construction, or operational or structural modifications to existing fishways, and prior to the relevant fish passage season and pertinent effectiveness studies to ensure it is operating as designed and to make minor adjustments to facilities and operations, as needed.	Maine DMR	Yes (for the upstream eel ladder); No (for “shakedowns” following operational or structural modifications to existing fishways).[e]	$0	No. We recommend a “shakedown” period only subsequent to the installation of the upstream eel ladder.
Have a licensed engineer certify that fishways are constructed and operating as designed at the end of each “shakedown” period.		No.[b,e]	$0	No.
Provide the Maine DMR, FWS, and NMFS with a copy of the as-built fishway drawings for any new or modified fishways as submitted to the Commission, along with the licensed engineer's letter of certification.	Maine DMR	No.[b]	$0	No.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
The applicant shall, consistent with safe working practices, keep the fishways in proper working order and shall maintain fishway areas clear of trash, logs, and material that would hinder passage. Routine maintenance shall be performed sufficiently before a migratory period such that fishways can be tested and inspected, and will be operational during the migratory periods.	Maine DMR	Yes. Yes.	$10,259 (This is the cost to modify the FPOMP. Both measures would be included in the modified FPOMP.)	Yes. Included in our recommended modifications to the FPOMP. Yes. Included in our recommended modifications to the FPOMP.
In consultation with the Maine DMR, FWS, and NMFS, the applicant shall draft and maintain written Fishway Operating Procedures (FOPs) for the Mattaceunk Project. These FOPs will include general schedules of routine maintenance, procedures for routine operation, procedures for monitoring and reporting on the operation of each fish passage facility or measure, and schedules for procedures for annual start-up and shutdown, and procedures for emergencies and project outages significantly affecting fishway operations. Copies of these FOPs, and any revisions made during the term of the license, will be sent to the Maine DMR, FWS, and NMFS.	Maine DMR	Yes. No.[b]	$10,259 (This is the cost to modify the FPOMP. Both measures are covered by the modified FPOMP.)	Yes. This measure is consistent with our recommendation to modify the FPOMP. No. The modified FPOMP would be filed with the

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
				Commission and made available to the public.
Meet annually in March with the resource agencies to review fish passage operations data.	Maine DMR	No.[b]	$0	No, regarding Maine DMR's recommendation to meet annually in March.
Draft an annual report to include the number of fish passed daily (by species), daily water temperature, air temperature, and any other related fishway operational information.		No.[b]	$259	No, regarding Maine DMR's recommendation to count the number of fish passed daily for all species.
Draft a fishway operations plan for all fishways each year following the annual meeting to review fish passage operations.		No.[f]	$3,000	No. Fish passage operations and maintenance plans would be modified for the existing fishways, or developed for any new fishways. Once modified or developed, those plans can be modified in consultation, but new plans are not needed annually.
Once installed, applicant shall maintain and operate permanent fish ways during the upstream and downstream migration periods for: (1) Atlantic salmon;	Maine DMR	Yes.	$25,000 (for existing upstream passage for	Yes.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
			Atlantic salmon); $25,000 (for downstream passage for Atlantic salmon)	
(2) American shad, blueback herring, alewife; and		No.[h]	$233,981 (for new upstream fishway for shad)	No. Installation of the shad fishway is not recommended for reasons explained in section 5.1.3. We recommend reassessing the need for shad passage in year 14.
(3) American eel.[248]		Yes.	$14,323 (for upstream eel ladder); $313,000 (for downstream	Yes.

[248] The specific migration periods recommended by Maine DMR are discussed in section 3.3.1.2, *Aquatic Resources, Environmental Effects* for eel and alosines, and in section 3.3.3.2, *Threatened and Endangered Species, Environmental Effects* for Atlantic salmon.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
			passage operations for eel)	
Modify the fishway operating schedules during the term of the license based on migration data, new information, and in consultation with the Maine DMR, FWS, and NMFS. Upon request of licensee, the actual dates of operation may be varied in any given year in response to river conditions, maintenance requirements, or annual variability in fish migration patterns, with the approval of Maine DMR, FWS, and NMFS, as appropriate.	Maine DMR	No.[g]	$0	No.
Design, install and maintain, in consultation with NMFS and FWS, a seasonal upstream eel ramp within two years of the effective date of the new license to provide upstream passage for eel. The upstream eel passage facility shall be designed in consultation with the resource agencies, and resource agencies shall review the 30 percent, 60 percent and 90 percent drawings.	Maine DMR	Yes.	$14,323	Yes.
Monitor the seasonal upstream eel ramp for use and effectiveness during one eel passage season.	Maine DMR	Yes.	$1,297	Yes.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Install an upstream fishway for shad in year 15 of the new license, and operate the structure in year 16 of the new license. Monitor the upstream fishway for shad for two years, following the completion of construction. The new upstream fishway proposed by the applicant should be designed to ensure safe passage for sea lamprey.	Maine DMR NMFS	No.[h] No.[h] No.[h]	$233,981 $5,967 $0	No. We recommend reassessing the need for an upstream fishway for shad in year 14 of any new license. No. No.
Implement additional operational and structural modifications and/or habitat enhancement measures, if necessary, to provide eel and shad passage (passage criteria for eel and shad shall be based on a review of the performance of comparable fish passage measures in New England).	Maine DMR	No.[i]		No.[c]
Beginning in the first passage season following license issuance, the licensee shall institute annual nighttime turbine shutdowns (from 8 PM to 4 AM) in combination with installation of the 1-inch clear spacing full-depth trash racks and opening the project's	Maine DMR	Yes.	$626,000	No. Recommend night-time shutdowns that begin within 2 years of license issuance.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
roller gate in support of downstream migrating eel.				
Provide downstream passage for eel for 12 weeks from August 1 through October 31 each year.		Yes.		No. Recommend providing downstream passage for up to 6 weeks each year.
The licensee shall conduct two years of studies to determine the effectiveness of the nighttime shutdowns, coupled with installation of the full-depth trash racks with 1-inch clear spacing and water releases from the roller gate for passing eel downstream in a safe, timely, and effective manner.	Maine DMR	Yes.	$5,245	Yes.
Install trash racks that would have 1-inch clear bar spacing to the full depth of the turbine intakes, and would be installed seasonally during the downstream migration seasons for eel, shad, and Atlantic salmon.	Maine DMR	Yes.	$101,462	Yes, for eel. No, for shad and Atlantic salmon.
Begin installing the seasonal trash racks with 1-inch clear bar spacing to the full depth of the turbine intakes during the first passage season for Atlantic salmon and eel.		Yes.	$0	No. Recommend installing full-depth trash racks with 1-inch clear bar spacing within 2 years of license issuance.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Provide downstream passage for shad after the upstream fishway for shad is operational (expected in year 16), by: (1) operating the downstream fishway continuously from April 1 to December 1; and (2) by opening the sluice gate (between 3 percent [225 cfs] and 9 percent [690 cfs] of station hydraulic capacity) for a 3 week period between April 1 and June 15 (exact schedule determined in consultation with resource agencies and based on environmental factors), and between June 1 and November 30, as needed based on monitoring results.	Maine DMR	No.[h]	$342,000	No.
Continue to maintain and operate the existing upstream pool and weir fishway annually from May 1 to November 10 to provide passage for adult Atlantic salmon to spawning habitats upstream of Weldon Dam. Continue to provide counts of adult Atlantic salmon that exit the existing upstream fishway and enter the impoundment to resource agencies.	Maine DMR	Yes. No.[b]	$25,000 $0	Yes. No.
Continue to provide auxiliary attraction water to the existing upstream fishway entrance of 7 cfs via a gravity fed pipe.	Maine DMR	Yes.	$0 – costs are accounted for in the item	Yes.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
			immediately above.	
Coordinate with resource agencies to stock uniquely marked Atlantic salmon smolts upstream of Weldon Dam in the first three years after relicensing to serve as a source of imprinted adult fish (i.e., fish homing to areas upstream of Weldon Dam) used for studying upstream passage of adults and downstream passage of kelts.	Maine DMR	Yes.	$7,063	Yes.
Conduct up to three years of upstream fishway effectiveness testing and up to three years of downstream kelt studies using the returning imprinted adult fish.	Maine DMR	Yes.	$14,705	Yes.
Implement additional operational and structural modifications and/or habitat enhancement measures, if necessary, to address performance standard deficiencies for upstream migrating Atlantic salmon adults.	Maine DMR	No.[i]	$0 – costs would be included as part of the effectiveness monitoring for upstream and downstream passage (see table 23)	No.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Continue to maintain and operate the downstream fish passage facility to provide downstream passage for Atlantic salmon smolts (juveniles) and kelts (post-spawning adults) from April 1 to June 15 and Atlantic salmon kelts from October 17 to December 1.	Maine DMR	Yes.	$25,000	Yes.
Open the project's log sluice (between 3 percent and 9 percent of station hydraulic capacity, or between approximately 225 cfs and 690 cfs) starting the first passage season following relicensing in support of downstream Atlantic salmon smolt outmigration for a 3 week period during the spring that would be determined in consultation with resource agencies.	Maine DMR	Yes.	$37,250	Yes.
Conduct a minimum of three years of Atlantic salmon smolt downstream passage survival monitoring for existing fish passage operations, coupled with operation of the log sluice and implementation of the 1-inch clear spacing full-depth trash racks. Conduct up to 3 years of studies to assess the sources of impoundment mortality for Atlantic salmon smolts.	Maine DMR	Yes. No.[b]	$25,372 $0	Yes. No.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Implement an adaptive management plan to address performance criteria for downstream passage of Atlantic salmon, should the proposed measures be inadequate.	Maine DMR	No.[i]	$0 – costs would be included as part of the effectiveness monitoring for upstream and downstream passage (see table 23)	No. Staff recommends the SPP, which includes a proposal to implement adaptive management.
Implement additional operational and structural modifications and/or habitat enhancement measures, if necessary, to address outmigrating Atlantic salmon smolts and kelts.	Maine DMR	No.[i]	$0 – costs would be included as part of the effectiveness monitoring for upstream and downstream passage (see table 23)	No.
Develop a mitigation plan, in consultation with NMFS and resource agencies, for the loss of Atlantic salmon smolts as a result of maintaining the project impoundment.	NMFS	No.[d]	$432	No. A project effect on smolt mortality in the impoundment has not been identified, thus there is currently no nexus.

