Appendix 11

Preliminary Terms and Conditions, Section 18 Preliminary Prescriptions

a) USFWS Terms and Conditions Letter to FERC (August 27, 2020)
b) NMFS Terms and Conditions Letter to FERC (August 28, 2020)

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
5 Post Office Square, Suite 18011
Boston, Massachusetts 02109

August 27, 2020

9043.1
ER 20/0280

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

RE: COMMENTS, RECOMMENDATIONS, PRELIMINARY TERMS AND CONDITIONS, AND PRELIMINARY PRESCRIPTIONS
Application Ready for Environmental Analysis,
Shawmut Hydroelectric Project, FERC No. 2322-069
Kennebec River, Kennebec and Somerset Counties, Maine

Dear Secretary Bose:

The U.S. Department of the Interior (Department) has reviewed the Federal Energy Regulatory Commission's (Commission and FERC) Notice of Application Accepted for Filing, Soliciting Motions to Intervene and Protests, Ready for Environmental Analysis and Soliciting Comments, Recommendations, Preliminary Terms and Conditions, and Prescriptions, dated July 1, 2020, for the Shawmut Project (FERC No. 2322) (Project), located in Kennebec and Somerset Counties, Maine. In response to the public notice, the Department is filing its comments, recommendations, and preliminary terms and conditions, and preliminary prescriptions for the Project pursuant to sections 18 and 10(j) of the Federal Power Act (FPA). The Department's submittal represents comments prepared by the U.S. Fish and Wildlife Service (Service) in consultation with the Bureau of Indian Affairs, National Park Service and the U.S. Geological Survey. This response is provided in accordance with the provisions of the Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq.*), the Federal Power Act (FPA), (16 U.S.C. 791 *et seq.*), the Endangered Species Act (ESA), 16 U.S.C. §1531 *et seq.*, and the National Environmental Policy Act (42 U.S.C. 4321 *et seq.*).

The comments, recommendations, terms and conditions are based in part on the results of studies performed during the licensing process and prior studies. These studies have been filed with the Commission by prior licensees and Brookfield White-Pine Hydro, LLC (Licensee) or incorporated into the Final License Application. Additional evidence and communications in support of the Department's recommendations and preliminary terms and conditions are contained in the Commission's formal docket for this Project, many of which were also filed with the Commission by the Licensee or are contained in our response.

Since additional information, discussions, and the Commission's environmental review process are on-going, these comments are preliminary and may be revised and modified as needed. Accordingly, the Department reserves the right to supplement the administrative record in support of its recommendations, and preliminary terms and conditions based on the results of new information and conclusions developed during the Commission's environmental analysis, including additional information or modified proposals from the Licensee.

Procedural Background

The Department has been an active participant throughout the relicensing process. In 2015, the Licensee submitted a pre-application document (PAD) and notice of intent (NOI) to file a license application for the Project. The Department, through the Service, submitted timely comments on both the PAD and NOI and provided study requests by letter dated January 19, 2016. In response, Licensee incorporated the Department's requested studies into its study plans. The Licensee provided the draft license application (DLA) on September 4, 2018, and the Service provided comments on November 9, 2018.

Project Operations and Facilities

The Project is the third dam on the Lower Kennebec River, above Lockwood and Hydro-Kennebec and below Weston. Currently, Lockwood and Hydro-Kennebec have upstream passage and it is planned for Shawmut and Weston. The Project is located in the Towns of Fairfield, Skowhegan, Clinton and Benton, in Kennebec and Somerset Counties, Maine.

The Shawmut Project works consists of the following constructed facilities: (1) a 24-foothigh, 1,480-foot-long concrete gravity dam consisting of: (i) a 380-foot-long overflow section with hinged flashboards, (ii) a 730-foot-long overflow section with an inflatable bladder, (iii) 25-foot-wide sluice section; (iv) a non-overflow section; and (v) a headworks containing 11 headgates that regulate flow into a forebay; (2) a 1,310-acre impoundment extending about 12 miles upstream; (3) two powerhouses adjacent to the forebay, separated by a 10-foot-high by 7-foot-wide Tainter gate and a 6-foot-high by 6-foot-wide deep gate; (4) eight turbine-generating units; (5) a 300-foot-long tailrace; (6) 250-foot-long generator leads connecting the powerhouses with a substation; and (7) appurtenant facilities.

Brookfield operates the project in a run-of-river mode keeping the headpond level within one foot of the 112.0 foot normal pond elevation and implements specific operating procedure to facilitate upstream and downstream fish passage at the project. Upstream passage for American eel is provided by a dedicated eel passage facility located adjacent to one of the powerhouses. There are no constructed upstream anadromous fishways at the project. Currently anadromous fish are captured and transported upstream of the Shawmut Project via a fish lift and transport system at the Lockwood Dam Hydroelectric Project No. 2574, located about 6 miles downstream. Downstream fish passage for American eel and anadromous fish at the Shawmut

Project is provided via a combination of routing flows through the project's spillways, turbines, and downstream fish passage facilities (e.g., deep gate and Tainter gate between the powerhouses). During the downstream eel migration season Units 7 and 8 are not run, however Units 1-6 are in operation and the deep gate is opened 2.5 feet. The current interim downstream eel migration window is September 15 to October 31.

Department of the Interior's Goals and Objectives

The Department seeks to accomplish several fish and wildlife resource goals and objectives through the Commission's relicensing process. The Service provided its goals and objectives in its January 19, 2016, comments on the Pre-Application Document and Study Requests for the Shawmut Project. We have reviewed and updated the Service's goals and they form the basis of our approach to our comments, recommendations, and preliminary terms and conditions for the Project.

Fish and Wildlife Resource Goals

1. Ensure that protection, mitigation and enhancement measures are commensurate with the Project's effects and contribute to meeting state and federal fish and wildlife objectives;

2. Recover federally proposed and listed species and prevent the listing of additional species;

3. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project;

4. Ensure that once the licensing process is complete, there is an adaptive management plan to incorporate new information and implement new management strategies over the term of the license, bringing us close to the desired level of protection for fish and wildlife resources.

Our specific objectives for aquatic ecosystems, terrestrial resources, threatened and endangered species are the following:

Objectives for Aquatic Ecosystems

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats;

2. Maintain and/or restore aquatic habitat connectivity in the watershed to provide movement, migration, and dispersal corridors for diadromous species (salmonids, river herring, American shad, and American eels), resident fish and other aquatic organisms and provide longitudinal connectivity for nutrient cycling processes;

3. Restore naturally reproducing stocks of American shad, alewife, blueback herring and American eel and resident fish to historically accessible riverine and lake habitats;

4. Provide an instream flow regime that meets the spawning, incubation, rearing, and migration requirements of salmonids and other resident fish and amphibian species, throughout the Project area and of diadromous fish in the Kennebec River that may be affected by the Project's water releases;

5. Meet or exceed Federal and state regulatory standards and objectives for water quality in the basin;

6. Minimize Project operation effects on water temperature and the potential negative effects to downstream fishery resources.

Objectives for Terrestrial Resources

1. Reduce the effect of the fluctuation zone on wildlife habitat and seek opportunities to enhance this habitat.

Objectives for Endangered, Threatened, Proposed and Sensitive Species

1. Reduce Project effects on state and Federal threatened, endangered, proposed and sensitive species;

2. Explore opportunities for potential protection, mitigation, and enhancement measures for threatened, endangered, and proposed species.

Our primary concern is to ensure the unimpeded upstream and downstream passage of American eel, and the eventual unimpeded upstream and downstream passage of Atlantic salmon, alewives, blueback herring, and American shad through the Project although the Department will focus on American eel. This will allow access to historical spawning, rearing, and migration habitats necessary for these species to complete their life cycles. This objective can be met by modifications to the fish passage facilities currently at the Project in concert with project operations that ensure for safe, timely, and effective passage for these species. These objectives are based on our statutory authority under the FPA and because diadromous species (alewives, blueback herring, American shad, and American eel) represent trust resources for the Service.

The Department reviews hydropower projects in accordance with these goals and the objectives of applicable national and regional resource management plans.

<u>Proposed Project Operation</u>

As identified in the Final License Application (FLA), the Licensee proposes to provide run-of-river flows with normal pond elevation of 112.0 feet U.S. Geological Survey datum and maintained within 1 foot of the full pool elevation of 112 feet. After maximum powerhouse capacity is reached, excess water is spilled through the spillway sluice (capacity 1,840 cfs). When flows exceed the capacity of the spillway sluice, sections of the rubber dam are deflated, and the hinged flashboards are dropped, to pass additional water. The Project units and spillway can pass approximately 40,000 cfs while maintaining a pond elevation of approximately 112.0 feet. The Licensee is not proposing any additional changes to current operations.

Fish and Wildlife Resource Recommendations

Section 10(j) of the FPA requires that each license issued for a hydropower project contain conditions to adequately and equitably protect, mitigate damages to, and enhance, fish and wildlife affected by the development, operation, and management of a project (16 U.S.C. § 803(j)). Accordingly, each license issued shall include such conditions, based on recommendations of the Service, National Marine Fisheries Service, and state fish and wildlife agencies. This section 10(j) fish and wildlife recommendation is submitted by the Service and included in this filing by the Department. It is developed in consultation with the Bureau of Indian Affairs, National Park Service, and United States Geological Survey and is based upon information developed during the licensing proceeding, thorough discussions with other interested state partners, tribal and non-governmental organizations, and a review of the current literature and is intended to support resource agency management goals and objectives. The Commission must adopt the fish and wildlife recommendations, unless it finds that adoption of such recommendations is inconsistent with the purposes of the FPA or other law.

The Service has identified its goals and objectives above. Its priorities for this license are to ensure the safe, timely, and effective passage for migrating fish at the Project; to assist in the recovery and maintenance of successful, self-sustaining stocks of native fishes; and to mitigate for the unavoidable losses of fish, wildlife, and their habitats due to Project operations. If the Commission determines that the fish and wildlife recommendations herein are inconsistent with the purposes and requirements of the FPA, then the Commission should contact the Service (Maine Field Office Project Leader, 306 Hatchery Road, East Orland, ME 04431). The Service reserves the right to amend recommendations, if warranted, based on new information and the results of the Commission's environmental review process.

Accordingly, pursuant to section 10(j) of the Federal Power Act (FPA) (16 U.S.C. §§ 791 *et seq*.) and to carry out the purposes of the Fish and Wildlife Coordination Act (16 U.S.C. §§ 661 *et seq.*), the Service provides the following background and recommendations and requests that the recommendations be included in the new project license to protect, mitigate damages to, and enhance fish and wildlife resources.

Background

The lower four dams on the Kennebec River are owned and operated by the parent company of the Project, Brookfield Renewable Energy. These are: Lockwood (P-2574), Hydro-Kennebec (P-2611), Shawmut (P-2322), and Weston (P-2325). Currently, upstream passage is provided at Lockwood and Hydro-Kennebec and will be provided at Shawmut and Weston by May 1, 2022. Once all four projects have upstream passage facilities, they will need to be tested to determine whether they meet the upstream passage criteria for the diadromous species of interest to the federal, tribal, and state partners. For salmon, this will require investing significant resources above all four dams to ensure there are enough returning adults to provide meaningful upstream efficiency results. If the Licensee plans to request juvenile salmon from the Service, the Licensee will need to coordinate as early as possible, at least 2 years, to ensure production of juveniles is planned.

Recommendation #1 – Stocking Plan

1. Within one year of license issuance, the Licensee must develop a plan, in consultation with the Service, NMFS, MDMR, and the Penobscot Indian Nation to acquire uniquely marked Atlantic salmon smolts (or other appropriate lifestage) for stocking upstream of the Shawmut Project. These fish will serve as a source of imprinted adult fish (i.e., fish homing to areas upstream of Shawmut Dam) needed to support any required upstream effectiveness testing.

Justification

In order to conduct upstream adult salmon studies to determine passage efficiency for the Projects on the Lower Kennebec River (Lockwood, Hydro-Kennebec, Shawmut, Weston; all owned by the Licensee), the Licensee, in conjunction with the above mentioned entities, will need to develop a plan. This plan will evaluate the best method to provide enough returning adults to make upstream passage efficiency studies meaningful at all four Projects. Juveniles will need to be stocked above the Project to provide imprinted adult fish. Significant numbers will need to be stocked to account for river and ocean mortality so enough adults return and provide meaningful passage efficiency results.

Recommendation #2 – Run-of-River Operation

1. The Licensee shall operate the project in an instantaneous run-of-river mode, whereby inflow to the project is equal to outflow from the project on an instantaneous basis, and water levels above the dam are not drawn down for the purpose of generating power. During normal operations, the impoundment should always be maintained at elevation 112 foot datum. Instantaneous run-of-river operation may be temporarily modified after consulting with, and receiving approval, by the Commission.

Justification

The Licensee proposes to continue to operate the Project in a run-of-river mode, with a formal condition to maintain a pond level within one foot of the normal pond elevation of 112 feet, such that Project outflows “generally equal inflows on a daily basis” (FLA p. E-3-10). The Licensee also describes run-of-river as, “outflow generally matches inflow” (FLA. p. E-3-14), with, “Temporary and minor fluctuations while managing the pond level may occur while turning units on and off, opening gates, and inflate/deflating the rubber dam segments” (FLA. p. E-4-76).

Outflow is measured very precisely at the Project. On March 22, 2016, the Licensee filed an Additional Information Request (AIR) document which included a spreadsheet of 15 years of project data. One of the columns provided was

"Project Discharge" (outflow) in hourly intervals. These data points are very specific (ex: April 5, 2009, at 11am, 30,406 cfs was discharged) and fluctuate on an hourly basis providing precise hourly, daily, monthly, and yearly discharges (outflows). "Project Discharge" is a measure of outflow from all the Project's pathways (turbines, intake forebay, three sections of 72 hinge boards, scissor sluice gate, and three rubber dams) centrally compiled into a single reading through Supervisory Control and Data Acquisition (SCADA) hardware and software.

Inflow does not appear to be measured very precisely. In the PAD (dated September 9, 2015), the Licensee uses the North Sydney gage (USGS gage 01049265) to calculate mean annual daily inflow for the Project. This gage is 13 miles downstream of the project and 5.5 miles below the Sebasticook River, a major tributary to the Kennebec River. Further the AIR document used the Madison gage (USGS gage 01047150), located 26 miles upstream, to prorate flows to the Project but omitted to include the Sandy gage (USGS gage 01048000), a significant tributary below the Madison gage. The Madison gage also is above the following ungaged tributaries; Wesserunsett, Martin, and Carrabassett streams.

Unfortunately, precise outflow and imprecise inflow sets up a situation where "run-of-river" on a "daily basis" with a headpond fluctuation of 1 foot may not produce a reliable indicator of "run-of-river." Indeed, the opposite may result. According to the FLA, the headpond is 12.3 miles long, is 1,310 acres (43,560 square feet/acre) and a depth of one foot holds approximately 57 million cubic feet of water. The maximum hydraulic capacity of the Project is 6,691 cfs, therefore, full generation, with no inflow, will use this volume in 2.37 hours. However, there is always inflow into the Project. According to Table 4-2 of the FLA, the average inflow (from the North Sydney gage, USGS gage 01049265) for August is 4,509 cfs. Over an hour this equals 16.2 million cubic feet per hour. If the turbines are operating as inflow equals outflow (passing 4,509 cfs) but the headpond is allowed to fluctuate up to 1 foot, the turbines could generate at full capacity (6,691 cfs) for 6.68 hours and still stay within the proposed operation of "run-of-river", on "a daily basis" with a headpond fluctuation of one foot.

Run-of-river flows are normal recommendations proposed by the natural resource agencies and adopted by the Commission to protect aquatic species and their habitat. This has recently been further defined with the recent addition of "instantaneous" to provide additional clarity on what this means. "Instantaneous run-of-river" operations should be exactly that. Precise hourly outflow measurements should be matched with precise hourly inflow measurements. Since precise inflow is currently unavailable at the Project the headpond should be maintained at the 112 foot elevation and at most vary by 0.5 feet not one foot.

Section 18 Authority to Prescribe Fish Passage

The Department includes a Preliminary Fish Passage Prescription as Attachment A. This Prescription includes provisions for the passage of American eels. The Department proposes to reserve its authority to prescribe fish passage facilities and operational measures for migratory fish 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 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 the Interior's Prescription for Fishways at the Shawmut Hydroelectric Project (FERC NO. 2322).*

The Department appreciates the opportunity to provide comments, recommendations, terms and conditions, and fish passage prescriptions on this application for a subsequent license. If you have any questions on these comments, please contact Antonio Bentivoglio, U.S. Fish and Wildlife Service at 207-974-6965 or Antonio_Bentivoglio@fws.gov. Please contact me at (617) 223-8565 if I can be of further assistance.

Sincerely,

Andrew L. Raddant
Regional Environmental Officer

Enclosure

ATTACHMENT A

BEFORE THE
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Brookfield White-Pine Hydro, LLC	**) Shawmut Project (P-2322)**
Applicant	**)**

UNITED STATES DEPARTMENT OF THE INTERIOR
DECISION DOCUMENT
PRELIMINARY PRESCRIPTION FOR FISHWAYS
PURSUANT TO SECTION 18 OF THE FEDERAL POWER ACT

Approved this 24 day of August, 2020, by:

Digitally signed by
ANNA HARRIS
Date: 2020.08.24
16:04:57 -04'00'

Anna Harris, Project Leader

United States Department of the Interior
U.S. Fish and Wildlife Service
306 Hatchery Road
East Orland, Maine 04431

TABLE OF CONTENTS

UNITED STATES DEPARTMENT OF THE INTERIOR
DECISION DOCUMENT
PRELIMINARY PRESCRIPTION FOR FISHWAYS
PURSUANT TO SECTION 18 OF THE FEDERAL POWER ACT

1 INTRODUCTION

On January 31, 2020, Brookfield White-Pine Hydro, LLC (BREG or Licensee) filed a final license application (FLA) for its Shawmut Hydroelectric Project (P-2322-069 or Project), located on the lower Kennebec River in Maine. On July 1, 2020, the Federal Energy Regulatory Commission (Commission) issued a Notice of Application Accepted for Filing, Soliciting Motions to Intervene and Protests, Ready for Environmental Analysis, and Soliciting Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions. In response, the United States Department of the Interior (Department) hereby submits its Preliminary Prescription for the Project, pursuant to Section 18 of the Federal Power Act, as amended. This Preliminary Prescription is submitted with its supporting administrative record.

The Department’s U.S Fish and Wildlife Service (Service or FWS) consulted internally with Bureau staff (Bureau of Indian Affairs, National Park Service, and the United States Geological Survey). The Preliminary Prescription was developed through a review process that included consultation among fisheries biologists and fishway engineers from the Service, the National Oceanic and Atmospheric Administration’s National Marine Fisheries Service (NMFS or NOAA), the Maine Department of Marine Resources (MDMR), the Maine Department of Inland Fisheries and Wildlife (MDIFW), and the Licensee.

2 ADMINISTRATIVE PROCESS, HEARING RIGHTS, AND SUBMISSION OF ALTERNATIVES

This Preliminary Prescription was prepared and will be processed in accordance with the Department’s regulations (43 C.F.R. Part 45). These regulations provide that any party to a license proceeding before the Commission in which the Department exercises mandatory authority is provided both the right to trial-type hearings on issues of material fact and the opportunity to propose alternatives to the terms contained in the Preliminary Prescription. Therefore, the Department hereby provides notice that any party to the license application process before the Commission may request a trial-type hearing on any issue of fact material to this Preliminary Prescription pursuant to, and in conformance with, the regulations of the Department at 43 C.F.R. §45.21. Such a request for a trial-type hearing must be filed with the Office of Environmental Policy and Compliance, Department of the

Interior, 1849 C Street, NW, Mail Stop 2629, Washington, DC, 20240; within 30 days of the filing of this document with the Commission. Should any request for trial-type hearing be filed, other parties may file interventions and responses thereto within 20 days of the date of service of the request for a hearing (43 C.F.R. §45.22). Trial-type hearings will be conducted, and a Modified Prescription developed, in accordance with the terms and time limits of 43 C.F.R. Part 45.

The Department further provides notice that any party to the license application process before the Commission may submit alternatives to the terms contained in the Preliminary Prescription by filing them pursuant to, and in conformance with, the Department's regulations at 43 C.F.R. §45.71. Any such alternative proposals must be filed with the Office of Environmental Policy and Compliance, Department of the Interior, 1849 C Street, NW, Mail Stop 2629, Washington, DC 20240, within 30 days of the date of the submission of this document to the Commission. Such alternative proposals will be analyzed in accordance with 45 C.F.R. §45.73.

Finally, the Department will accept and consider any comments on the Preliminary Prescription filed by any member of the public, state or federal agency, tribe, the Licensee, or other entity or person. Comments are due within 30 days of this Preliminary Prescription being filed with the Commission, and should be sent to:

Anna Harris, Project Leader
U.S. Fish and Wildlife Service
P.O. Box A
306 Hatchery Road
East Orland, Maine 04431
email: anna_harris@fws.gov

If no hearing is requested or alternative submitted, the Department will finalize its Preliminary Prescription for Fishways, with accompanying analysis, within 30 days of the close of the appeals period, in accordance with 43 C.F.R. 45.73.

3 PROJECT DESCRIPTION

The Project (Figure 1) is the third dam on the Kennebec River, located in the towns of Skowhegan, Fairfield, Clinton, and Benton, in Kennebec and Somerset Counties, Maine. It is located at river mile (RM) 66, upstream from the Lockwood (RM 63) and Hydro-Kennebec (RM 64) projects. The Project boundaries extend approximately 12.3 miles upstream from the Shawmut dam.

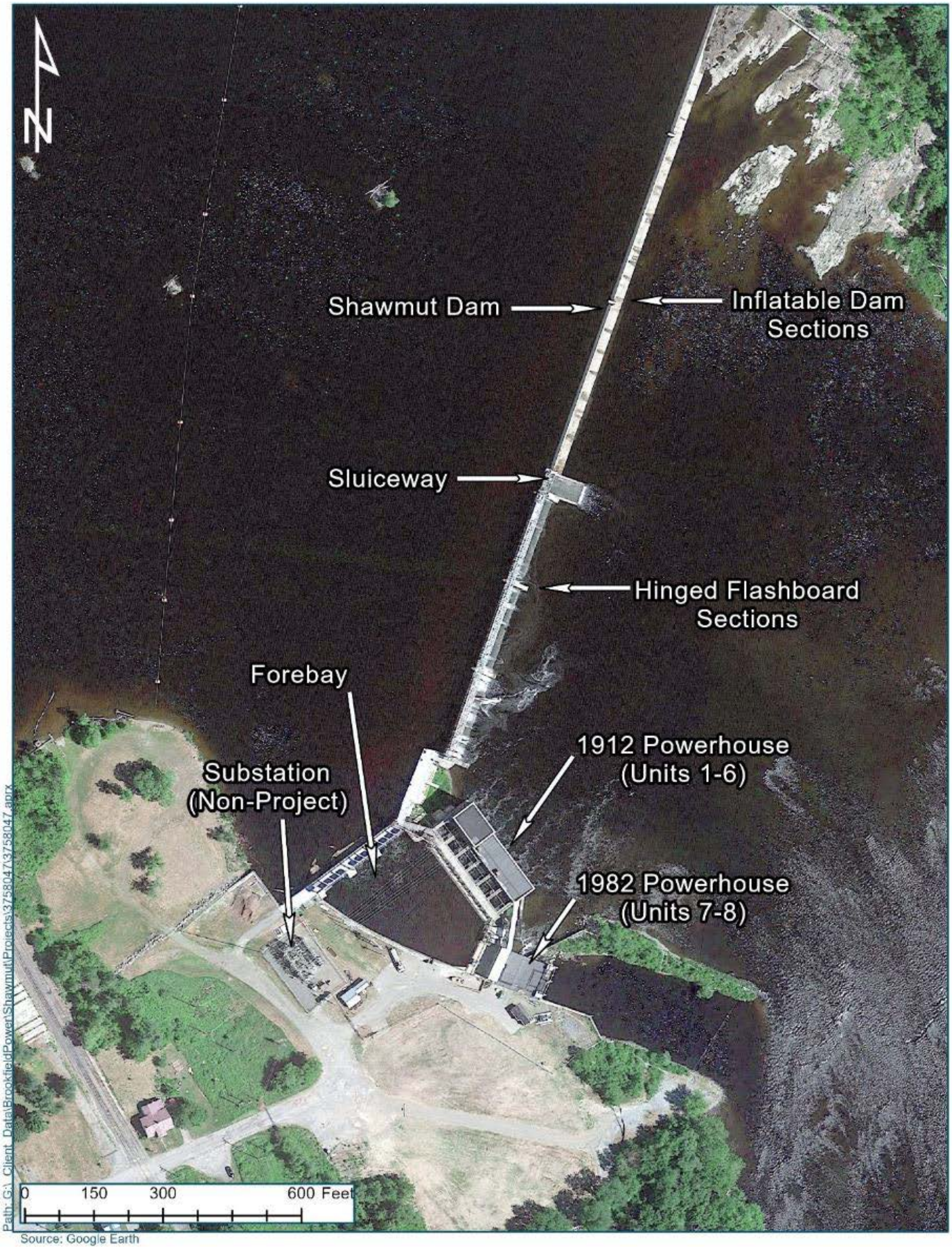

Figure 1. Overview of Shawmut Project Facilities. (Brookfield, 2020)

The following is summarized from the Shawmut Application for New License (Brookfield, 2020):

The existing structures at the Project consist of a concrete gravity dam, an enclosed forebay, an intake and headworks section, two powerhouses, a tailrace, an interconnection with the local utility's transmission system, and pertinent facilities. The dam is a concrete gravity type with an overflow section with the fixed crest at elevation of 108.0 feet. The spillway is comprised of several sections totaling 1,135 feet long with an average height of approximately 24 feet; the total dam is approximately 1,480 feet in length. The spillway is approximately 19 feet high and is comprised of 380 feet of hinged 4-foot-high flashboards serviced by a steel bridge with a gantry crane; a 730-foot-long section topped with an inflatable bladder composed of three smaller sections, each 4.46 feet high when inflated; and a 25-foot-wide sluice having a crest elevation of 104.0 feet and equipped with a timber and steel gate. The dam includes a non-overflow section between the hinged flashboards and the forebay headworks structure. An earthen dike with a concrete core wall is situated beyond the west abutment of the headworks structure.

The headworks and intake structure are integral to the dam and do not have trash racks. The forebay intake section contains 11 headgates and 2 filler gates. Five of the headgates are installed in openings 10 feet by 15.5 feet and 6 are installed in openings 10 feet by 12.5 feet. The two filler gates are 4 feet by 6 feet. In the 1912 powerhouse (Units 1-6), the intake section has 6 open flumes each fitted with two 10.5 feet by 14 feet double leaf slide gates and a continuous trash rack which extends from elevation 115.0 feet down to elevation 88.0 feet. The clear spacing of the racks in front of Units 1-6 is 1.5 inches. In the 1982 powerhouse (Units 7 and 8), the intake section contains 2 openings fitted with vertical headgates approximately 12-feet-high by 12-feet-wide and operated by hydraulic cylinders. Units 7 and 8 utilize trash racks which are serviced by a track mounted, hydraulically operated, trash rake with trash removal capabilities. The trash racks screening the Units 7 and 8 intakes extend from elevation 115.25 feet to 88.0 feet and have clear spacing of 3.5 inches.

The westerly non-overflow section contains a 2-foot-high by 2-foot-wide steel gate which was formerly used as an intake for process water serving the former Keyes Fibre Company mill adjacent to the Project (the mill was demolished in 2018). A retaining wall connects the west end of the non-overflow section to a concrete cut-off wall which serves as a core wall for an earthen dike.

The forebay is located immediately downstream of the headgate structure and is enclosed by two powerhouse structures. The 1912 powerhouse (Units 1-6) is located to the east and the 1982 powerhouse (Units 7-8) is located to the south. There is an approximately 240-foot-long concrete retaining wall located on the west side of the forebay. Located at the south end of the forebay between the powerhouses are two gates; a 10-foot-high by 7-foot-wide Tainter gate and a 6-foot-high by 6-foot-wide deep gate. Both discharge into a shallow plunge pool (exact dimensions are unknown but approximately 1 foot deep[1]) area connected to the river and immediately adjacent to the wooden plunge pool for the surface bypass sluice.

The Project tailraces are excavated riverbed located downstream of the powerhouses. The normal tailwater elevation of the stations is approximately 88.0 feet. From the 1982 powerhouse, water is released into a 300-foot-long tailrace approximately 45-feet-wide by 12-feet-deep. The tailrace for the 1912 powerhouse is approximately 140-feet-wide by 12-feet-deep and extends approximately 175 feet downstream.

The Project boundary extends approximately 12.3 miles upstream of the dam, and approximately 4,000 feet downstream of the dam. Above the dam, the Project boundary generally follows the 113.0 foot or the 114.0 foot contour, but also includes 2 parcels of land on the east and west bank in the upper portion of the Project. The total acreage of land and water within the proposed Project boundary combined is estimated to be 1,729 acres. Approximately 1,432 acres within the Project boundary is open water, consisting of an estimated 1,310 acres of impoundment waters and 90 acres of tailwater.

