ENVIRONMENTAL ASSESSMENT
FOR
HYDROPOWER LICENSE

Rollinsford Hydroelectric Project

FERC Project No. P-3777-011

Maine and New Hampshire

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

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ACRONYMS AND ABBREVIATIONS

APE	area of potential effect
certification	water quality certification
C.F.R.	Code of Federal Regulations
cfs	cubic feet per second
Commerce	U.S. Department of Commerce
Commission	Federal Energy Regulatory Commission
Consolidated Hydro	Consolidated Hydro New Hampshire, Inc
CPUE	Catch per unit effort
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
District	Salmon Falls Mill Historic District
DO	dissolved oxygen
EA	environmental assessment
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
°F	degree Fahrenheit
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
fps	feet per second
FWS	U.S. Fish and Wildlife Service
HPMP	Historic Properties Management Plan
Interior	U.S. Department of the Interior
IPaC	U.S. Fish and Wildlife Service Information for Planning and Consultation
kW	kilowatt
Maine DEP	Maine Department of Environmental Protection
Maine DIFW	Maine Department of Inland Fisheries and Wildlife
Maine DMR	Maine Division of Marine Resources
Maine SHPO	Maine State Historic Preservation Officer
mg/L	milligrams per liter
National Register	National Register of Historic Places
NERC	North American Electric Reliability Corporation
New Hampshire DES	New Hampshire Department of Environmental Services
New Hampshire FGD	New Hampshire Fish and Game Department
New Hampshire SHPO	New Hampshire State Historic Preservation Officer
NGVD29	National Geodetic Vertical Datum of 1929
NHPA	National Historic Preservation Act
NLEB	northern long-eared bat
NMFS	National Marine Fisheries Service
NPCC-New England	Northeast Power Coordinating Council's New England Region

PA	Programmatic Agreement
PIT tag	passive integrated transponder tag
Rollinsford	Rollinsford Hydroelectric Project No. 3777
rpm	revolutions per minute
SCORP	Statewide Comprehensive Outdoor Recreation Plan
Town	Town of Rollinsford
TU	Sebago Chapter of Trout Unlimited
USGS	U.S. Geological Survey
ZOP	zone of passage

ENVIRONMENTAL ASSESSMENT

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Washington, DC

Rollinsford Hydroelectric Project
FERC Project No. P-3777-011 – Maine and New Hampshire

1.0 INTRODUCTION

1.1 APPLICATION

On August 29, 2019, the Town of Rollinsford, New Hampshire (Town) filed an application with the Federal Energy Regulatory Commission (Commission or FERC) for a subsequent license to continue to operate and maintain the Rollinsford Hydroelectric Project No. 3777 (Rollinsford Project, or project).[1] The 1.5-megawatt (MW)[2] project is located on the Salmon Falls River in Strafford County, New Hampshire and York County, Maine (Figure 1). The project does not occupy federal land.

[1] The Commission issued the original license for the Rollinsford Project on September 18, 1981, with an effective date of September 1, 1981, and a term of 40 years. The current license expires on August 31, 2021. *Town of Rollinsford, New Hampshire,* 16 FERC ¶ 62,474 (1981).

[2] The September 18, 1981 license order authorized a generator capacity of 1,492 kilowatts (kW). The Town has not applied for an amendment to the authorized project capacity of 1,492 kW, and the Commission has not approved an amendment to the current license. However, in the license application, the Town states that the total installed capacity of the existing project is 1,500 kW and explains that the nameplate of each of the two generators indicates a rating of 833 kilovolt-amperes at a power factor of 0.90, which results in a generation capacity of 750 kW for each unit.

Figure 1. Location of the Rollinsford Project, FERC-licensed hydroelectric projects and exemptions, and non-powered dams on the Salmon Falls River (Source: Staff).

1.2 PURPOSE OF ACTION AND NEED FOR POWER

1.2.1 Purpose of Action

The purpose of the Rollinsford Project is to provide a source of hydroelectric power. Therefore, under the provisions of the Federal Power Act (FPA), the Commission

must decide whether to issue a subsequent license[3] to the Town for the Rollinsford Project, and what conditions should be placed on any license issued. In deciding whether to issue a license for a hydroelectric project, the Commission must determine that the project will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and developmental purposes for which licenses are issued (such as flood control, irrigation, and water supply), the Commission must give equal consideration to the purposes of: (1) energy conservation; (2) the protection of, mitigation of damage to, and enhancement of fish and wildlife resources; (3) the protection of recreational opportunities; and (4) the preservation of other aspects of environmental quality.

Issuing a subsequent license for the Rollinsford Project would allow the Town to continue to generate electricity at the project for the term of the license and making electric power from a renewable resource available to its customers.

This environmental assessment (EA) has been prepared in compliance with the National Environmental Policy Act of 1969 (NEPA)[4] to assess the environmental and economic effects associated with operation of the project, and alternatives to the proposed project. It includes recommendations to the Commission on whether to issue a subsequent license, and if so, recommends terms and conditions to become parts of any issued license.

In this EA, we assess the environmental and economic effects of: (1) operating and maintaining the project as proposed in the application and as specified in the Offer of Settlement for Modified Prescription for Fishways (Settlement Agreement);[5] (2)

[3] A subsequent license is a license for a water power project that is issued under Part I of the FPA after the expiration of a minor license that is not subject to sections 14 and 15 of the FPA. *See* 18 C.F.R. § 16(2)(d) (2020). A minor license is a license for a minor water power project that has a total installed generator capacity of 1.5 megawatts or less. *See* 18 C.F.R. § 4.30(b)(17) (2020).

[4] On July 16, 2020, the Council on Environmental Quality (CEQ) issued a final rule, *Update to the Regulations Implementing the Procedural Provisions of the National Environmental Policy Act* (Final Rule, 85 Fed. Reg. 43304), which was effective as of September 14, 2020; however, the NEPA review of this project was in process at that time and therefore this EA was prepared pursuant to CEQ's 1978 NEPA regulations.

[5] On March 5, 2021, Green Mountain Power Corporation (GMP), on behalf of the Town, filed a Settlement Agreement signed by the Town, GMP, and the U.S. Department

operating and maintaining the project as proposed by the Town, with additional or modified measures (staff alternative); and (3) the staff alternative with the mandatory conditions that have been filed to date. We also consider the effects of the no-action alternative. Under the no-action alternative, the project would continue to operate as it does under the existing license, and no new environmental protection, mitigation, or enhancement measures would be implemented. The primary issues associated with relicensing the project are minimum flows in the bypassed reach of the Salmon Falls River, upstream and downstream fish passage, and protecting cultural resources.

1.2.2 Need for Power

The Rollinsford Project provides hydroelectric generation to meet part of the local and regional power requirements, resource diversity, and capacity needs. The project has an installed capacity of 1.5 MW and an average annual energy production of about 5,837.9 megawatt-hours (MWh) from 2005 through 2018. The project provides power for sale into the local and regional power markets.

To assess the need for power, we looked at the needs in the operating region in which the project is located. The North American Electric Reliability Corporation (NERC) annually forecasts electrical supply and demand nationally and regionally for a 10-year period. The Rollinsford is located within the Northeast Power Coordinating Council's New England region (NPCC-New England) of the NERC. According to NERC's 2020 Long-Term Reliability Assessment, the net internal demand for this region is projected to decrease by about 0.1 percent from 2021 to 2030. The anticipated reserve margin (i.e., the primary metric used to evaluate the adequacy of projected generation resources to serve forecasted peak load) is forecasted to range from 30.9 percent in 2021 to 18.6 percent in 2030. The NPCC-New England assessment area is forecasted to meet NPCC-New England's reference margin level of 13.1 percent in 2021, 13.2 percent in 2022, and 12.7 percent in 2023 through 2030 (NERC, 2020).

Although demand is projected to decrease somewhat in the region, the project currently provides power that helps to meet part of the region's power requirements and capacity needs. The project provides power that can displace non-renewable, fossil-fired generation and contributes to a diversified generation mix. Displacing the operation of

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of the Interior (Interior). The Settlement Agreement purports to resolve, among the settling parties, disagreements over the terms of Interior's fishway prescriptions for American shad and river herring to be included in the subsequent license for the Rollinsford Project pursuant to Section 18 of the Federal Power Act. On April 22, 2021, GMP, on behalf of the Town, clarified that because the Section 18 fishway prescriptions would be mandatory conditions in any license issued for the project, there is no need for and it is not requesting the Commission's approval of the Settlement Agreement.

non-renewable facilities may avoid some power plant emissions and create an environmental benefit.

1.3 STATUTORY AND REGULATORY REQUIREMENTS

A subsequent license for the project would be subject to numerous requirements under the FPA and other applicable statutes. The major regulatory and statutory requirements are described in Appendix A.

1.4 PUBLIC REVIEW AND COMMENT

The Commission's regulations (18 C.F.R. § 16.8) require applicants to consult with appropriate resource agencies, tribes, and other entities before filing an application for a license. This consultation is the first step in complying with the Fish and Wildlife Coordination Act (16 U.S.C. § 661 *et seq*.), Endangered Species Act (ESA), National Historic Preservation Act (NHPA), and other federal statutes. Pre-filing consultation must be completed and documented according to the Commission's regulations.

1.4.1 Scoping

Before preparing this EA, staff conducted scoping to determine what issues and alternatives should be addressed. A scoping document was distributed to interested agencies and others on February 28, 2020. It was noticed in the *Federal Register* on March 5, 2020. The Maine Department of Inland Fisheries and Wildlife (Maine DIFW) filed comments on March 30, 2020.

1.4.2 Interventions

On April 29, 2020, the Commission issued a notice accepting the application and setting June 28, 2020, as the deadline for filing motions to intervene and protests.[6] The notice was published in the *Federal Register* on May 5, 2020. The U.S. Department of Commerce (Commerce) and the U.S. Department of the Interior (Interior) filed notices of intervention on June 25 and June 29, 2020, respectively.

[6] The notice established a 60-day period for filing motions to intervene and protests. The Commission's Rules of Practice and Procedure provide that if a filing deadline falls on a Saturday, Sunday, holiday, or other day when the Commission is closed for business, the filing deadline does not end until the close of business on the next business day. 18 C.F.R. § 385.2007(a)(2). Because the 60-day filing deadline fell on a Sunday (i.e., June 28, 2020), the filing deadline was extended until the close of business on Monday, June 29, 2020.

1.4.3 Comments on the License Application

On April 29, 2020, the Commission issued a notice setting June 28, 2020, as the deadline for filing comments, recommendations, terms and conditions, and prescriptions.[7] The following entities responded:

Respondent	Date Filed
Interior	June 25, 2020
Maine Division of Marine Resources (Maine DMR)	June 25, 2020
New Hampshire Fish and Game Department (New Hampshire FGD)	June 29, 2020
Commerce	June 29, 2020
Sebago Chapter of Trout Unlimited (TU)	June 30, 2020

The Town did not file reply comments.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 NO ACTION ALTERNATIVE

Under the no-action alternative, the project would continue to operate under the terms and conditions of the current license, and no new environmental protection, mitigation, or enhancement measures would be implemented. We use this alternative to establish baseline environmental conditions for comparison with other alternatives, and to judge the benefits and costs of any measures that might be required under a subsequent license.