[a] Monitoring by itself would not provide any evidence intensifying the effects of climate change, and NMFS did not provide or recommend methodology for identifying potential temperature changes that would indicate an intensification exclusive of the effects of climate change. Therefore, the recommendation is unrelated to the proposed action.

[b] Not a specific fish and wildlife measure. Measure that does not specifically provide for the protection, mitigation, or enhancement of fish and wildlife resources.

[c] This is a measure that would be included in the effectiveness monitoring plans for eel passage and the SPP for Atlantic salmon. However, any future operational or structural modifications would require Commission approval prior to implementation.

[d] Measure that does not specifically provide for the protection, mitigation, or enhancement of fish and wildlife resources. This is a measure that cannot be defined at the present time, because the need for mitigation has not been identified. Stipulations that there should be beneficial measures without mention of the specific measures to be implemented are outside the scope of section 10(j), as are measures that cannot be defined until the occurrence of future events (e.g., excessive smolt mortality in the project impoundment).

[e] There is no reserved authority under section 10(j) for measures related to uncertain, future actions. The effectiveness of the existing fishways can be tested prior to license issuance. Therefore, the recommendation does not fall within the scope of section 10(j).

[f] This is not a specific fish and wildlife measure. The plans have yet to be developed, and the plans' provisions are generic and uncertain. In addition, there is no reserved authority under section 10(j) for future, uncertain actions.

[g] This is not a specific fish and wildlife measure. Modifying the operating schedules without specific limits would represent an uncertain future action. There is no reserved authority under section 10(j) for future, uncertain actions.

[h] Maine DMR's justification for the recommendation is based on conditions that do not warrant passage at the project at this time, and the expectation that conditions will be favorable in the future. Measures instituted at a time conditioned on future events (i.e., presence of shad) that might never occur, are outside the scope of section 10(j).

[i] Not a specific fish and wildlife measure. Further, there is no reserved authority under section 10(j) for measures related to uncertain, future actions.

5.4 CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2) of the FPA, 16 U.S.C., § 803(a)(2)(A), requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. We reviewed the following 22 comprehensive plans that are applicable to the Mattaceunk Project. No inconsistencies were found.

Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. (Report No. 35). April 1999.

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6.0 FINDING OF NO SIGNIFICANT IMPACT

If the Mattaceunk Project is issued a new license as proposed with the additional staff-recommended measures, the project would continue to operate while providing enhancements to aquatic resources, improvements to recreation facilities, and protection of cultural and historic resources in the project area.

Based on our independent analysis, we find that the issuance of a license for the Mattaceunk Project, with additional staff-recommended environmental measures, would not constitute a major federal action significantly affecting the quality of the human environment.

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8.0 LIST OF PREPARERS

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APPENDIX A

LICENSE CONDITIONS RECOMMENDED BY STAFF

In this section, we present draft license articles for staff-recommended measures:

Draft Article 201. *Administrative Annual Charges*. The licensee must pay the United States annual charges, effective the first day of the month in which this license is issued, and as determined in accordance with the provisions of the Commission's regulations in effect from time to time, to reimburse the United States for the cost of administration of Part 1 of the Federal Power Act. The authorized installed capacity for that purpose is 19.2 megawatts.

Draft Article 202. *Exhibit Drawings.* Within 45 days of the effective date of this license, as directed below, the licensee must file two sets of the approved exhibit drawings and geographic information system (GIS) data in electronic file format on compact disks with the Secretary of the Commission, ATTN: OEP/DHAC.

(a) Digital images of the approved exhibit drawings must be prepared in electronic format. Prior to preparing each digital image, the FERC Project-Drawing Number (i.e., P-2520-1001 through P-2520-10XX) must be shown in the margin below the title block of the approved drawing. Exhibit F drawings must be segregated from other project exhibits, and identified as **Critical Energy Infrastructure Information (CEII) material under 18 C.F.R. § 388.113(c)**. Each drawing must be a separate electronic file, and the file name must include: FERC Project-Drawing Number, FERC Exhibit, Drawing Title, date of this License, and file extension in the following format [P-2520-1001, G-1, Project Boundary, MM-DD-YYYY.TIF]. All digital images of the exhibit drawings must meet the following format specification:

IMAGERY – black & white raster file
FILE TYPE – Tagged Image File Format, (TIFF) CCITT Group 4 (also known as T.6 coding scheme)
RESOLUTION – 300 dots per inch (dpi) desired, (200 dpi minimum)
DRAWING SIZE FORMAT – 22” x 34” (minimum), 24” x 36” (maximum)
FILE SIZE – less than 1 megabyte desired

Each Exhibit G drawing that includes the project boundary must contain a minimum of three known reference points (i.e., latitude and longitude coordinates, or state plane coordinates). The points must be arranged in a triangular format for GIS georeferencing the project boundary drawing to the polygon data, and must be based on a standard map coordinate system. The spatial reference for the drawing (i.e., map projection, map datum, and units of measurement) must be identified on the drawing and each reference point must be labeled. In addition, each project boundary drawing must be stamped by a registered land surveyor.

(b) The project boundary GIS data must be in a georeferenced electronic file format (such as ArcView shape files, GeoMedia files, MapInfo files, or a similar GIS format). The filing must include both polygon data and all reference points shown on the individual project boundary drawings. An electronic boundary polygon data file(s) is required for each project development. Depending on the electronic file format, the polygon and point data can be included in single files with multiple layers. The georeferenced electronic boundary data file must be positionally accurate to ±40 feet in order to comply with National Map Accuracy Standards for maps at a 1:24,000 scale. The file name(s) must include: FERC Project Number, data description, date of this License, and file extension in the following format [P-2520, boundary polygon/or point data, MM-DD-YYYY.SHP]. The data must be accompanied by a separate text file describing the spatial reference for the georeferenced data: map projection used (i.e., Universal Transverse Mercator, State Plane, Decimal Degrees, etc.), the map datum (i.e., North American 27, North American 83, etc.), and the units of measurement (i.e., feet, meters, miles, etc.). The text file name must include: FERC Project Number, data description, date of this License, and file extension in the following format [P-2520, project boundary metadata, MM-DD-YYYY.TXT].