The Project is operated in a run-of-river mode and the headpond is maintained within 1 foot of the full pool elevation of 112 feet during normal project operations. The Francis-type turbines (Units 1-6) are rated at 1,200 horsepower (hp) each, and 6 generators, 5 rated at 750 kilowatts (kW) each and one rated at 900 kW. The units have a net head of 23.5 feet. The two horizontal tube-type hydraulic turbines (Units 7 and 8) are rated at approximately 2,880 hp each, and two generators are rated at 2,000 kW each. The units have a net head of 22.6 feet. The total installed capacity of the Project, as limited by the generator nameplates for each unit, is 8,650 kW. Units 1-6 discharge 674 cubic feet per second (cfs) each for a total of 4044 cfs, and units 7 and 8 discharge 1200 cfs each for a total of 2400cfs. The maximum hydraulic capacity of the Project is approximately 6,690 cfs.

4 Resource Description

4.1 Kennebec River Watershed

The Kennebec River originates at the outlet of Moosehead Lake and flows south for approximately 145 river miles joining the Androscoggin River to form Merrymeeting Bay

[1] Normandeau Associates Inc. 2009. Evaluation of Silver American Eel Downstream Passage at the Shawmut Project, Kennebec River, Maine. Page 2.

which then drains into the Atlantic Ocean. The total Kennebec River drainage area is approximately 5,890 square miles.

Due to the ability of the juvenile American eels (*Anguilla rostrata*) to ascend wet surfaces, the catadromous American eel was never completely blocked from reaching freshwater growth habitat above the dams; however, their abundance was likely reduced. Yoder et al. (2006) conducted standardized boat electrofishing transects from Chops Point (26.9 miles downstream of former Edwards Dam) to the Wyman Dam (75 miles upstream of Edwards Dam) in 2002 and 2003, and reported that the numerical abundance of American eel (all life stages combined) was highest (200 to 400 fish per kilometer[km]) between Waterville and Augusta including the segment affected by the Edwards Dam removal, and numerical abundance declined to less than 50 to 100 eels per km upstream from the Lockwood Dam with no young-of-year. In addition, the highest average numbers and biomass of all fish combined occurred in the riverine segment between Waterville and Augusta, followed by the downstream tidal segments, and lastly by impounded river segments. The historic upstream limit of American eel is not known, but American eels currently are found in the Williams Project impoundment which is approximately 45 miles upstream of the Project.

The Shawmut Project is located within the documented or presumed historical range of alewife *(Alosa pseudoharengus)*, blueback herring *(Alosa aestivalis)*, American shad *(Alosa sapidissima)*, Atlantic salmon *(Salmo salar)*, and American eel (Foster and Atkins 1868; Atkins 1870; Atkins 1887; MDMR 2002). Alewife and American shad ascended as far upstream as Norridgewock Falls, the current location of the Abenaki and Anson projects, and into the lower part of the Sandy River above all projects (Foster and Atkins 1868 and Akins 1887) reported). Blueback herring likely had the same range as the closely related alewife and American shad. The original upstream limit of Atlantic salmon on the mainstem Kennebec River was likely12 miles above the Forks (confluence of the Kennebec and Dead River) and at Grand Falls on the Dead River and they ascended many miles up the Carrabassett and Sandy rivers, which were most likely their principal spawning grounds (Foster and Atkins 1868 and Akins 1887).

The Service favors several future conditions (goals) for diadromous fish species native to the Kennebec River:

1. Diadromous fish species have unfettered access to and from the freshwater habitats within the watershed that are key to those species completing one or more stages in their respective life cycles;
2. Diadromous fish populations are restored to their native range within the watershed at the sustainable ecosystem level, or a specified design population agreed to by the Service.

Resource agencies have identified the following target fish species for fish passage at the Project: Atlantic salmon; American eel, and the alosines: sea-run alewife, blueback herring, and American shad. The Kennebec River is part of the Endangered Species Act listed Gulf of Maine Distinct Population Segment of Atlantic salmon. Salmon spawning has occurred in the watershed and a few adults pass the Lockwood Dam each year. Based on coordination meetings with NMFS, it is our understanding that NMFS will provide information and a preliminary prescription for the Atlantic salmon and alosines. The Service will provide information and a preliminary prescription for the American eel.

4.2 American Eel

Declines in the abundance of American eel in Maine and elsewhere have been attributed to a combination of causes, including impaired passage and mortality at dams, commercial harvests, pollution, changes in oceanic currents, the exotic parasitic nematode *Anguillicoloides crassus*, habitat loss, and predation (Shepard 2015, pp. 53-89). Hydropower facilities are known to have local effects on American eel by blocking or impeding migration in freshwater habitats or between estuarine and freshwater habitats, causing mortality to individuals during their residency in fresh waters, and causing mortality to mature eels during their spawning migration from fresh waters. Due to these threats the American eel has been petitioned for listing. In 2015, a 12-month finding conducted by the Service found that based on the best available scientific and commercial information, the stressors were not of sufficient imminence, intensity, or magnitude to conclude that the American eel is in danger of extinction, or likely to become an endangered species within the foreseeable future throughout all or parts of its range (80 FR, page 60837).

4.2.1 Biology and Life History

The American eel is a facultative catadromous species, meaning that American eels spawn in the ocean and grow to maturity in either marine or freshwater habitats, or some combination thereof (Shepard 2015, pp. 7–24). American eels are panmictic, meaning that there is a single spawning site with no mating restrictions, neither genetic nor behavioral, upon the population, and that therefore random recombination occurs with each new generation of American eel. Thus, there are no unique adaptations to specific regions within the range of American eel from Canada to the Caribbean (Shepard 2015, pp. 4–10). The spawning location is located east of the Bahamas and south of Bermuda in the center of the gyre known as the Sargasso Sea. After spawning, American eel eggs hatch into leptocephali, a small transparent, larval stage that is passively transported in ocean currents for about one year. Leptocephali eventually metamorphose into glass eels which leave ocean currents and swim to coastal waters anywhere from the Caribbean to eastern Canada. Within days of reaching coastal waters, glass eels transform into small, fully developed, pigmented eels, often called elvers. Juvenile eels are usually referred to as yellow eels.

Small yellow eels are sexually indeterminate and cannot be differentiated histologically until reaching a length of about 200 millimeters.

Sexual maturation indicated by silvering can begin as early as 3 years or can happen much later, over 30 years. Females mature at later ages than males and eels mature at later ages in fresh water, as compared to marine and estuarine waters where growth is more rapid. Age at maturation also increases with latitude. For example, silvering in fresh waters of the Chesapeake Bay region occurs anywhere between 6 to 16 years of age (Helfman et al. 1987, pp. 44–45) but at 8 to 23 years in Canada (Cairns et al. 2005, p. 11). Depending on latitude, silver eel migration from the rivers occurs in large part in late summer in the north and late winter in the south. For example, silver eels migrate from the St. Lawrence River in large part from August to November, from Connecticut rivers in September through October, and in Georgia from October through March (Atlantic States Marine Fishery Commission [ASMFC] 2012, p. 132).

Downstream migration has been commonly perceived as occurring primarily at night. Overall, 81.2 percent of the 293 eel passage events (including yellow eels) at dams on the Shenandoah River occurred during turbine shutdown periods between 1800 and 0600 hours (Eyler et al. 2016 p. 972). The other 18.8 percent passed during the day or were not detected. Downstream movement from fresh water is accelerated by heavy rains and rises with stream flow. Two thirds of the 293 eel passage events at dams on the Shenandoah River coincided with high-discharge events (Eyler et al. 2016, p. 972). Downstream movement of eels was detected during each month of the year except July, and during day and night. Downstream migrants use tidal transport and travel near the surface but also make vertical movements past barriers, especially when encountering dams (Brown et al 2009, p. 10, ASMFC 2012, page 7).

4.2.2 Population Status and Management Goals

The decline of eels and the ecological services they provide is a widely held concern among coastal states in the northeast. Management objectives for American eel are outlined in the Interstate Fishery Management Plan (FMP) for American Eel published by the ASMFC (ASMFC 2000, page iv). The FMP's goals are to maintain and enhance the abundance of American eels in inland coastal waters and to contribute to the viability of the adult American eel spawning population at sea. An objective is to provide adequate upstream passage and escapement to inland waters for elvers and juvenile eels as well as to provide adequate downstream passage and escapement to the ocean for pre-spawn adult eels. Another objective is to restore American eel where they have been extirpated and increase their numbers where they still occur. The FMP identifies the lack of adequate up- and downstream passage for migrating juvenile and adult eels as an impact to the population.

Since its development in 2000, the FMP has been modified four times. Addendum I (approved 2006) established a mandatory reporting of harvest and effort by commercial fishers and dealers (ASMFC 2006, page 2). Addendum II (approved 2008) made recommendations for improving up- and downstream passage for American eels. The ASMFC recommended special considerations for American eels in Commission hydropower licensing proceedings. These considerations include, but are not limited to, improving up- and downstream passage, and collecting data on both directions of passage (ASMFC 2008). In addition, the 2012 Benchmark Stock Assessment (ASMFC 2012) found that the American eel population in U.S. waters is at or near historically low levels due to a combination of historical overfishing, habitat loss and alteration, productivity and food web alterations, predation, turbine mortality, changing climatic and oceanic conditions, toxins and contaminants, and disease. Addendum III (ASFMC 2013) contains a recommendation that jurisdictions identify opportunities to work within the Commission's review process and with non-Commission dam owners to improve downstream eel passage and to seek opportunities to improve upstream eel passage through obstruction removal and deployment of eel passage structures. Addendum IV (ASMFC 2014b) made changes to the commercial fishery, implementing restrictions on the elver and yellow eel commercial fisheries. Accordingly, the MDMR has identified adequate upstream and downstream passage for Maine's eel population as one of its objectives in the state's American eel species management plan (MDMR 1996, page 5).

American eels are widely distributed within Maine rivers where other diadromous species are either absent or in low abundance. American eels are able to scale natural falls and dams that are impassable to most other diadromous species (Yoder et al., 2008) and are abundant in the Kennebec River despite the presence of many dams. Tens of thousands have passed upstream at the Project over the last ten years (see Table 1).

The Project has interim upstream passage facilities and downstream measures that rely on interim seasonal operational changes. Providing safe, timely and effective upstream passage will enhance the abundance of eels in the Kennebec watershed. Likewise, providing safe, timely and effective downstream passage will avoid or minimize mortality of eels. This is consistent with regional fishery management goals (ASMFC 2000, entire) and the Service's 12-month finding (80 FR, page 60837).

5 EXISTING AND PROPOSED FISH PASSAGE FACILITIES

5.1 AMERICAN EEL

In 2003, the Licensee installed an interim upstream eel passage system at the Project. The facility was located at the eastern end of the spillway and consisted of two sections connected by a turning pool with the lower section parallel to the dam and the other section running up and over the flashboards.

In 2009, the Licensee installed a rubber dam on the spillway which sealed the leakage of water flowing through the flashboards and eels were no longer attracted to the eel facility. As a result, in 2010, the Licensee, with assistance from MDMR, installed a seasonal eelway in an eel migration location identified after numerous nighttime observations. The seasonal eelway consists of a 6-foot-long by 1-foot-wide angled wooden trough leading to a 5-gallon collection bucket. The trough is lined with textured substrate and attraction water for the eelway is provided via hoses connected to water drains at the non-overflow section of the dam and is located between the first section of the hinged flashboards and the Unit 1 tailrace.

After conducting nighttime observations in 2019, a second seasonal eelway was installed adjacent to the forebay plunge pool. This second eelway consists of a 6-foot-long by 1-foot-wide angled aluminum trough leading to a 5-gallon collection bucket. The trough is lined with Enkamat mesh and attraction water for the eelway is provided via hoses connected to a submersible pump in the forebay. These facilities are operated annually from June 15 to September 15, as river conditions allow.

This temporary eel passage system will continue to be monitored during construction of the new fishlift that is expected to be operational by May 1, 2022. The new fishlift will significantly change the water flow patterns below the Project. Because of this the Licensee is proposing to continue to monitor and pass eels at the existing facilities. Upon completion of the new fishway, nighttime observations will determine if eels congregate at different locations and in consultation with the resource agencies, a permanent location of an upstream eelway or eelways will be determined and constructed.

The Licensee proposes to continue the existing interim downstream eel passage measures. This consists of opening a deep gate (located directly below the forebay Tainter gate, between the two powerhouses), passing approximately 425 cfs, turning off Units 7 and 8 for 8 hours during the night for a 6-week period between September 15 and November 15, passing additional water through Units 1-6 as necessary. The clear spacing of the racks in front of Units 1-6 is 1.5 inches and is 3.5 inches in front of Units 7 and 8.

6 Management Plans

Section 10(a)(2)(A) of the Federal Power Act (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 a project.

On April 27, 1988, the Commission issued Order No. 481-A, establishing that it will accept FPA Section 10(a)(2)(A) comprehensive plan status to any Federal or state plan that: (1) is a comprehensive study of one or more of the beneficial uses of a waterway or waterways; (2) specifies the standards, the data, and the methodology used; and (3) is filed with the Secretary of the Commission.

As part of its independent environmental analysis, the Commission will identify and review comprehensive plans relevant to a proposed project and include a discussion of the proposed project's consistency or inconsistency with the plans. The Commission may recommend measures to reduce a proposed project's conflict with the goals of accepted plans. These measures may be included in the final licensing order. When there are major project-plan conflicts that cannot be resolved with mitigation, the Commission may recommend an alternative project design or license denial. A list of Resource Management Plans approved by the Commission as Comprehensive Plans which are relevant in this case is provided in Section 12.1.

7 STATUTORY AUTHORITY

Statutory authority to prescribe upstream and downstream passage facilities derives from Section 18 of the Federal Power Act, 16 USCS §8ll, which states in part that,

> *"…the Commission shall require the construction, maintenance and operation by a licensee at its own expense of …such fishways as may be prescribed by the Secretary of Commerce or the Secretary of the Interior."*

Such authority is further defined in section 170l(b) of the Energy Policy Act of 1992, P.L. 102-486, Title XVII, §l701 (b), 106 Stat. 3008, which states, in part:

> *That the items which may constitute a 'fishway' under Section 18 (Federal Power Act, 16 USCS §811) for the safe and timely upstream and downstream passage of fish shall 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 necessary to ensure the effectiveness of such structures, facilities, or devices for such fish.*

The Preliminary Prescription for Fishways herein is issued under authority delegated to the Regional Director from the Secretary of the Interior; the Assistant Secretary for Fish, Wildlife and Parks; and the Director of the Service pursuant to Section 18 of the Federal Power Act. (See 64 Stat. 1262; 209 Departmental Manual 6.1; 242 Departmental Manual

1.IA). In 2018, the Service's Regional Director in Region 5, further delegated signature authority for Preliminary Fishway Prescription to Field Supervisors[2].

8 ADMINISTRATIVE RECORD

Evidence to support the Department's Preliminary Prescription for Fishways is contained in the Administrative Record before the Commission and the additional materials are being provided under separate cover. Citations to the extant record are provided herein which includes the Service's Engineering Report (FWS 2019).

9 ALTERNATIVES CONSIDERED

The Licensee is planning to build a new upstream fishlift, to be completed by May 1, 2022. This new fishway will change the flow patterns affecting both upstream migrating eels and downstream migrating eels. The licensee is proposing to wait until the new fishlift is built before conducting studies to determine where a new permanent upstream eel passage facility or facilities will need to be built. Until that time, interim upstream measures are proposed. The Service believes that the new flow patterns associated with the new fishlift, downstream structures, and possible new downstream prescriptive measures for salmon and alosines will also affect downstream eel migration. As such the Service is considering interim downstream eel passage measures until such time as all construction is complete. This will be followed by studies and if necessary new downstream eel passage facilities. The Service has considerable experience recommending upstream and downstream eel passage facilities and provides some upstream options to jumpstart the planning process.

9.1 UPSTREAM EEL PASSAGE

The number of juvenile eels passing upstream at the Project is significant (see Table 1) and it is therefore important to continue the existing interim passage plan.

Table 1. Number of American eels passing upstream at the Shawmut Dam (Brookfield, 2020).

Year	**No. American Eels**	**Year**	**No. American Eels**
2010	1,480	2015	17,697
2011	4,878	2016	750
2012	32,153	2017	2,857
2013	15,160	2018	1,774

[2] FWS Memo. August 2, 2018. From Assistant Regional Director, Ecological Services, Region 5. To Ecological Services Field Office Supervisors, Region 5. Subject: Delegation of Authority to Sign Prescriptions for Fishways.

2014	39,266	2019	14,145

Applicant's Proposal. The Applicant proposes to maintain the two existing temporary upstream eel facilities until the new fishlift is constructed (expected by May 1, 2022). These are operational from June 15 to September 15. After construction of the new fishlift is completed, additional upstream juvenile eel studies will be conducted to determine where they are congregating so eelway(s) can be located to maximize upstream passage. The Service adopts this proposal with the following clarifications. There are a number of different types of eelways that could be built at the Project; eel ramp, eel lift, Delaware-style eel pass, laterally sloped eel ramp, and helical eel ramp (FWS 2019). The types differ in construction material, entrance and exit conditions, climbing substrate, slope, and each type has advantages in different settings. With the large numbers of juvenile eels passing the Project it is essential that extensive upstream studies are conducted. Once the juvenile eel location studies are conducted, the Licensee will consult with the Service to determine which type(s) of eelway(s) are recommended for specific locations.

9.2 Downstream Eel Passage

Applicant's Proposal. The Applicant proposes to provide downstream eel passage by shutting down Units 7 and 8 (trash rack clear spacing 3.5 inches) for at least eight hours each night between September 15 and November 15. At the same time the deep gate (6 foot by 6 foot) in the forebay will be opened 2.5 feet allowing up to 425 cfs to be discharged. Units 1-6, with trash racks having 1.5 inch clear spacing, may still be operational during this downstream eel migration window. The Service does not adopt this proposal.

Past Study Results Relevant to Interim and Permanent Downstream Alternatives

Downstream eel passage was studied in 2007 (Florida Power and Light, 2008) and 2008 (NextEra 2009) by the Licensee at that time. The following is a summary of the downstream passage study results to highlight what permanent facilities and/or operational modifications are needed to provide safe, timely, and effective downstream eel passage.

2007 Study Results (FPL, 2008)

Prior to conducting Project passage testing, walking surveys were conducted below Units 7 and 8, and at another site 0.75 miles below the Project. These collected 69 dead eels with just less than half being collected in the shallow eddy areas just downstream of Units 7 and 8. This indicates that at times, the Project causes significant eel mortality.

During the 2007 study season there were four routes of passage: Unit passage (predominantly through 7 and 8), surface bypass sluice (set at approximately 35 cfs), the near surface Tainter gate (set at approximately 260 cfs), and the forebay deep gate set at approximately 270 and 440 cfs. Only the deep gate and the turbine units were monitored for eel passage. This operational testing approach was determined to be "interim". Four trials were run (42 adult eels total) with 92 to 100 percent of the eels using Units 7 and 8, thus 0 to 8 percent used the surface sluice, Tainter gate, or deep gate. Immediate survival through Units 7 and 8 was 69 percent (29 of 42), 100 percent using other routes (3 of 3), resulting in Project survival of 71 percent (32 of 45). Units 1-6 were not operating at significant levels during the majority of the 2007 testing due to prevailing low flow conditions and therefore their configurations and operating characteristics in combination with the spill gates were not adequately tested for their effectiveness in passing adult eels downstream.

In summary, under the test operating conditions (Units 1-6 generally off, Units 7 and 8 running, and some other downstream routes open), mortalities were observed below the project. Percentage of flow through each route of passage in comparison to eel proportions was not reported making comparisons with 2008 studies impossible. Survival through Units 7 and 8, with trash rack clear spacing of 3.5 inches, was very poor. Not enough eels passed via other routes (Units 1-6, surface bypass sluice, near surface Tainter gate, and forebay deep gate) to determine whether these routes provide safe, timely, and effective passage. Long-term survival was not studied.

From a MDMR April 14, 2008, letter, (P. 18)[3]: MDMR believes that fish passage via sluiceways and/or controlled spills is the preferred method for downstream fish passage, and that fish passage through turbines should be avoided. The downstream passage studies did not quantify delayed mortality, which is usually measured by holding fish for up to 72 hours after they are passed through a turbine. Therefore, we recommend that all downstream passage survival estimates for all species be termed "immediate survival."

2008 Study Results

Based on the poor 2007 downstream radio telemetry study at the Project, the Licensee conducted an additional year that changed the operations from primarily using Units 7 and 8, to using Units 1 to 6 for nighttime generation. Under these operating conditions, three eel mortalities were collected below the Project in 2008. Only the deep gate and the turbines were monitored for eel passage. With the deep gate set at 1.5 feet (passing approximately 270 cfs), Units 1 to 6 on, and Units 7 and 8 off at night, approximately 58 percent (7 or 12) of the eels that entered the forebay passed via the deep gate. When the deep gate was set at 2.5 feet (approximately 425 cfs), Units 1-6 on, and Units 7 and 8 off at night, approximately 83 percent (25 of 30) of the eels that entered the forebay passed via the deep gate. Immediate survival of eels passing the deep gate set at 2.5 feet was 92 percent (23 of 25) and the immediate survival of eels passing the deep gate set at 1.5 feet was 57 percent (4 of 7). Immediate survival of eels passing through Units 1 to 6 was 90 percent (9 of 10).

[3] Maine Department of Marine Resources. 2008. Diadromous fish passage report for the lower Kennebec River watershed during the 2007 migration season. April 14, 2008.

In summary, under these test operating conditions (Unit 1-6 running, Units 7 and 8 off, varying levels of downstream flows via other routes), there were fewer mortalities observed below the project than in 2007. Percentage of flow through each route of passage was not reported making comparisons between routes and to 2007 data impossible. Not enough eels were used to determine immediate survival through each alternative route of passage. Immediate survival through Units 1-6 (trash rack clear spacing of 1.5 inches) was higher than through Units 7 and 8. Immediate survival with the deep gate set at 2.5 feet (425 cfs) was worse than with the deep gate set at 1.5 feet (270 cfs). Survival through the deep gate set at 1.5 feet was very poor. Immediate survival through other routes of passage was not studied. The 2008 Report also stated that, "to resolve the deep gate mortality issue, NextEra Energy in consultation with resource agencies will design and construct in 2009 a plunge pool below the outlet of the deep gate" (NextEra 2009). It is unclear if this has been constructed.

FWS Comments[4] from 2009:

The results of the telemetry study for American eel downstream passage at the Project show much improved passage using the deep gate opening passing 425 cfs (gate opening of 2.5 feet) and the nighttime shut down of Units 7 and 8. The total downstream fish passage efficiency of this operational change was 76.7 percent (attraction efficiency (25/30) and survival (23/25)). The Service believes this operational change (using Units 1-6) should be implemented on an interim basis because of the significantly improved downstream passage over current conditions. We recommend further investigation into determining methods of detecting eels in the forebay to better define the operational window, artificial lights to guide eels away from the intake screens and/or overlay screening on Units 5 and 6. We do not consider turbine passage a viable alternative for American eel because their size and body shape make them susceptible to injury, their long migration distance requires a high level of fitness, and the greater loss of reproductive potential that results from the mortality of migrating adults.

DMR Response[5] from 2009:

> *"We were encouraged by the results of FPL Energy's 2008 telemetry study at the Shawmut Project, which showed that altering nighttime operations and passing significant flow through a deep gate greatly improved downstream eel passage. When Units 7 and 8 were shut down at night, 25 of 30 tagged eels (83.3%) that passed the Shawmut Project utilized the deep gate when it was open 2.5 feet and*

[4] FWS. 2009. Fort Halifax, Lockwood, Shawmut, and Weston Projects (FERC Nos. 2552, 2574, 2322, 2325) Review of Diadromous Fish Passage Report for the Lower Kennebec River Watershed During 2008 Migration Season. May 6, 2009.

[5] Maine DMR. 2009. Diadromous Fish Passage Report for the Lower Kennebec River Watershed During the 2008 Migration Season. April 29, 2009.

passing approximately 425 cfs. The remaining five eels passed through Units 5 or 6; immediate survival was 4/5 (80%).

MDMR's goal is to achieve at least 90% upstream and downstream passage efficiency at each hydropower dam for each species. In addition, passage through turbines is not desired for a species that must migrate a considerable distance before spawning.

Therefore, we recommend that nighttime shutdown of Unit 7 and 8 and deep gate opened 2.5 ft for six week period at Shawmut be considered an "interim solution". We suggest for a "permanent solution" the bypass mortality should be no greater than 2% and that overlay screens be placed at Units 5 and 6 where most of the entrainment is occurring."

To summarize, based on two years of study with very few eels, the following outlines the 2007 and 2008 downstream eel study reports:

- Significant numbers of eels were found dead below the Project in 2007 (when Units 7 and 8 were prioritized at night), fewer were found in 2008 (when Units 1-6 were prioritized at night).
- Only immediate survival through the turbines and deep gate were examined. Long-term survival needs to be studied. Immediate survival via the Tainter gate and forebay surface bypass were not investigated.
- The studies in 2007 (42 eels) and 2008 (51) used very few eels, showed wide differences in immediate survival depending on route taken, and with few test eels used, results are expected to vary considerably.
- When Units 7 and 8 were running, most eels use this route of passage and immediate survival though Units 7 and 8 was very poor at 69 percent.
- Immediate survival through Units 1-6 was 90 percent but only 10 eels used this route.
- Immediate survival through the deep gate was 92 percent (23/25) when set at 470 cfs and dropped to 57 percent when passing 225 cfs.
- Immediate survival of eels using the spillway was 75 percent (3/4) for the Weston tagged group and 100 percent 3/3 for "tagged eels not in test", totaling 86 percent.

Based on these two years of study results it is impossible to determine the Project's overall downstream immediate survival, but it is clear that once eels enter the forebay unacceptable mortality levels occur through Units 7 and 8 and general turbine passage is not recommended. Depending on the amount of flow, the immediate survival through the deep gate was surprisingly low, likely due to the inadequate dimensions of the plunge pool (depth one foot). Mortality using other routes within the forebay (Tainter gate, forebay bypass sluice) were not estimated. Eels kept out of the forebay and passing via the spillway also experienced higher than expected mortality (14 percent). Without additional information, it appears that the deep gate, operated at 2.5 feet provides the safest route past the Project.

Alternative Interim Passage Measures

In considering Alternatives Interim Measures, the Service evaluated the immediate mortality rates going through all the possible routes of passage to determine which is the safest. Unfortunately, due to the low numbers of eels used, no clear safe route of passage is obvious but unsafe routes are clear. Passage through turbines is not recommended. All Alternatives include opening the deep gate to 2.5 feet and shutting down Units 7 and 8 for at least 8 hours a night.

Alternative #1: Shutdown all Turbine Units (1-8) between August 15 and October 31 for at least 8 hours, Provide Downstream Passage via the Deep Gate and Spillway.

The Service considered only providing passage via the deep gate and spillway. Survival for the deep gate at 2.5 feet was 92 percent and the spillway was 86 percent. Depending on what proportion of eels use each route, mortality could approximate 90 percent. Passage through turbines should be avoided. The migration window for the other Projects on the Kennebec (Lockwood, Hydro-Kennebec and Weston) is September 15-October 31 (see Table 3). However, historical silver eel harvest data conducted by the MDMR in the Kennebec River watershed show that a significant proportion of eels migrate in August. Downstream migrating silver eels were caught in July (0.6 percent), August (16.5 percent), September (62.7 percent), October (19.1 percent), and December (1.1 percent). Approximately 94 percent of the eels were caught between August 15 and October 31. The Service adopts this alternative.

Alternative #2: Shutdown Units 7 and 8, Provide Downstream Passage Via the Deep Gate and Other Routes, and Extend the Downstream Migration Window to August 15.

The Service considered using other routes of passage (Tainter gate, forebay surface bypass, spillway, log sluice) and the deep gate to provide downstream passage. When the deep gate was operating at both flows there were so few eels that used other routes of passage, that actual survival was difficult to determine. Survival at the log sluice, forebay surface bypass, and Tainter gate were not tested. Given the surprisingly high mortality at the spillway (14 percent) and deep gate at low flows (43 percent) the Service does not adopt this alternative.

Alternative Permanent Downstream Passage Measures

There are four general ways to improve downstream passage survival: provide physical barriers to prevent eels from entering areas where mortalities occur; provide guidance so eels bypass high risk areas; implement operational measures so high risk routes of passage are avoided; and combinations of the above three options. The following alternatives and discussion are provided to inform decisions to provide safe, timely, and effective downstream eel passage. At this point it is unclear what downstream passage measures may be prescribed for salmon and alosines. Physical barriers have been used at many other sites and if the screening has a small enough open spacing (at or below 3/4 inch), it can also prevent adult eels from using the turbines as a route of passage. Once downstream passage measures have been implemented for salmon and alosines, and downstream studies have been conducted, the Service will use the following general outline to help determine measures necessary for downstream migrating eels.

Alternative #1: Provide a Physical Barrier to Prevent Eels from Entering the Forebay.