[7] The notice established a 60-day period for filing comments, recommendations, terms and conditions, and prescriptions. The Commission's Rules of Practice and Procedure provide that if a filing deadline falls on a Saturday, Sunday, holiday, or other day when the Commission is closed for business, the filing deadline does not end until the close of business on the next business day. 18 C.F.R. § 385.2007(a)(2) (2020). Because the 60-day filing deadline fell on a Sunday (i.e., June 28, 2020), the filing deadline was extended until the close of business on Monday, June 29, 2020.

2.1.1 Existing Project Facilities

The Rollinsford Project is located on the Salmon Falls River in Strafford County, New Hampshire, and York County, Maine,[8] approximately 5 river miles upstream of the confluence of Salmon Falls River and the Cocheco River, where the two rivers join to form the Piscataqua River, near Dover, New Hampshire. The Piscataqua River flows approximately 12.7 miles before reaching the Gulf of Maine. The project boundary is shown in Figure 2.

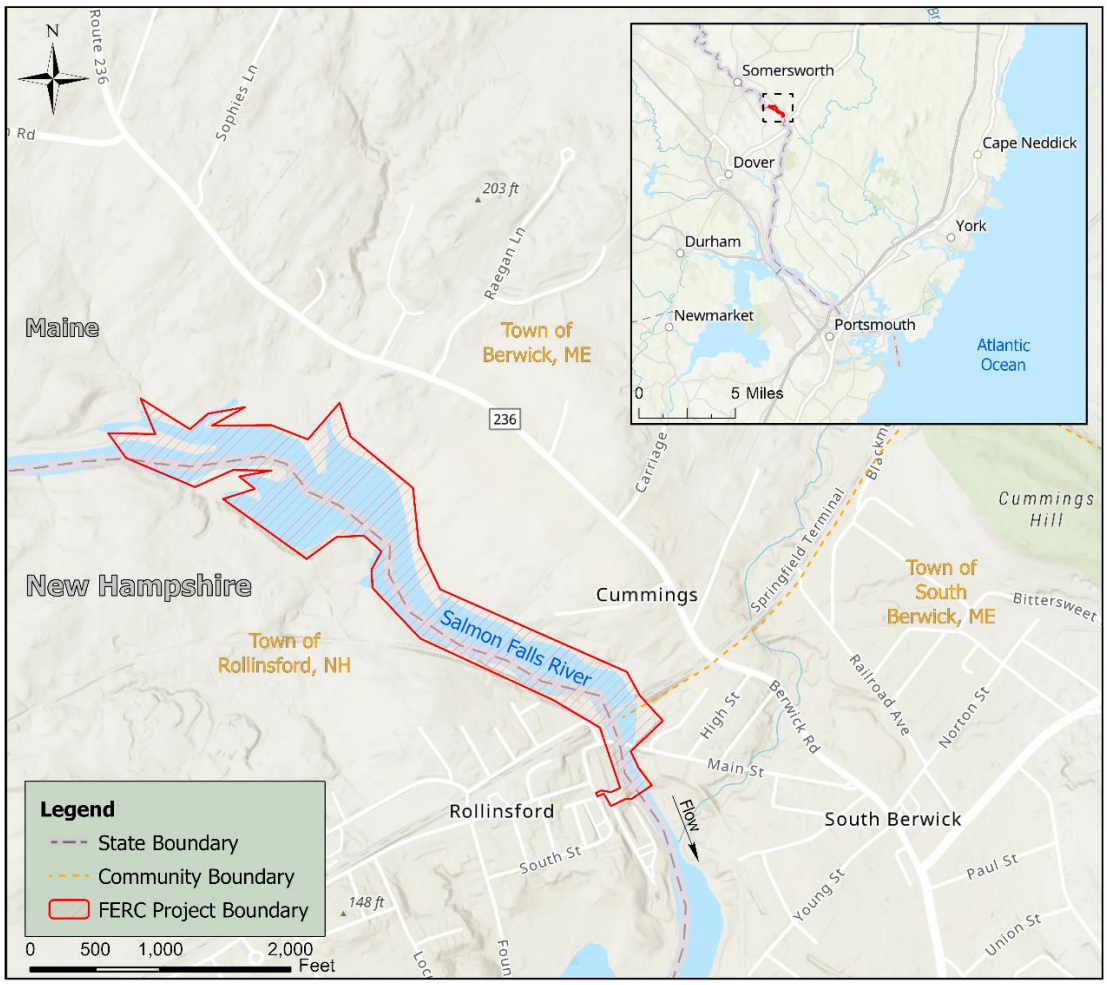

Figure 2. Existing Rollinsford Project Boundary (Source: Staff).

The Rollinsford Project includes the 317-foot-long, 19-foot-high concrete-masonry dam known as the Rollinsford Dam with the following sections: (1) a 12-foot-long left abutment; (2) a 247-foot-long spillway with 15-inch-high flashboards and a crest

[8] The majority of the project facilities, including the intake, penstock, and powerhouse, are located within the Town of Rollinsford. The left abutment of the dam is located in the Town of Berwick.

elevation of 71.25 feet National Geodetic Vertical Datum of 1929 (NGVD29) at the top of the flashboards; (3) a 22-foot-long right abutment; and (4) a 36-foot-long concrete headgate structure with five 5.5-foot-wide, 5.5-foot-high vertical lift gates. The dam creates an impoundment that has a surface area of approximately 84 acres at an elevation of 71.25 feet NGVD29.[9] The existing project facilities are shown in Figure 3.

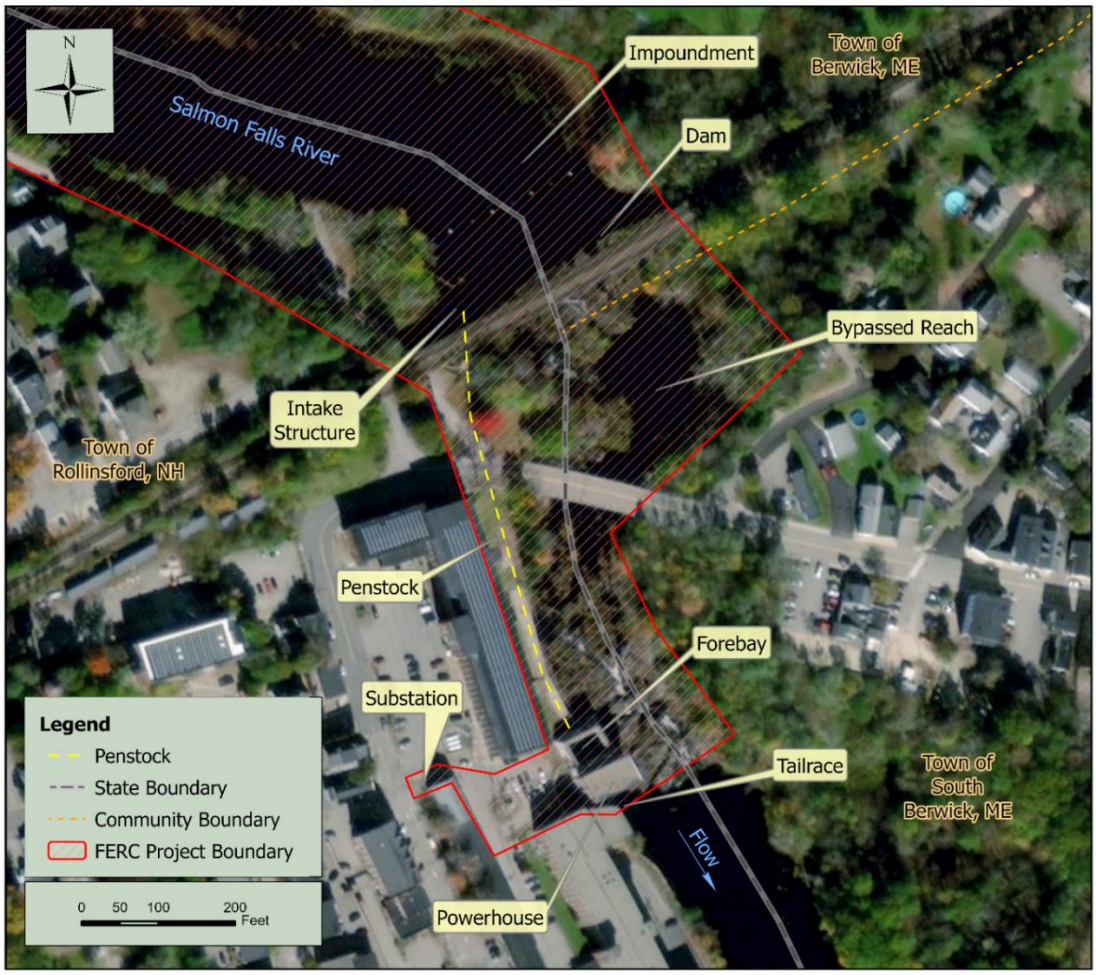

Figure 3. Existing Rollinsford Project Facilities (Source: Staff).

[9] The current license states that the impoundment is 70 acres. *See Town of Rollinsford*, 16 FERC ¶ 62,474 (1981); *Town of Rollinsford*, 21 FERC ¶ 62,392 (1982); *Town of Rollinsford*, 29 FERC ¶ 62,282 (1984). In the FLA, the Town indicates that the impoundment surface area is approximately 82 acres; however, staff used the georeferenced shapefile of the proposed project boundary that was filed by the applicant as part of the license application to measure the surface area associated with the impoundment, and found that the impoundment surface area is approximately 84 acres at an elevation of 71.25 feet NGVD29.

From the impoundment, water flows through the headgates to an intake headworks structure that includes: (1) an approximately 82-foot-long, 52-foot-wide bay; (2) a 22.8-foot-wide, 17.6-foot-high, inclined trashrack with 2.5-inch clear bar spacing installed in front of the penstock intake; (3) an 8-foot-wide, 4.7-foot-high waste gate; (4) a 4-foot-wide, 4-foot-high inoperable sluice gate;[10] and (5) a 21.5-foot-long spillway section with a crest elevation of 73 feet NGVD29.

From the intake headworks structure, water flows through a 600-foot-long, 10-foot-wide, 10-foot-high concrete penstock with a 9-foot-diameter steel liner installed within the lower 250 feet of the penstock. The penstock conveys water to a 30-foot-long, 40-foot-wide concrete forebay that provides water to two 750-kW vertical Z-type Francis turbine-generator units located in a 38-foot-long, 60-foot-wide concrete and brick masonry powerhouse. Water is discharged from the turbines through draft tubes to a 38-foot-long, 34-foot-wide, 15.5-foot-deep tailrace channel, where it returns to the Salmon Falls River. The project creates an approximately 680-foot-long bypassed reach.

A 100-foot-long, 4.16-kilovolt (kV) underground transmission line connects the turbine-generator leads to a 4.16/13.8 kV step-up transformer where the project is connected to the regional electric grid.