Draft Article 203. *Amortization Reserve*. Pursuant to section 10(d) of the Federal Power Act, a specified reasonable rate of return upon the net investment in the project must be used for determining surplus earnings of the project for the establishment and maintenance of amortization reserves. The licensee must set aside in a project amortization reserve account at the end of each fiscal year one half of the project surplus earnings, if any, in excess of the specified rate of return per annum on the net investment. To the extent that there is a deficiency of project earnings below the specified rate of return per annum for any fiscal year, the licensee must deduct the amount of that deficiency from the amount of any surplus earnings subsequently accumulated, until absorbed. The licensee must set aside one-half of the remaining surplus earnings, if any, cumulatively computed, in the project amortization reserve account. The licensee must maintain the amounts established in the project amortization reserve account until further order of the Commission.

The specified reasonable rate of return used in computing amortization reserves must be calculated annually based on current capital ratios developed from an average of 13 monthly balances of amounts properly included in the licensee's long-term debt and proprietary capital accounts as listed in the Commission's Uniform System of Accounts. The cost rate for such ratios must be the weighted average cost of long-term debt and preferred stock for the year, and the cost of common equity must 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).

Draft Article 204. *Headwater Benefits.* If the licensee's project was directly benefited by the construction work of another licensee, a permittee, or the United States on a storage reservoir or other headwater improvement during the term of the prior license (including extensions of that term by annual licenses), and if those headwater benefits were not previously assessed and reimbursed to the owner of the headwater improvement, the licensee must reimburse the owner of the headwater improvement for those benefits, at such time as they are assessed, in the same manner as for benefits received during the term of this new license. The benefits will be assessed in accordance with Part 11, Subpart B, of the Commission's regulations.

Draft Article 301. *Project Modification Resulting from Environmental Requirements*. If environmental requirements under this license require modification that may affect the project works or operations, the licensee must consult with the Commission's Division of Dam Safety and Inspections – New York Regional Engineer. Consultation must allow sufficient review time for the Commission to ensure that the proposed work does not adversely affect the project works, dam safety, or project operation.

Draft Article 302. *Contract Plans and Specifications*. At least 60 days prior to the start of any construction, the licensee must submit one copy of its plans and specifications and supporting design document to the Commission's Division of Dam Safety and Inspections (D2SI) – New York Regional Engineer, and two copies to the Commission (one of these must be a courtesy copy to the Director, D2SI). The submittal to the D2SI – New York Regional Engineer must also include as part of preconstruction requirements: a Quality Control and Inspection Program, Temporary Construction Emergency Action Plan, and Soil Erosion and Sediment Control Plan. The licensee may not begin construction until the D2SI – New York Regional Engineer has reviewed and commented on the plans and specifications, determined that all preconstruction requirements have been satisfied, and authorized start of construction.

Draft Article 304. *Cofferdam and Deep Excavation Construction Drawings*. Should construction require cofferdams or deep excavations, the licensee must: (1) review and approve the design of contractor-designed cofferdams and deep excavations prior to the start of construction; and (2) ensure that construction of cofferdams and deep excavations is consistent with the approved design. At least 30 days before starting construction of any cofferdams or deep excavations, the licensee must submit one copy to the Commission's Division of Dam Safety and Inspections (D2SI) – New York Regional Engineer and two copies to the Commission (one of these copies shall be a courtesy copy to the Commission's Director, D2SI), of the approved cofferdam and deep excavation construction drawings and specifications, and the letters of approval.

Draft Article 305. *As-built Drawings.* Within 90 days of completion of construction of the facilities authorized by this license, including a new upstream eelway and a new upstream shad fishway, the licensee must file for Commission approval, revised Exhibits A, F, and G, as applicable, to describe and show those project facilities as built. A courtesy copy must be filed with the Commission's Division of Dam Safety and Inspections (D2SI) – New York Regional Engineer, the Director, D2SI, and the Director, Division of Hydropower Administration and Compliance.

Draft Article 4XX. *Commission Approval, Filing Reports, Notification, and Filing of Amendments.*

(a) Resource Plan Requirements

Conditions found in Appendices X and X of this license require the licensee to prepare: (1) upstream and downstream American eel passage design plans (U.S. Fish and Wildlife Service [FWS] Condition 12.1); and (2) a fish passage operation and maintenance plan for American eel passage (FWS Condition 12.5.2) in consultation with FWS and the Maine Department of Marine Resources (Maine DMR). In addition, the National Marine Fisheries Service (NMFS) requires the licensee to: (1) construct upstream passage facilities for shad in year 15 of the license, which would be operational in year 16 (NMFS Condition 7.3.1.c); (2) install full-depth trash racks with 1-inch clear bar spacing (NMFS Condition 7.3.2.a); and (3) monitor the effectiveness of the upstream and downstream anadromous fish passage facilities (NMFS Conditions 7.3.1.d, 7.3.2.c, and 7.3.4). The conditions either do not provide for Commission approval, do not specify when the plan(s) would be filed with the Commission for approval, or do not specifically require the requisite design plans for the fish passage facilities. Therefore, the due date for filing each plan with the Commission is as specified below:

NMFS Fishway Prescription Condition No.	**FWS Fishway Prescription Condition No.**	**Plan Name**	**Due Date for Filing the Plan(s) with the Commission**
	12.1	Upstream American eel fishway design plan	Within 6 months of license issuance
	12.1	Downstream American eel fishway design plan (includes new full-depth trash rack with 1-inch clear bar spacing)	Within 6 months of license issuance
	12.5.2	Fishway operation and maintenance plan for upstream and downstream American eel passage	Within 6 months of license issuance

NMFS Fishway Prescription Condition No.	FWS Fishway Prescription Condition No.	Plan Name	Due Date for Filing the Plan(s) with the Commission
7.3.1.c		Upstream alosine *[shad]* fish passage design plan	December 31, 2032
7.3.2.a & 7.3.2.b		Downstream anadromous fish passage design plan (includes new full-depth trash rack with 1-inch clear bar spacing)	Within 6 months of license issuance
7.3.1.d & 7.3.4	12.6.1	Upstream diadromous fishway <u>effectiveness study plan(s) for:</u> ➢ Atlantic salmon & American eel ➢ Alosines *[shad]*	➢ Within 6 months of license issuance ➢ December 31, 2032
7.3.2.c & 7.3.4	12.6.2	Downstream diadromous fishway effectiveness study <u>plan(s) for:</u> ➢ Atlantic salmon & American eel ➢ Alosines *[shad]*	➢ Within 6 months of license issuance ➢ December 31, 2032

The licensee must include with each plan filed with the Commission documentation that the licensee developed the plan in consultation with FWS and Maine DMR, and received approval from FWS. Each such plan also must include a provision to file any resulting reports with the Commission, as well as the appropriate agency or agencies. In addition, each report must include any recommended additional operational and structural modifications and/or habitat enhancement measures to provide eel passage, if other proposed passage measures for eel are ineffective. The Commission reserves the right to make changes to any plan submitted. Upon Commission approval, the plan becomes a requirement of the license, and the licensee must implement the plan or changes in the project operation or facilities, including any changes required by the Commission.

(b) Requirement to Notify Commission of Planned and Unplanned Deviations from License Requirements, and Fulfilling License Requirements

One FWS fishway prescription condition in Appendix X and one NMFS fishway prescription condition in Appendix X would allow the licensee to modify the timing of seasonal American eel, Atlantic salmon, and shad fishway operations based on empirical passage timing data. The Commission must be notified as soon as possible in writing, but no later than 10 days after each such modification. Any modification(s) in the seasonal timing of fishway operation must be based on consultation with FWS, NMFS, Maine DMR, and the Penobscot Indian Nation. The Commission reserves the right to further modify the timing of fishway operations for any reason, including to address any any project or public safety concerns.

NMFS Fishway Prescription Condition No.	**FWS Fishway Prescription Condition No.**	**License Requirement**
7.3.3	12.5.1	Timing of seasonal fishway operation

(c) Requirement to File Amendment Applications

Certain conditions of NMFS's fishway prescription in Appendix X and FWS's fishway prescription in Appendix X contemplate unspecified long-term changes to project operation or facilities for the purposes of complying with the agencies' fishway prescriptions or mitigating environmental impacts (*e.g.*, Conditions 7.3.1 and 7.3.2 of NMFS's fishway prescription, and Condition 12.6.2 of FWS's fishway prescription require fishway effectiveness monitoring and potential additional protective measures or alternative actions to ensure that the design passage criteria are met. Such changes may not be implemented without prior Commission authorization granted after the filing of an application to amend the license.