This can be accomplished by building ¾ inch angled bar screens in front of the forebay. The Service's Engineering Manual (FWS, 2019) criterion for guiding eels to a safe passage route (i.e., bypass) is a maximum ¾ inch bar screening installed at a 45 degree angle to the flow field. This would be installed from the shoreline to the new downstream bypass associated with the new fish lift and thus would divert outmigrating eels away from the headworks. Another screening option would be ¾ inch angled bar racks inside the forebay diverting eels to the deep gate, Tainter gate, or forebay surface bypass.

Alternative #2: Provide Downstream Guidance so Eels Avoid High Risk Areas.

Guidance mechanisms (zigzag structure) are generally located near the dam collecting outmigrating eels via low-level pressurized bypasses that siphon water (and eels) over the dam. Guidance mechanisms could be installed within the forebay or in the headpond at the base of the dam.

Alternative #3: Conduct Nighttime Shutdowns of all Units to Prevent Turbine Mortalities.

Operational measures, like fall nighttime shutdowns at hydro projects is a common measure that prevents eel turbine entrainment and associated mortality. Current measures in Maine vary but generally nighttime shutdowns (dusk to dawn) last for at least 8 hours and through the fall (see Table 3). Based on MDMR analysis, a majority of eels migrate between August 15 and October 31. Unless additional studies prove otherwise, this would be the recommended shutdown window.

Alternative #4: Use a Combination of Screening (New and Existing) Inside the Forebay and Nighttime Shutdowns to Prevent Entrainment and Redirect Eels to Other Routes of Passage.

In order to inform which Alternative is chosen by the Service, downstream studies will need to be conducted immediately after all construction has been completed. These studies will need to determine both immediate survival as well as long-term survival (at least 96 hours holding period). The Service recommends using Hi-Z tags for both immediate and long-term survival studies. Sufficient numbers of adult eels should be injected into selected routes of passage. Specific Hi-Z tag study plans will be developed by the licensee and reviewed by the Service prior to completion of the fishlift. Radio telemetry studies will also be required to determine route of passage and delay. Project operation data specifically, total river flow, route specific flow, and turbine usage, should be collected.

10 Reservation of Authority to Prescribe Fishways

In order to allow for the timely implementation of fishways, including effectiveness measures, the Department proposes to reserve its 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 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 section 11 of the Department of Interior's Prescription for Fishways at the Shawmut Hydroelectric Project.*

11 Preliminary Prescription for Fishways

Pursuant to Section 18 of the Federal Power Act, as amended, the Secretary of the Department of the Interior, as delegated to the Service, hereby exercises his authority to prescribe the construction, operation, and maintenance of such fishways as deemed necessary, subject to the procedural provisions contained above.

The Department's Preliminary Prescription for Fishways reflects a number of issues and concerns related to fish restoration and passage that have been raised by the Licensee, Commission staff, and state and federal resource agencies. Fishways shall be constructed, operated, and maintained to provide safe, timely, and effective passage for American eels at the Licensee's expense.

11.1 Upstream and Downstream Passage

The Licensee will construct (if necessary), operate, maintain, and periodically test the effectiveness of fishways for American eels as described below. If studies show that new eelways are needed they will be designed, constructed, maintained, and operated (which includes Project operations) to effectively pass eels both upstream and downstream through the zone of passage in a safe, timely, and effective manner at the Licensee's expense.

11.2 Design Populations

Determination of the American eel populations in the Kennebec River is not possible at this time. However, current eel passage technologies should allow for sufficient passage. As noted in the Service's Engineering Fish Passage Manual (USFWS, 2019, Section 6.6 Fishway Capacity, p 6-11), capacity is a key component of a fishway to ensure that the biological goals for the target species can be achieved. The capacity for technical fishways that pass species other than American eel (e.g., alosines, Atlantic salmon) are derived based on an estimated rate of ascent as well as their body size. Typically, only a small number of fish can pass over a weir or through a section of fishway.

For example, the annual biological capacity of a Model A Steeppass for river herring is estimated to be 50,000 individuals (page 6-15, Table 5). This number is small compared to a larger fishway like the Denil, with an estimated capacity of 250,000 river herring. The higher value of the Denil is due to the fact that multiple river herring can pass through the fishway at one time.

A comparable estimate of capacity associated with the American eel does not exist. This is due to the fact that upstream migrating eel can vary in size, some being less than 6 inches. This allows them to congregate in very large numbers, making it feasible for their rate of ascent to be much higher than that of Alosines. Also, the timing of American eel migration is more spread out in time than for alosines. It is for this reason that, if placed in the correct location(s) and designed and operated correctly, one (or is some cases two) fishways for American eel can have the capacity to pass 10's, even 100's of thousands of eels. In 2017, an estimated 11,500 American eel were observed passing the eel ladder at the Stillwater Project on the Stillwater Branch of the Penobscot River (HDR, 2017, page 8).

Therefore, even though the Service has not determined a design population for eels, the Service believes that a properly located, designed, operated, and installed upstream eelway(s) will provide enough capacity for the eel population in the Kennebec River.

11.3 Fish Passage Operating Periods

The eelways shall be operational during the peak migration windows. Migration depends on geographic location, water temperature, river flow and other habitat cues. These dates may change based on new information, improved access at the lower dams, evaluation of new literature, and agency consultation. Based on statewide and Kennebec River watershed specific data, approved fish passage protective measures shall be operational during the following migration windows (See Table 2):

Table 2. Summary of migration periods for American eels.*

Species	**Upstream Migration Period**	**Downstream Migration Period**
American eel	June 1–September 15	August 15–October 31

*These dates are subject to change based on new information, improved access at the lower dams, evaluation of the literature, and agency consultation.

11.4 Fishway Operation and Maintenance Plan

Within 12 months of license issuance, the Licensee will prepare and provide to the Service a Fishway Operation and Maintenance Plan (FOMP) covering all operations and maintenance of the upstream and downstream fish passage facilities in operation at the time. The FOMP shall include:

a. A schedule for routine fishway maintenance to ensure the fishways are ready for operation at the start of the migration season;
b. Procedures for routine upstream and downstream fishway operations;
c. Procedures for monitoring and reporting on the operation and maintenance of the facilities as they affect fish passage.

The FOMP shall be submitted to the Service for review and approval prior to submitting the FOMP to the Commission for its approval. Thereafter, the Licensee will keep the FOMP updated on an annual basis to reflect any changes in fishway operation and maintenance planned for the year or if any additional fish passage structures have been completed. If the Service requests a modification of the FOMP, the 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 the Licensee will require the approval of the Service prior to implementation and prior to submitting the revised FOMP to the Commission for its approval.

Upon written request from the Service or other resource agencies, the Licensee shall provide information on fish passage operations, and project generating operations that may affect fish passage. Such information shall be provided within 10 calendar days of the request, or upon a mutually agreed upon schedule.

11.5 Inspection

The Licensee shall provide Service personnel, and its designated representatives, access to the project site and to pertinent project records for the purpose of inspecting the fish passage facilities and to determine compliance with the Prescription.

FISHWAY DESIGN REVIEW

The Licensee shall submit design plans to the Service and other resource agencies for review and approval during the conceptual, 30, 60, and 90 percent design stages. Designs shall be consistent with the 2019 Fish Passage Engineering Design Criteria Manual (FWS 2019, entire) or updated version.

Since it is unclear when new upstream and downstream eel passage measures will be constructed, the Licensee shall adhere to the following design milestone schedule once there is certainly on the construction timeline:

a. Conceptual design within 6 months of the Service determination that new facilities are needed;
b. 30 percent design within 3 months of (a) above;
c. 60 percent design within 6 months of (a) above and a basis of design report (if requested);
d. 90 percent design within 12 months of (a) above.

Following approval by the Service and the other resource agencies, the Licensee shall submit final design plans to the Commission for its approval prior to the commencement of fishway construction activities. Once the fishway is constructed, final as-built drawings that accurately reflect the project as constructed shall be sent to the Service and the other resource agencies.

11.6 FISH PASSAGE EFFECTIVENESS MEASURES

Effectiveness testing of both upstream and downstream American eel passage is critical to evaluating the passage success, diagnosing problems, determining when fish passage modifications are needed, and what modifications are most likely to be effective. It is essential to ensuring the effectiveness of fishways over the term of the license, particularly in cases where changing fish population sizes may change fish passage efficiency or limit effectiveness.

Effectiveness testing and evaluation plans shall be developed by the Licensee, in consultation with the Service at the time of license issuance. If fish passage facilities are not completed by this time, then effectiveness testing can be delayed until all relevant information is available. The Licensee must submit effectiveness testing and evaluation plans to the Service. These plans must be reviewed, accepted, and approved by the Service prior to implementation. The Licensee shall begin implementing effectiveness testing measures at the start of the first migratory season after a fishway is operational and shall conduct quantitative fish passage effectiveness testing and evaluation for a minimum of two years.

The Licensee shall meet annually, in the late fall, with the Service and the other resource agencies to report on the occurrence of fish passage maintenance and operations, monitoring results, and review the operating plan. Any changes and planned maintenance will be completed 30 days prior to the start of the next migratory season.

11.7 DOWNSTREAM AMERICAN EEL PASSAGE

At this time it is unclear what the final downstream passage measures and facilities for salmon and alosines will be at the Project and these determinations will influence downstream eel passage facilities and measures. The new fish lift, expected to be operational by May 1, 2022, will likely provide an additional safe downstream passage route but it is unclear if outmigrating eels will use it. The new fish lift will need to be tested for usage by eels once it is completed. Within the forebay, the deep gate and Tainter gate flows will be rerouted to exit in the Units 7 and 8 tailrace. It is unclear if outmigrating eels will use this and whether it will be safe. Based on these yet to be determined outcomes the Service prescribes the following:

1. Interim downstream passage measures shall be in effect until new downstream passage measures are constructed.
2. The Licensee shall implement the following interim downstream passage measures: All Units shall be shut down between August 15 and October 31 for 8 hours at night; the deep gate shall be open at least 2.5 feet allowing at least 425 cfs to pass; excess spill shall be passed via the spillway.
3. After the completion of the new upstream lift (expected by spring 2022), and if additional fish passage measures are needed, the Licensee shall conduct a one year shakedown period of all facilities.
4. The year following the shakedown, Licensee shall conduct downstream passage studies. These will include Hi-Z tagging for immediate and long-term survival and radio telemetry to determine route selection and delays. Study plans will be coordinated and approved by the Service and additional years of studies are predicated on acceptance of the previous year’s results. Inconclusive results or delays due to weather or other unforeseen events will require another year of studies.
5. Any new downstream facility(ies) needing construction shall be designed in consultation with the Service and the resource agencies and constructed by the Licensee. All entities shall review the conceptual, 30 percent, 60 percent, and 90 percent drawings which are to be consistent with the Service’s current Passage Engineering Design Criteria Manual. Construction of any new downstream measures shall be completed within 2 years of acceptance of the 90 percent design drawings.

6. If new facilities are needed the Licensee shall conduct at least 2 years of post-construction effectiveness studies of these new facilities.

Justification

The interim downstream passage measures are designed to maximize downstream eel survival. As such, the Service does not recommend passage through turbines. This leaves passage through other routes (deep gate, spillway, log sluice, Tainter gate) as possibilities. Of these, the deep gate resulted the highest survival followed by the spillway.

Once the new upstream fishway is built (and if new downstream construction is prescribed) it is likely to create new flow patterns, therefore permanent downstream eel passage options will need to be investigated. Past studies provided some information regarding survival at some of the routes, but the new fishway will provide a significant new downstream bypass and will shunt excess forebay water to the tailrace at Units 7 and 8. This will need to be tested and, based on the results, the Service, in consultation with the resource agencies, will determine what measures will be required.

11.8 Upstream American Eel Passage

1. The Licensee shall continue using the existing upstream eel passage facilities until the new upstream fishlift is constructed.
2. After completion of the new upstream fishlift (by May 1, 2022) or completion of other fish passage measures, the licensee shall conduct juvenile eel location studies to determine where to place upstream eel passage facilities.
3. After the Service determines that no more studies are needed, the Service will develop upstream eel passage measures that the Licensee shall construct.
4. If new upstream passage facilities are needed, or need to be relocated, the Licensee shall consult with the Service and complete construction within 1 year of approval by the Service of 90 percent designs of any new facilities.
5. If new facilities are needed the Licensee shall conduct at least 2 years of effectiveness studies after completed construction.

Justification

Dedicated upstream eel passage is necessary to provide access to rearing habitat upstream of the Project throughout the migratory season. We base this position on the fact that eels are currently present above the project. Upstream migrating juvenile eels can be effectively passed at hydroelectric projects (Solomon and Beach 2004, entire). Upstream eel passage facilities are briefly described in the Service’s Regional Fish Passage Engineer’s Report (FWS 2019, Section 13).

12 References Cited

12.1 Comprehensive Plans Filed at the Commission

Atlantic States Marine Fishery Commission (ASMFC). 1985. Fishery management plan for the anadromous alosid stocks of the eastern United States: American shad, hickory shad, alewife, and blueback herring: Phase II *in* Interstate Management Planning for migratory alosids of the Atlantic coast.

ASMFC. 1998. Fishery Management Report of the Atlantic States Marine Fishery Commission - American Shad Stock Assessment Peer Review Report.

ASMFC. 1999. Amendment 1 to the Interstate Fishery Management Plan for Shad and River Herring. Report No. 35 of the Atlantic States Marine Fisheries Commission.

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

ASMFC. 2007. Fishery Management Report of the Atlantic States Marine Fishery Commission - American Shad Stock Assessment Report for Peer Review Volume I. Stock Assessment Report 07-01 supplement.

ASMFC. 2007. Fishery Management Report of the Atlantic States Marine Fishery Commission - American Shad Stock Assessment Report for Peer Review Volume II. Stock Assessment Report 07-01 supplement.

ASMFC. 2009. Fishery Management Report of the Atlantic States Marine Fishery Commission - Amendment 2 to the Interstate Fishery Management Plan for Shad and River Herring (River Herring Management).

ASMFC. 2010. Fishery Management Report of the Atlantic States Marine Fishery Commission - Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management).

ASMFC. 2012. River Herring Stock Assessment Report for Peer Review. Stock Assessment Report No. 12-2, Vol. I.

ASMFC. 2012. River Herring Stock Assessment Report for Peer Review. Stock Assessment Report No. 12-2, Volume II.

ASMFC. 2014a. American shad habitat plan. Prepared by the Maine Department of Marine Resources. Submitted to the Atlantic States Marine Fisheries Commission as a requirement of Amendment 3 to the Interstate Management Plan for Shad and River Herring.

MDMR. 2014. Draft Kennebec River Atlantic Salmon Interim Restoration Plan 2015-2020. Maine Department of Marine Resources, Bureau of Sea-Run Fisheries and Habitat.

Maine State Planning Office. 1993. Kennebec River resource management plan: balancing hydropower generation and other uses.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 2018. Recovery plan for the Gulf of Maine Distinct Population Segment of Atlantic salmon (*Salmo salar*). 74 pp.

12.2 Documents Incorporated by Reference

Brookfield. 2020. Brookfield White Pine Hydro LLC. Application for New License for Major Water Power Project-Existing Dam. Shawmut Hydroelectric Project (FERC NO. 2322).

12.3 Correspondence

Maine Department of Marine Resources. 2008. Diadromous fish passage report for the lower Kennebec River Watershed during the 2007 migration season. April 14, 2008.

Maine Department of Marine Resources. 2009. Diadromous Fish Passage Report for the Lower Kennebec River Watershed during the 2008 Migration Season. April 29, 2009.

USFWS. 2009. Fort Halifax, Lockwood, Shawmut, and Weston Projects (FERC Nos. 2552, 2574, 2322, 2325) Review of Diadromous Fish Passage Report for the Lower Kennebec River Watershed During 2008 Migration Season. May 6, 2009.

12.4 Other References Cited in the Decision Document

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

ASMFC, 2006. Interstate Fishery Management Plan for American Eel. Addendum I. 8 pages.

ASMFC. 2008. Fishery Management Report for the Atlantic States Marine Fishery Commission – Addendum II to the Fishery Management Plan for American Eel. 8 pages.

ASMFC. 2012. American Eel Benchmark Stock Assessment. Stock Assessment Report No. 12-01. 342 pages.

ASMFC. 2013. Fishery Management Report of the Atlantic States Marine Fishery Commission – Addendum III to the Fishery Management Plan for American Eel. 22 pages.

ASMFC 2014b. Fishery Management Report for the Atlantic States Marine Fishery Commission – Addendum IV to the Fishery Management Plan for American Eel. 26 pages.

Brown, L., A. Haro, and T. Castro-Santos. 2009. Three-Dimensional Movement of Silver-Phase American Eels in the Forebay of a Small Hydroelectric Facility. Pages 277-

291 in J.M. Casselman and D.K. Cairns, editors. Eels at the edge: Science, Status, and Conservation Concerns. American Fisheries Society, Symposium. No. 58.
Cairns, D.K. and coauthors. 2005. Conservation status and population trends of the American eel in Canada. Canadian Science Advisory Secretariat, Department of Fisheries and Oceans, Canada
Eyler, S.M., S. Walsh, D.R. Smith, M.M. Rockey. 2016. Downstream Passage and Impact of Turbine Shutdowns on Survival of Silver American Eels at Five Hydroelectric Dams on the Shenandoah River. Tran. Am. Fish. Soc. 145:964-976.
FPL Energy Maine Hydro LLC. 2008. FPL Energy Maine Hydro LLC Diadromous Fish Passage Report for the Lower Kennebec River Watershed during the 2007 Migration Season.
HDR. 2017. American Eel Passage Assessment and Monitoring Report. Stillwater Hydroelectric Project (FERC No. 2172).
Helfman, G.S., D.E. Facey, L.S. Hales, and E.L. Bozeman. 1987. Reproductive ecology of the American eel. Am. Fish Soc. Symp. 1:42-56. In M.J. Dadswell, R.J. Kauda, C.M. Moffitt, R.L Saunders, R.A. Rulifson, and J.E. Cooper [eds.]. Common strategies of anadromous and catadromous fishes, American Fisheries Society, Symposium 1. Bethesda, Maryland, USA.
Maine Department of Marine Resources. 1996. American Eel (Anguilla rostrate) Species Management Plan. 75 pages.
MDMR. 2002. Draft Fishery Management Plan for the Lower Androscoggin River, Little Androscoggin River and Sabattus River. 2017. Maine Department of Marine Resources. Augusta, Maine. 44 pages.
NextEra Energy Maine Operation Services, LLC. 2009. NextEra Energy Diadromous Fish Passage Report for the Lower Kennebec River Watershed during the 2008 Migration Season.
Shepard, S.L. 2015. American eel biological species report. Supplement to: Endangered and Threatened Wildlife and Plants; 12-Month Petition Finding for the American Eel (*Anguilla rostrata*) Docket Number FWS-HQ-ES-2015-0143. U.S. Fish and Wildlife Service, Hadley, Massachusetts. xii +120 pages.
Solomon, D. J., and M. H. Beach. 2004. Manual for provision of upstream migration facilities for Eel and Elver. Science Report SC020075/SR2, Environment Agency, Bristol, UK. 72 pages.
USFWS. 2019. Fish Passage Engineering Design Criteria. USFWS, Northeast Region R5, Hadley, Massachusetts.
Yoder, C., B. Kulik, and J. Audet. 2006. The spatial and relative abundance characteristics of the fish assemblages in three Maine Rivers. MBI Technical Report MBI/12-05-1. Grant X-98128601 report to the U.S. EPA, Region I, Boston, MA.
Yoder, C., R. Thoma, L Hersha, E, Rankin, B. Kulik, and B. Apell. 2008. Maine Rivers Fish Assemblage Assessment: Development of an Index of Biotic Integrity for Non-

wadeable Rivers. (Addendum March 31, 2016). NBI Technical Report MBI/2008-11-2. Submitted to U.S. EPA, Region 1, Boston, MA. 55pp. + appendices.

12.5 Federal Register Notices

80 FR 60834. Endangered and Threatened Wildlife and Plants; 12-month Finding on Petitions to List 19 Species as Threatened or Endangered. Department of the Interior, Fish and Wildlife Service. Federal Register 80(195), 60834-60850. October 8, 2015.

Table 3. Rivers, projects, and current downstream American eel passage measures in Maine.

River/Project	Downstream Eel Passage Measures	Dates Measures Taken	Specific Downstream Bypass Measures	Turbine Measures
Penobscot				
Stillwater	Yes	August 15 – November 15	low level entrances opened at 30 cfs	no shut-downs
Orono	Yes	August 15 – November 15	low level entrances opened at 30 cfs	no shut-downs
Milford	Yes	August 15 – November 15	low level entrances opened at 30 cfs	no shut-downs
West Enfield	No			
Mattaceunk	No			
Medway	Yes	August 1 – November 15	downstream surface sluice with bellmouth opened	no shut-downs
Union				
Graham	No			
Ellsworth	Yes			Prioritized Units 1 and 4 first on/last off
Kennebec				
Lockwood	Yes	September 15 - October 31	the deep gate next to Unit No. 1 is opened for eels 1.5 feet (approx. 300 cfs) at least 8 hours per night starting 1 hr after sunset	no shut-downs
Hydro-Kennebec	Yes	September 15 - October 31	surface sluice stays wide open for eels	no shut-downs
Shawmut	Yes	September 15 - October 31	deep gate adjacent to Unit 7 open 2.5ft to release 425 cfs	Units 7 and 8 shut down for 8 hrs starting 1 hr after sunset
Weston	Yes	September 15 - October 31	log sluice is opened for eels at 6% of unit flow for at least 8 hours per night starting 1 hr after sunset	no shut-downs

Saco				
Cataract	Yes	September 1-October 31	bottom opening gates at either West Channel or East Channel are opened to minimum flow (400 cfs or inflow)	no shut-downs
Skelton	No			
Bar Mills	No			
Bonny Eagle	No			
West Buxton	No			
Hiram	No			
Androscoggin				
Brunswick	No			
Pejepscot	No			
Little Androscoggin				
Barker's Mill	Yes	August 15-November 15	To Be Determined	To Be Determined

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

August 28, 2020

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

RE: COMMENTS, RECOMMENDATIONS, PRELIMINARY TERMS AND CONDITIONS, and PRELIMINARY FISHWAY PRESCRIPTIONS for the Shawmut Hydroelectric Project (FERC No. 2322)

Dear Secretary Bose:

Enclosed is our preliminary prescription for fishways, pursuant to Section 18 [16 USC §811], recommended terms and conditions pursuant to Section 10(a) [16 USC §803(a)] and Section 10(j) [16 USC §803(j)] of the Federal Power Act for the Shawmut Hydroelectric Project (P-2322) on the Kennebec River, Maine (Attachment A). We are filing the preliminary prescription in response to the July 1, 2020, Notice of Application Ready for Environmental Analysis (REA), regarding Brookfield White Pine, LLC's final license application. Through the preliminary prescription, terms, and conditions, we act to preserve, protect, and restore diadromous fish in the Kennebec River watershed consistent with management goals established by federal and state resource agencies. For American eel, an ecologically important catadromous fish that is commercially and culturally significant to coastal communities, we support the actions of the U.S. Fish and Wildlife Service to improve upstream and downstream passage, and we reserve authority to act in the future. Based on our interagency coordination, we expect that their terms, conditions and recommendation will support our agency's goals for the species.

The Kennebec River supports several diadromous fish species including three species listed under the Endangered Species Act (ESA) (Atlantic salmon, Atlantic sturgeon, and shortnose sturgeon). Each species serves a unique and important ecological function by connecting the marine environment to freshwater and terrestrial ecosystems. Human activity has heavily affected these fish throughout their range over the past 250 years. As a result, diadromous fish populations are at historical lows. Our broader goals for the Kennebec River include sustainable diadromous fish stocks within the Kennebec River watershed, protecting fish habitat, and improving the prey base for offshore fish species, including groundfish in the Gulf of Maine. Improving fish passage facilities at the Shawmut Project is a priority action to meet these goals.

The Kennebec River is designated critical habitat for the Gulf of Maine Distinct Population Segment (DPS) of Atlantic salmon. Atlantic salmon has been recognized by us as one of the nine species most at risk of extinction in the near future, and as such, is one of the species highlighted in our “Species in the Spotlight: Survive to Thrive” initiative. Addressing the impacts of dams on Atlantic salmon and the ecosystems on which it depends is highlighted in the Species in the Spotlight action plan, the ESA listing determination, and Final Recovery Plan (USFWS and NMFS 2019). Section 7(a)(2) of the ESA requires that federal agencies ensure that any actions they authorize, fund or carry out are not likely to jeopardize the continued existence of any listed species or destroy or adversely modify any designated critical habitat. An ESA section 7 consultation is necessary before you issue any license for this project. We anticipate you will initiate formal ESA section 7 consultation with us once there is sufficient clarity on the proposed action and adequate information about the anticipated effects to inform your biological assessment.

In formulating our responses to the Commission’s REA notice, we carefully considered our different authorities under sections 10 and 18 of the Federal Power Act. Section 10 does not grant us mandatory authorities for the purposes of decommissioning and dam removal. However, under section 10(a), we may recommend decommissioning and dam removal as our preferred alternative in this proceeding, and we do so for the reasons outlined in the attachment. Section 18 grants mandatory authorities to prescribe fishways (16U.S.C 811). However, should the Commission reject our section 10(a) recommendation for decommissioning and dam removal, it is imperative that fishways are satisfactorily designed and implemented as a means to achieve our basic resource goals and objectives. Therefore, we concurrently submit our preliminary section 18 prescription for fishways with the presumption that the existing project facilities may remain in place throughout a new license term.

By this letter, we provide notice pursuant to 18 CFR §385.214(a), as amended, that we are intervening in this proceeding. We have a federal statutory responsibility for protection, mitigation, and enhancement of diadromous fish and their habitats affected by the results of this proceeding. We intervene for the purposes of becoming a party to represent our interests and those of the public in this proceeding. Service of process and other communications concerning this proceeding should be made to:

Regional Administrator
National Marine Fisheries Service
Greater Atlantic Regional Fisheries Office
55 Great Republic Drive
Gloucester, MA 01930

If you have questions or need additional information, please contact Matt Buhyoff in our Protected Resources Division (matt.buhyoff@noaa.gov or 207-866-4238).

Sincerely,

For Michael Pentony
Regional Administrator

cc: Service List

Attachment A: United States Department of Commerce's Recommended Terms and Conditions and Preliminary Prescription for Fishways for the Shawmut Hydroelectric Project (FERC No. 2322)

Attachment A

United States Department of Commerce's Preliminary Prescription for Fishways for the Shawmut Hydroelectric Project (P-2322)

BEFORE THE
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Brookfield White Pine Hydro, LLC

Shawmut Hydroelectric Project
Kennebec River
Kennebec County
Fairfield, Maine
FERC No. 2322-069

UNITED STATES DEPARTMENT OF COMMERCE'S
PRELIMINARY PRESCRIPTION FOR FISHWAYS
PURSUANT TO SECTION 18 OF THE FEDERAL POWER ACT

For **Michael Pentony, Regional Administrator**
Greater Atlantic Regional Fisheries Office
United States Department of Commerce
National Marine Fisheries Service
55 Great Republic Drive
Gloucester, MA 01930

Table of Contents

1. INTRODUCTION

The U.S. Department of Commerce through the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) hereby submits our Recommended Terms, Conditions, and Preliminary Prescription for Fishways for Brookfield White Pine Hydro LLC's (Brookfield or Licensee) Shawmut Hydroelectric Project (P- 2322) in response to the Federal Energy Regulatory Commission's (FERC or Commission) July 1, 2020, Notice of Application Ready for Environmental Analysis. This filing also includes a schedule for submitting modified prescriptions and recommendations. Comments, terms, and conditions included here are supported by congressionally signed mandates and our agency mission for protecting and conserving diadromous fish species and their associated habitat. We are submitting this document to the Commission with an index to its Administrative Record. Documents not currently in the record will be filed under separate cover.

A number of species listed under the Endangered Species Act of 1973, as amended, (ESA) occur in the Kennebec River watershed. These include the endangered Gulf of Maine (GOM) distinct population segment (DPS) of Atlantic salmon, the endangered shortnose sturgeon, the threatened GOM DPS of Atlantic sturgeon, and the endangered New York Bight DPS of Atlantic sturgeon. The Kennebec River has been designated as critical habitat for the GOM DPS of Atlantic salmon as far upstream as the confluence with the Carrabassett River (74 FR 29300, June 19, 2009) and as critical habitat for Atlantic sturgeon as far upstream as the Lockwood Dam (82 FR 39160, August 17, 2017). The historical range of Atlantic salmon in the Kennebec River is designated as Essential Fish Habitat (EFH) by the New England Fishery Management Council pursuant to the Magnuson-Stevens Fishery Conservation and Management Act.

2. ADMINISTRATIVE PROCESS, HEARING RIGHTS AND SUBMISSION OF ALTERNATIVES

This preliminary prescription was prepared, and will be processed, in accordance with our regulations at 50 CFR 221 et seq. These regulations provide that any party to a license proceeding before the Commission in which the Department of Commerce exercises mandatory authority has both the right to a trial-type hearing on issues of material fact and the opportunity to propose alternatives to the terms contained in the preliminary prescription.