2.1.2 Current Project Boundary

The current project boundary encompasses approximately 82 acres (Figure 2). The project boundary encloses: (1) the impoundment;[11] (2) approximately 7 acres of land on the shoreline of the impoundment, above the normal maximum pool elevation of 71.25 feet NGVD; (3) the 680-foot-long bypassed reach; (4) approximately 0.4 acre of land adjacent to the bypassed reach on the left side of the river; and (5) the project facilities listed above in section 2.1.1. The project boundary does not include any federal land.

2.1.3 Project Safety

The Rollinsford Project has been operating for more than 39 years under its existing license. During this time, Commission staff has conducted operational inspections focusing on the continued safety of the structures, identification of

[10] The gate opening was sealed with a steel plate in the early 1980s.

[11] The upper extent of the 84-acre impoundment that is formed at a surface elevation of 71.25 feet NGVD29 is located approximately 2.2 miles upstream of the dam. The current project boundary ends approximately 0.9 mile upstream of the dam; therefore, the project boundary includes only 70 acres of the 84-acre impoundment that occurs at 71.25 feet NGVD29.

unauthorized modifications, efficiency and safety of operations, compliance with the terms of the license, and proper maintenance.

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

2.1.4 Current Project Operation

The Town voluntarily operates the project as a run-of-river facility using an automatic pond controller, such that outflow from the project approximates inflow. The Town maintains the project impoundment at the flashboard crest elevation of 71.25 feet NGVD29. Pursuant to a December 13, 1984 amendment order,[12] the licensee must discharge a minimum flow of 10 cubic feet per second (cfs) to the bypassed reach, and maintain a total project discharge of 115 cfs or inflow to the impoundment, whichever is less, to the Salmon Falls River downstream of the powerhouse. The Town releases the 10-cfs minimum bypassed reach flow through a notch in the flashboards of the dam. The Town maintains a total discharge of 115 cfs to the downstream reach through a combination of flows from the powerhouse and the notch in the flashboards of the dam. These discharges to the Salmon Falls River downstream of the dam and powerhouse occur in both Maine and New Hampshire.

The minimum and maximum hydraulic capacities of the powerhouse are 80 and 456 cfs, respectively. The Town discharges all flow over the dam to the bypassed reach until inflow to the impoundment reaches 90 cfs (minimum hydraulic capacity of one unit plus the minimum bypassed reach flow over the dam). When inflow is between 90 cfs and 466 cfs (maximum hydraulic capacity of both units plus the minimum flow over the dam), the Town releases a minimum flow of 10 cfs from the dam to the bypassed reach, and diverts the remaining flow from the Salmon Falls River to the turbine-generator units to generate electricity. When river flow exceeds 466 cfs, the Town operates both units at the 456-cfs maximum hydraulic capacity and releases the remaining flow over the dam and through the waste gate that is located in the intake headworks structure.[13]

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[12] *Town of Rollinsford, New Hampshire*, 29 FERC ¶ 62,282 (1984), at Article 27.

[13] The waste gate releases flow to the bypassed reach approximately 50 feet downstream of the dam.

The annual energy production of the project from 2005 through 2018 averaged 5,837.9 MWh and ranged from a low of 4,466.4 MWh in 2007 to a high of 7,637.6 MWh in 2009.

2.2 APPLICANT'S PROPOSAL

2.2.1 Proposed Project Facilities

The Town proposes to modify the current project boundary upstream of the Rollinsford Dam to follow a contour elevation of 71.25 feet NGVD29 (i.e., the flashboard crest elevation), which would result in: (1) increasing the surface area of the impoundment included in the project boundary from 70 acres to approximately 84 acres; and (2) removing approximately 7 acres of land from the project boundary that is on the shoreline of the impoundment.

The Town proposes to modify the project boundary downstream of the Rollinsford Dam by removing 0.4 acre of land adjacent to the east bank of the bypassed reach, and 0.3 acre of land adjacent to the transformer.

Collectively, the proposed changes would increase the amount of land and water enclosed by the project boundary from 82 to approximately 88 acres.

2.2.2 Proposed Operation and Environmental Measures

As described in the license application and the Settlement Agreement, the Town proposes to:

- Continue operating the project in a run-of-river mode, such that outflow from the project approximates inflow at all times;

- Maintain the surface elevation of the impoundment at the flashboard crest elevation of 71.25 feet NGVD29 under normal operating conditions;

- Continue to discharge all inflow to the bypassed reach when the project is not generating;

- To enhance aquatic habitat in the bypassed reach, increase the minimum bypassed reach flow from 10 cfs to 35 cfs or inflow, whichever is less, when

the turbine-generators are operating, by increasing the size of the notch in the flashboards;[14]

- Construct and operate a Denil fishway at the dam and excavate the lower section of the bypassed reach to provide upstream passage for American shad and river herring if GMP does not install, operate, and maintain a new trap and haul facility at the South Berwick Project No. 11163 (located approximately 1 mile downstream of the Rollinsford Project), to trap fish and transport them upstream to the impoundments of the Rollinsford Project, the Lower Great Falls Project No. 4451, and the Somersworth Project No. 3820;[15]

- To enhance water quality in the project impoundment, implement a draft Water Quality Mitigation and Enhancement Plan (water quality plan) that includes:[16] (1) drawing down the impoundment by 1.25 feet by releasing flow for project generation during "critical low flow periods"[17] to "flush stagnant water from the impoundment;" (2) refilling the impoundment by retaining all inflow except for the proposed 35-cfs bypassed reach minimum flow; and (3)

[14] Beginning four years after license issuance, the Town proposes to release the 35-cfs minimum bypassed reach flow from: (1) January 1 – August 31 through the notch in the flashboards; (2) September 1 – October 31 through: (a) a proposed downstream fish passage facility (25 cfs) that would be located 190 feet downstream of the dam (discussed below); and (b) the existing waste gate in the intake headworks structure (10 cfs) that is located 50 feet downstream of the dam; and (3) November 1 – December 31 through the notch in the flashboards.

[15] If GMP files a request to install, operate, and maintain a trap and haul facility at the South Berwick Project with the Commission, and the Commission denies GMP's request, then the Town proposes to construct the Denil fishway and excavate the lower bypassed reach prior to the fourth passage season after the denial. If GMP receives authorization to install a trap and haul facility, but later discontinues the operation of the trap and haul facility during the term of a subsequent license, then the Town proposes to install a Denil fishway and excavate the lower bypassed reach four years after the cessation of the trap and haul operation. The Town defines the upstream passage season for American shad and river herring as April 15 to July 15.

[16] *See* Commission staff's June 22, 2021 Memorandum, which includes the Town's proposed draft water quality plan as Enclosure B.

[17] The Town defines "critical low flow periods" as when total inflow to the project has been less than 80 cfs for seven consecutive days during the months of July 1 through September 15.

monitoring water temperature and dissolved oxygen (DO) concentrations in the impoundment, bypassed reach, and tailrace from July 1 through September 15 for three years after license issuance to determine the effectiveness of the impoundment drawdown procedures in improving water quality within the impoundment;

- Conduct an upstream eel passage facility siting survey for two passage seasons, beginning the first passage season after license issuance, to determine the optimal location for siting an upstream eel ramp, and install the upstream eel ramp within 2 years of completing the survey;[18]

- To protect eels during downstream passage from September 1 through October 31, implement nighttime turbine shutdowns from 8 p.m. to 4 a.m. for three consecutive nights following rain accumulations of 0.5 inch or more over a 24-hour period, within 4 years of license issuance;

- Install a downstream eel passage facility for adult eels within 4 years of license issuance, including a new 185-foot-long steel flume that would convey 25 cfs from the intake headworks structure to a plunge pool located 190 feet downstream of the dam;

- Operate the proposed downstream eel passage facility from September 1 through October 31 each year; and

- Consult with the New Hampshire and Maine State Historic Preservation Officers prior to conducting any land-disturbing activities or alterations to known historic structures within the project boundary, to determine whether to conduct archaeological or historical surveys or to implement avoidance or mitigation measures during the activity.

[18] The Town does not provide dates for when the upstream eel passage facility siting survey would occur, or when the facilities would be installed and operated on an annual basis.

2.3 MODIFICATIONS TO APPLICANT'S PROPOSALS – MANDATORY CONDITIONS

2.3.1 Section 18 Fishway Prescription

Interior's preliminary section 18 prescription[19] would require the Town to:

- Install upstream fish passage facilities for American shad and river herring[20] by March 15 of the third calendar year after license issuance, including: (1) a "technical" fishway[21] at the dam; and (2) either a technical fishway or a nature-like fishway[22] in the lower section of the bypassed reach (condition 11.8);

- Operate and maintain the upstream fish passage facilities annually from April 15 through July 15 (condition 11.3);

- Conduct an upstream eel passage facility siting survey from May 1 through October 31 for up to two years,[23] beginning the first passage season after the

[19] As discussed in Appendix A, Interior filed its prescription pursuant to section 18 of the FPA, 16 U.S.C. § 811. Interior's prescription is included in Appendix H.

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

[21] A "technical" fishway is a constructed chute, series of pools, or elevator-like lift designed to provide a pathway over a dam for fish migrating upstream. Interior states that a 4-foot-wide Denil fish ladder (or equivalent) installed at a slope no greater than 1:8 (vertical:horizontal) would accommodate the anticipated production potential of the Rollinsford impoundment, including 21,315 river herring, 2,731 shad, and approximately 500 resident or target species.

[22] Interior's prescription requires the nature-like fishway to be designed to pass the "minimum required flows in the bypass," including the "sum of the minimum bypass release and discharge from the technical fishway at the dam." Interior recommends a minimum bypassed reach flow of 60 cfs from April 15 through July 15 under section 10(j), and FWS's Fish Passage Engineering Design Criteria Manual (FWS, 2019; Design Criteria Manual) includes a flow of 50 cfs through a technical fishway. Accordingly, the prescription effectively requires the nature-like fishway to pass 110 cfs during the upstream alosine migration period.

[23] *See* Commission staff's June 10, 2021 Memorandum on email correspondence with Ms. Julianne Rosset about Interior's preliminary prescriptions under section 18 for the Rollinsford Project.

prescribed upstream anadromous fish passage facility is installed (i.e., after March 15 of the third year after license issuance), and consult with the U.S. Fish and Wildlife Service (FWS) and other resource agencies to determine optimal locations for siting permanent upstream eel passage facilities (condition 11.9);

- Install an upstream eel passage facility no later than May 1 of the second calendar year after the siting survey is complete, and operate and maintain the facility from May 1 through October 31 each year (condition 11.9);[24]

- Develop a plan to provide downstream passage for American shad and river herring within three years of license issuance, including design plans for permanent downstream passage facilities, and operate and maintain the facilities from June 1 through November 15 annually (conditions 11.3 and 11.11);

- Develop a plan to provide downstream passage for American eel within three years of license issuance, including design plans for eel passage facilities and/or operational measures, and implement the measures from August 15 through November 15 annually (conditions 11.3 and 11.10);

- To protect emigrating eels until permanent downstream passage facilities are operational, shut down the turbines from dusk to dawn for three consecutive nights following rain accumulations of 0.50 inch or more over a 24-hour period, from August 15 through November 15 annually (conditions 11.3 and 11.10);

- Design upstream and downstream eel and anadromous fish passage facilities in a manner that is consistent with the FWS's Fish Passage Engineering Design Criteria Manual (FWS, 2019; Design Criteria Manual; conditions 11.8, 11.9, 11.10, 11.11);

[24] Interior's preliminary prescription includes a conflicting provision that would require the upstream eel passage facilities to be operational within five years of license issuance (condition 11.6.1). In order to meet a five-year operational deadline, the Town would have to complete construction of the upstream eel passage facilities less than two months after the second study season of the upstream eel passage facility siting study. Since a five-year operational date is inconsistent with the prescribed construction schedule and the time needed to conduct the siting surveys, staff assumes that the reference to a five-year operational date is a typographical error in the prescription.