Draft Article 4XX. *Operation Compliance Monitoring Plan*. Within 6 months of license issuance, the licensee must file with the Commission, for approval, an operation compliance monitoring plan that is based on the existing monitoring equipment approved by the Commission (55 FERC ¶ 62,259 (1991)). The plan must include, but not necessarily be limited to:

(1) a detailed description of how the project facilities will operate the project to comply with the requirements specified in Draft Article 4XX, *Project Operation,* during normal operation, and in the event of an emergency;

(2) a detailed description of how the licensee will monitor compliance with the operational requirements specified in Draft Article 4XX, *Project Operation,* including descriptions of the mechanisms and structures (*i.e.*, type and exact locations of all flow and impoundment elevation monitoring equipment and gages) used, and procedures for maintaining and calibrating monitoring equipment;

(3) a detailed description of how the licensee will monitor compliance with the minimum flow requirements specified in Draft Article 4XX, *Minimum Flow Requirements;*

(4) the methods and frequency for reporting monitoring data to the Commission, the Maine Department of Environmental Protection (Maine DEP), the Maine Department of Marine Resources (Maine DMR), Maine Department of Inland Fisheries and Wildlife, (Maine DIFW), National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (FWS), and U.S. Geological Survey (USGS); and

(5) an implementation schedule.

The licensee must include with the plan, documentation of consultation with Maine DEP, Maine DMR, Maine DIFW, NMFS, FWS, and USGS; copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies; and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee must allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons based on project-specific information.

For any temporary modifications of project operations, the licensee must include, as part of its emergency notification to the Commission, an incident report. The report must, to the extent possible, identify the cause, severity, and duration of the incident, and any observed or reported adverse environmental impacts resulting from the incident. The report also must include: (1) operational data necessary to determine compliance with the article; (2) a description of any corrective measures implemented at the time of the occurrence and the measures implemented or proposed to ensure that similar incidents do not recur; and (3) comments or correspondence, if any, received from Maine DEP, Maine DMR, Maine DIFW, NMFS, FWS, and USGS regarding the incident. Based on the report and the Commission's evaluation of the incident, the Commission reserves the right to require modifications to the project facilities and operations to ensure future compliance.

The Commission reserves the right to require changes to the monitoring plan. The licensee must not begin implementing the plan until the Commission approves the plan. Upon Commission approval, the licensee must implement the plan, including any changes the Commission required.

Draft Article 4XX. *Project Operation*. The licensee must operate the Mattaceunk Project in a run-of-river mode with pondage with year round use of the 4-foot-high flashboards such that outflow approximately equals inflow. The impoundment fluctuation limits must maintain the following impoundment surface elevation of:

(1) Within 1.0 foot of the top of the flashboards crest elevation of 240.0 feet (U.S. Geological Survey [USGS] datum) during normal operations;
(2) No lower than 2.0 feet below the flashboard crest elevation of 240.0 feet (USGS datum) when needed to allow an adequate margin for debris loads, ice loads, or sudden pool increases that might cause flashboard failure;
(3) Within 1.0 foot of the top of the dam crest elevation of 236.0 feet when flashboards are not in place (i.e., during flashboard replacement).

Water surface elevations may be temporarily modified if required by operating emergencies beyond the control of the licensee, or for short periods upon agreement among the licensee, the Maine Department of Environmental Protection (Maine DEP), the Maine Department of Marine Resources (Maine DMR), the National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (FWS). If water surface elevations or minimum flow releases are so modified, the licensee must notify the Commission, and Maine DEP, Maine DMR, NMFS, and FWS, no later than 10 days after each such incident, and file an incident report with the Commission, and Maine DEP, Maine DMR, NMFS, and FWS no later than 30 days after each such incident.

Draft Article 4XX. *Minimum Flow Requirements*. To protect the water quality and aquatic resources of the Penobscot River, the licensee must discharge from the Mattaceunk Project into the Penobscot River a continuous minimum flow of 1,674 cubic feet per second (cfs), or inflow, whichever is less, throughout the year and maintain a daily average minimum flow of 2,392 cfs from July 1 through September 30 and 2,000 cfs from October 1 through June 30, unless inflow is less than the stated daily average minimum flows, in which case outflow from the project must approximate inflow to the project.

These flow requirements may be temporarily modified if required by operating emergencies beyond the control of the licensee, or for short periods, upon agreement among the licensee and the Maine Department of Environmental Protection (Maine DEP), Maine Department of Marine Resources (Maine DMR), National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (FWS). If minimum flows are so modified, the licensee must notify the Commission and Maine DEP, Maine DMR, NMFS, and FWS, no later than 10 days after each such incident, and file an incident report with the Commission and Maine DEP, Maine DMR, NMFS, and FWS no later than 30 days after each such incident.

Draft Article 4XX. *American Eel Upstream and Downstream Passage Monitoring Plans*. In accordance with section 12.6 of the U.S. Department of the Interior's Fishway Prescription filed May 23, 2017, and attached to this license as Appendix B, the licensee must develop fish passage effectiveness monitoring plans for upstream American eel passage (section 12.6.1) and downstream American eel passage (section 12.6.2). In addition to the provisions included in the section 12.6 of the prescription, the licensee must include, with the effectiveness monitoring plan(s):

(1) goals and objectives of the monitoring;

(2) performance criteria for determining the success of the eel passage measures;

(3) methodology used to monitor the effectiveness and efficiency of the upstream and downstream passage measures;

(4) provisions to report the results of the monitoring (i.e., development of a report) and consulting with the agencies regarding the results (to including an annual meeting); and

(5) a provision to identify and implement (upon Commission approval) (a) additional monitoring studies, or (b) operational and structural modifications and/or habitat enhancement measures to provide eel passage, if, after 1 year of upstream monitoring and 2 years of downstream monitoring, the proposed passage measures for eel are ineffective at achieving the upstream and downstream effectiveness and survival performance criteria.

<u>Draft Article 4XX.</u> *Fish Passage Operations and Maintenance*. The licensee must operate and maintain, or provide for the operation and maintenance of all existing, and any new or modified upstream or downstream fish fishways.

Within 90 days of license issuance, the licensee must file, with the Commission for approval, a revised Fish Passage Operations and Maintenance Plan that is based on, and includes the provisions of the final Fish Passage Operations and Maintenance Plan, filed on August 31, 2016, with the following modifications:

The modifications to the Fish Passage Operations and Maintenance Plan include adding provisions to:

(1) Perform routine maintenance before the migration season, such that the existing fishways would be fully operational during the migratory period;

(2) Clear debris from the trash racks of all turbine intakes prior to the migration season, and determine the frequency of debris clearing during the migration season with final approval from the Commission;

(3) Monitor outflows from the downstream surface bypass pipe, using a method approved by the Commission, to detect debris blockages during the fish passage season;

(4) Include procedures for filing with the Commission for informational purposes, an annual report on the operation of the existing fishways and project generation;

(5) Develop and include shutdown procedures for the existing fishways; and

(6) Develop and include procedures for operation and maintenance of the existing fishways during emergencies and project outages.

All revisions to the Fish Passage Operations and Maintenance Plan must be developed after consultation with the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (FWS), and Maine Department of Marine Resources (Maine DMR), and Penobscot Indian Nation (PIN). The licensee must include with the plan documentation of consultation, copies of recommendations on the completed plan after it has been prepared and provided to the agencies above, and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee must allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the plan with the Commission for approval. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project specific information.

The Commission reserves the right to require changes to the Fish Passage Operations and Maintenance Plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Updates to the plan must be developed after consultation with NMFS, FWS, Maine DMR, and the PIN. The licensee must include with the updated plan, documentation of consultation, copies of recommendations on the completed report after it has been prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated in the updated plan. The licensee must allow a minimum of 30 days for the entities to comment and to make recommendations prior to filing the updated plan with the Commission for approval. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons based on project-specific reasons. The Commission reserves the right to require changes to the Fish Passage Operations and Maintenance Plan based on the updates. Updates to the plan must not begin until the licensee is notified by the Commission that the updates are approved. Upon Commission approval, the licensee must implement the updates to the plan, including any change required by the Commission.