Any party to the proceeding may challenge the facts upon which our section 18 prescription is based by requesting a trial-type hearing within 30 days (50 CFR 221.4). The challenge is limited solely to the facts; the party may not use this process to contest the weight accorded to the facts or the opinions drawn from these facts by the agency. Agency expertise in forming its opinions and conclusions is entitled to deference under the law and the Commission lacks the authority to modify the Secretary of Commerce's prescription. The prescription, however, including the opinions and conclusions upon which it is based, may be challenged in the Court of Appeals after the Commission issues its license.

Although a party may not use the trial type hearing process to challenge the agency's prescriptive opinions and conclusions – in other words, the Licensee cannot challenge the deliberative choices made by the agency in the preliminary prescriptive process – a party may submit alternative prescriptions according to agency regulations at 50 CFR 221.70 et seq. Requests for a trial-type hearing or alternatives to the terms contained in this preliminary prescription must be submitted within 30 days of this filing to the following address: Kara Meckley, Chief, Habitat Protection Division, NMFS Office of Habitat Conservation, 1315 East-West Highway, F/HC2, Silver Spring, MD 20910; and electronically submitted to Kara.Meckley@noaa.gov.

Modified prescriptions, conditions, and other recommendations are due within 60 days of the close of the Commission's National Environmental Policy Act (NEPA) comment period or in accordance with a schedule otherwise established by the parties to the licensing. We will file our analysis of any alternative prescriptions with the Commission at that time.

We will consider any comments on the preliminary prescription filed by any member of the public, state or federal agency, the Licensee, or other entity or person. Comments must be filed within 30 days of the filing of this preliminary prescription to the following address: Jennifer Anderson, Assistant Regional Administrator for Protected Resources, NMFS Greater Atlantic Regional Fisheries Office, 55 Great Republic Drive, Gloucester, MA 01930; and electronically submitted to nmfs.gar.Shawmut@noaa.gov.

3. NMFS STATUTORY AUTHORITY

The preliminary comments, recommendations, terms and conditions, and prescriptions herein are provided in accordance with the provisions of the Federal Power Act (FPA), 16 U.S.C. § 791 et seq., the Fish and Wildlife Coordination Act, 16 U.S.C. § 661 et seq., the Endangered Species Act (ESA), 16 U.S.C. §1531 et seq., the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 et seq., Atlantic Coastal Fisheries Cooperative Management Act, 16 USC §§5101, et seq., and the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. § 1801 et seq. NMFS interests in these proceedings are well founded in our engagement in fisheries management and restoration associated with the 1998 Kennebec Agreement and Endangered Species Act species protection and recovery planning. These statutory authorities afford us the responsibility for protecting and managing a variety of living marine resources that may be affected by the proposed relicensing including: alewife, blueback herring, American shad, Atlantic salmon, sea lamprey, and American eel.

4. GOALS AND OBJECTIVES

4.1. HABITAT

We are responsible for the stewardship of the nation's living marine resources and their habitats. NMFS is responsible for the stewardship of the nation's ocean resources and their habitat. We provide vital services for the nation, which ensure the following: productive and sustainable fisheries; safe sources of seafood; the recovery and conservation of protected resources; and healthy ecosystems—all backed by sound science and an ecosystem-based approach to management. The NMFS 2020-2023 Geographic Strategic Plan for New England and Mid-Atlantic includes goals for amplifying the economic value of commercial and recreational fisheries while ensuring their sustainability, and conserving and recovering protected species while supporting responsible fishing and resource development (NMFS, 2020).

Diadromous fish species, including American shad, alewife, and blueback herring, were historically important prey items for commercially important groundfish species (e.g., Atlantic cod, haddock) in the Gulf of Maine (Ames, 2004). The loss of prey may have hastened the decline of nearshore groundfish stocks. Large-scale restoration efforts in the Kennebec River system, and elsewhere, have enhanced the abundance of diadromous fish species, and may aid in the restoration of cod and other groundfish species.

4.2. Protected Resources

A national goal of the NMFS Protected Resources Strategic Plan is to stabilize the most critically endangered species and improve populations of those species nearing recovery (NOAA, 2016). Preventing the extinction of Atlantic salmon is a national priority under the Species in the Spotlight program. The Species in the Spotlight effort is a component of the strategic plan focusing attention on the nine most critically endangered species in the country under our jurisdiction. Together with the U.S. Fish and Wildlife Service (USFWS), we (collectively, "the Services") are charged with conserving and recovering species listed as threatened or endangered under the ESA. Recovery is the process of restoring listed species and the ecosystems upon which they depend to the point they no longer require the protections of the ESA. Goals and objectives specific to the Kennebec River as stated below are based on our statutory authority and derived from our overarching long-term agency goals and objectives.

4.3. NMFS Objectives for the Kennebec River

Our principal objective for the Kennebec River is to provide access to historical spawning, rearing, and migration habitats necessary for diadromous species to complete their life cycles and to ensure access to seasonal habitats necessary to contribute to the enhancement of the stocks. Modifications to Shawmut Project facilities and project operations to ensure the safe, timely, and effective passage of migrating adults and juveniles past the Project, including passage necessary for dispersal and seasonal movement, will facilitate this principal objective.

4.4. Atlantic States Marine Fisheries Commission

The ASMFC acts to coordinate the conservation and management of 25 nearshore fish species. Commissioners, representatives of the state's marine fisheries management agency, legislators and appointed stakeholder representatives for each state constitute the ASMFC. The commissioners deliberate policy regarding interstate fisheries management, fisheries science, habitat conservation, and law enforcement. In furtherance of their mission, the states work closely with their federal partners, including us. Through this forum, the states collaborate to ensure the sound management and conservation of shared coastal resources and the associated fishing and non-fishing public benefits. We are an active partner of the ASMFC. Agency representatives participate on several ASMFC committees and boards, including the Sturgeon Technical Committee and Management Board, Shad and River Herring Technical Committee and Management Board, Fish Passage Working Group, Assessment Science Committee, and Habitat Committee.

Management authority for American shad, blueback herring, alewife, and American eel lies with the coastal states and the Services, and is coordinated through the ASMFC. The ASMFC developed Interstate Fishery Management Plans (FMP) for these species under the authority of the Atlantic Coastal Fisheries Cooperative Management Act. There is also an FMP for Atlantic sturgeon; Amendment I of the FMP prohibits any directed fishery or landings. Each FMP recognizes the depletion of stocks from overfishing, habitat loss (including the presence of dams), inconsistent management actions, and lack of data.

The goals and objectives of the following ASMFC fishery management plans are consistent with our agency's objectives for restoring runs of American shad, blueback herring, alewives, and American eel to historical habitat within the Kennebec River watershed. Implementing fish passage protection measures at the Shawmut Project is a critical step toward achieving our restoration goals.

The stated goal of the ASMFC American shad FMP is to " Protect, enhance, and restore Atlantic coast migratory stocks and critical habitat of American shad in order to achieve levels of spawning stock biomass that are sustainable, can produce a harvestable surplus, and are robust enough to withstand unforeseen threats." (ASMFC, 2010). Objectives for attaining this goal include, among others:

- Maximize the number of juvenile recruits emigrating from freshwater stock complexes.
- Restore and maintain spawning stock biomass and age structure to achieve maximum juvenile recruitment.

The stated goal of the ASMFC river herring FMP is to “Protect, enhance, and restore East Coast migratory spawning stocks of … alewife (*Alosa pseudoharengus*), and blueback herring (*A. aestivalis*) in order to achieve stock restoration and maintain sustainable levels of spawning stock biomass” (ASMFC, 2009). Objectives for attaining this goal include, among others:

- Prevent further declines in alewife and blueback herring abundance.
- Promote improvements in degraded or historical alosine critical habitat throughout the species’ range.

The stated goal of the ASMFC American eel FMP is to “ Conserve and protect the American eel resource to ensure its continued role in the ecosystems while providing the opportunity for its commercial, recreational, scientific, and educational use” (ASMFC, 1999). Specifically, the goal aims to:

- Maximize the number of juvenile recruits emigrating from freshwater stock complexes.
- Restore and maintain spawning stock biomass and age structure to achieve maximum juvenile recruitment.

4.5. STATE OF MAINE

The State of Maine’s Department of Marine Resources (MDMR), Division of Sea-Run Fisheries and Habitat mission is to “protect, conserve, restore, manage and enhance diadromous fish populations and their habitat in all waters of the State; to secure a sustainable recreational fishery for diadromous species; and to conduct and coordinate projects involving research, planning, management, restoration or propagation of diadromous fishes.” MDMR has identified the following sea-run fish species of most management concern: Atlantic salmon, American shad, alewife, blueback herring, American eel, shortnose sturgeon, Atlantic sturgeon, rainbow smelt, sea lamprey, sea-run brook trout, and striped bass. Several of these sea-run fish currently use the habitat within the Shawmut Project area, including Atlantic salmon, alewife, blueback herring, and American eel.

Maine’s fishery management in the Kennebec River is guided by the *Kennebec River Resource Management Plan* (MSPO, 1993). The goal of that plan is to restore, maintain, and enhance diadromous fish resources for the benefit of the people of Maine and provide increased employment through expansion of commercial and recreational fisheries for diadromous fish resources. Objectives in support of these goals include, among others, to identify, maintain, and enhance diadromous fish habitat essential to the viability of the resource and to provide, maintain, and enhance access of diadromous fish to and from suitable spawning areas.

The management plan does not contain specific objectives for Atlantic salmon; however, specific objectives for alewives and American shad are as follows:

- To restore and enhance American shad populations in the Kennebec River. This objective includes the goal of achieving an annual production of 725,000 shad above Augusta.
- To restore and enhance alewife populations in the Kennebec River. This objective includes the goal of achieving an annual production of 6.0 million alewives above Augusta.

The strategy developed to meet these objectives involves two phases of restoration (MSPO, 1993). The first phase required the removal of the Edwards Dam (FERC No. 2389), which occurred in 1999, and the stocking of alewives above Augusta. The second phase began with the removal of the Edwards Dam and requires the implementation of fish passage at each of mainstem dams on the Kennebec River (Lockwood, Hydro Kennebec, Shawmut, and Weston) up to the Abenaki Dam (FERC No. 2364) in Madison, as well as on the mainstem dams on the Sebasticook River up to the confluence of the east and west branches.

5. Species and Habitat Specific Goals and Objectives

The following discussion outlines our goals and objectives for diadromous species restoration in the Kennebec River watershed.

5.1. Alewife and Blueback Herring

Alewife and blueback herring are iteroparous, diadromous species occurring in waters of the eastern United States. Our management goal is to maximize production of river herring in the Kennebec River by providing access to historical spawning and rearing habitat in the watershed through safe, timely, and effective passage at barriers. We anticipate the Kennebec River will produce approximately 6 million adult river herring per year once historical spawning habitat is accessible (MSPO, 1993). The estimated production potential of the habitat above the Shawmut Project is 614,995 alewives (235 alewives/acre * 2,617 acres) (Attachment B: Shawmut Upstream Fish Passage Design Populations).

5.2. American Shad

American shad are an iteroparous, diadromous species occurring in waters of the eastern United States. Our management goal is to maximize production of American shad in the Kennebec River by providing access to spawning and rearing habitat in the watershed. We anticipate the Kennebec River will produce over 725,000 returning American shad per year once spawning habitat is accessible (MSPO, 1993). The estimated production potential of the habitat above the Shawmut Project is 354,000 shad (111 shad/acre * 3,189 acres) (Attachment B).

5.3. Atlantic Salmon

Atlantic salmon are a diadromous species occurring in waters of the northeast United States; the GOM DPS is listed as endangered under the ESA and is the only remaining population in the U.S. Our goal for the GOM DPS of Atlantic salmon is to recover the species by increasing their abundance, genetic diversity, and distribution of Atlantic salmon and eventually remove the species from the list of endangered species (USFWS & NMFS, 2019a). Our management objective for this relicensing is to eliminate, or minimize to the extent practicable, the effects of the Shawmut Project on the GOM DPS of Atlantic salmon and its critical habitat. Restoring endangered Atlantic salmon to the point where it is a secure, self-sustaining member of its ecosystem is a primary goal of our endangered species program (USFWS & NMFS, 2019a).

The GOM DPS consists of three Salmon Habitat Recovery Units (SHRUs): the Merrymeeting Bay, Penobscot Bay, and Downeast Coastal SHRUs. The Kennebec River is within the Merrymeeting Bay SHRU. Each SHRU must achieve specific recovery criteria for the downlisting or delisting of the GOM DPS (USFWS & NMFS, 2019a). The draft SHRU Specific Implementation Strategy (USFWS & NMFS, 2019b) for the Recovery Plan indicates that the Merrymeeting Bay SHRU is important to salmon recovery for the following reasons:

- The Kennebec River in the Merrymeeting Bay SHRU contains the most abundant and suitable habitats for Atlantic salmon in the SHRU. Rivers with abundant, high quality habitats that can support large populations are more resilient to anthropogenic and environmental stressors than smaller rivers.

- The Merrymeeting Bay SHRU contains a wide range of diverse habitats that are necessary for supporting an abundant, diverse, and resilient population of Atlantic salmon.

- The historical record (Foster & Atkins, 1867) suggests that the Kennebec River has the potential to produce at least 100,000 returning adult Atlantic salmon when freshwater and marine conditions are favorable.

- The Sheepscot River in the Merrymeeting Bay SHRU contains the southernmost locally adapted stock of Atlantic salmon.

- The Kennebec River portion of the Merrymeeting Bay SHRU may have greater resilience to climate change because of its high gradient systems and cool water influences.

- The Merrymeeting Bay SHRU has tremendous capacity for river herring production that likely conveys many ecological benefits to Atlantic salmon (Saunders et al., 2006).

The draft SHRU Specific Implementation Strategy outlines the best opportunities for achieving the recovery strategy objectives in this SHRU, and emphasizes the need to restore access to the abundant, high quality habitat that is in the Sandy River upstream of the four lower river dams.

Critical Habitat

Critical habitat is the specific areas within the geographic area occupied by the species at the time it was listed, which contain the physical or biological features that are essential to the conservation of endangered and threatened species and that may need special management or protection. The final rule designating critical habitat for the GOM DPS identified physical and biological features (PBFs) essential for the conservation of Atlantic salmon (74 FR 29300; June 19, 2009) (Table 1).

Table 1. Physical and Biological Features of Atlantic Salmon Critical Habitat.

PBFs for Spawning and Rearing (S&R) Habitat	
S&R 1	Deep, oxygenated pools and cover (*e.g.*, boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.
S&R 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.
S&R 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.
S&R 4	Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.
S&R 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.
S&R 6	Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.
S&R 7	Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.
PBFs for Migration (M) Habitat	
M 1	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.
M 2	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.
M 3	Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.
M 4	Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.
M 5	Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration.
M 6	Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

Habitat areas designated as critical habitat must contain one or more physical and biological features within the acceptable range of values required to support the biological processes for which Atlantic salmon use that habitat. Both the proper functioning of ecosystem processes and the diversity and abundance of coevolved diadromous species are habitat elements that are essential to the persistence and recovery of endangered Atlantic salmon. The entirety of the Shawmut Project area is designated as critical habitat for Atlantic salmon.

5.4. Sea Lamprey

Sea lamprey are a semelparous, diadromous species occurring in waters of the eastern United States. Sea lamprey are native to coastal rivers of Maine, including the Kennebec River. The historical abundance and distribution of sea lamprey in the Kennebec River is unknown, but it is assumed that they could have accessed habitat up to the falls in Indian Stream Township prior to the construction of dams (Houston et al., 2007). Our management goals and objectives for sea lamprey in the Kennebec River focus on improving access to historical spawning and nursery habitat throughout the drainage by providing safe, timely, and effective passage at barriers.

5.5. Riparian and Aquatic Habitat

Agency objectives for protecting riparian and aquatic habitats include avoiding, minimizing, and mitigating the direct, indirect, and cumulative effects of the Shawmut Project on riparian and aquatic habitats and habitat functions. This includes accounting for the project's effects on the recruitment and transport of large woody material (LWM). The physical and biological features for designated Atlantic salmon critical habitat include freshwater migration sites with woody debris cover (74 FR 29300, June 19, 2009). The Final Recovery Plan for Atlantic salmon identifies the reduction of habitat complexity associated with the lack of large wood and boulders as a stressor related to the threat of species viability (USFWS & NMFS, 2019a).

6. CONSIDERATION OF CLIMATE CHANGE

On January 4, 2016, we issued revised guidance for the treatment of climate change in NMFS Endangered Species Act decisions (NMFS, 2016). The guidance provides seven policy considerations pertaining to: (1) future climate conditions and uncertainty; (2) projecting climate change effects on the future status of species; (3) evaluating the adequacy of existing regulatory mechanisms to reduce greenhouse gas emissions; (4) making critical habitat designations in a changing climate; (5) future benefits; (6) responsiveness and effectiveness of management actions in a changing climate; and (7) incorporating climate change in project designs. Measures within this prescription are intended to mitigate the potential impacts of climate change for critically endangered Atlantic salmon and the full suite of diadromous fish by ensuring safe access to climate resilient habitat upstream of the project.

6.1. Climate Change Effects to Habitat for diadromous Species

Alterations in stream temperatures, volume, velocity, and other abiotic characteristics affected by climate change and the presence of dams can influence larval and juvenile fish development, as well as the ecology and biota of the river (Hare et al., 2016; Spence et al., 1996). The slowing of free-flowing water by dams can exacerbate the effects of climate change by altering streamflow temperature via increased water residence times (e.g., reduced flow velocity) and decreased daily temperature fluctuations (Bergkamp et al., 2000; Hare et al., 2016). The distribution, abundance and composition of many benthic invertebrate and fish communities are determined by water velocity. Fluctuating water levels may delay migration, impact spawning conditions, and reduce or expose spawning and rearing habitat (Beiningen, 1976). Lower water levels may also concentrate fish and increase predation and competition among species (Spence et al., 1996). Any forage species that are temperature dependent may also shift in distribution as water temperatures warm.

Since fish maintain a body temperature almost identical to their surroundings, thermal changes of a few degrees Celsius can critically affect biological functions in salmonids (USFWS & NMFS, 2005). While some fish populations may benefit from an increase in river temperature for greater growth opportunity, there is an optimal temperature range and a limit for growth after which salmonids will stop feeding due to thermal stress (USFWS & NMFS, 2005). Thermally stressed fish may also become more susceptible to mortality from disease (Clews et al., 2010).

Atlantic salmon are among the two most vulnerable species to climate change in the Northeast U.S. Continental Shelf (Hare et al., 2016). This is due to factors including habitat specialization, dependence on both freshwater and marine resources, sensitivity to water temperatures, and complex spawning cycles (Hare et al., 2016). American shad, blueback herring, and alewife were identified in the same report as highly vulnerable to the anticipated effects of climate change.

Atlantic salmon are cold-water fish and have a thermal tolerance zone where activity and growth is optimal (DeCola, 1970). Temperature can be a stimulant for salmon migration, spawning, and feeding (Elson, 1969). Temperature can also significantly influence egg incubation success or failure, food requirements and digestive rates, growth and development rates, vulnerability to disease and predation, and may be responsible for direct mortality (Spence et al., 1996; Whalen et al., 1999). When temperatures exceed 23° C, adult Atlantic salmon can cease upstream movements, seeking refuge in cooler water (Baum, 1997). Salmon mortalities have been associated with daily average temperatures of 26 to 27° C (Baum, 1997). Thus, increasing sea and river temperatures could have a significant impact on sea-run fish abundance, reproduction, and distribution in the Kennebec River watershed.

Atlantic salmon may be especially vulnerable to the effects of climate change in New England, since the areas surrounding many river catchments where salmon are found are heavily populated and have already been affected by a range of stresses associated with agriculture, industrialization, and urbanization (Elliott et al., 1998). Climate effects related to temperature regimes and flow conditions determine juvenile salmon growth and habitat (Friedland, 1998). One study conducted in the Connecticut and Penobscot Rivers, where temperatures and average discharge rates have been increasing over the last 25 years, found that dates of first capture and median capture dates for Atlantic salmon have shifted earlier by about 0.5 days per year (Juanes et al., 2004). These consistent shifts correlate with long-term changes in temperature and flow (Juanes et al., 2004). Temperature increases are also expected to reduce the abundance of salmon returning to home waters, particularly near the southern edge of the geographic range (Beaugrand & Reid, 2003).

6.2. Potential Effects of Climate Change in the Project Area

The global mean temperature has risen 0.85°C from 1880 to 2012; the linear trend over the last 50 years is nearly twice that for the last 100 years (IPCC, 2007, 2014). Precipitation has increased nationally by 5 centimeters (cm), associated with an increased frequency of heavy downpours (Melillo et al., 2014). Observed changes in marine systems thought to be associated with global climate change; these changes include ocean acidification, decreased productivity, altered food web dynamics, shifting species distributions, among others (Hoegh-Guldberg &

Bruno, 2010).

The Intergovernmental Panel on Climate Change (IPCC) models predict that Maine's annual temperature will increase another 1.7–2.8 °C by 2050 (Fernandez et al., 2015). The IPCC models also predict that precipitation will continue to increase across the Northeast U.S. by 5–10 percent by 2050, although the distribution of this increase is likely to vary across the climate zones (Fernandez et al., 2015); model predictions show greater increases in precipitation within interior Maine. Total accumulated snow is predicted to decline in Maine especially along the coast where total winter snow loss could exceed 40 percent relative to recent climate (Fernandez et al., 2015). Since 2004, the rate of increase in sea surface temperature in the Gulf of Maine has accelerated to 0.23 °C per year; a rate faster than 99 percent of the world's oceans (Fernandez et al., 2015).

Beyond the general information on model predictions for the Northeast U.S. and the State of Maine, fine scale predictions on how climate change will impact the Shawmut Project area is not available. As there is significant uncertainty in the rate and timing of change as well as the effect of any changes experienced in the project area due to climate change, it is difficult to predict the impact of these changes on any particular species. However, based on the IPCC model information for Maine, it is possible that changing seasonal temperature regimes could result in changes to the timing of seasonal migrations for all diadromous fish in the Kennebec River watershed. Ensuring access to a diversity of suitable habitat, including climate resilient habitats, is essential for the continued survival and recovery potential of diadromous species. Safe, timely, and effective passage at the Shawmut Project, and ultimately passage at each barrier to migration, will support our restoration goals by promoting access to a greater expanse and diversity of spawning, rearing and nursery habitat that is expected to support population resiliency in light of changing conditions.

7. CONSIDERATION OF DAM REMOVAL

Throughout this document, and in ample filings contained in the licensing administrative record, we describe our thorough consideration of the factors related to the Project's effects on fisheries, and the need for fish passage. Within this relicensing process, we consider decommissioning and subsequent removal as a reasonable alternative that the Commission must analyze. Dam removal has well defined benefits for fish passage, water quality, and habitat restoration in support of ecological functions and values, commercial and recreational fisheries, and sustainable coastal communities. Without man-made barriers to impede essential fish movements, all fish may move freely and naturally, according to their life history adaptations for fulfilling their biological requirements.

The Kennebec River watershed once produced large runs of diadromous fish, including Atlantic salmon, American shad, blueback herring, alewife, American eel, and sea lamprey. These runs once contributed to substantial commercial, recreational, and subsistence fisheries (Foster & Atkins, 1867). Diadromous production within the Kennebec watershed, has been in general decline throughout the 20th century (MSPO, 1993). The Kennebec River Restoration Plan clearly identifies the lack of passage at dams as a significant detriment to the diadromous fishery (MSPO, 1993). The Final Recovery Plan for Atlantic salmon identifies dams and their related effects as a significant threat to species viability (USFWS & NMFS, 2019a). The 2009 Atlantic salmon critical habitat designation defines freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment as a physical and biological feature of critical habitat (74 FR 29300, June 19, 2009). Significant spawning and rearing habitat exists upstream of the Shawmut Dam. Existing dams, including the Shawmut Dam, prevent access to historically productive habitat.

Dam removal would address the following ecosystem functions and values:

Loss of migration, spawning, rearing and nursery habitat –The Shawmut dam fully blocks passage of diadromous species. The dam and current/proposed bypass reach flows limit the ability of these fish to access historical habitat and fully realize the potential productivity in the watershed. Dam removal would contribute to mitigation of cumulative effects (e.g., delay, passage inefficiencies, downstream mortality, and increased predation) of multiple barriers in the watershed; whereas, modification of the Project through the addition of fish passage would maintain these negative effects to some degree with a compromised bypass reach flow. Fish passage measures do not fully mitigate hydroelectric project effects (FERC 2004; Accession #20041008-0140). Dam removal would be a key step in the comprehensive planning efforts by us, the USFWS, the State of Maine, and other stakeholders for restoring diadromous fish.

Ecosystem and societal functions – Diadromous fish support key ecological functions as a mechanism for nutrient transport, prey for commercially and recreationally important fish, and baitfish for the lobster industry. For example, the current price for harvested river herring in the lobster bait industry in Maine is approximately $75 per crate (MDMR, 2020). A crate is roughly equal to 400 river herring. A restored river herring run in the Kennebec River would result in a potential annual harvest worth over $640,000 assuming an escapement of 43%. Dam removal will support restoration of these key species in support of these ecological and social functions and values.

Habitat loss due to impoundment effects – Dams inundate lotic habitat that alters ecosystem structure and function (Poff et al., 1997). The Shawmut dam impounds approximately 1,310 acres of lotic habitat that under a natural condition would be higher gradient river habitat that is more suitable for salmonids and other diadromous species. Considering the number of impoundments in the Kennebec River watershed, transforming the degraded river reach back into high quality habitat would alleviate some of the cumulative effects of multiple dams; thereby, rebalancing the public benefits of energy production within the basin and fisheries production.

8. FACTUAL BACKGROUND

8.1. PROJECT SPECIFICS

The following description is from the Final License Application for the Shawmut Project (Accession #20200131-5356).

8.1.1. PROJECT DESCRIPTION AND PROPOSED MEASURES

The Shawmut Project is located at river mile 70 (24.5 miles above head-of-tide in Augusta, Maine) and is the third dam on the mainstem of the Kennebec River. The Shawmut Project includes a 1,310-acre impoundment, a 1,135-foot long dam with an average height of about 24 feet, headworks structure, enclosed forebay, and two powerhouses with intake structures. The crest of the dam has 380 feet of 4-feet high hinged flashboards serviced by a steel bridge with a gantry crane, a 730 foot long inflatable bladder composed of three sections, each 4.5 feet high when inflated and a 25 foot wide by 8 foot deep log sluice equipped with a timber and steel gate.

The headworks and intake structures are integral to the dam and the powerhouses, respectively. The forebay intake section contains eleven headgates and two filler gates. Five of the headgates are installed in openings 10 feet wide by 15.5 feet high and six are installed in openings 10 feet by 12.5 feet. The two filler-gate openings are 4 feet by 6 feet. A non-overflow concrete gravity section of dam connects the west end of the concrete filled forebay gate openings with a concrete cut-off wall which serves as a core wall for an earth dike.

The forebay is located immediately downstream of the headgate structure and is enclosed by two powerhouse structures, the original 1924 powerhouse located to the east and the 1982 powerhouse located to the south. An approximately 240-feet-long concrete retaining wall is located on the west side of the forebay. Located at the south end of the forebay between the powerhouses is a 10-feet by 7-feet Taintor gate. In addition, a 6-feet wide by 6-feet deep gate and a surface sluice (4-feet-wide by 22-inches-deep, passing 35 cfs) that is used for downstream fish passage discharges into a 3-feet-deep man-made plunge pool are located at the south end of the forebay. In the old powerhouse, the intake section has six open flumes each fitted with two 10.5-feet by 14-feet double leaf slide gates and a continuous trash rack. In the newer powerhouse, the intake section contains two openings fitted with vertical headgates about 12-feet-high by 12-feet-wide and operated by hydraulic cylinders. The trash racks are serviced by a track mounted, hydraulically operated trash rake with trash removal capabilities. The trash racks screening the intakes are 1.5-inch clear spacing in front of Units 1-6 (Francis units) and 3.5 inch clear spacing in front of Units 7 and 8 (propeller units).

The original powerhouse contains six horizontal Francis-design units and the newer powerhouse contains two horizontal propeller units, having a total combined installed capacity of 8.74 MW and combined flow of approximately 6,700 cfs. The project's tailrace channels are excavated riverbed located downstream of the powerhouses. The Project is typically operated in a run-of-river mode, normally passing a minimum flow of 2,110 cfs, with a normal full pond elevation of about 112.0 ft. msl.

8.1.2. PROJECT OPERATIONS

The Shawmut Hydroelectric Project (Project) operates as a run-of-river facility, and the impoundment experiences little fluctuation during normal operations, maintaining the pond level within a foot of the normal full pond elevation of 112.0 feet U.S. Geological Survey (USGS) datum during normal operations. The maximum hydraulic capacity of the turbines is 6,690 cubic feet per second (cfs). After maximum flow to the turbines has been achieved, excess water is spilled through the spillway sluice. When flows exceed the capacity of the spillway sluice (1,840 cfs), sections of the rubber dam are deflated, and the hinged flashboards are dropped, to pass additional water. The project units and spillway can pass approximately 40,000 cfs while maintaining a pond elevation of approximately 112.0’.