- Develop a fishway operation and maintenance plan that includes provisions for: (1) operating and maintaining upstream and downstream fish passage facilities at the project; and (2) monitoring and reporting on the operation and maintenance of the facilities as they affect fish passage (condition 11.4); and

- Develop plans for testing the effectiveness of upstream and downstream fish passage facilities for a minimum of two years after the facilities are operational (condition 11.7).

2.3.2 Water Quality Certifications

The Maine Department of Environmental Protection's (Maine DEP) and New Hampshire Department of Environmental Service's (New Hampshire DES) water quality certifications (certification)[25] would require the Town to:

- Operate the project in run-of-river mode whereby outflow to the project equals inflow at all times, and water levels upstream of the dam are not drawn down for the purpose of generating power (New Hampshire DES condition E-10a);

- Maintain the surface elevation of the impoundment at the flashboard crest elevation of 71.25 feet NGVD29 (Maine DEP condition 1A; New Hampshire DES condition E-10c);[26]

- When drawing down the impoundment for scheduled project maintenance, lower the impoundment water level no more than 6 inches per day to protect aquatic resources in the impoundment (New Hampshire DES condition E-10e);

- When refilling the impoundment after a drawdown for maintenance or emergencies, release 90 percent of the inflow downstream to the Salmon Falls River and use the remaining 10 percent of inflow to refill the impoundment (New Hampshire DES condition E-10d);

- Develop an operation compliance monitoring plan to document compliance with run-of-river operation, impoundment elevation limits, and minimum

[25] As discussed in Appendix A, the Maine DEP and the New Hampshire DES issued certifications pursuant to section 401(a)(1) of the Clean Water Act (CWA), 33 U.S.C. § 1341(a)(1). Maine DEP's certification is included in Appendix I, and New Hampshire DES's certification is included in Appendix J.

[26] New Hampshire DES states that the impoundment elevation should also include "any additional elevation required to pass" the minimum bypassed reach flows required by condition E-10b.

bypassed reach flow releases (Maine DEP condition 1B; New Hampshire DES condition E-12);

- Prior to the installation of upstream fish passage facilities at the project (discussed below),[27] release a year-round minimum bypassed reach of 35 cfs or inflow, whichever is less, to protect aquatic life in the bypassed reach when the project is generating (Maine DEP condition 2A; New Hampshire DES condition E-10b);

- After the installation of upstream fish passage facilities at the project, and when the project is generating, release to the bypassed reach: (1) a minimum flow of 35 cfs or inflow, whichever is less, from July 16 – April 14; and (2) an unspecified minimum flow from April 15 – July 15, the quantity of which must be determined in consultation with resource agencies (Maine DEP condition 2A; New Hampshire DES condition E-10b);

- When the project is not generating, release all impoundment inflow to the bypassed reach (Maine DEP condition 2A; New Hampshire DES condition E-10b);

- Conduct an upstream eel passage facility siting survey, and install and operate an upstream eel passage facility in accordance with schedules established by the Commission and measures prescribed by Interior (Maine DEP condition 3A);

- Construct and operate a Denil fishway to provide upstream passage for anadromous fish in consultation with resource agencies, in accordance with the schedule established by the Commission, and as prescribed by Interior, "unless an exception for trap and truck operations is requested within two years of

[27] The agencies do not provide a schedule for installing upstream fish passage facilities in either certification. The agencies state that, prior to the installation of the upstream fish passage facilities, bypassed reach flows should be released over the spillway when the project is not generating. For all other operating conditions, including when the project is generating and after the fish passage facilities are installed, the agencies state that the Town must consult with the resource agencies to determine the manner in which flows will be released to the bypassed reach.

issuance of a new license, and approved by USFWS and by FERC" (Maine DEP condition 3B);[28]

- Construct and operate downstream eel and anadromous fish passage facilities in consultation with resource agencies, in accordance with schedules established by the Commission, and as prescribed by Interior (Maine DEP conditions 4A and B);

- Design upstream and downstream fish passage facilities in consultation with resource agencies and in a manner that is consistent with the FWS's Design Criteria Manual (Maine DEP conditions 3C and 4C);

- Provide upstream and downstream passage for anadromous fish and American eel in a manner that is consistent with Interior's section 18 fishway prescription (New Hampshire DES condition E-13);[29]

- Conduct effectiveness studies for the upstream and downstream fish passage facilities in consultation with resource agencies and in accordance with schedules established by the Commission (Maine DEP conditions 3D and 4D);

- Develop a fishway operation and maintenance plan describing the operation and maintenance of the upstream and downstream fish passage facilities (Maine DEP conditions 3E and 4E);

- To protect water quality in the impoundment during low flow periods: (1) finalize the proposed water quality plan within 60 days of license issuance, in consultation with the New Hampshire DES and Maine DEP (Maine DEP condition 5A); (2) for two years following license issuance, monitor DO in the impoundment following seven days of inflow less than 80 cfs, between July 1

[28] Maine DEP does not specify where the trap and haul facility would be located or who would submit the request to install a trap and haul facility. Based on the similarities between condition 3 and the upstream fish passage measures included in the Settlement Agreement, staff assume that Maine DEP is referring to an exception that would occur if GMP submits a request to provide upstream fish passage via trap and haul at the South Berwick Project No. 11163.

[29] New Hampshire DES's condition E-13 also requires the Town to comply with "any modifications made to the preliminary prescriptions that are acceptable to the FWS, including, but not limited to, any modifications made to be consistent with the Settlement Agreement by and between" the Town, GMP, and FWS.

and September 15 (Maine DEP condition 5B);[30] and (3) if monitoring indicates that DO is below 5.0 milligrams per liter (mg/L), then implement the water quality plan in the third year following license issuance (Maine DEP condition 5B);

- Finalize the proposed water quality plan in consultation with the New Hampshire DES, and implement the plan to improve water quality in the Salmon Falls River during low flow periods (New Hampshire DES condition E-14);

- Monitor DO and temperature in the impoundment, tailrace, and bypassed reach every five years, including five weeks of monitoring during "periods of relatively low flows and high temperatures" and "when the Project is, and is not, generating," in order to determine whether changes in project operation are necessary to comply with New Hampshire DES's water quality standards during the term of a subsequent license (New Hampshire DES condition E-15); and

- Continue to provide informal access to the project for recreation and navigation; and consult with Maine DIFW within 6 months of license issuance about improvements to access for streamside angling, including additional signs and trails to the tailrace and bypassed reach (Maine DEP condition 6A).

2.4 STAFF ALTERNATIVE

Under the staff alternative, the project would be operated as proposed by the Town with two exceptions. First, we do not recommend the Town's conditional proposal to: construct and operate a Denil fishway at the dam and excavate the lower section of the bypassed reach to provide upstream passage for shad and river herring, if GMP does not install, operate, and maintain a new trap and haul facility at the South Berwick Project No. 11163 (located approximately 1 mile downstream of the Rollinsford Project), to trap fish and transport them upstream to the impoundments of the Rollinsford Project, the Lower Great Falls Project No. 4451, and the Somersworth Project No. 3820. Since GMP has not submitted a request to amend the license for the South Berwick Project to provide upstream fish passage that would transport shad and river herring upstream of the Rollinsford Project dam via trap and haul, there is no proposal for the facility before the Commission at this time. The Town has also not filed any information demonstrating that a trap and haul alternative is reasonably foreseeable. Therefore, Commission staff does not evaluate the trap and haul alternative on the merits in this EA, and does not

[30] Maine DEP does not specify the monitoring duration.

recommend it.[31] To provide upstream passage for American shad and river herring, staff recommends installing a Denil fishway at the project dam and a nature-like fishway in the bypassed reach by March 15 of the third calendar year after license issuance, and operating and maintaining the facility annually from April 15 through July 15, as prescribed by Interior (conditions 11.3 and 11.8).

Second, we do not recommend the Town's proposal to enhance water quality in the project impoundment by implementing a water quality plan that includes procedures for drawing down and refilling the impoundment during low flow periods, with the intent of increasing DO concentrations in the impoundment. Staff concludes that the low DO concentrations in the impoundment are the result of natural biochemical processes during periods of low flow, and not the result of project operation. While the proposed water quality plan could improve DO concentrations in the impoundment during low flow conditions in the summer, staff concludes that the proposed plan would likely result in a net adverse effect on aquatic organisms in the Salmon Falls River. For instance, the drawdown and refill process would disrupt attraction and conveyance flows necessary to provide upstream and downstream passage for American shad, river herring, and American eels, and disrupt minimum flow releases to the bypassed reach, which could strand fish and freshwater mussels. Therefore, staff does not recommend the Town's proposed water quality plan.

The staff alternative includes 9 of the 10 fishway prescription conditions filed by Interior (Appendix A), 8 of the 13 certification conditions filed by Maine DEP, 8 of the 11 certification conditions filed by New Hampshire DES, and the following modifications and additional staff-recommended measures:

- To protect and enhance aquatic habitat in the bypassed reach, release a year-round minimum flow of 35 cfs to the bypassed reach from a notch in the flashboards when the project is generating, as proposed by the Town and required by the Maine DEP's and the New Hampshire DES's certifications (conditions 2A and E-10b, respectively), but do so for only two years after license issuance, prior to the installation of fish passage facilities in the bypassed reach (instead of the full license term, as proposed by the Town);

- Beginning on April 15 of the third year after license issuance (i.e., when the staff-recommended upstream fish passage facility would be installed in the bypassed reach), release the following minimum bypassed reach flows from the staff-recommended upstream and downstream anadromous fish passage facilities: (1) 60 cfs or inflow, whichever is less, from April 15 – July 15; and

[31] The Commission cannot amend the South Berwick Project No. 11163 license in this license proceeding.