The licensee must draft an annual report subsequent to the fish passage seasons for all fishways. The report must include periods of fishway operation, periods of fishway shutdowns, including unscheduled shutdowns, fishway maintenance. The licensee must provide the report to the NMFS, FWS, Maine DMR, and PIN and the Commission, and meet annually in March with NMFS, FWS, Maine DMR, and PIN, to the extent each entity is willing, to review the data.

The licensee must operate the upstream eel fishway for a "shakedown" period subsequent to construction. The "shakedown" period must occur prior to the relevant fish passage season and pertinent effectiveness studies.

Draft Article 4XX. *Upstream Shad Passage Report.* Within 14 years of license issuance, the licensee must file with the Commission, for approval, a report that analyzes the need for measures to pass shad upstream of the Mattaceunk Project. The report must be developed after consultation with the National Marine Fisheries Service (NMFS), the Maine Division of Marine Resources (Maine DMR), and the Maine Department of Environmental Protection (Maine DEP); and include: (1) a discussion of any recommendations by the licensee and NMFS, Maine DMR, and Maine DEP regarding the need for measures to pass shad upstream past the Mattaceunk Project; and (2) all relevant documentation of the licensee's consultation with NMFS, Maine DMR, and Maine DEP.

Draft Article 4XX. *Species Protection Plan*. Within 90 days of license issuance, the licensee must file, with the Commission for approval, a revised Species Protection Plan for the protection of Atlantic salmon. The plan must be based on, and include the provisions of, the final Species Protection Plan, filed on August 31, 2016, as Attachment A of Volume V of the Final License Application, with the following modifications:

(1) Remove the provision to seasonally install trash racks with 1-inch clear bar spacing to the full depth of the turbine intakes for the purpose of protecting smolts and kelts;

(2) Revise the upstream passage effectiveness study methodology to include the type of telemetry tag to be used on upstream migrating adults and the appropriate timing for stocking tagged smolts, and refile the Species Protection Plan with the revised study plan;

(3) Include the proposed passage effectiveness study plans as attachments to the Species Protection Plan;

(4) Determine the need for an additional 1 or 2 years of effectiveness studies, with final approval from the Commission, if the upstream fishway meets the 95 percent performance standard after the first year;

(5) Determine the need for future effectiveness studies, and/or fishway modifications, with final approval from the Commission, if after 3 years of upstream passage effectiveness studies, the upstream fishway does not meet the 95 percent effectiveness performance standard;

(6) Revise the number of downstream passage effectiveness studies for smolts to indicate that a minimum of 3 years of study would be conducted;

(7) Revise the criteria for achieving the performance standard to state that the performance standard would be considered achieved, if a total 3 years of downstream passage effectiveness studies for smolts demonstrate that the downstream passage facilities meet a 96 percent survival performance standard;

(8) Determine, with final approval from the Commission, when to begin implementation of phased spill measures for downstream passage of smolts, with the restriction that phased spill measures would be implemented after a minimum of 1 year and a maximum of 3 years of conducting downstream passage effectiveness studies for smolts, and non-spill passage measures;

(9) Determine, with final approval from the Commission, the 3 week period during which any phased spill measures would occur for downstream passage of smolts;

(10) Determine the need for an additional 1- or 2-years of downstream passage effectiveness studies for kelts, with final approval from the Commission, if the downstream fishway meets the 96 percent survival performance standard for kelts after the first year;

(11) Determine the need to conduct at least one year of additional effectiveness study, with final approval from the Commission, if the downstream fishway does not meet the 96 percent survival performance standard for kelts after the first year;

(12) Determine the need for future effectiveness studies, and/or fishway modifications, with final approval from the Commission, if after 3 years of downstream passage effectiveness studies, the downstream fishway does not meet the 96 percent survival performance standard for kelts;

(13) Remove the provision to conduct a study to evaluate smolt mortality in the project impoundment;

(14) Remove the provisions requiring reevaluation of upstream and downstream passage effectiveness every 10 years; and

(15) Add a provision to file an application to amend the license and get Commission approval, prior to implementing any future, and currently unspecified operational, structural, and/or habitat enhancement measures that may be used to improve passage and/or address performance criteria for upstream and downstream migrating Atlantic salmon.

All revisions to the Species Protection Plan must be developed after consultation with the NMFS (National Marine Fisheries Service), FWS (U.S. Fish and Wildlife Service), Maine DMR (Maine Department of Marine Resources), and PIN (Penobscot Indian Nation). The licensee must include with the plan, documentation of consultation, copies of recommendations on the completed plan after it has been prepared and provided to the agencies above, and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee must allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Updates to the Species Protection Plan must be developed after consultation with the NMFS, FWS, Maine DMR, and PIN. The licensee must include with the updated plan documentation of consultation, copies of recommendations on the updated plan after it has been prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated in the updated plan. The licensee must allow a minimum of 30 days for the entities to comment and to make recommendations prior to filing the updated plan with the Commission for approval. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons based on project-specific reasons. The Commission reserves the right to require changes to the Species Protection Plan based on the updated plan.

<u>Draft Article 4XX.</u> *Reservation of Authority to Prescribe Fishways*. Authority is reserved to the Commission to require the licensee to construct, operate, and maintain, or provide for the construction, operation, and maintenance of such fishways as may be prescribed by the Secretaries of the Interior or Commerce pursuant to section 18 of the Federal Power Act.

<u>Draft Article 4XX</u>. *Downstream Angler Access Area Improvements.* Within three years of the effective date of this license, the licensee must complete installation of the following improvements at the Downstream Angler Access Area: (1) a pulley system to assist boaters with moving car top boats and other small watercraft up and down the existing stairs; and (2) a ramp adjacent to the existing recreation pavilion to provide wheel chair access to the pavilion and its associated picnic table. Within 90 days of completion, the licensee must file with the Commission a report documenting the completed recreation improvements. The documentation may include photographs, aerial photographs, as-built drawings, or other means, provided that the documentation clearly

demonstrates the recreation improvements have been constructed in substantial conformity as approved.

Article 4XX. *Recreational Facilities*. The licensee must operate and maintain the following recreational facilities for the term of the license: (1) the existing canoe portage located on the western side of the impoundment with a take-out about 650 feet upstream from the dam and put-in below the dam; and (2) the Downstream Angler Access Area, located on the east bank of the Penobscot River which includes angler access via stairs from the parking area to the river, a covered picnic area adjacent to the parking area, and parking for six to eight vehicles.

Draft Article 4XX. *Programmatic Agreement and Historic Properties Management Plan*. The licensee must implement the "Programmatic Agreement between the Federal Energy Regulatory Commission and the Maine State Historic Preservation Officer for Managing Historic Properties that may be affected by Issuing a License to Great Lakes Hydro America, LLC for the Operation of the Mattaceunk Hydroelectric Project in Aroostook and Penobscot Counties, Maine," executed on ________ by the Maine State Historic Preservation Officer (SHPO), and including but not limited to the Historic Properties Management Plan (HPMP) for the project. Pursuant to the requirements of this Programmatic Agreement, the licensee must file, for Commission approval, a HPMP within one year of issuance of this order. When filing the HPMP for Commission approval, the licensee must include documentation of consultation with the Maine SHPO and the Penobscot Indian Nation Tribal Historic Preservation Officer (THPO) during the development of the HPMP.

The Commission reserves the authority to require changes to the HPMP at any time during the term of the license. If the Programmatic Agreement is terminated prior to Commission approval of the HPMP, the licensee must obtain approval from the Commission, the Maine SHPO, and the Penobscot Indian Nation THPO before engaging in any ground-disturbing activities or taking any other action that may affect any historic properties within the project's area of potential effects.

Draft Article 4XX. *Use and Occupancy*. (a) In accordance with the provisions of this article, the licensee has 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 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 has the continuing responsibility to supervise and control the use 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 must take any lawful action necessary to correct the violation. For a permitted use or occupancy, that action includes, if necessary, canceling 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 water craft at a time and where said facility is intended to serve single-family type dwellings; (3) embankments, bulkheads, retaining walls, or similar structures for erosion control to protect the existing shoreline; and (4) food plots and other wildlife enhancement. 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 must also ensure, to the satisfaction of the Commission's authorized representative, that the use 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 must: (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 impoundment 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 or roads where 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 impoundment. No later than January 31 of each year, the licensee must file with the Commission 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. No report filing is required if no conveyances were made under paragraph (c) during the previous calendar year.