Total project outflow varies as units, gates, and spillway mechanisms (i.e., rubber dam bladders or flashboards) are opened or closed to manage pond elevations within a run-of-river mode. The bladder sections can only be operated in a fully inflated position or a fully deflated position; each section is capable of passing up to approximately 7,000 cfs when deflated while maintaining a pond level of approximately elevation 112.0’. The top elevation of the rubber bladders is 112.5’ to allow a six-inch freeboard above normal full pond. As is typical of operational conditions at any hydropower project, pond levels generally fluctuate within a limited range as the facilities (i.e., units, gates, hinged flashboards and rubber bladders) are operated to manage water levels and flows, as well as to manage variable inflows.

8.1.3. PROJECT FISHWAYS

Existing Upstream Passage

There are no upstream fish passage facilities for species other than American eel at the Shawmut Project. Upstream passage of river herring, American shad, and Atlantic salmon is provided via trap and truck operations from the Lockwood dam, the first dam on the Kennebec River.

Existing Downstream Passage

Downstream fish passage at Shawmut is provided through a combination of a sluice and a Taintor gate. The sluice is located on the right-hand side of the intake structure next to Unit 6. It is 4 feet wide by 22 inches deep and the amount of flow can be adjusted by adding or removing stoplogs. With all stoplogs removed, the sluice passes between 30 and 35 cfs which is discharged over the face of the dam into a 3-foot-deep plunge pool. The Taintor gate located next to the sluice measures 7 feet high by 10 feet wide and can pass up to 600 cfs.

The sluice and Taintor gate are operated for fish passage typically from April 1 through June 15 and from November 1 through December 31, as river flow and ice conditions allow. Downstream passage is also provided along the Shawmut spillway during periods of excess river flow that results in spill and via the lowering of four hinged boards that provide a combined 560 cfs of spill flow.

8.1.4. Proposed Fishways

Proposed Upstream Fishways

In 2016, the Commission ordered an amendment to the license for the Shawmut Project and required the construction of an upstream fishway[1]. On December 31, 2019, Brookfield filed the final design drawings and operations and maintenance plans for the required upstream fishway, a fish lift (Accession # 20200107-0019). In letters on July 13 and 23, 2020, the Commission indicated that it would instead require the consideration of the unconstructed upstream fishway in relicensing (Accession #s 20200713-3022, 20200713-3034, and 20200723-5012). On July 30, 2020, Brookfield filed a letter indicating that it was now proposing the construction of the previously required upstream fishway and provided the complete record of the fishway's design consultation (Accession # 20200730-5142).

- The proposed fish lift is designed to operate up to a total design attraction flow of 340 cfs (5% of station capacity). The flow can be apportioned such that up to 225 cfs can pass the fishway entrance and up to 225 cfs can pass the auxiliary water system (AWS). However, the combined flow is designed not to exceed 340 cfs. The fish lift is designed to operate between the 5% (20,270 cfs) and 95% (2,540 cfs) river flows for the fish passage season, however, it could remain functional outside of these design conditions. The entrance will be 10 feet wide with an invert elevation of 79.6 feet. The entrance will have a hinged flap gate to adjust the head loss and velocity across the entrance. The design head loss across the entrance is six inches, however, this could change based upon river conditions and/or operational considerations. The design tailwater elevations at the entrance range from 88.6 feet (95% exceedance), 89.1 feet (normal conditions) to 91.5 feet (5% exceedance). Fish will pass into a 12-foot-wide holding/staging channel before

[1] Merimil Limited Partnership and Brookfield White Pine Hydro, LLC, 155 FERC ¶ 61,185 (2016).

passing a V-gate into the hopper. The V-gate is designed to operate with up to a 6-foot-wide opening. The hopper will have a volume of 490 cubic feet. The hopper will have a sloped braille on the upstream and downstream sides that will shunt fish into the hopper as it lifts. Attraction/conveyance water will be transferred from the AWS above the hopper where a series of baffles, weirs, and screens take the energy out of the water and streamline it before passing the hopper. The attraction/conveyance water can be adjusted based upon gate settings. The lift is designed to have up to a 15 minute cycle time; however, conditions may necessitate timing adjustments throughout the passage season. The hopper will transfer fish into a metal exit flume where they will be flushed via a 600 gallon water storage tank through a 20-inch-diameter pipe to the headpond. The AWS provides water from the headpond and is located next to the fish lift. Water from the AWS will pass over a wedge wire screen where some of the water will enter an attraction chamber and be available to pass upstream of the hopper. The remainder of the water not passing through the wedge wire screen will pass over an ogee-type spillway and discharge in the tailrace next to the fish lift entrance. The attraction water chamber is designed to pass 115 to 225 cfs above the hopper and 115 to 225 cfs over the ogee, with a total flow of 340 cfs under normal conditions.

The AWS entrance will be 12 feet wide with a control gate and stop log slots and will provide an additional means for downstream passage. The upstream fishway bypass, located downstream of the dam in the vicinity of the Taintor gate between the two powerhouses, will allow fish to move directly from the tailrace of the new powerhouse to the tailrace of the old powerhouse is 10.5 feet wide by 81.46 feet long. There is normally a 1.5 foot difference in elevation between the two tailraces that will need to be managed for fish to pass. The bypass will have a sloping entrance gate to control the velocity and the head loss across the entrance. The entrance is 6.8 feet wide. The upstream fishway bypass will use up to 100 to 140 cfs of water to attract and convey fish. The existing downstream bypass located between the two powerhouses will be reconstructed between the upstream fishway bypass and the propeller units powerhouse where there is an existing Taintor gate to include a 10-feet-wide channel that will provide additional far field attraction to the entrance of the upstream fishway bypass. The channel is designed to pass up to 600 cfs for downstream passage.

- The Licensee proposes to implement operational prioritization of generating units 1-6 (Francis units), where the unit closest to the proposed fish lift entrance (Unit 1) will be operated first-on and last-off, followed consecutively by Units 2 through 6.

Proposed Downstream Fishways

Described below is our understanding of the licensee's proposed measures. We derived details regarding proposed downstream passage measures associated with the proposed upstream fish passage facility from the Licensee's July 30, 2020, filing that included documentation surrounding that proposed facility and its operation, as described above. In the Final License Application (FLA), Brookfield states that it is "proposing certain mitigation and enhancement (PM&E) measures for the Shawmut Project including implementation of measures specifically related to the Shawmut Project that are included in the SPP." On July 13, 2020, the Commission issued a letter order rejecting the SPP filed by Brookfield (Accession # 20200713-3023). However, the Commission did not clarify whether those measures in the rejected SPP that related to the Shawmut relicensing proposal remain valid. In light of this ambiguity, we assume that any measures from the rejected SPP that the Licensee describes in the FLA remain elements of the Licensee's proposal.

- The Licensee proposes to install a guidance boom (e.g., Worthington boom) with rigid panels, ½ inch perforations, and a depth of 10 feet in the forebay in front of units 7 and 8 (propeller units).
- The proposed upstream fishway facility, described above, will provide a new downstream passage opportunity via the spillway channel AWS. AWS flow of 115-225 cfs in excess of the flow required for fish lift operation will be discharged to the Unit 1-6 tailrace adjacent to the fish lift entrance.
- The Licensee proposes to implement operational prioritization of units 1-6 (Francis units), where the unit closest to the proposed fish lift entrance (Unit 1) will be operated first-on and last-off, followed consecutively by Units 2 through 6.
- The Licensee proposes to continue operation of the Taintor gate sluice at maximum capacity (i.e., 600 cfs) for the duration of the smolt outmigration window.
- The Licensee proposes to continue operation of the 35 cfs surface sluice from April 1 to December 31, as river conditions allow.

- The Licensee proposes to lower four hinged boards, which will provide a combined 560 cfs of spill flow that can be used primarily by outmigrating salmon smolts. This is an interim measure that will only be implemented until the proposed guidance boom in the project forebay is installed.

8.2. Kennebec River Watershed

The Kennebec River originates at the outlet of Moosehead Lake in northwestern Maine and flows south for approximately 145 river miles, where it joins the Androscoggin River and four other smaller rivers to form Merrymeeting Bay. Merrymeeting Bay drains into the Atlantic Ocean through the Lower Kennebec River, a long saltwater tidal channel. The Lower Kennebec River and Merrymeeting Bay are known collectively as the Kennebec Estuary. Tidal processes extend upstream as far as Augusta, which is considered head-of-tide (MDACF, 2007).

The Kennebec River basin has a total drainage area of approximately 5,890 square miles. The two largest lakes in the watershed are Moosehead Lake on the Kennebec River and Flagstaff Lake, located on the Dead River, a major tributary entering near The Forks, Maine. Other major lakes and rivers within the watershed include Brassua Lake, Sebasticook Lake, the Belgrade Lakes, China Lake, Cobbosseecontee Lake, and the Moose, Dead, Carrabassett, Sandy, and Sebasticook Rivers. The Carrabassett and Sandy Rivers are considered to be major contributors to river flow in the Kennebec River; both are "flashy," and rapid increases and decreases in river flow are common (MDACF, 2007). Combined, both tributaries contribute approximately 40 percent of the peak discharge of the Kennebec River watershed during floods (MDACF, 2007).

Major flooding may occur within the Kennebec River basin as a result of snowmelt, rain-on snow events, or major precipitation. In addition to hydropower purposes, several impoundments in the basin provide benefits to flood management, including Moosehead Lake, Flagstaff Lake, and the Brassua reservoir. These projects provide significant benefits downstream for flood management by attenuating peak flows (MDACF, 2007). Springtime is generally the period of most concern for flooding, when rain and snow melt combine to produce high water conditions. The reservoirs are generally operated to provide the maximum drawdown just before spring ice break-up (usually around late March), providing storage capacity to hold a portion of the spring flows, filling the reservoirs by early June.

Flows from the Kennebec River headwater storage dams, including those of the Moosehead (FERC No. 2671), Flagstaff (FERC No. 2612), and Brassua (FERC No. 2615) Projects are generally coordinated to provide an average target river flow of 3,600 cfs at Madison, Maine. The determination of how much water to release from each of the storage reservoirs is made primarily based on natural flows, local minimum and recreational flow requirements, target reservoir levels and drawdown limits, snowpack, and weather forecast. The regulated flow target at Madison is based on a long history of agreements among many parties on the Kennebec River, and the operations of downstream projects, such as Shawmut, have been premised on this historical water management.

8.3. FISH RESOURCES – HISTORICAL

The Kennebec River Resource Management Plan describes the historical fish resources of the Kennebec River (MSPO, 1993).

Historically, the Kennebec River had extensive and diverse aquatic habitat accessible for large numbers of diadromous species (Foster & Atkins, 1867). The Kennebec River has at least three natural barriers in the watershed that limited diadromy: Ticonic Falls in Waterville (which was likely the upstream limit for shortnose sturgeon, Atlantic sturgeon, rainbow smelt, and striped bass), Norridgewock Falls in Skowhegan (which was likely the upstream limit for American shad and river herring) and an unnamed falls above the Kennebec River gorge in Indian Stream Township (which was likely the upstream limit for Atlantic salmon) (MSPO, 1993; NMFS, 2009). The Shawmut Project is located between the historic Ticonic Falls and Norridgewock Falls.

American shad was a major species fished for in the Kennebec River, especially subsequent to the construction of the Augusta Dam in 1837. This dam may have reduced the shad resource by as much as half. Although the landings prior to 1887 are only estimates, Atkins reported that the average annual landings for shad in Bowdoinham, Dresden, and Woolwich were 120,000 fish for the years 1830-36. This same district was reported to have landed 180,000 shad in 1867 and the catch for the entire Kennebec River was estimated at 225,000 shad.

Historically, alewives ascended the Kennebec River in immense numbers as far as Norridgewock Falls, 89 miles from the sea on the mainstem (Foster & Atkins, 1869). They ascended the Sandy River as far as Farmington and spawned in Temple Pond until a dam was built at New Sharon in 1804. The Sandy River was not considered a principal alewife tributary because of its lack of ponded habitat and dead water areas. Atkins and Foster (1867) gave the following account of diadromous fisheries of the Sandy River:

> *Although it has a great many miles of spawning ground for salmon, and but a limited extent suitable for shad or alewife. Both the latter, however, came into the river and ascended as far as Farmington. The lower part of the river maintained an excellent shad fishery. But in 1804 the New Sharon Dam was built. This stopped shad and alewives but a fishway is said to have been maintained for a few years which permitted salmon to pass. A few years later another dam was thrown across the river nearer its mouth, and the fishways were no longer maintained.*

Data for blueback herring and sea lamprey are limited. However, each was historically common in the Kennebec River watershed (Foster & Atkins, 1867).

Atlantic salmon were once abundant in the Kennebec River from Merrymeeting Bay up to the impassable falls in Indian Stream Township. The historical record (Foster & Atkins, 1867) suggests that the Kennebec River has the potential to produce at least 100,000 returning adult Atlantic salmon when freshwater and marine conditions are favorable. The runs of salmon were cut off with the construction of mainstem dams. Access to upstream habitat was not restored until the Edwards Dam was removed in 1999, and a fish trap was constructed at the Lockwood Dam in 2006.

8.4. Fish Resources – Present Day

The Kennebec River has the potential to support numerous diadromous fish species, including Atlantic salmon, American shad, blueback herring, alewife, American eel, and sea lamprey. Federal and state management actions in the Kennebec River include stocking of adult salmon (collected at the Lockwood Dam), salmon eggs, and river herring into habitat above the Shawmut Project, stocking of game fish for recreational fishing, and engaging in licensing or permitting actions for activities affecting aquatic habitat. Mandates and regulations guide management activities that identify protection and conservation of sea-run fish and their habitat as public trust resources.

8.4.1. American Shad

Coast-wide landings of American shad decreased dramatically from the early 1900s, when approximately 50 million pounds were being landed annually, to the 1980s when only 3.8 million pounds were being landed annually (ASMFC, 2010). In response to these dramatic declines in commercial landings, the ASMFC completed a Cooperative Interstate Fishery Management Plan for American shad in 1985 recommending management measures that focused on regulating exploitation and promoting stock restoration efforts that would largely be left up to the discretion of individual states that had regulatory authority over the species (ASMFC, 2010). In 1994, the plan review team and management board determined that the original FMP was insufficient in protecting and restoring the remaining stocks, leading to the adoption of Amendment 1 to the FMP in 1999 (ASMFC, 2010). Amendment 1 established benchmarks that effectively created a ceiling for directed fishing mortality. This action was in effect until the adoption of Amendment 3 in 2010. Amendment 3 incorporates the recommendations of the ASMFC stock assessment (ASMFC, 2007) that accounted for combined human-induced instantaneous mortality (including directed fishing, dam-induced, pollution, and bycatch) and natural mortality to establish benchmark values for total instantaneous mortality. Under Amendment 3, states are required to monitor bycatch of American shad in jurisdictional waters and submit sustainable fisheries management plans for any areas that remain open to commercial or recreational fisheries. Amendment 3 also requires states and jurisdictions to submit a habitat plan regardless of whether their commercial fishery would remain open. The State of Maine produced a plan with Kennebec River-specific information for American shad, including general threats, data availability, current work and recommended actions (MDMR, 2014).

The water quality in the Kennebec River has improved dramatically since the era of gross pollution (the 1930s through the early 1970s) that preceded the passage of the Clean Water Act. Since 1976, the Kennebec River has had adequate dissolved oxygen levels to support shad and other diadromous fish species in the lower river (MSPO, 1993). MDMR has been monitoring the abundance of juvenile shad in the Kennebec River estuary since 1979. The *American Shad Habitat Plan* indicates that over the entire sampling period (1979-2012), the overall highest average catch per unit effort (CPUE) for juvenile American shad was found in the Abagadasset River (11.46 shad per haul), followed by the upper Kennebec River below Lockwood dam (9.02) (MDMR 2014). Merrymeeting Bay (4.99), the Cathance (3.83), Eastern (2.87), and the lower Kennebec rivers (2.09) all have lower but consistent CPUE values (MDMR, 2014). The strength of these data in identifying successful spawning areas is limited because sampling is performed after the spawning event, and juvenile shad may have become dispersed from their natal location by passive larval drift. These data may provide some insight into juvenile shad habitat (MDMR, 2014).

The first fish passage facility on the mainstem Kennebec River was constructed at the Lockwood Dam in 2006. The FLA indicates that, since then, a small number of American shad have been trapped, with an average of 117 (range 0 to 836) captured annually (Table 2). Shad are either trucked upstream or released back downstream of the Lockwood Project.

Table 2. Diadromous fish counts at the Lockwood Project (P-2574) from 2006 to 2019 (based on information presented in the FLA).

Year	River Herring	American Shad	Atlantic Salmon
2006	4,094	0	15
2007	3,448	18	16
2008	131,201	0	22
2009	45,969	0	32
2010	76,745	39	5
2011	37,847	17	60
2012	179,358	5	5
2013	103,242	0	7
2014	115,667	1	18
2015	91,850	26	31
2016	224,990	836	37
2017	289,188	213	39
2018	307,035	437	11
2019	240,594	44	56

8.4.2. Alewife and Blueback Herring

Alewife and blueback herring stocks across their range have declined considerably from their historical abundances (ASMFC, 2009). Both species serve as important prey for federally managed groundfish stocks (Ames, 2004). On August 5, 2011, we received a petition from the Natural Resource Defense Council to list alewife and blueback herring as threatened species. On August 12, 2013, we published a determination that listing alewife or blueback herring under the ESA was not warranted. However, we acknowledged that populations of both species are at historically low abundances and committed to revisiting the status of both species within 3 to 5 years (78 FR 48944, August 12, 2013). In March 2017, a D.C. district court vacated the finding on blueback herring under the ESA. On August 15, 2017, the Department of Commerce announced its intent to reinitiate the status review of alewife and blueback herring under the ESA (82 FR 38672, August 15, 2017). On June 19, 2019, we published a new determination that listing alewife or blueback herring under the Endangered Species Act was not warranted (84 FR 28630, June 19, 2019).

The State of Maine annually stocks adult alewife collected in the trapping facility at the Lockwood Project into numerous locations in Maine, not all of them in the Kennebec River watershed. In 2016, MDMR stocked alewives into China Lake, Pushaw Lake, the Hydro Kennebec headpond, Shawmut headpond, Lovejoy Pond, Stetson Pond, Threemile Pond, Patties Pond, Sabattus River, Vinalhaven and Wesserunsett Lake (Accession # 20170329-5234). Of these locations, only the Shawmut headpond and Wesserunsett Lake are located above the Shawmut Project.

Approximately 2,617 acres of alewife spawning habitat has been identified within the Kennebec River watershed above the Shawmut Project (as calculated by MDMR in Attachment B). At 235 river herring per acre, it is assumed that approximately 615,000 alewives could be produced in the upstream habitat. There is minimal information on the number of blueback herring produced per acre, but based on three years of passage data at the Benton Falls Project in the Sebasticook River, we assume that the 3,694 acres of blueback spawning habitat upstream of Shawmut could produce between 237 and 484 blueback herring per acre, which would equate to 875,500-1,788,000 fish (Attachment B).

8.4.3. Atlantic Salmon

Atlantic salmon conservation and restoration efforts have been underway for more than 150 years in Maine following stock depletions resulting from commercial fisheries, pollution, and habitat loss due to impassable dams. The Craig Brook National Fish Hatchery and later the Green Lake National Fish Hatchery established an artificial propagation and fish culture program in Maine. These programs have allowed Atlantic salmon to persist when many of Maine's rivers were not suitable for salmon survival; they also allowed for maintenance of an economically important recreational fishery through the early 1990s. Today, the hatchery and stocking program are preventing the extinction of the species. Currently there is no allowable fishery for sea-run Atlantic salmon in U.S. waters. The commercial fishery for Atlantic salmon closed in 1947 and the last recreational fishery for Atlantic salmon closed in 2008.

Atlantic salmon were initially listed as endangered by USFWS and NMFS under the ESA in 2000. This initial federal listing of Atlantic salmon as endangered (65 FR 69459, November 17, 2000) and original recovery plan put emphasis on making major improvements to the conservation hatchery and stocking programs, as well as expanding habitat conservation efforts (USFWS & NMFS, 2005). Conservation efforts included reducing the negative effects of aquaculture, protecting accessible freshwater habitats by reducing threats from water and land use practices, and identifying and mitigating the effects associated with poor water quality.

In 2009, the GOM DPS was expanded to include Merrymeeting Bay and the entire Penobscot River watershed (74 FR 29344, June 19, 2009). The 2009 listing rule called particular attention to dams and the inadequacy of regulatory mechanisms related to dams as two of the three primary threats to Atlantic salmon that resulted in the designation of the GOM DPS as endangered. Designation of critical habitat for the Gulf of Maine DPS of Atlantic salmon occurred at this time (74 FR 29300, June 19, 2009). Conservation actions in response to this new listing and designation of critical habitat built off previous efforts. The USFWS and NMFS issued a new recovery plan for Atlantic salmon on February 12, 2019 (USFWS & NMFS, 2019a). The recovery plan presents a recovery strategy based on the biological and ecological needs of the species as well as current threats and conservation accomplishments that affect its long-term viability. The recovery approach 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 recovery plan is based on two premises: first, that recovery must focus on rivers and estuaries located in the GOM DPS until the Services have a better understanding of the threats in the marine environment, and second, that survival of Atlantic salmon in the GOM DPS will be dependent on conservation hatcheries through much of the recovery process. In addition, the scientific foundation for the plan includes conservation biology principles regarding population viability, an understanding of freshwater habitat viability, and threat abatement needs. The recovery plan identifies dams in the GOM DPS as a primary threat to the survival and recovery of Atlantic salmon.

NMFS, USFWS, and hydropower developers in the GOM DPS, as well as state resource agencies and tribes, have worked together to craft plans to address improving survival of salmon migrating past hydropower projects, reducing delays during migration, and implementation of fish passage. Downstream and upstream fish passage improvement projects and fish passage studies are underway at many hydropower projects within the designated critical habitat for Atlantic salmon.

The abundance of Atlantic salmon in the GOM DPS is critically low. The proportion of fish that are of natural origin is low (10-year average is 12%), but appears stable or increasing (CMS, 2020; USASAC, 2019). The conservation hatchery program has prevented extinction. However, stocking of hatchery eggs, fry, and smolts has not contributed to an increase in the overall abundance of salmon and, to date has not been able to increase the naturally reared component of the GOM DPS. Continued reliance on the conservation hatchery program is expected to prevent extinction in the short term, but recovery of the GOM DPS cannot be accomplished without significant increases in naturally reared salmon. Significant improvements in freshwater and marine survival are necessary to increase the abundance of naturally reared salmon.

The Shawmut Project is within the GOM DPS for Atlantic salmon and is within designated critical habitat. There are approximately 90,000 modelled rearing habitat units in the Kennebec River that occur within designated critical habitat. Of these, approximately 63,000 habitat units occur above the Shawmut Project (Wright et al., 2008). The Sandy River, a large tributary that flows into the mainstem upstream of Shawmut, contains 36,000 modelled habitat units and is where essentially all stocking of Atlantic salmon occurs in the Kennebec River watershed. Between 2009 and 2018, Maine DMR stocked nearly 7 million salmon eggs (USASAC, 2019) in the Sandy River. In addition, all adult pre-spawn salmon that are trapped at the Lockwood dam are trucked to spawning habitat in the Sandy River; 228 adults were trucked to the habitat between 2009 and 2018 (FLA). Therefore, smolts produced from wild production and stocking in the Sandy River, as well post-spawn adult salmon (kelts), migrate downstream through the Shawmut Project area annually.

8.5. Species Life History Summary

The life history of each diadromous species is well documented in the literature. Summaries are included in past fishway prescriptions filed by NMFS (Accession #s 20190424-5024 and 20180628-5102) and remain accurate and relevant. Therefore, we provide the life history information by reference only.

8.6. Project Impacts - Fish Passage

Dams and hydropower generation facilities on a river adversely affect the behavior, life cycle, and survival of diadromous fish. Historical runs of migratory fish across the northeastern United States were largely eliminated by dams, pollution, and over-fishing (ASMFC, 2009, 2010). Dammed river systems prevent the volitional passage of migrating fish. Diadromous species must negotiate fishways or be manually transported above barriers during upstream migrations to access suitable spawning and rearing habitat to complete their life cycle. Migration delay caused by fishways or trapping facilities can limit spawning success and the number of repeat spawning adults (Castro-Santos & Letcher, 2010). Except for American eel, the Shawmut Project does not provide upstream fish passage facilities for any diadromous species, which prevents the achievement of fisheries management and restoration goals for the Kennebec River. Therefore, the continued operation of the Shawmut Project represents a continued impact on public trust resources.

Adult and juvenile diadromous fish migrating downstream must locate and use bypass facilities, gates, spillways, or turbines to pass a hydroelectric project. Depending on site-specific conditions, downstream passage via these potential routes of egress can result in injury, delay, or mortality (Miracle et al., 2009; Pracheil et al., 2016; Stich, Bailey, et al., 2015). In addition, emigrants may experience impingement on hydraulic structures (e.g., trash racks) causing injury, delay, or mortality (Schilt, 2007).

Brookfield conducted downstream passage studies prior to the current relicensing to provide information that informs decisions regarding fish passage improvements at the project. The studies are an American eel downstream survival study conducted in 2007 and an Atlantic salmon smolt survival study conducted in 2013 (Accession #20140328-5114), 2014 (Accession #20150325-5184), and 2015 (Accession #20160331-5144). These studies are summarized below. To our knowledge, there have been no studies carried out, and therefore there is no empirical information regarding the project's effects on downstream migrating shad, blueback herring, alewife, or adult Atlantic salmon. Below, we describe the existing effect of the project on downstream migrating Atlantic salmon smolts based on the results on the survival studies conducted between 2013 and 2015.

The FLA summarizes the results of three years of downstream smolt survival studies at the Shawmut Project between 2013 and 2015. The results of the smolt studies provide project and route-specific survival estimates as well as an estimate for passage route utilization. The whole station survival of hatchery smolts at Shawmut was estimated to be 96.3%, 93.6%, and 90.6% in 2013, 2014, and 2015, respectively (Accession #20160331-5144). Therefore, the three-year average survival at the project is 93.5%. When assessed along with the average survival at the other three lower river dams in the Kennebec (i.e., Weston (95.1%), Hydro Kennebec (evaluated 2012 to 2014) (92.9%), and Lockwood (98.6%) (Brookfield 2016)), we estimate that cumulative smolt survival through the lower Kennebec river averages 81.1% (ranging between 73.6% in 2014 and 86.7% in 2013); that is, between 13% and 26% of outmigrating smolts die due to the direct effects of dam passage annually. This estimate does not include other sources of mortality that occur within the 50-km reach between the Sandy River and the Lockwood dam, such as predation. Additionally, it is well documented that latent effects of dam passage are associated with migratory delay and sublethal injury that are not detectable by the standard passage study design (Budy et al., 2002; Haeseker et al., 2012; ISAB, 2007; Schaller & Petrosky, 2007; Stich, Zydlewski, et al., 2015). These effects lead to additional losses of smolts in the estuarine and marine environment attributable to dam passage. Dam passage, particularly turbine passage, often leads to disorientation, loss of equilibrium, scale loss, and physical injury that may lead to higher disease and predation rates, as well as lower general fitness generally.

Cumulatively, dams can significantly delay smolt outmigration, especially in low water years, because the individual fish must search and find an available passage route. Delays can lead to mortality of Atlantic salmon by creating conditions that increase the risk of predation (Blackwell & Juanes, 1998), and can also reduce overall physiological health or physiological preparedness for seawater entry and oceanic migration (Budy et al., 2002). Various researchers have identified a “smolt window” or period of time in which smolts must reach estuarine waters or suffer irreversible negative effects (McCormick et al., 1998). Late migrants lose physiological smolt characteristics due to high water temperatures during spring migration. Similarly, artificially induced delays in migration from dams can result in a progressive misalignment of physiological adaptation of smolts to seawater entry, smolt migration rates, and suitable environmental conditions and cues for migration. If so, then these delays are expected to reduce smolt survival (McCormick et al., 1998). Given these delayed effects of dam passage, we anticipate that the mortality estimates derived from the Licensee's studies should be considered an underestimate of what is actually occurring.

In addition to overall survival, the 2013-2015 studies provided information pertaining to route selection and route-specific survival. Although informative, the sample sizes used to estimate passage route survival were small and because of this, these study results should only be considered rough approximations of the survival through any particular passage route. The options for downstream passage at the Shawmut Project (as described in section 8.1.1) include the spillway, the Taintor gate sluice, the smaller surface sluice, and any of the eight turbines (Francis units 1-6, Propeller units 7-8). When flow is available in excess of station capacity and fish passage facility needs, the project passes water over the spillway. In recent years, the Licensee has lowered four hinged flashboards on an interim basis to provide an additional non-turbine passage route during the smolt outmigration in the spring.