(2) 35 cfs or inflow, whichever is less, from July 16 – April 14, to protect and enhance aquatic habitat in the bypassed reach;

- Provide downstream passage for American eel, American shad, and river herring as prescribed by Interior (conditions 11.3, 11.10, and 11.11), by installing the following facilities by March 15 of the third calendar year after license issuance and operating the facilities on an annual basis from May 15 – November 15: (1) a diversionary guidance boom in the impoundment, upstream of the headgates, that prevents downstream migrating alosines from entering the intake headworks; (2) a surface bypass weir with a hydraulic capacity of 35 cfs at the dam; and (3) a 4-foot-deep plunge pool downstream of the dam;

- Develop a fishway plan for the staff-recommended upstream and downstream eel and fish passage facilities that includes the following provisions: (1) design specifications that are based on the FWS Design Criteria Manual; (2) a schedule for submitting conceptual and final design plans for review and approval to the resource agencies and the Commission; (3) construction schedules for installing the fishways by the staff-recommended installation dates; (4) annual fishway operation schedules and conveyance flows that are based on the FWS Design Criteria Manual; (5) seasonal fishway maintenance procedures, including debris management; and (6) monitoring and reporting on the operation and maintenance of the facilities as they affect fish passage, consistent with Interior's prescription conditions 11.4, 11.10, and 11.11;

- Avoid the removal of trees with diameters that are equal to or greater than 3 inches at breast height from April 1 through October 1, to protect NLEB; and

- Develop a Historic Properties Management Plan (HPMP) in consultation with the New Hampshire State Historic Preservation Officer (SHPO) and Maine SHPO to protect historic properties that are eligible for or listed on the National Register.

Fishway Prescriptions Not Recommended

The staff alternative does not include the following preliminary fishway prescription condition because, pursuant to sections 4(e) and 10(a) of the FPA, the condition is for an action that does not serve a project-related benefit:

- Develop plans for testing the effectiveness of upstream and downstream fish passage facilities for a minimum of two years after the facilities are operational (condition 11.7).

Water Quality Certification Conditions Not Recommended

The staff alternative does not include the following water quality certification conditions because, pursuant to sections 4(e) and 10(a) of the FPA, the benefits would not justify the costs, or the conditions are for actions that do not serve a project-related purpose or provide a project-related benefit:

- After the installation of upstream fish passage facilities at the project, and when the project is generating, release an unspecified minimum bypassed reach flow from April 15 – July 15, the quantity of which must be determined in consultation with resource agencies (Maine DEP condition 2A and New Hampshire DES condition E-10b);

- Consult with the resource agencies to determine the manner in which flows will be released to the bypassed reach (Maine DEP condition 2A);

- Construct and operate a Denil fishway to provide upstream passage for anadromous fish in consultation with resource agencies, in accordance with the schedule established by the Commission and as prescribed by Interior, "unless an exception for trap and truck operations is requested within two years of issuance of a new license, and approved by USFWS and by FERC" (Maine DEP condition 3B);

- Conduct effectiveness studies for the upstream and downstream fish passage facilities in consultation with resource agencies and in accordance with schedules established by the Commission (Maine DEP certification conditions 3D and 4D);

- Monitor DO in the impoundment if inflow is less than 80 cfs for seven days from July 1 – September 15, for two years after license issuance, and if monitoring indicates that DO is below 5.0 mg/L, then implement the water quality plan required by certification condition 5A in the third year following license issuance (Maine DEP condition 5B);

- Finalize the proposed water quality plan in consultation with the New Hampshire DES to protect water quality in the impoundment during low flow periods (New Hampshire DES condition E-14);

- Monitor DO and temperature in the impoundment, tailrace, and bypassed reach every five years, including five weeks of monitoring during "periods of relatively low flows and high temperatures" and "when the Project is, and is not, generating," in order to determine whether changes in project operation

are necessary to comply with New Hampshire water quality standards during the term of a subsequent license (New Hampshire DES condition E-15); and

- Continue to provide informal access to the project for recreation and navigation; and consult with Maine DIFW within 6 months of license issuance about improvements to access for streamside angling, including additional signs and trails to the tailrace and bypassed reach (Maine DEP condition 6A).

Section 10(j) Measures Not Recommended

Under section 10(j), Interior recommends a protocol to avoid adverse effects on the northern long-eared bat by undertaking one of the following measures: avoid any tree removal activities associated with the operation or maintenance of the Rollinsford Project between April 1 and October 1, or conduct bat exit surveys to determine if bats are utilizing potential roost trees. The staff alternative includes a seasonal restriction on the removal of trees with diameters that are equal to or greater than 3 inches at breast height, from April 1 through October 1, but does not include conducting bat surveys prior to tree removal, because pursuant to sections 4(e) and 10(a) of the FPA, the benefits of the bat surveys would not justify the costs.

The staff alternative does not include the following measures that were filed as section 10(j) recommendations[32] because, pursuant to sections 4(e) and 10(a) of the FPA, the benefits do not justify the costs, or the recommendations are for actions that do not address a project-related effect or provide a project-related benefit:

- Commerce's recommendation to release a minimum bypassed reach flow of 35 cfs or inflow, whichever is less, from July 16 - April 30, and 60 cfs or inflow, whichever is less, from May 1 - July 15;

- Commerce's recommendation to develop a headpond refill plan to protect fish and aquatic habitat;

- Commerce's recommendation to develop a plan for assessing the suitability of habitat for diadromous fish under the required minimum bypassed reach flows;

[32] As discussed in Appendix D, *Fish and Wildlife Agency Section 10(j) Recommendations*, some of the measures listed below are outside of the scope of section 10(j). Here, we account for all measures that were characterized as section 10(j) recommendations by the resource agencies but are not being adopted by Commission staff.

- Interior's recommendation to release a minimum bypassed reach flow of 35 cfs or inflow, whichever is less, from July 16 to April 14, and 60 cfs or inflow, whichever is less, from April 15 - July 15; and

- Interior's recommendation to notify the resource agencies and the Commission of any activity that may affect a federally listed species in a manner not considered in any subsequent license issued by the Commission.

2.5 STAFF ALTERNATIVE WITH MANDATORY CONDITIONS

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

2.6 ALTERNATIVE CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

Project decommissioning was considered as an alternative to the project but has been eliminated from further analysis because it is not reasonable in the circumstances of this case. This alternative is presented in Appendix B.

3.0 ENVIRONMENTAL ANALYSIS

This section includes: (1) a general description of the project vicinity, (2) an explanation of the scope of our cumulative effects analysis, and (3) our analysis of the proposed action and other recommended environmental measures. Sections are organized by resource area (aquatics, recreation, *etc.*). Historic and current conditions are described under each resource area. Current conditions are the baseline against which the environmental effects of the proposed action and alternatives are compared, including an assessment of the effects of proposed protection, mitigation, and enhancement measures, and any cumulative effects of the proposed action and alternatives. Staff conclusions and recommended measures are discussed in section 5.1, *Comprehensive Development and Recommended Alternative*.[33]

[33] Unless otherwise indicated, our information is taken from the application for license filed by the Town on August 29, 2019; the Town's January 29, 2020, March 27, 2020, and April 22, 2021 responses to staff's requests for additional information; the Settlement Agreement filed on March 5, 2021; and Commission staff's telephone conversation memo filed June 22, 2021.

3.1 GENERAL DESCRIPTION OF THE RIVER BASIN

The Rollinsford Project is located on the Salmon Falls River in Rollinsford, Strafford County, New Hampshire and South Berwick, York County, Maine. The Salmon Falls River watershed drains an area of 236 square miles from eight towns in Maine and ten towns in New Hampshire. The Salmon Falls River starts at Great East Lake and flows south-southwest for approximately 38 miles, forming the border between Maine and New Hampshire. The Salmon Falls River and the Cocheco River join in Dover, New Hampshire, approximately 5 miles downstream from the Rollinsford Project, to form the Piscataqua River, which flows approximately 12.7 miles to the Gulf of Maine.

Significant water features in the Salmon Falls River Basin include Great East Lake, Lovell Lake, Lake Murdock, Little River, Branch River, Great Works River, and Milton Three Ponds. The watershed includes hundreds of small streams, ponds, and wetlands. Landscapes range from forested floodplains and peat lands, to open grasslands and mixed pine, oak, and hemlock forests.

Land in the immediate project vicinity is highly developed, including the towns of Berwick and South Berwick, Maine, and Somersworth, New Hampshire. However, several parcels of state, municipal, and privately-managed conservation land are located in the towns of South Berwick, Maine, and Somersworth and Rollinsford, New Hampshire.

Based on climatological data recorded at the Rochester, New Hampshire airport for the period 2000 through 2016, located approximately 6.3 miles northwest of the project, the average air temperature is 58 °F, with July being the warmest month and January the coldest month (NOAA, 2016). The average annual precipitation is 42.0 inches. From 2000 through 2016, June was the wettest month and January the driest.

Several municipal wastewater treatment facilities empty into the Salmon Falls River, including facilities located in Berwick and South Berwick, Maine, and Milton, Somersworth, and Rollinsford, New Hampshire. The river is a source of water for the Berwick Water Department and Somersworth Water Works.

There are currently 15 dams on the river, beginning with the South Berwick dam, located at the head of tide in South Berwick, Maine. Historically, there have been as many as 24 dams along the mainstem of the river, but some have been removed or breached. There are currently four hydropower projects on the Salmon Falls River that operate under a FERC license and three hydropower projects that operate under a FERC small hydroelectric power project exemption. Table 1 details the name, location, and attributes of the 15 dams on the Salmon Falls River from downstream to upstream. The dam locations are shown in Figure 1.

Table 1. Dams located on the Salmon Falls River.

Dam/Project Name	FERC No.	FERC Project Type	River Mile	Generation Capacity (MW)	Dam Height (feet)
South Berwick	11163	License	3.9	1.2	26
Rollinsford	**3777**	**License**	**5.0**	**1.5**	**19**
Lower Great Falls	4451	License	7.4	1.28	32
Salmon Falls River Dam II	NA	NA	8.4	NA	6
Somersworth	3820	License	8.8	2	17
Boston Felt	4542	Exemption	19.8	0.15	10
North Rochester	3985	Exemption	25.8	0.3	21
South Milton	3984	Exemption	28.1	1.5	15
Milton Leather Board Dam	NA	NA	28.3	NA	32
Milton Three Ponds Dam	NA	NA	28.7	NA	19
Salmon Falls River Dam VII	NA	NA	37.5	NA	10
Waumbek Dam	NA	NA	37.7	NA	17
Rowe Dam	NA	NA	38.5	NA	14.7
Horn Pond Dam	NA	NA	42.7	NA	14
Great East Lake Dam	NA	NA	44.6	NA	15

NA: Not applicable. (Source: Staff)

3.2 SCOPE OF CUMULATIVE EFFECTS ANALYSIS

According to the Council on Environmental Quality's regulations that implement NEPA,[34] a cumulative effect is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person

[34] On July 16, 2020, CEQ published its *Update to the Regulations Implementing the Procedural Provisions of the National Environmental Policy Act Regulations* (85 Fed. Reg. 43304-43376). These regulations apply to all NEPA processes begun after September 14, 2020 (40 C.F.R. § 1506.13 (2020)). Because the NEPA process for this license application began prior to the effective date of the new regulations, this EA was prepared in compliance with the original implementing regulations published in 1978.

undertakes such other actions. Cumulative effects can result from individually minor, but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

Based on our review of the license application, as well as agency and public comments, we have identified water quality and migratory fish species (i.e., American eel, American shad, river herring, and sea lamprey) as resources that could be cumulatively affected by the continued operation and maintenance of the Rollinsford Project, in combination with other hydroelectric projects, and other past, present, and foreseeable future activities in the Salmon Falls River Basin. We discuss these cumulative effects at the end of section 3.3.1.