(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 certification 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 water craft at a time and are located at least one-half mile (measured over project waters) from any other private or public marina; (6) recreational development consistent with an 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 project waters at normal 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 60 days before conveying any interest in project lands under this paragraph (d), the licensee must file a letter with the Commission, 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 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 Commission's authorized representative, 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 must 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 must determine that the proposed use of the lands to be conveyed is not inconsistent with any approved report on recreational resources of an Exhibit E; or, if the project does not have an approved report on recreational resources, that the lands to be conveyed do not have recreational value.

(3) The instrument of conveyance must include the following covenants running with the land: (i) the use of the lands conveyed must not endanger health, create a nuisance, or otherwise be incompatible with overall project recreational use; (ii) the grantee must 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; and (iii) the grantee must not unduly restrict public access to project lands or waters.

(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 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 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.

APPENDIX B

U.S. DEPARTMENT OF THE INTERIOR'S SECTION 18 PRELIMINARY FISHWAY PRESCRIPTIONS

RESERVATION OF AUTHORITY TO PRESCRIBE FISHWAYS

In order to allow for the timely implementation of fishways, including effectiveness measures, the Department reserves its authority through the Commission's inclusion of the following condition in any license(s) it may issue for the Project:

> Pursuant to Section 18 of the Federal Power Act, the Secretary of the Interior herein exercises his authority under said Act by reserving that authority to prescribe fishways during the term of this license and by prescribing the fishways described in the Department of Interior's Prescription for Fishways at the Mattaceunk Hydroelectric Project.

PRELIMINARY PRESCRIPTION FOR FISHWAYS

Pursuant to Section 18 of the Federal Power Act, as amended, the Secretary of the Department of Interior, as delegated to the Service, hereby exercises his authority to prescribe the construction, operation and maintenance of such fishways as deemed necessary.

Fishways shall be constructed, operated, and maintained to provide safe, timely and effective passage for American eels at the expense of the Licensee. To ensure the immediate and timely contribution to the restoration and enhancement of American eel in the Penobscot River upstream of the Mattaceunk Project, the following are included and shall be incorporated by the Licensee to ensure the effectiveness of the fishways pursuant to section 1701(b) of the 1992 National Energy Policy Act (P.L. 102-486, Title XVII, 106 Stat. 3008).

12.1 <u>TIMING OF PASSAGE IMPLEMENTATION</u>

American eel are currently present in the Penobscot River watershed and at the Mattaceunk Project and would benefit from immediate implementation of safe, timely, and effective upstream and downstream passage. The Commission will need to include appropriate license articles requiring preparation of detailed design plans, installation schedules and studies to evaluate effectiveness of all upstream and downstream measures to be developed in consultation with the Service and other resource agencies. In order to allow for proper consultation with resources agencies and approval by the Commission of all design plans, permanent American eel upstream and downstream passage must be operational no later than 2 years after the date of issuance of a new license.

12.2 DESIGN CRITERIA

12.2.1 DESIGN POPULATION

The Licensee will design upstream and downstream fish passage for American eels that is sufficient to pass all available upstream and downstream migrating eels that arrive at the Project.

The total number of American eels reaching the Projects depends on a number of factors, including the overall efficiency and cumulative losses of eels attempting to migrate upstream at the Milford, Orono, Stillwater, and West Enfield Dams. The Service does not have a precise estimate of the number of eels that would be expected to use upstream fish passage at the Project. Given the cumulative effect from the dams below the Project and the presence of eel at the Project, fish passage will enhance the American eel population of the western Atlantic Ocean and adjacent continental waters and assist towards achieving state and regional management goals.

12.2.2 AMERICAN EEL PASSAGE EFFICIENCY

The Licensee shall operate the Project to minimize the impact of the Project on upstream migration for juvenile American eel that approach the Project tailwater and spillway. Numerical criteria for upstream American eel passage attraction efficiency may be developed in the future when additional information about eel abundance and movement in the vicinity of the Project becomes available. Once eels have entered an eel ramp, 90 percent must move upstream and exit within 24 hours, based upon standard eel ramp evaluation methods developed by the Service and MDMR for eel ramp fishways at Maine hydroelectric projects (FERC No's. 2555, 2556, 2364, 2365, 2611, 2574, 2322, 2325, 5073, 2942, 2984, 2931, 2941, and 2932).

The Licensee shall operate the Project to exceed the minimum downstream survival efficiency criterion of 76 percent of the adult (i.e. silver) American eel moving downstream past the Project. This performance standard is based upon Sweka et al. (2014) which indicates that cumulative silver eel survival passing three to four dams—in this case, Mattaceunk, West Enfield dams followed by either Milford dam for eels passing down the main stem, or the Stillwater and Orono dams for eels passing down the Stillwater Branch of the river – must exceed a minimum of 76 percent at each dam, and must be higher to rebuild the American eel population.

12.3 UPSTREAM EEL PASSAGE

Within two years of License issuance, the Licensee shall design and construct an eel upstream passage ramp at the west abutment of the spillway. The exact location of this eel fishway and other design criteria to be determined by the U.S. Fish and Wildlife Service following consultation with the licensee and Maine Department of Marine

Resources. The design shall be consistent with Service eel passage design criteria contained in the *2017 Fish Passage Engineering Design Criteria Manual* (USFWS 2017).

12.4 DOWNSTREAM EEL PASSAGE

Licensee shall shutdown all generation nightly (8 pm to 4 am) from August 1 through October 31 annually to provide out-migrating American eels safe and timely downstream passage. Licensee shall install full depth one inch trash racks, as either permanent structures or seasonal overlays, during the downstream eel passage operations.

12.5 FISHWAY OPERATION AND MAINTENANCE

12.5.1 OPERATING DATES

The Licensee shall operate the upstream eel fishway during the months of June through August. The Licensee shall operate the downstream eel fishway during the months of August through October. The seasonal schedule for downstream eel passage operations may be modified in consultation with agencies based upon empirical passage timing data developed for the Project and/or a predictive model for eel movement through the Project waters.

12.5.2 FISHWAY OPERATION AND MAINTENANCE PLAN

Within 12 months of license issuance, Licensee will develop a Fishway Operation and Maintenance Plan (FOMP) covering all operations and maintenance of the upstream and downstream fish passage facilities provided for American eel. The FOMP shall be submitted to the Service for review and approval. Thereafter, Licensee will keep the FOMP updated on an annual basis, to reflect any changes in fishway operation and maintenance planned for the year. If the Service requests a modification of the FOMP, Licensee shall amend the FOMP within 30 days of the request and send a copy of the revised FOMP to the Service. Any modifications to the FOMP by Licensee will require approval by the Service prior to implementation. Licensee shall provide information on fish passage operations, and Project generating operations that may affect fish passage, upon written request from the Service. Such information shall be provided within 10 days of the request, or upon a mutually agreed upon schedule.

12.6 FISH PASSAGE EFFECTIVENESS MONITORING PLAN

Efficiency testing of both upstream and downstream American eel passage is critical to evaluating the success of the passage structures and operations, diagnosing problems, and determining when fish passage modifications are needed and what modifications are likely to be effective. It is essential to ensuring the effectiveness of fishways over the term of the license, particularly in cases where the changing size of fish populations may also change fish passage efficiency or limit effectiveness.

12.6.1 UPSTREAM AMERICAN EEL EFFECTIVENESS MONITORING

The Licensee will develop a Fishway Effectiveness Monitoring Plan (Upstream Plan) in consultation and with the approval of the Service and submit the Upstream Plan to the FERC for approval within six months of license issuance. The Upstream Plan shall include an upstream efficiency study on juvenile American eel at the new upstream eel fishway to determine the upstream passage efficiency of the fishway throughout the upstream migration season.

The Upstream Plan shall include the standard methods required by the Service and MDMR for eel ramp fishways at Maine hydroelectric projects on the Kennebec and Presumspcot Rivers (FERC No's. 2555, 2556, 2364, 2365, 2611, 2574, 2322, 2325, 5073, 2942, 2984, 2931, 2941, and 2932), and other projects. These standard study methods consist of two components; (1) evaluating attraction efficiency to the facility, and (2) evaluating effectiveness passing eels that have entered the upstream eel passage structure. Attraction efficiency shall be assessed with nighttime observations of migrating eels at the Project in comparison to the number of eels passed. Attraction shall be assessed on a minimum of three nights during the first year of operation. Passage effectiveness shall be assessed with captive eels placed in a holding tank at the fishway entrance. A minimum of 100 eels shall be used in the study and 90 percent must pass the fishway within 24 hours, a criterion developed by MDMR and used to assess all of the eel ramps installed at dams on the Kennebec and Presumpscot Rivers, and at other projects.