Overall, the study results (Table 3) are consistent with our understanding of passage route survival for Atlantic salmon smolts as documented at many other hydro projects in the GOM DPS. That is, smolts that pass via spill and through downstream fishways survive at a higher rate and in better condition than smolts that pass through turbines. On average, the survival rate through the turbines is approximately 7% lower than the survival rate through non-turbine routes (i.e., bypass, spillway) (Table 3). As indicated above, the difference in survival is likely greater than observed as we anticipate that smolts that pass through turbines are more likely to be exposed to sublethal effects, including injury and disorientation, that can lead to higher rates of indirect or latent mortality lower in the river or in the estuary. For example, injury rates of Atlantic salmon smolts at the Ellsworth Project on the Union River in Maine were significantly higher through the turbines (22% to 30%) than through the downstream bypass (3.8%) (Accession # 20171229-5079).

Table 3. Passage survival and passage route utilization rate of salmon smolts released upstream of the dam (including data on releases above the Weston Project, as available) in each of the three study years at the Shawmut Project (Accession # 20160331-5144).

Route	Year	Survival	Utilization
Bypass	2013	96.7%	47.9%
	2014	100.0%	20.1%
	2015	100.0%	60.1%
Francis Units	2013	97.7%	18.8%
	2014	81.4%	10.5%
	2015	84.3%	3.1%
Propeller Units	2013	100.0%	31.3%
	2014	91.5%	20.1%
	2015	77.9%	21.1%
Spill	2013	100.0%	2.1%
	2014	97.9%	49.4%
	2015	88.7%	15.7%

Approximately 50%, 30%, and 24% of salmon smolts were entrained in the eight project turbines in 2013, 2014, and 2015, respectively. Most of these went through the larger propeller units (7-8), but a significant proportion went through the smaller Francis units (1-6) despite the presence of racks with 1.5-inch spacing. The annual variation in route utilization was likely attributable to flow in the river. In high flow years (such as 2014 when median non-bypass spill was 7,591 cfs), a higher proportion of fish would be anticipated to pass the project via the spillway. In lower flow years (such as 2013 and 2015, which had 1,175 cfs and 0 cfs of non-bypass spill, respectively) spill passage may not be an option and, therefore, passage rates through the turbines and the bypass increase. The highest proportion of turbine entrainment occurred in 2013, a low flow year with minimal spill to provide an alternative passage route (Accession # 20160331-5144). Although 2015 had lower river flow than 2013, spill passage was provided through the three lowered hinged boards on the spillway in that study year, which may have contributed to the lower proportion of turbine entrainment.

8.6.1. Delayed Mortality

In addition to direct mortality sustained by Atlantic salmon at the Shawmut Project, some smolts experience delayed mortality in the estuary attributable to their experience at the project. Studies have investigated what is referred to as latent or delayed mortality, which occurs in the estuary or ocean environment and is associated with passage through one or more hydro projects (Budy et al., 2002; Haeseker et al., 2012; ISAB, 2007; Schaller & Petrosky, 2007; Stich, Zydlewski, et al., 2015). The concept describing this type of delayed mortality is known as the hydrosystem-related, delayed-mortality hypothesis.

Budy et al. (2002) examined the influence of hydropower experience on estuarine and early ocean survival rates of juvenile salmonids migrating from the Snake River to test the hypothesis that some of the mortality that occurs after downstream migrants leave a river system may be due to cumulative effects of stress and injury associated with multiple dam passages. The primary factors leading to hydrosystem stress (and subsequent delayed mortality) cited by Budy et al. (2002) were dam passage (turbines, spillways, bypass systems), migration conditions (e.g., flow, temperature), and collection and transport around dams, all of which could lead to increased predation, greater vulnerability to disease, and reduced fitness associated with compromised energetic and physiological condition. More recent studies have corroborated the indirect evidence for hydrosystem delayed mortality presented by Budy et al. (2002) and provided data on the effects of in-river and marine environmental conditions (Haeseker et al., 2012; Schaller & Petrosky, 2007). Based on an evaluation of historical tagging data describing spatial and temporal mortality patterns of downstream migrants, Schaller and Petrosky (2007) concluded that delayed mortality of Snake River Chinook salmon was evident and that it did not diminish with more favorable oceanic and climatic conditions. Estimates of delayed mortality reported in this study ranged from 75% to 95% (mean = 81%) for the study years of 1991-1998 and 6% to 98% (mean = 64%) for the period of 1975-1990. Haeseker et al. (2012) assessed the effects of environmental conditions experienced in freshwater and the marine environment on delayed mortality of Snake River Chinook salmon and steelhead trout. This study examined seasonal and life-stage-specific survival rates of both species and analyzed the influence of environmental factors (freshwater factors included: river flow spilled and water transit time; marine factors included: spring upwelling, Pacific Decadal Oscillation, and sea surface temperatures). Haeseker et al. (2012) found that both the percentage of river flow spilled and water transit time influenced in-river and estuarine/marine survival rates, whereas the Pacific Decadal Oscillation index was the most important factor influencing variation in marine and cumulative smolt-to-adult survival of both species. Also, freshwater and marine survival rates were shown to be correlated, demonstrating a relation between hydrosystem experience on estuarine and marine survival. The studies on Pacific salmon described above clearly support the delayed-mortality hypothesis proposed by Budy et al. (2002).

Stich et al. (2015) conducted an analysis on nine years (2005 to 2013) of Atlantic salmon smolt movement and survival data in the Penobscot River to determine what effect several factors (e.g., release location and date, river discharge, photoperiod, gill NKA enzyme activity[2], number of dams passed) have on survival through the estuary (Stich, Zydlewski, et al., 2015). They determined that estuary survival decreased as the number of dams passed during freshwater migration increased from two to nine. They estimated that each dam passed in the Penobscot led to a mortality rate of 6% in the estuary. This mortality was attributed to migratory delay and sublethal injuries (such as scale loss) sustained during dam passage. These effects make smolts more susceptible to predation and disease.

No studies have addressed the amount of hydrosystem delayed mortality that occurs on the Kennebec River. However, as the projects are similar in scale, configuration, and operation to those studied in the Penobscot River, it is reasonable to assume that delayed mortality occurs. Based on its similarity to the hydro dams on the Penobscot (in terms of passage route alternatives and the presence of turbines) we assume that the Shawmut Dam will have the same delayed mortality rate described by Stich et al (2015) (i.e., 6%); that is, we expect that of the smolts that successfully pass the dam, 6% will die in the estuary due to delayed effects of that dam passage.

8.6.2. POSTSPAWN ADULT ATLANTIC SALMON (KELTS)

The FLA indicates that downstream passage studies for kelts have not been conducted to date at the Shawmut Project or at any of the other lower Kennebec River hydropower projects. Kelt studies conducted in the lower Penobscot River, however, documented that most kelts passed the dams in spilled water, typically over the spillways, but also through gates and sluices (Hall & Shepard, 1990). In periods of low flow, it is anticipated that kelts will become entrained in turbines at higher rates if the rack spacing in front of the turbine intakes does not exclude them. Observation of the initial approach of kelts at the Veazie and Milford projects (Penobscot River) reflected the distribution of flow, whereby the proportion of kelts that approached spillways was correlated with spillway flow (Hall & Shepard, 1990). Shepard made a similar finding at the

[2] gill Na+/K+-ATPase (NKA) in is involved in ion regulation in both freshwater and seawater.

confluence of the Stillwater Branch and the mainstem Penobscot, where kelts followed routes in approximate proportion to flow in the two channels (Shepard, 1989).

The licensee conducted a desktop assessment of the mortality potential for outmigrating Atlantic salmon kelts for the Weston, Shawmut, and Lockwood Projects in their Biological Evaluation for the interim species protection plan in 2013 (Accession #20130221-5160). At each individual project, downstream passage of outmigrating kelts must occur via one of three routes:1) unregulated spillage, 2) permanent or interim downstream bypass facilities, or, 3) the Project turbines. These three potential routes of passage were considered and incorporated into the whole station kelt survival model for each project.

The Licensee calculated whole station kelt survival for each of the Projects by integrating river flows, project operating flows, spill effectiveness, downstream bypass effectiveness rates, turbine entrainment rates, and spillway and turbine survival rates using the Advanced Hydro Turbine model (Franke et al., 1997). Given the lack of site-specific empirical data related to the route selection of Atlantic salmon kelts through the various turbine units, it was assumed (for modeling purposes) that the distribution of kelt passage through the turbines would be equal to the distribution of outflow through those units at maximum discharge. A fork length – body width relationship was applied to the length frequency distribution of sea-run returns to the Penobscot River (1978-2009) to determine the proportion of kelts that could fit through the trash rack spacing at the various project intakes. Although the 1.5-inch rack spacing at the Francis units at the Shawmut Project excludes kelts, the Licensee estimated that 70.9% of kelts can swim through the racks in front of the propeller units, which have 3.5” spacing. Based on the characteristics of the propeller units, they concluded that 81.1% of kelts would survive passage through those units. Lacking information regarding the movement of kelts in the Shawmut project forebays, it was assumed that all kelts expected to pass via the Francis units (due to the assumption that they would move in proportion to flow distribution) but prevented from doing so by their body widths relative to the trash rack spacing, would next attempt passage via the propeller units. Using the estimated passage route utilization and modelled survival, the Licensee determined that kelt survival at median flow would be 89%. They further concluded that at higher flows, more fish would pass over the spillway, which would increase survival, and that at lower flows more kelts would move through the propeller units, which would decrease survival. The Licensee also estimated kelt survival at the Weston and Lockwood Projects under median flow conditions (i.e., the value with 50% flow exceedance) at 73% and 88%, respectively. They did not estimate kelt survival at the Hydro Kennebec Project (i.e., second dam on the river) as at that time they did not own that project. However, if we assume that the Hydro Kennebec Project has a survival rate similar to the other three projects (i.e., 73% to 89%), we can conclude that the overall survival of kelts passing all four projects is expected to be between 42% and 51%.

8.6.3. Cumulative Effects on the GOM DPS of Atlantic salmon and Diadromous Trust Species

Atlantic salmon are a critically endangered species and their recovery depends on abating threats in freshwater as well as in the marine environment. One of the primary threats, as detailed in the ESA listing and the 2019 recovery plan, is the presence of multiple FERC-licensed hydroelectric dams. The recovery plan indicates that in order to reclassify (i.e., downlist or delist) the species:

> *Regulatory mechanisms for hydroelectric and non-hydroelectric dams [must be] in place and effectively enforced to maintain accessible and fully accessible upstream and downstream passage, water quality conditions that support a recovered population, and properly functioning critical habitat features.*

The recovery objectives specify that all three of the recovery units must be recovered in order for the GOM DPS to be delisted. The Kennebec River contains the majority of the high quality rearing and spawning habitat in the Merrymeeting Bay recovery unit, with over a third of all modelled rearing habitat located above the Shawmut Project (Wright et al., 2008). Therefore, it is extremely unlikely that the recovery unit and, thus, the GOM DPS, can be recovered without this habitat being accessible and without safe and timely outmigration from the habitat.

The studies conducted by Brookfield between 2013 and 2015 (2012 and 2014 for the HydroKennebec Project) indicate that the cumulative direct mortality associated with downstream passage at the four lower dams (i.e., Weston, Shawmut, Hydro Kennebec, and Lockwood) on the river equates to an average of 18.5% (range: 13.3% (2013) to 26.4% (2014)) of the salmon smolts leaving the Kennebec River (Brookfield 2016; Accession #20160331-

5144). Indirect latent mortality, caused by migratory delay and injury caused by dam passage, is likely to result in an additional 6% per dam (Stich, Zydlewski, et al., 2015). Therefore, based on this information it appears that these projects, cumulatively, are killing approximately 40% of the outmigrating salmon smolts produced or stocked in the Kennebec River. Marine survival is variable and extremely low, but regardless of the marine survival rate, it is reasonable to expect that a 40% reduction in the number of smolts will lead to a 40% reduction in returning prespawn adults.

Similar to juvenile Atlantic salmon, cumulative mortality for downstream migrating adult Atlantic salmon is expected to be quite high through the Kennebec River. Although field studies are limited, the licensee's desktop analysis from 2013 provides an estimate of the proportion of kelts that leave the Sandy River that survive to the estuary (Accession # 20130221-5160). Given the project specific survival estimates provided, we would not expect more than 49% of outmigrating kelts to survive to Merrymeeting Bay.

There is scant information regarding the cumulative direct and indirect mortality of other diadromous species in the Kennebec River. Given that other migratory fish species may also experience dam-related delay, predation, and injury or disorientation, we can assume with relative confidence that these same mechanisms that cumulatively affect migrating Atlantic salmon similarly affect alosines and other diadromous species.

Given these effects, it is probable that Atlantic salmon cannot be recovered in the Merrymeeting Bay recovery unit, nor is it likely that the successful restoration of other diadromous fish will be possible, without substantial increases in survival at all four projects. In order to minimize the factors that lead to latent mortality, safe, timely, and effective passage for diadromous species is essential. We anticipate that passage through well-designed downstream fishways/bypasses, or over spillways with adequate flow and plunge pool depth, rather than through turbines, will reduce both direct and indirect mortality associated with project effects.

8.6.4. Lower Kennebec Species Protection Plan (Kennebec SPP).

On December 31, 2019, Brookfield filed with the Commission its *Proposed Lower Kennebec Species Protection Plan for Atlantic Salmon, Atlantic Sturgeon, and Shortnose Sturgeon and*

Draft Biological Assessment (SPP) for the four hydroelectric projects located on the lower Kennebec River in Maine: Lockwood (P-2574); Hydro Kennebec (P-2611); Shawmut (P-2322); and Weston (P-2325) (FERC Accession: 20191231-5199). Ostensibly, the intention of this SPP was to propose measures to be incorporated into the project licenses at all four lower Kennebec projects for the protection of Atlantic salmon and to comply with the Endangered Species Act. It was anticipated that FERC would request reinitiation of ESA consultation to consider the effects of proposed license amendments on Atlantic salmon, shortnose sturgeon, Atlantic sturgeon, and relevant critical habitat. On February 7, 2020, we filed a letter with the Commission that outlined our concerns with that SPP regarding the scope, magnitude, or range of potential measures necessary for the protection of endangered Atlantic salmon in the Kennebec River and by extension, the Gulf of Maine DPS as a whole (Accession # 20200207-5128). On July 13, 2020, the Commission issued Brookfield a letter order rejecting its Kennebec SPP. In the letter, the Commission acknowledged our concerns as well as the concerns filed by the U.S. FWS and Maine DMR (Accession # 20200713-3022). The Commission indicated that it expects Brookfield to re-file the SPP once it has addressed the agencies' concerns. Our understanding is that these SPP measures would become requirements of the existing FERC licenses for these projects, and any proposed license amendments would trigger ESA section 7 consultation with us to ensure that the proposed actions are not likely to jeopardize the continued existence of any ESA listed species or result in the destruction or adverse modification of their critical habitat.

As section 7 consultations are forward looking assessments of all effects of a proposed action (which in this case would be the continued operation of these facilities pursuant to their amended licenses), the SPP, and eventually our Biological Opinion(s), need to include a comprehensive assessment of all effects of the continued operation of the Lockwood, Hydro Kennebec, Shawmut, and Weston facilities pursuant to their amended licenses over the remaining life of the licenses or potential term of any new license. It is reasonably foreseeable that, in addition to the modifications and improvements that will be required of the Shawmut Project as a result of relicensing, Brookfield will concurrently be proposing modifications and improvements to the other three lower Kennebec hydroelectric projects, for which a comprehensive evaluation of the cumulative impacts of all lower Kennebec projects will be required. Therefore, it is important to consider any effects of the Shawmut relicensing in the context of the four projects as a whole.

9. MANDATORY CONDITIONS AND RECOMMENDATIONS

9.1. Section 10(a) Consistency with Comprehensive Plans

Section 10(a)(1) of the FPA requires the project adopted by the Commission to be, in its judgment, the "best adapted to a comprehensive plan for ... beneficial public uses, including … purposes referred to in section 4(e) ..." 16 USC §803(a)(1). This includes consideration of adequate protection, mitigation and enhancement of fish and wildlife, including related spawning grounds and habitat 16 USC §803(a). Section 10(a)(2) requires that, in making this determination, the Commission consider the recommendations of federal agencies exercising jurisdiction over resources of the state in which the project is located (16 USC §803(a)(2)). Our interest at the Shawmut Project is safe, timely, and effective fish passage for the benefit of diadromous fish species, as well as habitat considerations for migration, spawning, and rearing.

In fulfilling the balancing provisions of section 10(a) of the FPA, FERC guidance states that it must consider the economics of hydropower projects in terms of a project's current operating costs as compared to likely alternative power (72 FERC ¶ 61,027 (1995)). The Project's power benefits are to be evaluated as previously licensed, and under the new license with the mitigation and enhancement measures set forth in the recommendations, prescriptions, and conditions under FPA sections 10(j) and section 18.

The Kennebec River watershed once produced large runs of Atlantic salmon, American shad, blueback herring and alewife, as well as other sea-run fish including shortnose and Atlantic sturgeon (MSPO, 1993). Diadromous fish once contributed to substantial commercial, recreational, and subsistence harvests (MSPO, 1993) that were economically important to coastal communities. Anadromous fish production within the Kennebec River experienced dramatic declines throughout the past 150 years. Multiple plans since the 1980s, including the Kennebec River Resource Management Plan (1993), KHDG Settlement Accord (1998) and Atlantic salmon recovery plan (2019), highlight the importance of fish passage and habitat restoration as critical to supporting a restored anadromous fishery. Significant spawning, rearing, and migratory habitat exists above the Shawmut Project. Existing dams prevent access to those historical habitats. Atlantic salmon were virtually extirpated from their historical range within the Kennebec River watershed. Accordingly, a decision to decommission and remove the Shawmut

Project and thereby remove a significant barrier to recovering an endangered species, and support the restoration of several anadromous fish, would fulfill the Commission's mandate under the FPA to ensure the best comprehensive use of a waterway.

As a federal agency responsible for managing anadromous fish and their habitat, we recommend the Commission fully consider the substantial resource benefits that would accrue from restoring the aquatic resources of the Kennebec River impacted by the operation of hydroelectric facilities such as the Shawmut Project. If the Commission determines decommissioning and removing the Shawmut Project ensures the best comprehensive use of a waterway, then we recommend the Licensee develop and implement a plan to decommission and remove the Shawmut Project and restore the riverine corridor within 10 years of any new license order.

The dam removal option is a better alternative from the perspective of habitat functions and values such as fish passage, water quality, and habitat suitability. Without artificial barriers to block volitional fish movement and behavior, all fish may move freely and naturally, according to their life history adaptations. Implementing this decommissioning and dam removal recommendation would go a long way to reversing decades of degradation and stalled recovery efforts in the Kennebec River. Dam removal would alleviate the direct project related impacts on survival past the project, thereby reducing cumulative mortality within the system; loss of habitat, thermal alteration, water quality impairment, and predation due to impoundment; reductions in nutrient and energy exchange between freshwater and marine ecosystems; alteration of the natural hydrologic regime; restriction to sediment and large woody material transfer. Addressing these dam related impacts on fisheries resources and habitat through dam removal would significantly advance a comprehensive approach to protecting and restoring commercially and culturally important public trust resources. On May 20, 2019, the Licensee distributed a study it commissioned, *Energy Enhancements and Lower Kennebec Fish Passage Improvements Study* (Feasibility Study), for stakeholder review and comment, as required by FERC. Among several other decommissioning options, the Feasibility Study determined that decommissioning and dam removal at Shawmut was both feasible and reasonably practical (FERC Accession #s 20190701-5155 and 20190701-5154). Therefore, this perspective should be afforded full consideration in the National Environmental Policy Act analysis.

Our section 10(a) recommendation for decommissioning and removal of the Shawmut Project is consistent with the management goals and restoration of public trust resources under Commission approved comprehensive plans that include, but are not limited to:

- Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for shad and river herring (River Herring), Arlington, Virginia. May 2009.
- Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, (American Shad) Arlington, Virginia. February 2010.
- Maine State Planning Office. 1992. Maine Comprehensive Rivers Management Plan. Volume 4. Augusta, Maine. December 1992.
- National Marine Fisheries Service. 2019. Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon. Hadley, Massachusetts. January 2019.

Whether through dam removal or implementation of our fishway prescription, successful restoration of diadromous fish into historical habitat will substantially enhance the depressed stocks and support the recovery potential of endangered Atlantic salmon. In lieu of the preferred option - dam removal and habitat restoration – fishways are a necessary precursor and a fundamental element of any successful restoration action. In lieu of dam removal, our long-term resource goals and objectives can only be achieved via effective fishways. Therefore, we are filing the preliminary section 18 prescriptions for fish passage facilities necessary to achieve safe, timely, and effective passage.

9.2. SECTION 10(J) PROTECTION, MITIGATION AND ENHANCEMENT OF FISH AND WILDLIFE

The following Section 10(j) recommendations are for the protection, mitigation of damages to, and enhancement of fish and wildlife resources and their habitat at the Shawmut Project. These recommendations are consistent with state and federal management goals and objectives for restoring, protecting, and enhancing fish and wildlife resources in the Kennebec River watershed, and are based on our assessment of project related impacts on those resources. Evidentiary support for these recommendations is contained in the Commission's administrative record and cited herein. Recommendations submitted by us pursuant to Section 10(j) of the FPA must be accepted by the Commission, as conditions to any license(s) issued, unless, after giving due weight to our subject matter expertise, the Commission finds, based on substantial evidence in the record, that the recommendations are inconsistent with the FPA.

1. Within one year of license issuance, the Licensee should develop a plan for the management of large woody material (LWM) at the project in consultation with the agencies that will include: a) a description of the source(s) of debris to be made available; b) guidelines and measures for transporting or sluicing biologically and/or geomorphologically beneficial material downstream of the project, if determined necessary through consultation; c) provisions for storage of beneficial LWM and disposal of unused debris; and d) guidelines and measures for the disbursement and transport of stored LWM with priority given to habitat enhancement projects in the Kennebec River or its tributaries.

Rationale

Large woody material (LWM) is a critical element of a properly functioning lotic ecosystem. LWM influences geomorphic processes that can increase the heterogeneity of physical habitat, thereby imparting beneficial biological effects (Smith, 1996). LWM also provides instream structure and serves as an important source of nutrients that support primary biological productivity. The Shawmut Project is located within designated critical habitat for Atlantic salmon. The physical and biological features for Atlantic salmon critical habitat specifically include freshwater migration sites with woody debris cover (74 FR 29300, June 19, 2009). Coastal Maine watersheds are largely LWM-limited (Magilligan et al., 2016). The Final Recovery Plan for Atlantic salmon identifies the reduction of habitat complexity associated with the lack of large wood and boulders as a stressor related to the threat of species viability (USFWS & NMFS, 2019a). The Shawmut Project traps mobilized woody material. The Licensee has not proposed any plan or measures related to the management of LWM. Without any such plan, LWM will continue to be periodically removed and disposed. Therefore, the project would continue to impose a negative effect upon aquatic habitat and a physical and biological feature of critical habitat for endangered Atlantic salmon.

2. Within one year of license issuance, the Licensee must develop a plan, in consultation with the resource agencies and the Penobscot Indian Nation (PIN), to acquire uniquely marked Atlantic salmon smolts (or other appropriate lifestage) for stocking upstream of the Shawmut Project. These fish will serve as a source of imprinted adult fish (i.e., fish homing to areas upstream of Shawmut Dam) needed to support any required upstream effectiveness testing.

Rationale

In order to determine the passage efficiency of the new fishway, a source of prespawn salmon will need to be identified. Until such time as the passage standards have been achieved at the four lower dams on the Kennebec, we anticipate that all naturally reared and wild adults trapped at the Lockwood Project will be trucked to habitat in the Sandy River. Therefore, hatchery smolts (or other appropriate lifestages) will need to be stocked in the river to provide a source of prespawn salmon that can be used for the studies. Given the current management of hatchery stocks (i.e., no locally adapted stock exists for the Kennebec), these fish would likely need to be of Penobscot origin, and therefore, their use would have implications on the salmon recovery program as a whole. As the conservation hatcheries are operated by the U.S. FWS, we are including this recommendation in cooperation with them, to ensure early coordination in the development of a plan that will allow for the dam assessments to occur, while mitigating the impacts to the recovery program.

3. Operate the facilities at the project in a run-of-river mode in which outflow from the Project impoundment, including spillage, leakage, lockage, fish passage, etc. is equal to the inflow to the impoundment to the extent possible. The Project should minimize fluctuations of the reservoir, within one foot of the top of the flashboards on a regular basis, or within one foot of the permanent crest when replacing flashboards.

Rationale

Run of river operations more closely reflect normal flow conditions, mitigating to some degree the environmental impacts associated with the impoundment and project operations. Flow fluctuations after storm events are more gradual at a run of river dam, minimizing the occurrence of stranding of fish, flushing of biota and alteration of stream channel configuration (Hunter, 1992). Furthermore, native biota have evolved to survive in a dynamic river system such that natural flow variations have little impact on downstream fish and invertebrates (Hunter, 1992). Fish have adapted to utilize specific habitat types during various life stages. Maintaining natural stream hydrology protects spawning and refuge habitat and minimizes the occurrence of stranding of juvenile and adult life stages (Hunter, 1992). The Licensee proposes to operate the project run-of-river, and we support that proposal with this recommendation.

9.3. SECTION 18 PRESCRIPTION FOR FISHWAYS

We hereby submit the following preliminary prescription for fishways 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.

We base the following mandatory fishway prescription on the best biological and engineering information available at this time, as described in the explanatory statements that accompany each prescription. We developed the basis for this prescription over a period of several years by our biological and engineering staff, in consultation with the Licensee, the USFWS and other entities that participated both in this relicensing proceeding, as well as prior informal section 7 consultation. We fully considered a broad array of issues in formulating the preliminary prescription for fishways. Consideration for this analysis is documented in the Administrative Record as submitted with the Commission. Our conclusion that the prescription for fishways is justified is based on, but not limited to, the following primary points: (1) numerous long-standing resource agency management and restoration goals are achieved through fish passage, (2) a well-documented historical presence of robust diadromous fish populations within the Kennebec River watershed prior to dam construction, (3) professional experience across the region demonstrates that diadromous fish will be motivated to migrate above barriers such as the Shawmut dam when effective passage is provided, (4) access to the spawning, rearing and migration habitat above the Shawmut Project is necessary for the recovery and restoration of diadromous fish, including the critically endangered Atlantic salmon, (5) consideration of the cumulative impacts on migratory fish and their habitat resulting from a heavily dammed riverine system, and (6) state and federal comprehensive plans, as well as the Kennebec Hydro Developers Group (KHDG) Settlement Agreement (1998), indicate the significant potential for diadromous fish populations in the Kennebec River watershed once fish passage and habitat restoration is accomplished. Specific citations and detailed explanations in support of these reasons are found in the text of this prescription.

We support each prescription measure with 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 summarize the supporting information and analysis supporting the prescription. We include an index to the administrative record for this filing herein, and reserve the right to file updated and supplemental supporting information as needed.

9.3.1. UPSTREAM FISH PASSAGE - DIADROMOUS SPECIES

The Licensee shall construct, operate, and maintain upstream fish passage facilities that pass diadromous fish species in a safe, timely, and effective manner. The size of the fishway shall accommodate the anticipated production potential of the Kennebec River: approximately 1.54 million blueback herring, 134,000 alewife, 177,000 American shad, 12,000 Atlantic salmon, and other resident or target species (Attachment B). The design elements of the fishway shall ensure successful passage of river herring, American shad, Atlantic salmon, and sea lamprey. The movement of sea lamprey is improved by ensuring edges are rounded and surfaces are smooth (PLTW, 2017). Incorporation of these design considerations should also provide benefits to other upstream migrating fish by reducing potential sources of injury. The fishway shall operate for the full range of design flows based on the migratory season for each species in accordance with provisions of Section 8.3.5. The fishway shall be constructed and operational within two years of license issuance. This deadline for operation of the new upstream fishway is to ensure sufficient time for a shakedown and evaluation before implementing potential fish passage requirements contained within any new license for the Shawmut Project. The operation date also recognizes that substantial progress has already been made to design this fishway in cooperation with the resource agencies; however, it may change in consultation with the agencies. Any additional design review will proceed consistent with the provisions in Section 9.3.5.

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. If the defined performance standards described in Section 9.3.4 have not been met after three years of testing, additional adaptive measures will be implemented, in consultation with the resource agencies, to further improve fish passage and reduce delay. Such measures may include, but are not limited to operational modifications, structural enhancements, additional fishway entrances, or additional fishways.

Additional protective measures or alternative actions 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.

The Licensee did not propose upstream fish passage facilities for diadromous fish in its license application. However, in 2016, the Commission ordered an amendment to the license for the Shawmut Project and required the construction of an upstream fishway[3]. On December 31, 2019, Brookfield filed the final design drawings and operations and maintenance plans for the required upstream fishway (Accession # 20200107-0019). In letters dated July 13 and 23, 2020, the Commission indicated that it would instead require the consideration of the unconstructed upstream fishway in relicensing (Accession #s 20200713-3022, 20200713-3034, and 20200723-5012). The Licensee's proposed fishway, with our required performance monitoring and adaptive management provisions, meets the intent of our prescription.

[3] Merimil Limited Partnership and Brookfield White Pine Hydro, LLC, 155 FERC ¶ 61,185 (2016).