3.2.1 Geographic Scope

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

We have identified the geographic scope for water quality to include the Salmon Falls River Basin, from the origin of the Salmon Falls River at the outlet of Great East Lake, to the confluence of the Salmon Falls River and Cocheco River in Dover, New Hampshire. We chose this geographic scope because the operation and maintenance of the Rollinsford Project in combination with the other dams and activities on the Salmon Falls River could affect water quality in the Salmon Falls River Basin.

For migratory fish species, our proposed geographic scope includes the Salmon Falls and Piscataqua rivers, from the origin of the Salmon Falls River at the outlet of Great East Lake to the mouth of the Piscataqua River in Portsmouth, New Hampshire. We chose this geographic scope because the operation and maintenance of the project, in combination with other dams and hydroelectric projects in the Salmon Falls and Piscataqua rivers, may affect movements of migratory fish from the outlet of Great East Lake to the mouth of the Piscataqua River.

3.2.2 Temporal Scope

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

3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

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

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

3.3.1 Aquatic Resources

3.3.1.1 Affected Environment

Water Quantity

The Salmon Falls River at the project has a drainage area of 232 square miles. The project dam creates an approximately 84-acre impoundment with a maximum depth of 12 feet. Average monthly flows at the project, from 1968 to 2005 and 2011 through 2018, range from a low of 138 cfs in August to a high of 914 cfs in April, with an average annual flow of 407 cfs (Table 2).[35]

Table 2. Mean, median, maximum, and minimum flows at the Rollinsford Project from 1968 to 2005 and 2011 to 2018.

Month	Median Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)
January	337	388	3,222	47
February	322	389	3,544	62
March	490	635	6,917	84
April	795	914	6,896	70
May	382	477	4,597	55

[35] These flows are derived from Salmon Falls River flows reported at USGS gage No. 01072100 near Milton, New Hampshire, by multiplying flow data from the USGS gage by the ratio of the drainage areas at the Rollinsford Project (232 mi^2) and the USGS gage (108 mi^2).

June	189	297	4,919	23
July	97	143	1,796	27
August	90	138	1,534	20
September	90	156	2,131	13
October	322	392	5,134	19
November	408	446	2,642	43
December	391	494	3,974	47
Annual	292	407	6,917	13

(Source: Town, 2019, as modified by staff).

The Town voluntarily operates the project as a run-of-river facility, such that outflow from the project approximates inflow. A pond level sensor is installed near the project intake to monitor and ensure the project impoundment is maintained at the flashboard crest elevation of 71.25 feet NGVD29, and to regulate turbine operation. The project maintains a minimum flow of 10 cfs or inflow to the bypassed reach through a notch in the flashboards of the dam. In addition, the project releases 115 cfs or inflow, whichever is less, to the Salmon Falls River downstream of the powerhouse, through a combination of flows from the powerhouse and spill from the dam.

Flows in the range of 90 cfs to 466 cfs (the respective minimum and maximum hydraulic capacities of the project turbines, plus the 10-cfs minimum bypassed reach flow), are used for hydropower generation. Flows in the Salmon Falls River equal or exceed the maximum hydraulic capacity of the project approximately 30 of the time on an annual basis, based on the prorated gage flows near Milton, New Hampshire. Similarly, the minimum hydraulic capacity is equaled or exceeded approximately 85 percent of the time on an annual basis, based on the prorated gage flows near Milton, New Hampshire. Generation flows are discharged to the mainstem of the Salmon Falls River at the end of the 680-foot-long bypassed reach.

Water Quality

State Water Quality Classifications

Both New Hampshire and Maine have regulatory authority over water quality in the Salmon Falls River. The Salmon Falls River at the project is classified as Class B in New Hampshire[36] and Class C in Maine.[37]

In New Hampshire, the DO concentration must not be less than 5 milligrams per liter (mg/L) or 75 percent of saturation, whichever is higher. The New Hampshire water quality standard for temperature is only narrative, stating temperature increases associated with water diversions shall not be such as to appreciably interfere with the uses assigned to the class. The section of the river in which the project is located is listed on the Clean Water Act section 303(d) list of impaired waters for pH, with the source unknown (New Hampshire DES, 2017).

In Maine, the DO concentration must not be less than 5 mg/L or 60 percent of saturation, whichever is higher, and temperature must not exceed 71 °F or ambient temperature. The section of river in which the project is located is listed on the Clean Water Act section 303(d) list of impaired waters (Maine DEP, 2016) for the following impairments: *Escherichia coli*, ammonia, eutrophication, DO, phosphorus, and biochemical oxygen demand.

There are eight permitted National Pollutant Discharge Elimination System (NPDES) discharge points in the vicinity of the project, four of which are from municipal wastewater treatment plants (USEPA, 2018). The Town of Rollinsford's wastewater treatment facility is located less than a quarter mile downstream of the project powerhouse.

Water Quality Study

The Town conducted a water quality study from June through October in 2018, to determine if the project: (1) is impacting water quality in the Salmon Falls River upstream and downstream of the project; and (2) follows New Hampshire and Maine's surface water quality standards. Four locations (Figure 4) were monitored within the vicinity of the project during the study, including: (1) in the Salmon Falls River, upstream of the current project boundary, but within the impoundment in the proposed project boundary (RL-1); (2) the deepest location in the impoundment (RL-2); (3) the

[36] In New Hampshire, Class B water bodies are considered acceptable for fishing, swimming, and other recreational purposes, and after treatment, are potential water supplies.

[37] In Maine, Class C water must ensure suitability for designated uses of drinking water, fishing, agriculture, recreation, industrial processes, cooling water, hydroelectric power generation, navigation, and habitat for fish and other aquatic life.

bypassed reach (RL-3); and (4) the project tailrace (RL-4). The study was conducted over a range of typical flows and weather conditions, including periods of low river flow and warm air temperatures.

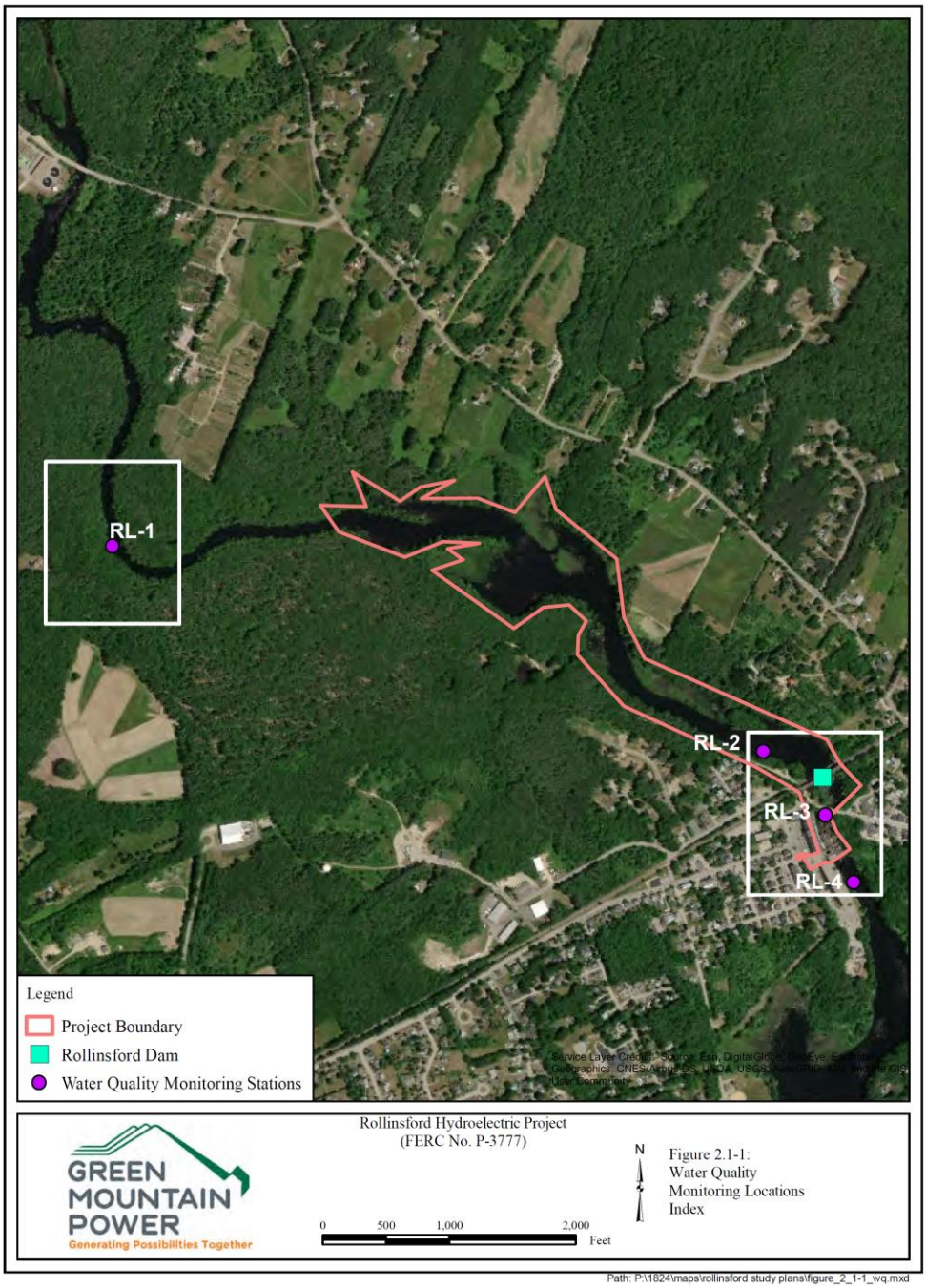

Figure 4. Water quality monitoring locations (Source: Town, 2019, as modified by staff).

As part of the water quality study, the Town collected DO and water temperature data in 15-minute intervals from July through September 2018 at the four sampling points

shown in Figure 4. The meter in the impoundment (RL-2) was deployed within the top 25 percent of depth when depths were greater than 40 inches. The downstream meters (RL-3 and RL-4) were installed to approximately mid-depth or less in the water column. Mean DO concentrations in the upper impoundment ranged from 7.0 mg/L in July to 8.0 mg/L in September. DO concentrations in the upper impoundment dropped below 5.0 mg/L in July (3.0 mg/L) and August (3.8 mg/L). Mean DO concentrations in the top 3 feet of the deepest location of the impoundment ranged from 6.4 mg/L in July to 7.7 mg/L in August. DO concentrations in the deepest location of the impoundment dropped below 5.0 mg/L in July (3.8 mg/L) and September (3.4 mg/L). Mean DO concentrations ranged from 7.8 mg/L in July to 8.5 mg/L in September in the bypassed reach, and from 7.5 mg/L in August to 8.6 mg/L in July in the tailrace. DO concentrations in the bypassed reach and tailrace never fell below 5.0 mg/L. Mean water temperature was highest in the bypassed reach and tailrace in July (76.5°F), and lowest upstream of the impoundment (69.8°F) in September.