12.6.2 DOWNSTREAM AMERICAN EEL EFFECTIVENESS MONITORING

The Licensee will develop a Downstream Passage Effectiveness Monitoring Plan (Downstream Plan) in consultation and with the approval of the Service and submit the Downstream Plan to the FERC for approval within six months of license issuance. The Downstream Plan shall demonstrate that downstream passage survival meets the criterion in Section 12.2.2. If this passage rate is not met, then Licensee and the Service will assess passage enhancements including, but not limited to, an extended passage season, 0.75 inch trash rack spacing, a deep bypass gate, or new downstream eel passage facilities based upon angled trash racks (Sojkowski 2017, entire). Licensee will implement the solution selected by the Service.

The Service recommends that silver eel passage effectiveness monitoring be conducted with radio telemetry methods in order to determine migratory delay, route of downstream passage (i.e. via the two surface bypasses, the roll gate, spill, turbines, or spillway), immediate survival, and latent survival passing Mattaceunk Dam.

12.7 <u>FISHWAY INSPECTIONS</u>

The Licensee will provide Service personnel and other Service-designated representatives, timely access to the fish passage facilities at the Project and to pertinent Project operational records for the purpose of inspecting the fishways to determine compliance with the Fishway Prescription.

APPENDIX C

NMFS'S SECTION 18 PRELIMINARY FISHWAY PRESCRIPTIONS

7.3 Section 18 Preliminary Fishway Prescription

We hereby submit the following preliminary fishway prescriptions pursuant to Section 18 of the FPA, 16 USC §811. Section 18 of the FPA states in relevant part that, "the Commission must require the construction, maintenance, and operation by a Licensee of...such fishways as may be prescribed by the Secretary of Commerce or the Secretary of the Interior." Congress provided guidance on the term "fishway" in 1992 when it stated as follows:

> "The items which may constitute a 'fishway' under Section 18 for the safe and timely upstream and downstream passage of fish must be limited to physical structures, facilities, or devices necessary to maintain all life stages of such fish, and Project operations and measures related to such structures, facilities, or devices which are necessary to ensure the effectiveness of such structures, facilities, or devices for such fish." Pub.L. 102-486, Title XVII, § 1701(b), Oct. 24, 1992.

The following mandatory fishway prescriptions are based on the best biological and engineering information available at this time, as described in the explanatory statements that accompany each prescription. This prescription has been developed over a period of several years by our biological and engineering staff, in close consultation with the Licensee, the USFWS and other entities that participated in this relicensing proceeding. Each prescription is supported by substantial evidence contained in the record of pre-filing consultation, and subsequent updates, compiled and submitted in accordance with the Commission's procedural regulations. The explanatory statements included with each prescription are intended to summarize the supporting information and analysis upon which these prescriptions are based. We include an index to the administrative record for this filing herein, and reserve the right to file updated and supplemental supporting information in conjunction with comments submitted on our preliminary prescription.

7.3.1 Upstream Fish Passage – Anadromous Species

The Licensee shall construct, operate and maintain upstream fish passage facilities that pass anadromous fish species in a safe, timely and effective manner consistent with the performance standards described in Section 7.3.4. Based on the fish passage alternative report filed in the FLA, and the best scientific information available at this time, we believe that any one of the following fishways could be satisfy the standard of safe, timely and effective: a nature-like fishway, fish lift, or vertical slot fishway for alosines and Atlantic salmon in conjunction with the existing pool and weir fishway for

Atlantic salmon. We also consider ice harbor fishways to be an acceptable design for passing alosines because they are successful at passing American shad at projects on the U.S. West Coast. However, because the fishway will not be built for another 15 years, and because new studies and testing will occur during this interim time period, the specific performance criteria by which safe, timely and effective passage will ultimately be determined pursuant to the process identified in section 7.3.5.

The Licensee shall keep the fishways in proper order and shall keep fishway areas clear of trash, logs, and material that would hinder passage. Anticipated maintenance shall be performed in sufficient time before a migratory period such that fishways can be tested and inspected and will properly operate prior to the migratory periods.

The Licensee proposed the following actions to increase survival of upstream migrating anadromous fish:

a. Maintain the existing pool and weir fishway for Atlantic salmon.

b. Additional operational and structural modifications and/or habitat enhancement measures, if necessary, to address performance standard deficiencies for upstream migrating Atlantic salmon adults.

c. Installation of an effective upstream passage structure for alosine species in year 15 of the new license, to be operational year 16.

d. Conduct up to three years of upstream passage monitoring for Atlantic salmon and two years of upstream passage monitoring of alosines.

e. Additional operational and structural modifications and/or habitat enhancement measures, if necessary, to provide alosine passage (passage criteria for alosine shall be based on a review of the performance of comparable fish passage measures in New England).

We incorporate by reference the GLHA proposed measures in this prescription and further require the following:

- Maintain the trap associated with the existing pool and weir fishway for Atlantic salmon.

- Additional protective measures or alternative actions (e.g., additional fishway entrances, increased attraction flows) may be necessary based on monitoring, and as determined by the resource agencies, to address performance standard deficiencies for upstream migrating Atlantic salmon and alosines.

Additional protective measures or alternative actions (e.g., spillage, turbine shutdowns) may be necessary for Atlantic salmon pending analysis of the Commission's proposed action under section 7 of the ESA and conclusions of our anticipated Biological Opinion.

7.3.2 Downstream Fish Passage – Anadromous

The Licensee shall construct, operate and maintain downstream fish passage facilities for anadromous fish species that provide safe, timely and effective downstream passage consistent with the performance standards described in Section 7.3.5. The downstream passage facility shall be comprised of a protective barrier leading to a bypass system. The bypass system shall be comprised of (1) a surface entrance leading to a pipe or sluice to convey fish around the project and discharge to flowing water below the project such as the tailrace with sufficient depth (at least 4 ft.) to avoid injury (USFWS 2017) and (2) increased spill through an opening (e.g., log sluice) adjacent to the powerhouse discharging to flowing water below the project with sufficient depth (at least 4 ft.) to avoid injury. Downstream passage facilities shall be operational within two years after the issuance of a new license. The Licensee shall keep the downstream passage facilities in proper order and clear of trash, logs, and material that would hinder passage Anticipated maintenance shall be performed in sufficient time before a migratory period such that fishways can be tested and inspected and will operate effectively prior to the migratory periods.

The Licensee proposed the following actions to improve survival of downstream migrating anadromous fish:

a. Installation of trash racks having 1-inch clear spacing to the full depth of all turbine intakes within two years of license issuance. The trash racks would be deployed during the fish passage season.

b. Beginning in the first passage season following license issuance, operate existing downstream fishway plus open the log sluice (between 3% and 9% of station capacity or between 225 cfs and 690 cfs) for three weeks. The schedule will be determined in consultation with agencies and based on environmental factors including river temperatures and flows.

c. Conduct up to three years of downstream passage monitoring for Atlantic salmon and two years of downstream passage monitoring of alosines.

d. Annual extended seasonal operation of the downstream fishway and log sluice operation (~225 cfs and 690 cfs) from June 1 to December 1, as necessary based on smolt and alosine study results, once upstream passage for alosines (American shad and river herring) is operational (expected year 16 of a new license term).

e. Implement an adaptive management plan to address performance criteria for downstream passage should the proposed measures be inadequate.

f. Additional operational and structural modifications such as spill and/or habitat enhancement measures, if necessary, to address performance standard deficiencies for outmigrating Atlantic salmon smolts and kelts, and alosines.

We incorporate by reference GLHA proposed measures in this prescription and prescribe the following additional measures:

- Additional protective measures or alternative actions such as additional spill or intakes screening sufficient to attain performance standards for outmigrating Atlantic salmon smolts and kelts, and alosines. Additional protective measures for Atlantic salmon will be determined during the section 7 consultation with FERC regarding the issuance of a new license for the Project.