Rationale

Restoration of diadromous fish is a long standing resource goal for the Kennebec River watershed, consistent with the 1993 Kennebec River Resources Management Plan, 1998 KHDG Settlement Accord, and 2019 Atlantic Salmon Recovery Plan. The requirement for dedicated fish passage facilities issued during this licensing proceeding, as well as the Commission-required construction and improvement of upstream fishways at the Lockwood and Weston Projects, is necessary to support our broader restoration goal for the watershed. In concert with the recently (2018) constructed upstream fishway at the downstream Hydro Kennebec project, and planned new upstream fishways at the downstream Lockwood and upstream Weston projects, upstream fish passage at Shawmut will allow for swim-through passage of approximately 20 miles of mainstem migratory, spawning and rearing habitat for diadromous fish and allow Atlantic salmon to access approximately 16,500 units of habitat (Wright et al., 2008). Fish passage at Shawmut, along with the construction of new fishways and improvement of passage conditions at other hydroelectric facilities on the river and the implementation of the state of Maine's resource management plan for the Kennebec River (MSPO, 1993), will stimulate increased fish passage at dams along the mainstem and tributaries. The timing of passage implementation, within two years of license issuance, reflects the timing of relicensing for the Shawmut project and the time necessary to construct and shakedown the fishway following license issuance.

The Licensee consulted with the resource agencies on the design plans for the proposed fish lift at the 30%, 60%, and 90% design phases. A study using radio tagged alewives was conducted to determine the most suitable location for the new fishway entrance. Based on an analysis of where the majority of fish congregate, Brookfield determined, in consultation with the agencies, that the most suitable location was just upstream of the older powerhouse near the non-overflow section of the dam. Additionally, they determined that a short bypass should be constructed to allow fish to readily move between the tailrace of the new powerhouse and the tailrace of the old powerhouse in order to enhance the probability of fish finding the entrance. Subsequent to the radio tagging study, a three dimensional hydraulic modeling of the area was performed in order to visually depict the future conditions, ensure there were no hydraulic limitations to passage, and inform any additional changes to fine tune the design to better attract fish to the fishway.

The Licensee determined, based upon agency review and consultation, that the best option to adequately pass the full suite of species was a fish lift design. A fish lift designed and constructed to meet the USFWS fishway design criteria is expected to address the fish passage requirements for each target species.

We further support this position on the factual background herein and the following facts:

a. Diadromous fish historical habitat has been identified in many reaches of the Kennebec River watershed (Foster & Atkins, 1867).

b. Atlantic salmon, American shad, alewife, blueback herring, and sea lamprey currently have access to spawning, rearing, and migratory habitat in the Kennebec River downstream of the existing Lockwood Project. These species will have swim through access to the project tailwater and to the Kennebec River upstream of the Weston project by May 31, 2022, prior to the required passage implementation date at the Shawmut project (Accession # 20200713-3034).

c. The state of Maine has stocked alewife in lake habitat above the Shawmut Project since 1986 (MSPO, 1993). Additionally, the state of Maine has stocked Atlantic salmon fry or eggs in habitat above the Shawmut Project since 2001 (USASAC, 2019). Both of these efforts result in juveniles imprinted to spawning habitat within the Kennebec River. Those juveniles surviving to maturity and returning to the Kennebec River will home to natal habitat. Those adults will require safe, timely, and effective passage past the Shawmut Project to access those natal waters.

d. Dams such as the Shawmut dam are an impediment to upstream migration of diadromous fish (74 FR 29300, June 19, 2009; 74 FR 29344, June 19, 2009; 78 FR 48944, August 12, 2013)

e. Properly designed and located fishways, with suitable near-field and far-field attraction are capable of passing Atlantic salmon, sea lamprey, American shad, and river herring upstream of dams (Bunt et al., 2012; Larinier, 2002; Larinier & Marmulla, 2004; NMFS, 2011; USFWS, 2017).

Based on the best scientific information available at this time, as well as multiple fishway design consultations conducted in collaboration with Brookfield, USFWS, MDMR, and the MDIFW, we conclude that a fish lift and appurtenant facilities containing the specifications filed by Brookfield with the Commission on December 31, 2019 and July 30, 2020, could potentially satisfy the standard of a safe, timely and effective fishway. We have confidence based on experience that this design will function for the full suite of diadromous species. However, we note that this site presented challenges in the design of an upstream fishway. Specifically, the river is very wide with flow discharge points in multiple areas along the Project dam that could attract upstream migrants. Therefore, we acknowledge there is some uncertainty that the proposed single upstream fishway will be sufficient to meet or exceed effectiveness standards. To address this uncertainty, our adaptive requirements include the construction of additional fishway entrances and/or fishways in the event that monitoring demonstrates its necessity. Our required monitoring and adaptive protocol are necessary to ensure the upstream fishway meets or exceeds standards for safe, timely, and effective passage (see Section 9.3.4 for monitoring requirements).

9.3.2. DOWNSTREAM FISH PASSAGE

The Licensee shall construct, operate, and maintain downstream fish passage facilities for diadromous fish species that provide safe, timely, and effective downstream passage consistent with the performance standards described in Section 9.3.4. The downstream passage facilities shall be operational within two years of the issuance of the new license.

The Licensee has proposed and we are requiring the following measures to improve the downstream passage facility at the Shawmut dam:

1. The installation of a fish guidance system leading to a bypass surface entrance to reduce entrainment into the propeller units. The guidance system will include a 10-foot deep hanging rigid panel.
2. The operation of the Taintor gate sluice at maximum capacity (i.e., 600 cfs) for the duration of the smolt outmigration window.
3. The operation of the bypass gate/surface sluice from April 1 to December 31, as river conditions allow.

4. Operational prioritization of the Francis units, where the unit closest to the lift entrance (Unit 1) will be operated first-on and last-off, followed consecutively by Units 2 through 6.

In addition to the Licensee proposed actions, we also require the following measures for protecting downstream migrating fish:

5. Installation of 1-inch clear space trashracks or overlays at existing trashracks for the Francis units and the propeller units. Velocities in front of the trashracks must be sufficiently low to reduce the risk of impingement during periods critical for downstream fish passage.
    - If: 1) it is demonstrated that the approach velocities in front of the racks at the propeller units are excessive; and 2) after consultation with NMFS, it is therefore determined that the installation of the required 1-inch trashracks are infeasible, the Licensee will instead install 1.5-inch trashracks and extend the depth of the required guidance boom to 20 feet.
    - If: 1) it is demonstrated that the approach velocities in front of the racks at the Francis units are excessive; and 2) after consultation with NMFS, it is therefore determined that the installation of the required trashracks are infeasible, the Licensee will instead implement one or more of the adaptive measures listed below, in consultation with NMFS.
6. If the defined performance standards (section 9.3.4) cannot be met with the above proposed and required measures within the monitoring period defined therein, additional adaptive measures will be implemented to further reduce fish injury and mortality to meet the defined performance standards. Such adaptive measures may include, but not be limited to, alternate unit prioritization, unit curtailment or shutdowns, lowering hinged flashboards along the spillway, replacing the upward-opening Taintor gate with a downward-opening slide gate, or limiting passage into the project forebay by installing a guidance boom or rigid rack structure upstream of the headworks.

These protection measures are consistent with criteria used nationally (NMFS, 2011; USFWS, 2017). The Licensee shall keep the downstream passage facilities in proper order and clear of trash, logs, and material that would hinder flow and 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. Additional measures specific to Atlantic salmon may also be required depending on the outcome of the ESA section 7 consultation and requirements of any Incidental Take Statement issued as part of the anticipated Biological Opinion.

Design review of any new downstream fish passage facility shall follow the process outlined in Section 8.3.7. Fishway Design Review such that modifications can be implemented and operational within two years of license issuance.

Rationale

Dedicated fish passage facilities are necessary to protect diadromous species emigrating past the Project. As described in section 8.6.3 *Cumulative Effects on the GOM DPS of Atlantic salmon*, substantial improvements in safe, timely, and effective passage at this project will be essential to support recovery of Atlantic salmon and the restoration of our other diadromous trust species. We base this position on the factual background herein and the following:

1. Downstream migrating diadromous species are exposed to direct and indirect project related impacts (Brookfield, 2016; Franke et al., 1997).

2. Downstream passage survival is a critical component to achieving recovery goals for ESA-listed Atlantic salmon (Nieland et al., 2013; USFWS & NMFS, 2019a).

3. Downstream migrating adults and juvenile Atlantic salmon and alosines require protection from project operations that result in injury and mortality (Franke et al., 1997; Hecker et al., 2007; Larinier, 2000; Taylor & Kynard, 1985) (74 FR 29344, June 19, 2009, 78 FR 48944, August 12, 2013).

Entrainment Prevention - Propeller Units

The Licensee proposes to install a guidance boom with 10-foot rigid panels to prevent entrainment into the propeller units. Guidance booms have been shown to be relatively effective at reducing turbine entrainment at other projects in the Kennebec River including at the Lockwood, Hydro Kennebec, and Weston Projects. The bypass efficiency for juvenile salmon at the Lockwood Project increased to an average of 53% (2013-2015) with the installation of a guidance boom with 10-foot rigid panels placed upstream of the powerhouse (Brookfield 2016). The 2013-2015 Shawmut studies indicated that 21.1% to 31.3% of Atlantic salmon smolts pass the project via the propeller units, and that up to 22.1% (average of 10.2%) of those are killed. We expect that the proportion of fish that are entrained in the units will be reduced with the construction of a floating guidance boom, as proposed.

Renkawitz et al. (2012) monitored migration depth of outmigrating salmon smolts in the Penobscot River in 2005. Although they did not document movements in freshwater habitat, the study reach began in the upper estuary (beginning at the location of the former Veazie Dam) where the salinity is considered negligible (Renkawitz et al., 2012). The study determined that smolts generally migrate within the upper 16-feet (5-meters) of the water column. The proportion of smolts in this zone varied as they moved along the salinity gradient, with an average of 86.7% migrating within the 16-foot zone in the estuary, and 98.2% in that zone in Penobscot Bay. Lacking freshwater specific data, we assume that smolts in the mainstem are generally swimming within 16 feet of the surface, but that they will make use of the entire water column. Similarly, Hedger et. al (2009) found that migrating Atlantic salmon kelts frequently traveled within 16 feet of the surface but will make use of the entire water column (Hedger et al., 2009). For American shad, Stier and Crance (1985) suggested that for all life history stages, including juveniles, the optimum range for river depth is between 5 and 20 feet (Stier & Crance, 1985). Therefore, we expect that the proposed guidance boom will prompt avoidance behavior of some proportion of downstream migrating fish and prevent entrainment of those fish in the propeller units. However, the depth of the proposed boom (10 feet) is not sufficient to prevent even fish that are typically surface-oriented from sounding under the panels and within the vicinity of the unsafe propeller units. Therefore, we expect that some proportion of fish would still be entrained in the propeller units, with some of those being killed.

The 3.5-inch-spaced racks currently in place at the propeller units are spaced too far apart to physically exclude all but the largest fish in the river. The Licensee estimated that 70.9% of Atlantic salmon kelts can swim through propeller unit racks with 3.5-inch spacing, with an estimated survival through the propeller units of only 81.1%. Survival of alosines through the Project's propeller units is unknown. However, turbine passage survival is generally related to fish size (Franke et al., 1997). Juvenile alosines are smaller and narrower than smolts (Scott & Scott, 1988). Similar to smolts, alosines are weak swimmers and orient with the flow (Bell, 1991). Given juvenile alosines are smaller than smolts and turbine entrainment is related to fish size, it can be expected that downstream passage survival rates of juvenile alosines through the Project's propeller units would be similar or higher than that observed for smolts.

The propeller units are demonstrably the least safe passage route for migrating fish at the Shawmut Project. As described above, while we agree with the Licensee that the proposed guidance boom will provide some beneficial effects, including behavioral guidance towards the Taintor gate and 35 cfs surface sluice, we do not anticipate that the Licensee's proposed measure will adequately protect downstream migrating fish from becoming entrained into the propeller units. Therefore, in addition to the Licensee's proposed guidance boom, we are requiring the installation of 1-inch clear spaced racks on the propeller units. This close rack spacing is consistent with USFWS guidelines for the exclusion of salmon smolts (USFWS, 2017) and this spacing is expected to be narrow enough to also exclude salmon kelts and most adult alosines. The installation or planned installation of 1-inch racks is common for hydropower projects in Maine as a measure for the protection of Atlantic salmon and other diadromous species, including at projects associated with Brookfield or its subsidiaries (Brown's Mill, FERC No. 5613; Ellsworth, FERC No. 2727; Mattaceunk, FERC No. 2520; Milford, FERC No. 2354; Orono, FERC No. 2710; Stillwater, FERC No. 2712). While insufficient for exclusion, we do anticipate that 1-inch racks will also prevent the entrainment of some proportion of juvenile alosines, adult American eel, and adult sea lamprey through the stimulation of avoidance behavior (USFWS, 2017).

To illustrate the potential effect of the different configurations at the propeller units (i.e., existing, guidance boom, guidance boom plus 1-inch racks), we can compare a rough estimate of the number of smolts that could be killed. Given the range of route utilization rates (21.1% to

31.3%), an average mortality of 10.2%, a 5-year average number of salmon eggs stocked upstream of the project (744,000; USASAC 2019), an average egg to smolt survival rate (1.33%; Nieland et al. 2020), an average survival rate past the Weston Project (95%; Brookfield 2016), and an estimate of background mortality (i.e., non-dam related mortality such as predation) (0.5% per kilometer; Stich et al 2015), we can approximate that between 174 and 259 smolts would be killed annually through the propeller units under existing conditions. With the proposed boom, we assume that this would be reduced to 82 to 122 smolts annually, assuming a 53% effectiveness rate. In a meta-analysis of the effectiveness of racks to reduce smolt entrainment, Alden Research Laboratory estimated an average effectiveness of racks with 1-inch spacing as 51.3% (Alden 2012). Therefore, with the addition of the 1-inch racks, we would expect mortality due to the propeller units to be further reduced to 40 to 59 smolts annually. This represents a 77% reduction in mortality from existing conditions, and a 51% further reduction from the Licensee's proposal. This is a rough approximation, and underestimates the number of smolts killed as it does not include fish that are produced through natural production. However, it is a useful method for comparing the effectiveness of the different measures.

The Licensee’s FLA provided insufficient detail with which to determine existing approach velocities at the propeller unit intakes. Therefore, at this time, we are unable to determine, with certainty, the feasibility of the installation of the close-spaced racks that we are requiring. Therefore, in the event that the installation of 1-inch clear spaced racks is infeasible due to the demonstration of excessive approach velocities (which would increase the risk of impingement), we are requiring: 1) the installation of 1.5-inch clear spaced racks to prevent entrainment of kelts and larger diadromous fish; and 2) modification of the Licensee’s proposal to extend the panels that will guide fish to the bypass from 10-feet to 20-feet in order to divert more fish from the forebay, and away from the turbine intakes and to maximize the effectiveness of the proposed guidance boom and thereby further reduce the number of smolts and juvenile river herring that pass through the propeller units.

<u>Entrainment Prevention - Francis Units</u>

The Licensee’s proposal does not include any measures to reduce entrainment of fish through the Francis units. U.S. Fish and Wildlife Service fish passage guidelines dictate a maximum of 1-

inch-clear rack spacing for the prevention of salmon smolt entrainment (USFWS, 2017). While the existing 1.5-inch-clear rack spacing at the Francis units may be sufficient to exclude Atlantic salmon kelts, it does not prevent the entrainment of salmon smolts as they are small enough to swim through the spacing. Survival of alosines through the Project's Francis units is unknown. However, as described above, it can be expected that downstream passage survival rates of juvenile alosines through the Project's Francis units would be similar or higher than that observed for smolts.

To illustrate the potential effect of the different configurations at the Francis units (i.e., existing versus 1-inch racks), we can compare a rough estimate of the number of smolts that could be killed. Given the range of route utilization rates (3.1% to 18.8%), an average mortality of 12.2%, a 5-year average number of salmon eggs stocked upstream of the project (744,000; USASAC 2019), an average egg to smolt survival rate (1.33%; Nieland et al. 2020), an average survival rate past the Weston Project (95%; Brookfield 2016), and an estimate of background mortality (i.e., non-dam related mortality such as predation) (0.5% per kilometer; Stich et al 2015), we can approximate that between 30 and 186 smolts would be killed annually through the Francis units under existing conditions. In a meta-analysis of the effectiveness of racks to reduce smolt entrainment, Alden Research Laboratory estimated an average effectiveness of racks with 1-inch spacing as 51.3% (Alden Research Laboratory, 2012). Therefore, with the addition of the 1-inch racks we would expect mortality due to the propeller units to be reduced to 15 to 90 smolts annually. This represents a 51% reduction in mortality from the Licensee's proposal. This is a rough approximation, and underestimates the number of smolts killed as it does not include fish that are produced through natural production. However, it is a useful method for comparing the effectiveness of the different measures.

The Licensee proposes to discontinue lowering four sections of hinged boards after the proposed guidance boom has been installed in the project forebay. In a July 1, 2020, call log describing a conversation between Brookfield and FERC staff (20200701-3048), Brookfield indicated that it will discontinue dropping the hinged boards for downstream fish passage because "…the proposed forebay guidance boom will be sufficient to direct downstream migrants to the surface bypass routes and meet downstream survival standards for salmon; therefore, there is no need for additional spill." We do anticipate that the new fish passage opportunity provided by the AWS system at the proposed upstream fishway will attract and successfully pass some of the smolts that would otherwise have passed through the lowered flashboards. However, the Licensee has not provided any analysis to support this assumption. Undoubtedly, some proportion of these fish will enter the forebay, and will pass the project either via the bypass or through any of the eight project turbines. Although not a consideration described by the Licensee in its FLA or in the documentation associated with the upstream fishway, we anticipate that the lowering of hinged boards after the construction of the proposed upstream fishway could result in false attraction to upstream migrants, resulting in reduced upstream fishway efficacy. Therefore, while the Licensee's proposal to discontinue lowering of the flashboards following an interim period could result in additional turbine entrainment, we ultimately agree with the proposal, conditional on the implementation of additional protective requirements as described below.

The Licensee does not propose any measures to mitigate the risk of entrainment into the Francis units. As described above, we anticipate that the risk of entrainment through these units will remain the same, or possibly increase under the Licensee's proposal. Therefore, we are requiring measures to significantly reduce this impact. The available information supports that either turbine shutdowns or narrow spaced racks could adequately address this project effect. However, we also recognize that any operational modifications, such as unit shutdowns or the continued lowering of hingeboards that result in increased flows over the spillway could negatively impact attraction to the new upstream fishway. For these reasons, we are requiring the installation of racks with 1-inch clear spacing. Narrow-spaced racks will reduce entrainment of target species and life stages during all outmigration windows, providing a more comprehensive approach to reducing project effects without affecting the distribution of flow downstream of the Project. The Licensee's FLA provided insufficient detail with which to determine existing approach velocities at the Francis unit intakes. Therefore, at this time, we are unable to determine, with certainty, the feasibility of the installation of the close-spaced racks that we are requiring. Therefore, in the event that the installation of 1-inch clear spaced racks are infeasible due to the demonstration of excessive approach velocities (which would increase the risk of impingement), we are requiring that the Licensee implement one or more of the adaptive measures identified above, in consultation with us (alternate unit prioritization, unit curtailment or shutdowns, lowering hinged flashboards along the spillway, replacing the upward-opening

Taintor gate with a downward-opening slide gate, or limiting passage into the project forebay by installing a guidance boom or rigid rack structure upstream of the headworks).

Conclusion

Based on the best scientific information available at this time, we conclude that the proposed downstream passage protection measures with our required additional measures would reasonably address existing project effects and should satisfy the standard of a safe, timely, and effective fishway. We have confidence based on experience that the required design features will function for the full suite of diadromous species. Our required monitoring and adaptive protocol are necessary to ensure the upstream fishway meets or exceeds standards for safe, timely, and effective passage operation (see Section 9.3.4 for monitoring requirements).

9.3.3. SEASONAL MIGRATION WINDOWS

Based on state-wide and Kennebec River watershed specific data, approved fish passage protective measures 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 (Table 4). These dates may change based on new information and agency consultation.

Table 4. Summary of migration periods for which fish passage is required. The migration period for Atlantic salmon is dependent on presence and may be refined in consultation with the resource agencies.

Species	Upstream Migration Period	Downstream Migration Period
Atlantic salmon	May 1–November 10	April 1 – June 15 (smolts and kelts) October 15 – December 31 (kelts)
American shad	May 15–July 31	July 15 – November 30 (juveniles) June 1 – July 31 (adults)
Alewife and Blueback herring	May 1–July 1	July 15 – November 30 (juveniles) June 1 – July 31 (adults)

Rationale

a. Adult alosine in Maine rivers commonly migrate upstream between May and June, and as late as August and emigrate soon after spawning from June to early August (ASMFC, 2009, 2010; Brookfield, 2016; Loesch, 1987).

b. Juvenile alosine in Maine rivers typically emigrate in September and October but may emigrate as early as August and as late as December (Loesch, 1987; Mullen et al., 1986; Weiss-Glanz et al., 1986).

c. Adult Atlantic salmon typically migrate to upstream spawning habitat beginning in the month of April (Baum, 1997). Trap operations at the former Veazie Dam typically captured adult salmon from May to November (Dubé et al., 2011; Dubé, 2012)

d. Following spawning in the fall, Atlantic salmon kelts in Maine rivers typically return to the sea immediately, or over-winter in freshwater habitat and migrate in the spring, typically April or May (Baum 1997).

e. Based on NMFS Penobscot River smolt trapping studies in 2000 - 2005, smolts migrate in Maine rivers between late April and early June with a peak in early May (Fay et al., 2006).

9.3.4. PASSAGE PERFORMANCE STANDARDS AND MONITORING

Fishways need to be monitored to ensure they are constructed, operate, and function as intended, and to determine whether improvements are needed to ensure safe, timely, and effective passage is provided. Therefore, the Licensee must monitor upstream and downstream fishways at the Shawmut Project. Monitoring will ensure fish passage protection measures are constructed, operated, and functioning as intended for the safe, timely, and effective passage of migrating fish. We will evaluate the results of the monitoring against performance standards developed for each species. Those performance standards are presently in development for alosine and Atlantic salmon. Based on the best available information from dam impact assessment on other rivers in the GOM DPS, the performance standard for Atlantic salmon will likely include a project survival standard of at least 97% for downstream passage, and 96% for upstream passage, with the upstream and downstream passage standards also taking delay into consideration. We anticipate performance standards for alosine will be similar to those required on other river systems (e.g. Turner's Falls, FERC No. 1889), such that upstream passage efficiency will be at least 70% within 48 hours of a fish approaching the project works; and downstream passage survival will exceed 95%. We expect to finalize performance standards during ESA consultation and in the development of monitoring plans. If information suitable to derive standards is available, we will incorporate such standards in our modified prescription.

The following requirements are to ensure data collected reflect conditions at the Project:

1. Licensee will develop study design plans in consultation with NMFS and state and federal resource agencies. The Licensee must obtain approval from the resource agencies prior to filing these plans with the Commission for final approval.

2. Licensee must conduct all monitoring according to scientifically accepted practices.

3. Licensee shall begin monitoring at the start of the first migratory season after each fishway facility (Atlantic salmon and alosines) is operational and shall continue for up to three years or as otherwise required through further consultation.

4. Licensee shall conduct studies to evaluate the effectiveness of fishways for juvenile and adult life stages of alosines and Atlantic salmon.

5. The Licensee shall prepare 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.

6. The Licensee shall include resource agencies' comments in the monitoring study reports submitted to the Commission for final review.

7. The Licensee shall prepare annual fish passage reports that consist of data from the fish passage season including passage counts for each species, daily river flow conditions, fishway operational settings, and Project operations.

8. The Licensee shall include resource agencies' comments in the annual reports submitted to the Commission for final review.

9. The Licensee shall allow resource agencies or their designees to access the fishway for inspection throughout the length of the license provided reasonable notice.

FERC's determination about achieving any up- or downstream performance standards must be based upon an average of three consecutive years of up- or downstream passage monitoring at the Shawmut Project. That is, the standard will only be considered achieved if the average of three years of studies meets or exceeds that standard. If, after the first or second year of each three-year evaluation, it is determined that it is statistically impossible or improbable that the standard can be met, the study will cease and additional measures will be implemented as soon as possible. The implementation of any new operational or facility modifications or measures will necessitate an additional monitoring period (as defined above) or a desktop evaluation, if such an evaluation is determined an appropriate alternative to an empirical study in consultation with the agencies. The same monitoring protocol will occur for any new upstream or downstream fish passage measure implemented at the Project through our reservation of Section 18 authority.

9.3.5. FISHWAY DESIGN REVIEW

In the event there are significant changes to the designs that have already been reviewed or if there are new configurations that have not been reviewed, the Licensee shall submit design plans to NMFS for review and approval during the conceptual, 30, 60 and 90 percent design stages. The Licensee shall incorporate into their schedule a minimum of 30 days of review time by resource agencies for each stage.

The Licensee shall adhere to the following design milestone schedule for downstream diadromous passage facilities:

1. Conceptual design within 6 months of license issuance,

2. 30% design within 9 months of license issuance,

3. 60% design within 12 months of license issuance and a basis of design report (if requested), and

4. 90% design within 18 months of license issuance.

If necessary, the Licensee shall adhere to the following design milestone schedule for upstream diadromous passage facilities:

1. Conceptual design within 36 months of license issuance,

2. 30% design within 39 months of license issuance,

3. 60% design within 42 months of license issuance and

4. 90% design within 48 months of license issuance.

The Licensee may deviate from the design milestone schedule based on design complexity or permitting constraints; however the deviation requires approval by the resource agencies before filing extension of time requests with the Commission. The Licensee shall allow reasonable time to construct the fishway such that it is operational as prescribed. Following NMFS approval, the Licensee shall submit final design plans to the Commission for final approval prior to the commencement of fishway construction activities. Once the fishway is constructed, final as-built drawings that accurately reflect the project as constructed shall be filed with NMFS.

10. Reservation of Authority

10.1. Sea Lamprey

The state of Maine's Kennebec River Resource Management Plan (MSPO, 1993) currently excludes sea lamprey from restoration goals for diadromous species. Additionally, there is no information with which to evaluate the current survival and passage efficiency of sea lamprey at the Shawmut Project, nor the potential beneficial effects of our required measures. However, we recognize that management objectives for sea lamprey may change during the term of the new license. If a management program for sea lamprey is initiated for the Kennebec River during the license term, and post-licensing monitoring information or desktop evaluations demonstrate that survival and passage efficiencies at the Shawmut project are insufficient to achieve those management objectives, then the licensee will need to modify operations or facilities that meet any standard established to achieve those objectives. Therefore, we reserve our authority to prescribe operational or facility modifications or additional fishways for the benefit of sea lamprey in the future.

10.2. STANDARD RESERVATION

This prescription for fishways 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 diadromous fish through the Project facilities. This reservation of authority includes, without limitation, our authority to amend this fishway prescription 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 Shawmut Hydroelectric Project (FERC No.2808). The Secretary of Commerce reserves his authority to prescribe additional or amended fishways as he may decide are required in the future.

11. ADMINISTRATIVE RECORD

Evidence to support our prescription for fishways is contained in the Administrative Record before the Commission. Citations to the extant record are provided below.

12. LITERATURE CITED

Alden Research Laboratory, L. (2012). Atlantic Salmon Survival Estimates at Mainstem Hydroelectric Projects on the Penobscot River: PHASE 3 FINAL REPORT.

Ames, E. P. (2004). Atlantic cod stock structure in the Gulf of Maine. *Fisheries, 29*(1), 10-28. doi:10.1577/1548-8446(2004)29[10:ACSSIT]2.0.CO;2

ASMFC. (1999). Amendment 1 to the Interstate Fishery Management Plan for Shad and River Herring. Report No. 35 of the Atlantic States Marine Fisheries Commission.

ASMFC. (2007). Fishery Management Report of the Atlantic States Marine Fishery Commission - American Shad Stock Assessment Report for Peer Review Volume II. Stock Assessment Report 07-01 supplement.

ASMFC. (2009). Fishery Management Report of the Atlantic States Marine Fishery Commission - Amendment 2 to the Interstate Fishery Management Plan for Shad and River Herring (River Herring Management).

ASMFC. (2010). Fishery Management Report of the Atlantic States Marine Fishery Commission - Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management).

Baum, E. (1997). *Maine Atlantic salmon: a national treasure.* . Atlantic Salmon Unlimited. Hermon, ME.

Beaugrand, G., & Reid, P. C. (2003). Long-term changes in phytoplankton, zooplankton, and salmon related to climate. *Global Change Biology, 9*, 801-817.

Beiningen, K. T. (1976). Fish Runs: . *Investigative Reports of Columbia River Fisheries Project*, 65p.

Bell, M. C. (1991). Fisheries handbook of engineering requirements and biological criteria. *DTIC Document. US Army Corps of Engineers, North Pacific Division*, 353.

Bergkamp, G., McCartney, M., Dugan, P., McNeely, J., & Acreman, M. (2000). Dams, ecosystem functions and environmental restoration. *Thematic Review II.1 prepared as an input to the World Commission on Dams, 1: 1-187*.

Blackwell, B. F., & Juanes, F. (1998). Predation on Atlantic salmon smolts by striped bass after dam passage. *North American Journal of Fisheries Management, 18*(4), 936-939.