Vertical profiles of DO and water temperature were collected in the impoundment from July through August 2018 during 10 sampling events. DO percent saturation was approximately 75 percent for all sampling events within the upper five feet of the water column. Measurements were made starting at 4 inches from the surface, followed by 3-foot increments from the surface to 1.6 feet from the bottom. Thermal stratification was evident during nine sampling events in July and August, when DO concentrations fell below 5.0 mg/L approximately 6.56 feet from the surface, the point of thermal stratification.[38] The mean water temperature throughout the water column ranged from 72.5°F to 80.6°F during the study.

To satisfy state resource management objectives, Maine DEP collected additional vertical profiles of water quality in the impoundment from June through October 2018. During these 10 sampling events, the DO concentration measured approximately 7.0 mg/L within the upper 4.92 feet of the water column. Thermal stratification was evident in five of the ten vertical profiles in June, July, and early August, as DO concentrations decreased from 8.9 mg/L to 0.2 mg/L between the upper 3.28 feet of the water column and the lower 13 feet of the water column. Mean water temperature throughout the water column ranged from 49.3°F to 79.2 °F during the study.

[38] Thermal stratification is a natural phenomenon that occurs when water bodies form distinct thermal layers, including a warm surface layer (epilimnion), a layer with an abrupt change in temperature (thermocline), and a cool dense lower layer (hypolimnion). A thermocline is identified by a rapid decrease in temperature as depth increases, typically greater than 1 degree Celsius per meter of depth. Persistent stratification can result in low DO concentrations in the lower part of the water column.

Sampling results from the 2018 water quality study indicate that the impoundment is eutrophic, with a trophic state index of 53.[39]

Aquatic Habitat

Impoundment

The Rollinsford Dam creates an impoundment that has a gross volume of 456 acre-feet, with a surface area of approximately 84 acres at the normal pond elevation of 71.25 feet NGVD29 (with 15-inch-high flashboards). The maximum water depth in the impoundment is approximately 12 feet. The shoreline length within the project boundary is approximately 2.4 miles, encompassing both banks of the Salmon Falls River above the project dam to the reaches of the impoundment. There are also several small vegetated islands in the impoundment as well. Bottom substrate in the littoral zone is primarily sand, silt, and mud. Emergent aquatic vegetation and submergent aquatic vegetation beds are also common within the impoundment.

Bypassed Reach

The reach of the Salmon Falls River that is bypassed by the project (i.e., the "bypassed reach") is approximately 680 feet long and varies in width from 218 feet near the project dam to approximately 159 feet at the confluence with the tailrace. Mesohabitats include a series of pools, cascades, and falls. The substrate in the bypassed reach consists primarily of ledge outcrops and boulders, with some cobble. The elevation change from the beginning to the end of the bypassed reach is approximately 31 feet, which equates to a stream gradient of 4.6 percent. Much of this elevation change is contained within two falls that are approximately 4 to 5 feet high near the downstream end of the bypassed reach. Figure 5 and Figure 6 show the upper and lower portions of the bypassed reach, respectively.

[39] The trophic state index is a commonly used method characterizing a lake's trophic state and overall health and is defined as the total weight of the biomass in a water body at a specific location and time (Carlson, 1977). A value of 53 indicates the waterbody has sufficient nutrients and fairly high productivity.

Figure 5. Upper end of the bypassed reach (Source: Town, 2019).

Figure 6. Lower end of the bypassed reach (Source: Town, 2019).

Fishery Resources

The Salmon Falls River, in the vicinity of the Rollinsford Project, is known to support a variety of fish species, including macrohabitat generalists such as yellow perch, largemouth bass, bluegill, golden shiner, brown bullhead, and redfin pickerel; and fluvial-dependent fish such as white sucker and fallfish (Table 3). Several non-native species are present at the project, including: black crappie, bluegill, and several species of bass that were introduced to the Salmon Falls River via stocking.

Table 3. Fish species found at the Rollinsford Project.

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
American eel	*Anguilla rostrata*
American shad	*Alosa sapidissima*
Black crappie	*Pomoxis nigromaculatus*
Blueback herring	*Alosa aestivalis*
Bluegill	*Lepomis macrochirus*
Bridle shiner	*Notropis bifrenatus*
Brook trout	*Salvelinus fontinalis*
Brown bullhead	*Ameiurus nebulosus*
Brown trout	*Salmo trutta*
Common shiner	*Luxilus cornutus*
Eastern silvery minnow	*Hybognathus regius*
Fallfish	*Semotilus corporalis*
Golden shiner	*Notemigonus crysoleucas*
Largemouth bass	*Micropterus salmoides*
Longnose dace	*Rhinichthys cataractae*
Rainbow trout	*Oncorhynchus mykiss*
Rainbow smelt	*Osmerus mordax*
Redfin pickerel	*Esox americanus americanus*
Sea lamprey	*Petromyzon marinus*
Smallmouth bass	*Micropterus dolomieu*
White perch	*Morone Americana*
White sucker	*Catostomus commersoni*
Yellow perch	*Perca flavescens*

(Source: Town, 2019, as modified by staff).

Anadromous Fish

Anadromous fish, including American shad, alewife, and blueback herring historically occurred in the Salmon Falls River and may have migrated at least as far upstream in the Salmon Falls River as Somersworth, New Hampshire (Old Berwick

Historical Society, 2020). In 2002, upstream fish passage facilities were installed at the South Berwick Project that is located 1.1 miles downstream of the Rollinsford Project.[40] Similarly, shad, alewives, and blueback herring are provided passage downstream via the fish passage facilities at the South Berwick Project.

American Shad

American shad are the largest member of the herring family and spend the majority of their life cycle in the ocean. In the northern part of the United States, the shad spawning run usually begins in May (depending on water temperatures) and continues until the water temperature reaches approximately 70 °F in late June or early July. When adults reach their freshwater spawning grounds, they broadcast spawn in areas with sand and gravel substrates. After hatching, juveniles gradually move downstream in schools before they out-migrate in the fall to the ocean from June through November (Stier and Crance, 1985).

In the Salmon Falls River, American shad may have migrated upstream at least as far as Somersworth, New Hampshire (Chadbourne, 1790s; Old Berwick Historical Society, 2020), which is approximately 4 miles upstream of the Rollinsford Project, until 1847 when dams prevented anadromous fish from migrating upstream (Noon, 2002). American shad are present downstream of the South Berwick Project, approximately 1.1 miles downstream of the Rollinsford Project. However, no shad have been recorded using the upstream fishway at the South Berwick Project, and no entity has reported observing shad in the Salmon Falls River between the South Berwick Project dam and the Rollinsford Project dam.

River Herring

Alewives and blueback herring, collectively known as "river herring," spend most of their lives at sea, but return to their natal rivers along the eastern seaboard of North America to reproduce (Greene et al., 2009). River herring spawn in coastal streams, tributaries, and backwater areas of major rivers from April to mid-July. Alewife spawn approximately 3 to 4 weeks earlier than blueback herring when present in the same watershed. Alewives prefer to spawn in lakes, ponds, and slow-flowing backwaters, while blueback herring prefer flowing water. Alewives spawn over a range of substrates, including gravel, sand, detritus, and submerged vegetation. Blueback herring tend to

[40] A 4-foot-wide Denil fishway provides upstream and downstream passage at the South Berwick Project. For the downstream migration season, the facility is re-configured by removing the baffles from the Denil fishway and inserting stop logs at a turn pool in the ladder, which diverts and discharges fishway flow and migrants directly to the tailwater (Consolidated Hydro, 2007).

spawn over gravel and clean sand substrates (CRASC, 2004). Juveniles emigrate to the sea from June through November (Collette and Klein-MacPhee, 2002). The characteristics of river herring development parallel those of American shad, and the young of the two species are difficult to distinguish. Juvenile blueback herring begin their seaward migration slightly earlier and at higher water temperatures (peaking at 57 °F to 59 °F) than American shad. Adult blueback herring spend three to six years at sea before returning to spawn in their natal streams. The average length of adults is less than 12 inches (Hartel et al., 2002). Approximately 24,571 and 16,418 river herring passed upstream using the fish passage facilities at the South Berwick Project in 2018 and 2019, respectively.

Sea Lamprey

Adult sea lamprey are parasitic fish that feed on other fish species using their sucking disc, rasping teeth, and tongue to attach to and penetrate the tissues of prey fish. The sucking disc is also used during spawning to construct 1 to 3-foot diameter nests in the substrate. Sea lamprey do not feed during their upstream spawning migration from May through June and thus are not parasitic while in the river (Hartel et al., 2002). Sea lamprey spawn during the spring in shallow areas of moderate current with gravel and rubble substrate. Spawning in one nest, or redd, may continue from 16 hours to 3.5 days. During the spawning run, adults undergo considerable physiological change and deterioration and die after spawning.

After hatching, the larvae remain in the substrate for several days before emerging and drifting downstream. The larvae settle in depositional areas with soft substrate and transform into ammocoetes. Ammocoetes burrow into soft sediments and emerge from the sediment surface to filter feed. This stage lasts up to seven years until the ammocoetes transform into the parasitic adult phase and migrate to sea. Downstream migration occurs primarily in the spring, but also during the fall.

Catadromous Fish

The American eel spends most of its life in fresh or brackish water before migrating to the Sargasso Sea to spawn. It occurs throughout the Atlantic Ocean and Atlantic Ocean coastal drainages in North America (Boschung and Mayden, 2004). Spawning likely occurs from February through April in the Sargasso Sea; although the act of spawning has never been observed. Fertilized eggs and larvae, known as the planktonic phase, drift with the Gulf Stream currents along the east coast of the United States (Jenkins and Burkhead, 1993). Following this phase, larvae metamorphose (or transform) into what is termed a “glass” eel. Glass eels make their way into brackish waters by the use of flood tides. Once skin pigments develop in glass eels, they are considered “elvers.”

Upstream eel migration peaks in May and persists through October (Sorensen and Bianchini, 1986; Facey and Van Den Avyle, 1987). When migrating upstream, juvenile eels must climb over or around dams. Climbing over or around dams is a well-documented behavior for juvenile eels (Gulf of Maine Council on the Marine Environment (GMCME), 2007).

As eels mature, elvers become juvenile, or "yellow" eel. The majority of eels collected in freshwater rivers are typically yellow eel, which is considered the primary growth phase of its life cycle (Ross et al., 2001). Yellow eels are typically sedentary during the day, often burying in mud or silt, and becoming active at night to feed (Jenkins and Burkhead, 1993). They associate with pools or backwater habitats, and often have relatively small home ranges (Gunning and Shoop, 1962). The juvenile stage can last from 5 to 40 years before finally maturing into silver eel and out-migrating from mid-August to mid-December to spawning grounds (i.e., Sargasso Sea) (Boschung and Mayden, 2004). When migrating downstream in the fall, eels can pass over dams and spillways, but could be susceptible to injury depending on the height of the dam and depth of the water below the dam. Adult eels are presumed to die after spawning (Boschung and Mayden, 2004; Jenkins and Burkhead, 1993).