- Point measurements of approach velocities immediately upstream of the intakes and trash racks shall not exceed 2.0 feet per second (fps) within a 2-foot square grid as measured within 6 to 12 inches upstream of the racks. Point measurement data will be made available to the NMFS and the resource agencies as part of the annual monitoring requirements.

The proposed actions, including the modifications identified above, provide a reasonable approach for mitigating project impacts on downstream migrating anadromous fish. Additional measures, such as increasing the amount of spill, specific to Atlantic salmon may also be required depending on outcome of the ESA section 7 consultation and requirements of any Incidental Take Statement issued as part of the anticipated Biological Opinion.

7.3.3 Seasonal Migration Windows

Fishways shall be operational during the migration windows for each life stage of Atlantic salmon (adults, kelts and smolts), and adults and juveniles of American shad, blueback herring, and alewife. These dates may change based on new information and agency consultation. The migratory seasons for anadromous fish are well known in the major rivers of the Northeast (Loesch 1987, ASMFC 2000). Based on state-wide and Penobscot River watershed specific data, approved fish passage protective measures shall be operational during the follow migration windows:

a. Upstream alosine (once construction of the new fishway is complete): May 1 to July 31

b. Upstream Atlantic salmon: May 1 – Nov 10 unless the Milford fishways begins capturing fish earlier in the calendar year in which case the fishway will open prior to May 1

c. Downstream alosine (once construction of the new fishway is complete): June 1 –November 30

d. Downstream kelt: April 1 to June 15 and October 17 – December 1

e. Downstream smolt: April 1 to June 15

7.3.4 Passage Performance Standards and Monitoring

The degree to which fish passage facilities are considered safe, timely and effective will be evaluated based on performance criteria. Fishways (upstream and downstream) must operate in a way that complies with any Incidental Take Statement issued as part of the anticipated Biological Opinion. A performance standard of 95% for adult Atlantic salmon upstream passage and 96% for downstream passage of Atlantic salmon smolts and kelts is identified in GLHA's proposed Species Protection Plan. This proposal is consistent with requirements for other projects in the Penobscot River. We note that the upstream and/or downstream passage standards may be modified by the Incidental Take Statement in any Biological Opinion issued by us for this project. When analyzing telemetry test data, individual salmon (smolt or kelt) must pass the project forebay area within 24 hours in order for it to be considered a successful passage attempt that can be applied towards the downstream passage performance standard (i.e., if a fish takes longer than 24 hours it will not be considered to have passed successfully). The project forebay area is defined as 200 meters upstream of the trash racks to approximately 1 mile downstream of the powerhouse. When analyzing telemetry test data, we anticipate the upstream passage performance standard of 95% will be considered achieved if: 1) 75% of adult test fish pass the project area within 48 hours of approaching the dam; and 2) the remaining 20% of test fish pass the project within 96 hours. The project area is defined as 200 meters downstream of the project dam/powerhouse to the upstream fishway exit. In the event that monitoring results indicate that fishways at the project do not meet the performance criteria for Atlantic salmon, additional operational and structural modifications (e.g., spill) and/or habitat enhancement measures shall be required as determined by the resource agencies and as specified in the adaptive management steps contained in the Atlantic salmon Species Protection Plan or as modified by the Incidental Take Statement in any Biological Opinion issued by NMFS for this project.

Preliminary modelling results from Stich et al. (*in review*) indicate that once passage is provided at a dam, high upstream and downstream passage survival of American shad is necessary, including at the Mattaceunk Project, to reach and maintain population management goals. Fishways that are able to pass shad are able to pass alosines given similarities in swimming performances and behavior (USFWS 2017); accordingly, we have prescribed a fishway that can pass shad in a safe, timely and effective manner. To achieve stated recovery goals for alosines upstream of the Mattaceunk Project, we will require that the Licensee meet fish passage performance standards for American shad and river herring. Because we are not requiring construction of the new fishway until 2034, and the performance standards need to be based on the best available information at that time, we will delay establishing the performance standards until we can determine what is safe, timely and effective upstream and downstream passage for alosines. Based on currently available information (Stich et al. *in review*), we anticipate that safe, timely and effective passage for shad and river herring is likely to mean that 90% of alosine must pass upstream of the project within 24 hours (and survive the passage attempt) and that 95% of alosines must pass downstream of the project (and survive the passage attempt). This, however may change in the next several years. In the event that monitoring results indicate that fishways at the project do not meet the established performance criteria for American shad or river herring, additional operational and structural modifications (as described above) shall be required as determined by the resource agencies in consultation with the Licensee.

The Licensee shall monitor the ability of Atlantic salmon, American shad, blueback herring and alewife to use the upstream and downstream fish passage facilities. Monitoring for all fish passage facilities is required to ensure they function as designed and intended for providing safe, timely and effective passage. This includes pre-season inspection and maintenance consistent with measures described in 7.3.1 for upstream fishways and 7.3.2 for downstream fishways. Monitoring will help identify potential issues and deficiencies that may affect successful passage. Monitoring should include behavioral responses, numbers and species passing, and condition of the fish passing through the facilities. Based on the results of monitoring, structural or operational modifications may be required to meet the goals of the prescription (FERC 1993, 2004). In this case, we expect that structural or operational modifications would be required if the performance standards outlined in section 7.3.5 are not met.

The Licensee proposed to conduct the following monitoring studies:

a. Atlantic salmon - up to three years of monitoring for the upstream fishway effectiveness, downstream kelt studies using the returning imprinted adult fish, and smolt downstream passage measures.

b. Alosine - two years of monitoring for the new upstream and downstream measures.

c. American eel - one year of monitoring for the upstream eel ramp and two years of monitoring of downstream eel passage.

The proposed timeframes are acceptable; however, additional years may be needed in the event of poor passage performance, extreme weather, or inadequate sampling methodologies. Specific to Atlantic salmon, additional monitoring may be necessary and will be described in any appropriate Incidental Take Statement issued as part of the anticipated Biological Opinion. In addition to the Licensee's proposal, the following is required:

- Study design plans will be developed in consultation with NMFS and state and federal resource agencies. The study design shall be approved by the agencies prior to filing with the Commission for final approval.
- All monitoring will be completed with scientifically accepted practices.
- Monitoring shall begin at the start of the first migratory season after the each fishway facility (Atlantic salmon, alosines and American eel) is operational and shall continue to be conducted for the time frames proposed or as otherwise required.
- Reports of the monitoring studies shall be provided to the resource agencies for a minimum 30-day review and consultation prior to submittal to the Commission for final approval.
- The Licensee shall include resource agencies' comments in the annual reports submitted to the Commission for final review.

7.3.5 Fishway Design Review

The Licensee shall submit design plans to the resource agencies for review and consultation during the conceptual, 30, 60 and 90 percent design stages. Conceptual designs shall be provided to the agencies no later than two years before the anticipated operational date. Conceptual designs for the proposed full-depth 1" clear trash racks shall be provided at least six months prior to the first downstream passage season following issuance of any new license by FERC. Following resource agency approval, the Licensee shall submit final design plans to the Commission for final approval prior to the commencement of fishway construction activities; this filing must include all unaddressed resource agency comments. Once the fishway is constructed, final as-built drawings that accurately reflect the project as constructed should be filed with us and the USFWS.

7.4 Reservation of Authority

This preliminary prescription was developed in response to the proposals being considered by the Commission in this proceeding, our current policies and mandates, and our understanding of current environmental conditions at the Project. If any of these factors change over the term of the license, then we may need to alter or add to the measures prescribed in this licensing process. Therefore, we hereby reserve authority under Section 18 of the FPA to prescribe such additional or modified fishways at those locations and at such times as we may subsequently determine are necessary to provide for effective upstream and downstream passage of anadromous fish through the Project facilities, including without limitation, our authority to amend the following fishway prescriptions upon approval by us of such plans, designs, and completion schedules pertaining to fishway construction, operation, maintenance, and monitoring as may be submitted by the Licensee in accordance with the terms of the license articles containing such fishway prescriptions. We propose to reserve authority by requesting that the Commission include the following condition in any license it may issue for the Project:

> *Pursuant to Section 18 of the Federal Power Act, the licensee shall build the fishways described in the National Marine Fisheries Service' Prescription for Fishways at the Mattaceunk Project (FERC No.2520). The Secretary of Commerce reserves his authority to prescribe additional or amended fishways as he may decide are required in the future.*