Brookfield. (2016). Weston, Shawmut, and Lockwood Projects, Kennebec River, and Pejepscot and Brunswick Projects, Androscoggin River Evaluation of Atlantic Salmon Passage, Spring 2015. Prepared by Normandeau Associates, Inc.

Budy, P., Thiede, G. P., Bouwes, N., Petrosky, C. E., & Schaller, H. (2002). Evidence Linking Delayed Mortality of Snake River Salmon to Their Earlier Hydrosystem Experience. *North American Journal of Fisheries Management, 22*(1), 35-51. doi:10.1577/1548-8675(2002)022<0035:eldmos>2.0.co;2

Bunt, C., Castro-Santos, T., & Haro, A. (2012). Performance of fish passage structures at upstream barriers to migration. *River Research and Applications, 28*(4), 457-478.

Castro-Santos, T., & Letcher, B. H. (2010). Modeling migratory energetics of Connecticut River American shad (*Alosa sapidissima*): implications for the conservation of an iteroparous anadromous fish. *Canadian Journal of Fisheries and Aquatic Sciences, 67*(5), 806-830.

Clews, E., Durance, I., Vaughan, I. P., & Ormerod, J. (2010). Juvenile salmonid populations in a temperate river system track synoptic trends in climate. *Global Change Biology, 16*, 3271-3283.

CMS. (2020). *Collaborative Management Strategy for the Gulf of Maine Distinct Population Segment of Atlantic Salmon. Report of 2019 Activities.* Retrieved from https://atlanticsalmonrestoration.org/resources/documents/cms-annual-reports-2020

DeCola, J. N. (1970). Water quality requirements for Atlantic salmon. *Federal Water Quality Administration, Needham Heights, Mass.(USA). New England Basins Office*, 42.

Dubé, N. R., Dill, R., Spencer, R. C., Simpson, M. N., Cox, O. N., Rukznis, P. J., Dunham, K. A., & Gallant, K. (2011). *Penobscot River: 2010 Annual Report*. Retrieved from

Dubé, N. R., R. Dill, R.C. Spencer, M.N. Simpson, P.J. Rukznis, K.A. Dunham, O.N. Cox, and K. Gallant. (2012). Penobscot River: 2011 Annual Report. xiv + 175.

Elliott, S. R., Coe, T. A., Helfield, J. M., & Naiman, R. J. (1998). Spatial variation in environmental characteristics of Atlantic salmon (Salmo salar) rivers. *Canadian Journal of Fisheries and Aquatic Sciences, 55*(S1), 267-280.

Elson, P. F. (1969). High temperature and river ascent by Atlantic salmon. *International Council for the Exploration of the Sea, M:12*, 9pp.

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

Fernandez, I. J., Schmitt, C., Stancioff, E., Birkel, S. D., Pershing, A., Runge, J., Jacobson, G. L., & Mayewski, P. A. (2015). *Maine's climate future: 2015 update. Orono, ME. University of Maine*. Retrieved from http://digitalcommons.library.umaine.edu/climate_facpub/5

Foster, N., & Atkins, C. (1869). Second report of the Commissioners of Fisheries of the State of Maine 1868. Sprague, Owen and Nash, Printers to the State, Augusta, Maine.

Foster, N. W., & Atkins, C. G. (1867). Report of Commission on Fisheries.

Franke, G. F., Webb, D. R., Fisher, R. K., Mathur, D., Hopping, P. N., March, P. A., Headrick, M. R., Laczo, I. T., Ventikos, Y., & Sotiropoulus, F. (1997). Development of environmentally advanced hydropower turbine system design concepts. *U.S. Department of Energy and Hydropower Research Foundation*.

Friedland, K. D. (1998). Ocean climate influences on critical Atlantic salmon (*Salmo salar*) life history events. *Canadian Journal of Fisheries and Aquatic Sciences, 55*(S1), 119-130.

Haeseker, S. L., McCann, J. A., Tuomikoski, J., & Chockley, B. (2012). Assessing Freshwater and Marine Environmental Influences on Life-Stage-Specific Survival Rates of Snake River Spring–Summer Chinook Salmon and Steelhead. *Transactions of the American Fisheries Society, 141*(1), 121-138. doi:10.1080/00028487.2011.652009

Hall, S., & Shepard, S. (1990). Report for 1989 evaluation studies of upstream and downstream facilities at the West Enfield Project (FERC #2600-010) *Bangor Hydro-Electric Company*, 23.

Hare, J. A., Morrison, W. E., Nelson, M. W., Stachura, M. M., Teeters, E. J., Griffis, R. B., Alexander, M. A., Scott, J. D., Alade, L., & Bell, R. J. (2016). A vulnerability assessment of fish and invertebrates to climate change on the Northeast US continental shelf. *PLoS One, 11*(2), e0146756.

Hecker, G. E., Amaral, S. V., Stacey, P., & Dixon, D. A. (2007). Developing turbine blades to minimize turbine mortality. Waterpower. Paper No. 097. XV Chattanooga TN, HCI Publications Inc., Kansas City, MO.

Hedger, R. D., Hatin, D., Dodson, J. J., Martin, F., Fournier, D., Caron, F., & Whoriskey, F. G. (2009). Migration and swimming depth of Atlantic salmon kelts Salmo salar in coastal zone and marine habitats. *Marine Ecology Progress Series, 392*, 179-192.

Hoegh-Guldberg, O., & Bruno, J. F. (2010). The impact of climate change on the world's marine ecosystems. *Science, 328*(5985), 1523-1528.

Houston, R., Chadbourne, K., Lary, S., & Charry, B. (2007). Geographic distribution of diadromous fish in Maine. *US Fish and Wildlife Service, Gulf of Maine Coastal Program, Falmouth, Maine*.

Hunter, M. A. (1992). Hydropower flow fluctuations and salmonids: a review of the biological effects, mechanical causes, and options for mitigation. *119*, 1-45.

IPCC. (2007). Climate Change 2007: The Physical Science Basis. . *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA*, 996.

IPCC. (2014). Climate change 2014 synthesis report. . *Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland*, 151.

ISAB. (2007). Latent Mortality Report: Review of Hypotheses and Causative Factors Contributing to Latent Mortality and their Likely Relevance to the "Below Bonneville" Component of the COMPASS Model. *ISAB 2007-1*.

Juanes, F., Gephard, S., & Beland, K. F. (2004). Long-term changes in migration timing of adult Atlantic salmon (Salmo salar) at the southern edge of the species distribution. *Canadian Journal of Fisheries and Aquatic Sciences, 61*(12), 2392-2400. doi:10.1139/f04-207

Larinier, M. (2000). Dams and Fish Migration: dams, ecosystem functions and environmental restoration. *Environmental Issues, Dams and Fish Migration, Final Draft, June 30, 2000.*

Larinier, M. (2002). Biological factors to be taken into account in the design of fishways, the concept of obstructions to upstream migration. *Bulletin Francais de la Peche et de la Pisciculture*(364), 28-38.

Larinier, M., & Marmulla, G. (2004). *Fish passes: types, principles and geographical distribution–an overview.* Paper presented at the Proceedings of the second international symposium on the management of large rivers for fisheries.

Loesch, J. G. (1987). Overview of life history aspects of anadromous alewife and blueback herring in freshwater habitats. *American Fisheries Society Symposium, 1*, 89-103.

Magilligan, F., Graber, B., Nislow, K., Chipman, J., Sneddon, C., & Fox, C. (2016). River restoration by dam removal: Enhancing connectivity at watershed scales. *Elementa, 4*.

McCormick, S. D., Hansen, L. P., Quinn, T. P., & Saunders, R. L. (1998). Movement, migration, and smolting of Atlantic salmon (*Salmo salar*). *Canadian Journal of Fisheries and Aquatic Sciences, 55*(S1), 77-92.

MDACF. (2007). *Maine Department of Agriculture, Conservation, and Forestry. Historic Flooding in Major Drainage Basins, Maine*. Retrieved from https://www.maine.gov/dacf/flood/docs/maineriverbasin/maineriverbasinreport.pdf

MDMR. (2014). American Shad Habitat Plan. *Submitted to the Atlantic States Marine Fisheries Commission as a requirement of Amendment 3 to the Interstate Management Plan for Shad and River Herring*.

MDMR. (2020). Historical Maine Alewife Landings: Last updated February 20, 2020. .

Melillo, J. M., Richmond, T., & Yohe, G. (2014). Climate change impacts in the United States: the third national climate assessment. *U.S. Global Change Research Program* 841 pp. doi:10.7930/J0Z31WJ2.

Miracle, A., Denslow, N. D., Kroll, K. J., Liu, M. C., & Wang, K. K. (2009). Spillway-Induced Salmon Head Injury Triggers the Generation of Brain αII-Spectrin Breakdown Product Biomarkers Similar to Mammalian Traumatic Brain Injury. *PLoS One, 4*(2), e4491.

MSPO. (1993). Kennebec River resource management plan: balancing hydropower generation and other uses. *Maine State Planning Office*, 201.

Mullen, D. M., Fay, C. W., & Moring, J. R. (1986). Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic): alewife/blueback herring. *U.S. Fish and Wildlife Service Biological Report 82(11.56). U.S. Army Corps of Engineers, TR EL-82-4. 21 pp.*

Nieland, J. L., Sheehan, T. F., Saunders, R., Murphy, J. S., Lake, T. R. T., & Stevens, J. R. (2013). *Dam impact analysis model for Atlantic salmon in the Penobscot River, Maine*: US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center.

NMFS. (2009). *Biological valuation of Atlantic salmon habitat with the Gulf of Maine Distinct population Segment*.

NMFS. (2011). Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon.

NMFS. (2016). *Revised guidance for the treatment of climate change in NMFS Endangered Species Act decisions. June 17, 2016.*

NMFS. (2020). *New England and Mid-Atlantic Geographic Strategic Plan 2020-2023*. Retrieved from https://www.fisheries.noaa.gov/resource/document/noaa-fisheries-strategic-plans.

NOAA. (2016). *NOAA Fisheries Protected Resources strategic plan: 2016 – 2020. Conserving America's marine protected species. August 2016*.

PLTW. (2017). *Practical guidelines for incorporating adult Pacific lamprey passage at fishways*. Pacific Lamprey Technical Workgroup. White Paper. Retrieved from https://www.fws.gov/pacificlamprey/mainpage.cfm

Poff, N. L., Allan, J. D., Bain, M. B., Karr, J. R., Prestegaard, K. L., Richter, B. D., Sparks, R. E., & Stromberg, J. C. (1997). The natural flow regime. *BioScience, 47*(11), 769-784.

Pracheil, B. M., DeRolph, C. R., Schramm, M. P., & Bevelhimer, M. S. (2016). A fish-eye view of riverine hydropower systems: the current understanding of the biological response to turbine passage. *Reviews in Fish Biology and Fisheries, 26*(2), 153-167.

Renkawitz, M. D., Sheehan, T. F., & Goulette, G. S. (2012). Swimming depth, behavior, and survival of Atlantic salmon postsmolts in Penobscot Bay, Maine. *Transactions of the American Fisheries Society, 141*(5), 1219-1229.

Saunders, R., Hachey, M. A., & Fay, C. W. (2006). Maine's diadromous fish community: past, present, and implications for Atlantic salmon recovey. *Fisheries, 31*(11), 537-547.

Schaller, H. A., & Petrosky, C. E. (2007). Assessing Hydrosystem Influence on Delayed Mortality of Snake River Stream-Type Chinook Salmon. *North American Journal of Fisheries Management, 27*(3), 810-824. doi:10.1577/m06-083.1

Schilt, C. R. (2007). Developing fish passage and protection at hydropower dams. *Applied Animal Behaviour Science, 104*(3), 295-325.

Scott, W. B., & Scott, M. G. (1988). *Atlantic Fishes of Canada* (Vol. 219: 731p.): Canadian Bulletin of Fisheries and Aquatic Sciences.

Shepard, S. (1989). 1988 Progress Report of Atlantic salmon Kelt RadioTelemetry Investigations in the Lower Penobscot River. *A Cooperative Study By Maine Atlantic Sea-Run Salmon Commission and Bangor Hydro-Electric Company*.

Smith, R. D. (1996). Geomorphic effects of large woody debris in streams. *USDA Forest Service Technical Report, Pacific Northwest Research Station, Juneau, AK.*, 113-127.

Spence, B. C., Lomnicky, G. A., Hughes, R. M., & Novitzki, R. P. (1996). *An ecosystem approach to salmonid conservation*: ManTech Environmental Research Services, Corporation.

Stich, D. S., Bailey, M. M., Holbrook, C. M., Kinnison, M. T., & Zydlewski, J. D. (2015). Catchment-wide survival of wild-and hatchery-reared Atlantic salmon smolts in a changing system. *Canadian Journal of Fisheries and Aquatic Sciences, 72*(9), 1352-1365.

Stich, D. S., Zydlewski, G. B., Kocik, J. F., & Zydlewski, J. D. (2015). Linking behavior, physiology, and survival of Atlantic salmon smolts during estuary migration. *Marine and Coastal Fisheries, 7*(1), 68-86.

Stier, D. J., & Crance, J. H. (1985). *Habitat suitability index models and instream flow suitability curves: American shad*: National Coastal Ecosystems Team, Division of Biological Services, Research ….

Taylor, R. E., & Kynard, B. (1985). Mortality of juvenile American shad and blueback herring passed through a low-head Kaplan hydro-electric turbine. *Transactions of the American Fisheries Society, 114*, 430-435.

USASAC. (2019). *Annual report of the U.S. Atlantic Salmon Assessment Committee. Report No. 31 - 2018 Activities. Prepared for the U.S. Section to NASCO.*

USFWS. (2017). *Fish passage Engineering Design Criteria*. Retrieved from Hadley, MA:

USFWS, & NMFS. (2005). *Final recovery plan for the Gulf of Maine Distinct Population Segment of Atlantic salmon (Salmo salar). National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). November 2005*. .

USFWS, & NMFS. (2019a). *Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (Salmo salar): Final Plan for the 2009 ESA Listing*. US Fish and Wildlife Service, National Marine Fisheries Service.

USFWS, & NMFS. (2019b). *SHRU Specific Recovery Implementation Strategy. Draft.* Retrieved from https://atlanticsalmonrestoration.org/resources/documents/atlantic-salmon-recovery-plan-2015/appendix-to-recovery-plan/recovery-implementation-strategy/view

Weiss-Glanz, L. S., Stanely, J. S., & Moring, J. R. (1986). Species Profiles: Life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic) - American shad. *U.S. Fish and Wildlife Service Biological Report 82(11.59). U.S. Army Corps of Engineers, TR EL-82-4. 16 pp.*

Whalen, K. G., Parrish, D. L., & McCormick, S. D. (1999). Migration timing of Atlantic salmon smolts relative to environmental and physiological factors. *Transactions of the American Fisheries Society, 128*(2), 289-301.

Wright, J., Sweka, J., Abbott, A., & Trinko, T. (2008). GIS-Based Atlantic Salmon Habitat Model. Appendix C in: NMFS (National Marine Fisheries Service). Biological valuation of Atlantic salmon habitat within the Gulf of Maine Distinct Population Segment.

DRAFT. NOAA National Marine Fisheries Service, Northeast Regional Office, Gloucester, MA.

13. Kennebec River Fishway Reports

MDMR has conducted monitoring of fish passage and management activities for more than 30 years. Licensees for mainstem hydropower facilities have also documented fish passage through seasonal counts and a number of studies. While not cited directly in this document, the data generated and conclusions developed therein were considered in our decision process. The fish passage studies are generally available on the FERC e-library. Those less accessible are provided within our administrative record.

14. RESOURCE MANAGEMENT PLANS

In developing its terms and conditions, we considered the following resource management plans.

Atlantic States Marine Fishery Commission (ASMFC). 1985. Fishery management plan for the anadromous alosid stocks of the eastern United States: American shad, hickory shad, alewife, and blueback herring: phase II in Interstate Management Planning for migratory alosids of the Atlantic coast.

ASMFC. 1998. Fishery Management Report of the Atlantic States Marine Fishery Commission - American Shad Stock Assessment Peer Review Report.

ASMFC. 1999. Amendment 1 to the Interstate Fishery Management Plan for Shad and River Herring. Report No. 35 of the Atlantic States Marine Fisheries Commission.

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

ASMFC. 2007. Fishery Management Report of the Atlantic States Marine Fishery Commission - American Shad Stock Assessment Report for Peer Review Volume I. Stock Assessment Report 07-01 supplement.

ASMFC. 2007. Fishery Management Report of the Atlantic States Marine Fishery Commission - American Shad Stock Assessment Report for Peer Review Volume II. Stock Assessment Report 07-01 supplement.

ASMFC. 2009. Fishery Management Report of the Atlantic States Marine Fishery Commission - Amendment 2 to the Interstate Fishery Management Plan for Shad and River Herring (River Herring Management).

ASMFC. 2010. Fishery Management Report of the Atlantic States Marine Fishery Commission - Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management).

ASMFC. 2012. River Herring Stock Assessment Report for Peer Review. Stock Assessment Report No. 12-2, Vol. I.

ASMFC. 2012. River Herring Stock Assessment Report for Peer Review. Stock Assessment Report No. 12-2, Volume II.

Maine Department of Marine Resources (MDMR). 2014. American shad habitat plan. Prepared by the Maine Department of Marine Resources. Submitted to the Atlantic States Marine Fisheries Commission as a requirement of Amendment 3 to the Interstate Management Plan for Shad and River Herring.

MDMR. 2014. Draft Kennebec River Atlantic Salmon Interim Restoration Plan 2015-2020. Maine Department of Marine Resources, Bureau of Sea-Run Fisheries and Habitat.

Maine Department of Marine Resources (MDMR) and Maine Department of Inland Fisheries and Wildlife (MDIFW). 2008. Strategic plan for the restoration of diadromous fishes to the Penobscot River. March 2008.

MDMR, and MDIFW. 2016. Fisheries management Plan for the Mousam River Drainage. Draft. Maine Department of Marine Fisheries and Maine Department of Inland Fisheries and Wildlife.

MDMR, and MDIFW. 2017. Draft Fisheries Management Plan for the Lower Androscoggin River, Kennebec River and Sabattus River. Maine Department of Marine Resources and Maine Department of Inland Fisheries and Wildlife.

Maine State Planning Office. 1993. Kennebec River resource management plan: balancing hydropower generation and other uses.

U.S. Fish and Wildlife Service, Maine Department of Inland Fisheries and Wildlife, Maine Atlantic Sea Run Salmon Commission and Maine Department of Marine Resources. 1987. Saco River Strategic Plan for Fisheries Management. January 1987.

15. FEDERAL REGISTER NOTICES

32 Federal Register 4001 Office of the Secretary, Native Fish and Wildlife, Endangered Species (shortnose sturgeon). Federal Register 32(48):4001. March 11, 1967

65 FR 69459. Endangered and threatened species; final endangered status for a distinct population segment of anadromous Atlantic salmon (*Salmo salar*) in the Gulf of Maine. Department of the Interior Fish and Wildlife Service and Department of Commerce National Oceanic and Atmospheric Administration. Federal Register 65(223): 69459-69483. November 17, 2000

74 FR 29300. Endangered and threatened species; designation of critical habitat for Atlantic salmon (*Salmo salar*) Gulf of Maine Distinct Population Segment; Final Rule. Department of Commerce National Oceanic and Atmospheric Administration. Federal Register 74(117): 29300–29341. June 19, 2009

74 FR 29344. Endangered and threatened species; determination of endangered status for the Gulf of Maine Distinct Population Segment of Atlantic salmon, final rule. Department of the Interior Fish and Wildlife Service and Department of Commerce National Oceanic and Atmospheric Administration. Federal Register 74(117): 29344–29387. June 19, 2009

77 FR 5880. Endangered and threatened wildlife and plants; threatened and endangered status for Distinct Populations Segments of Atlantic sturgeon in the Northeast Region. Department of Commerce, National Oceanic and Atmospheric Administration. Federal Register 77(24): 5880-5912. February 6, 2012

78 FR 48944. Endangered and threatened wildlife and plants; endangered species act listing determination for alewife and blueback herring. Department of Commerce National Oceanic and Atmospheric Administration. Federal Register 78(155): 48944-48994. August 12, 2013

80 FR 60834. Endangered and threatened wildlife and plants; 12-month findings on petitions to list 19 Species as endangered or threatened species. Department of Interior U.S. Fish and Wildlife Service. Federal Register 80(195): 60834-60850. October 8, 2015

82 FR 38672. Endangered and threatened species; initiation of a status review for alewife and blueback herring under the Endangered Species Act (ESA). Department of Commerce, National Oceanic and Atmospheric Administration. 82(156):38672-38674. August 15, 2017

82 FR 39160. Endangered and Threatened Species Designation of Critical Habitat for the Endangered New York Bight, Chesapeake Bay, Carolina and South Atlantic Distinct Population Segments of Atlantic Sturgeon and the Threatened Gulf of Maine Distinct Population Segment of Atlantic Sturgeon Federal register 82(158): 39160-39274. August 17, 2017

84 FR 28630. Endangered Species Act Listing Determination for Alewife and Blueback Herring. Department of Commerce. National Oceanic and Atmospheric Administration. 84FR 28630. June 19, 2019

ATTACHMENT B: SHAWMUT UPSTREAM FISH PASSAGE DESIGN POPULATIONS

Shawmut Upstream Fish Passage Design Populations
Submitted to Brookfield on December 23, 2016 by Don Dow, P.E., NMFS
Data assembled by Maine Department of Marine Resources (contact: Gail Wippelhauser, Ph.D.), and National Marine Fisheries Service (contact: Dan Tierney)

Abbreviations
Maine Department of Marine Resources (MDMR)
National Oceanic and Atmospheric Administration (NOAA)
NOAA's National Marine Fisheries Service (NMFS)
United States Fish and Wildlife Service (USFWS)
United States Geological Survey (USGS)

Introduction
Shawmut is currently the third mainstem dam on the Kennebec River located just above the Hydro Kennebec Project in the Village of Shawmut in the towns of Fairfield and Benton Maine. In 2018, it is anticipated that Brookfield Power will construct an upstream fishway as a condition of their ESA Section 7 Interim Species Protection Plan with NMFS. Order of magnitude estimates are needed for diadromous fish such as adult shad, alewife, blueback herring and Atlantic salmon in order to size the upstream passage facilities appropriately. A similar exercise was completed for the Hydro Kennebec Project and submitted on March 23, 2013 to Brookfield Power. This design memorandum is a modification of that design memorandum.

American Shad (as calculated by MDMR)
Total Production: 354,000 shad (111 shad/acre x 3189 acres)
Total to be passed at Shawmut: 177,000 shad

In the 1980s, the MDMR developed a method of estimating the number of adult American shad that would be produced by a specific amount of habitat (total production) and the number of adult spawners that would be needed to sustain that total production (spawning escapement). Unit production for American shad is based on information from the Connecticut River, because runs of shad in Maine have not been restored and detailed information on historical abundance is lacking. In the past, MDMR used 111 shad/acre (=2.3 shad/100 yd^2), based on the number of American shad annually passed at the Holyoke Dam during the early 1980s and the amount of habitat between Holyoke Dam and Turners Falls Dam, the next upriver dam. Annual passage numbers for Holyoke from 1980-2004 indicate a slight decline in unit production to 101 shad/acre (2.0 shad/100 yd^2); however, we will use 111shad/acre to maintain consistency with other Maine fisheries management plans.

The use of 111 shad/acre is further supported by historical information on commercial landings in Maine. A significant fishery for American shad existed in the freshwater tidal section of the Kennebec River and its tributaries after access to inland waters was obstructed by impassable dams at the head-of-tide. From 1896-1906 the average annual landings of American shad in the Kennebec River were 802,514 pounds. This represents 267,500 adult shad, assuming an average weight of three pounds per fish (note: fish way design assumes four pounds per fish), and a commercial yield of 0.6778 shad/100 $yd^{2.}$ If the exploitation rate ranged from 25-50%, then the total run from Merrymeeting Bay to Augusta (including tributaries) may have ranged from 535,000-1,070,000 shad. This represents a production of to 68-131shad/acre (equivalent to 1.4-2.7 adult shad/100 $yd^{2)}$.

There is 15,391,304 $yd^2$of shad habitat above the Shawmut Project. The following formula converts shad per acre to shad per 100 yd^2.

111 shad/acre x 1 acre / 4.84 100 yd^2= 2.3 shad per 100 yd^2

Therefore total production is:

(15,391,304 yd^2 / 100 yd^2) x 2.3 shad per 100 yd^2= 354,000 shad

Assuming a 50% escapement rate to maintain a shad run above Shawmut, the required amount of passage at Shawmut is:

354,000 shad x 50% escapement = 177,000 shad

Alewives (as calculated by MDMR)
Total Production: 614,995 alewives (235 alewives per acre x 2617 acres)
Total to be passed at Shawmut: 134,000 alewives

In the 1980s, the MDMR developed a method of estimating the number of adult alewife that would be produced by a specific amount of habitat (total production) and the number of adult spawners that would be needed to sustain that total production (spawning escapement). Total production is computed by multiplying the total surface area of known or assumed historical spawning habitat by the number of adults produced per unit of spawning habitat (unit production). Spawning escapement is a percentage of total production. Both total production and spawning escapement are computed for specific bodies of water, for example, a river reach or lake. The number of adult fish that need to be passed upstream at each fishway is estimated by dividing spawning escapement needed for all waters above the facility by an assumed passage efficiency (a goal of 90% is typically used).   The surface area of spawning habitat for each species was determined from USGS 7.5 minute topographical maps.

Unit production for alewife (235 fish/acre) was developed from the commercial harvest in six coastal Maine watersheds for the years 1971-1983, which was assumed to be 100 pounds/surface acre of ponded habitat. This value was slightly less than the average of the lowest yield/acre for all six rivers, and within the range of yields experienced in other watersheds. Assuming a weight of 0.5 pounds per adult, the commercial yield equals 200 adults/surface acre. The commercial harvest was assumed to represent an exploitation rate of 85%, because most alewife runs were harvested six days per week. Exploitation rates on the Damariscotta River, for example, ranged from 85-97% for the years 1979-1982. When commercial yield is adjusted for the 15% escapement rate, the total production is 235 adult alewives/acre.

The unit production is derived from coastal alewife populations that spawn in lakes and ponds that are relatively rich in nutrients (mesotrophic or eutrophic). Many of the large lakes in the Penobscot basin (e.g. Sebec Lake, Schoodic Lake, and Seboeis Lake) are relatively nutrient poor (oligotrophic) and may not produce 235 alewife/acre. However, MDMR is not aware of any information on alewife production in oligotrophic lakes, and will use 235 fish/acre for planning purposes.

Because Maine’s commercially harvested alewife populations began to decline in the mid-1980s under this high exploitation level, MDMR is now recommending that municipalities have a three-day closure for conservation purposes. Therefore, minimum escapement for this plan is assumed to be 45% of total production (equivalent to a three-day closure).

The total production above Shawmut is adjusted by the 15% escapement rate which yields:

235 alewives/acre x 15% = 35 alewives per acre.

The number of alewives needed to pass Shawmut to sustain a population is then decreased by 10% for each barrier passage inefficiency between Shawmut and the subject spawning habitat area. Through a spreadsheet analysis, this equals 134,000 alewives (10% less than Hydro Kennebec) needed to pass Shawmut to sustain a population.

Blueback Herring (as calculated by MDMR)
Total Production: 1,535,000 Blueback Herring (484blueback herring per acre)
Total to be passed at Shawmut: 1,535,000 Blueback Herring

In the past, MDMR has not had sufficient information about blueback herring runs in Maine to develop an estimate of unit production. However, based on three years of passage data at Benton Falls, production is 237 to 484 per acre for 875,500-1,788,000 fish. MDMR has no information on how much available habitat is used or escapement needs. Therefore, 1,535,000 blueback herring is the conservatively assumed design population for the Shawmut fish lift

Atlantic Salmon (as calculated by NMFS and MDMR)
Total Production: 11,639 Atlantic salmon adults (174,581 habitat units (240 eggs per unit)) /7200 eggs per female)*2= 11,639 adults (male + female)*
Total to be passed at Shawmut: 11,639 Atlantic salmon

The amount of Atlantic salmon habitat units (1 unit = 100 m^2) above the project will be determined based on information from a GIS model developed by the USFWS and NMFS (NMFS et al. 2010). The total number of habitat units can then be used to estimate Atlantic salmon production (i.e., the number of juvenile Atlantic salmon smolts that could be produced in the available habitat upstream of the dam). The spawning and rearing habitat above the Shawmut Dam is estimated to be 178,143 salmon habitat units. Using the current estimate of 240 eggs per habitat unit and approximately 7200 eggs produced per female Atlantic salmon (Baum, E.T. January 1997. Maine Atlantic Salmon Management Plan with Recommendations Pertaining to Staffing and Budget Matters), the estimated number of Atlantic salmon productivity above Shawmut is estimated to be 11,639 adults.

Summary of Design Population Rates for Fish Passage at Hydro Kennebec (Rounded Up)

American Shad	177,000 fish
Alewives	134,000 fish
Blueback Herring	1,535,000 fish
Atlantic Salmon	12,000 fish