American eels are present in the Rollinsford Project impoundment and bypassed reach, and have been documented at the South Milton Project No. 3984, located approximately 20 miles upstream. Approximately 2,362 American eels passed upstream of the South Berwick Project in 2018, and 1,062 eels passed upstream of South Berwick Project in 2019.

Freshwater Mussels

In 2018, the Town conducted a freshwater mussel survey in the impoundment and bypassed reach of the Rollinsford Project. The objective of the survey was to determine the presence, distribution, demographics (inferred from size distribution), and habitat of freshwater mussel species that occupy the study areas. There are few data on freshwater mussels in the Salmon Falls River, and none of New Hampshire's state-listed or Species of Greatest Conservation Need species have ever been documented in the river (Nedeau et al., 2000). Three mussel species were documented during the 2018 study, including: eastern elliptio, eastern floater, and triangle floater. All three species were found in the impoundment, and only eastern elliptio and triangle floater were found in the bypassed reach. Eastern elliptio was most abundant (2,000 individuals), followed by triangle floaters (35 individuals), and eastern floaters (20 individuals).[41]

[41] *See* August 29, 2019 final license application, at Appendix G, *Mussel Survey.*

3.3.1.2 Environmental Effects

Mode of Operation

The Town proposes, and Interior and Commerce recommend under section 10(j) that the Town continue operating the Rollinsford Project in a run-of-river mode and maintain an impoundment elevation of 71.25 feet NGVD29. New Hampshire DES's certification requires the Town to operate the project in a run-of-river mode (condition E-10a) and maintain the surface elevation of the impoundment at 71.25 feet NGVD29, plus any additional elevation required to pass the minimum flows to the bypassed reach (condition E-10c). Maine DEP's certification requires the Town to maintain the surface elevation of the impoundment at the flashboard crest elevation of 71.25 feet NGVD29 (certification condition 1A). Interior, Commerce, and New Hampshire DES specify that inflow should equal outflow at all times and that impoundment levels should not be fluctuated for the purpose of generating power. Interior and New Hampshire DES state that run-of-river operation could be temporarily modified for operating emergencies beyond the control or for short periods after mutual agreement between the Town, Interior, the National Marine Fisheries Service (NMFS), New Hampshire DES, New Hampshire FGD, Maine DEP, and Maine DIFW. New Hampshire FGD supports Interior's recommendation.

Our Analysis

Operating a dam on a riverine system has the potential to affect water temperature and DO concentrations by increasing the residence time of water in an impoundment and exposing water at the surface to the heat of the sun. DO is an important indicator of water quality and is required at an adequate concentration to sustain aquatic resources. High temperatures are associated with lower DO concentrations and shifts in water chemistry that can be harmful to fish and other aquatic organisms. Changes in temperature are most evident during low flow periods when residence time is already longer because of the reduced volume of water reaching the impoundment.

Continuing to operate the project in a run-of-river mode and maintain an impoundment elevation of 71.25 NGVD, as proposed by the Town, would result in no change in the amount, schedule, or duration of flow released to the Salmon Falls River downstream of the project. Run-of-river operation would continue to minimize the length of time water is retained in the impoundment and help avoid increasing water temperatures in the upper levels of the impoundment from solar heating. This measure would also limit fluctuating water levels, which influence the reproductive success of fish that spawn in near-shore areas (Sammons and Bettoli, 2000), such as smallmouth bass and bluegill. By continuing to operate the project in a run-of-river mode, habitat in the impoundment and habitat in the Salmon Falls River downstream of the project would

remain unchanged from current conditions for aquatic organisms, including fish and macroinvertebrates.

Continuing to maintain an impoundment elevation of 71.25 feet NGVD would result in no change to the operation of the impoundment. The Town could release minimum bypassed reach flows through flashboard notches and/or fish passage facilities; therefore, the impoundment surface elevation would not need to be raised above 71.25 feet NGVD to pass the minimum flows, as contemplated by New Hampshire DES's condition E-10c. Therefore, aquatic habitat in the impoundment would remain unchanged from current conditions for aquatic organisms, including fish and macroinvertebrates.

Water Quality

The Town proposes to implement its draft water quality plan[42] for the project to enhance DO conditions in the impoundment during low flow periods. The draft plan includes the following provisions: (1) draw down the impoundment by 1.25 feet within 48 hours by releasing flow for project generation during "critical low flow periods" to "flush stagnant water from the impoundment;"[43] (2) refill the impoundment by retaining all inflow except for the proposed 35-cfs bypassed reach minimum flow; and (3) monitor water temperature and DO concentrations in the impoundment, bypassed reach, and tailrace from July 1 through September 15 for three years after license issuance to determine the effectiveness of the impoundment drawdown procedures in improving the water quality within the impoundment.

Maine DEP's certification requires the Town to consult with it and New Hampshire DES to finalize its water quality plan within 60 days of license issuance (condition 5A). Then, for two years following license issuance, Maine DEP's certification requires the Town to monitor DO in the impoundment following seven days of inflow less than 80 cfs, between July 1 and September 15 (condition 5B). If monitoring indicates that DO is below 5.0 mg/L, the certification requires the Town to implement the draft water quality plan in the third year following license issuance (condition 5B).

New Hampshire DES's certification condition E-14 requires the Town to consult with New Hampshire DES within 60 days after license issuance to finalize the proposed

[42] *See* Commission staff's June 22, 2021 Memorandum, which includes the Town's proposed draft water quality plan as Enclosure B.

[43] The Town defines "critical low flow periods" as when total inflow to the project has been less than 80 cfs for seven consecutive days during the months of July 1 through September 15.

water quality plan, and to implement the plan to improve water quality in the Salmon Falls River during low flow periods (condition E-14). The certification also requires the Town to monitor DO and temperature in the impoundment, tailrace, and bypassed reach every five years beginning the fifth year after license issuance, and ending five years prior to the expiration of the license, to determine the effects of project operation on water temperature and DO, and determine if additional changes to project operation are necessary to comply with New Hampshire DES's surface water quality standards (condition E-15).

Our Analysis

As mentioned in the previous section, DO is required at an adequate concentration to sustain aquatic resources. Low flow conditions can result in low DO concentrations that can be harmful to fish and other aquatic resources, especially during the summer months when warmer water has less capacity to absorb oxygen. As discussed in section 3.3.1.1, *Affected Environment, Water Quality*, during the 2018 water quality study, the Town observed low DO concentrations in the impoundment (i.e., below 5.0 mg/L) that may not be adequate to sustain aquatic life. DO concentrations in the upper impoundment (station RL-1) dropped below 5.0 mg/L in July (3.0 mg/L) and August (3.8 mg/L) and DO concentrations in the top 3 feet of the deepest location of the impoundment (station RL-2) dropped below 5.0 mg/L in July (3.8 mg/L) and September (3.4 mg/L). Thermal stratification in the impoundment was evident during sampling events in July and August 2018, when DO concentrations fell below 5.0 mg/L (down to a minimum of 0.2 mg/L) in the hypolimnion (i.e., below approximately 6.56 feet from the surface).

Based on the data from the water quality study, low DO concentrations in the impoundment typically occur in the summer (July – September), when flows are low and when the project is not generating (i.e., when flows are less than 80 cfs plus the minimum bypassed reach flow). The low DO events occurred about 1 percent of the time at the upper end of the impoundment (i.e., 81 out of 7,780 measurements) and 3 percent of the time in the lower portion of the impoundment (i.e., 206 out of 6,594 measurements). The data collected during the 2018 water quality study showed that DO in the lower impoundment was below 5.0 mg/L for a total of 51.5 hours (2.1 days) from July through September 2018, for as little as 15 minutes at a time to up to one day at a time.

The Town currently operates the project in a run-of-river mode, such that outflow approximates inflow at all times. The Town discharges all flow over the dam to the bypassed reach until inflow to the impoundment reaches 90 cfs (minimum hydraulic capacity of one unit plus the minimum flow over the dam), and only diverts water from the impoundment for project generation when inflow is greater than 90 cfs. Operating the project in a run-of-river mode minimizes the length of time water is retained in the impoundment on an instantaneous basis. Since the project is currently operated in run-of-

river mode, the data collected during the 2018 water quality study, including the low DO concentrations, appears to reflect natural biochemical processes occurring in the impoundment and not operation of the project for electric generation. Specifically, the impoundment is subjected to cycles of solar heating during periods of low flow during the summer that reduce DO concentrations. In addition, because the impoundment thermally stratifies during the summer, water in the hypolimnion is subjected to biological activity, such as the decomposition of organic matter, that consumes DO. These biochemical processes are contributing to low DO in the impoundment, even though the project is being operated in a run-of-river mode to minimize project effects on water quality.

The Town proposes to continue operating the project in a run-of-river mode, which will continue to minimize the length of time water is retained in the impoundment on an instantaneous basis. In addition, as part of the water quality plan, the Town proposes to improve water quality in the impoundment by temporarily drawing down the impoundment during low flow periods and flushing stagnant water from the impoundment. The Town proposes to draw down the impoundment by releasing water through the intake gates located in the headgate structure. At an impoundment elevation of 71.25 feet NGVD, the gates are located at 7.92 to 12.42 feet below the surface, which corresponds with the thermocline and hypolimnion based on the impoundment stratification depths recorded during the 2018 water quality study.

As stated above, during the 2018 water quality study, thermal stratification was evident beginning at approximately 6.56 feet from the surface. Based on the depth of the intake gates (i.e., 7.92 to 12.42 feet below the surface), the drawdowns would pull low-DO water from the hypolimnion and release it downstream. Because the water discharged downstream would likely have much lower DO concentrations than water flowing into the impoundment, the composite DO concentration in the impoundment (i.e., average DO concentration across the full depth of the impoundment) should increase as the impoundment refills. However, if low flow conditions persist after the Town draws down the impoundment to 70.0 feet NGVD29, and the biochemical processes that produced the low-DO conditions continue to occur as the impoundment refills, aquatic organisms in the impoundment could continue to be adversely affected by low DO.

The drawdown procedure included in the proposed water quality plan could strand freshwater mussels in the impoundment and expose them to desiccation.[44] This effect would likely be strongest for mussels living near the normal pond elevation of 71.25 feet

[44] For further discussion on the effects of a 1.5-foot impoundment drawdown on mussels, see section 3.3.1.2 *Environmental Effects, Drawdown Procedure for Scheduled Maintenance*.

NGVD29 because this elevation would be the first to be dewatered and last to be rewatered during a drawdown and refill cycle.

Under current conditions, there is no evidence that low DO events occur downstream of the impoundment. The water quality study documented mean DO concentrations from 7.8 mg/L in July to 8.5 mg/L in September in the bypassed reach, and from 7.5 mg/L in August to 8.6 mg/L in July in the tailrace. DO concentrations in the bypassed reach and tailrace never fell below 5.0 mg/L. However, if the impoundment is drawn down in accordance with the plan, low-DO water from the hypolimnion would be released into the tailrace for 48 hours. These discharges would be the only source of inflow for the downstream reach for the entire 48-hour period. The low DO water from the hypolimnion would likely adversely affect water quality in the downstream reach and adversely affect aquatic organisms in the Salmon Falls River downstream of the powerhouse, especially, freshwater mussels that have limited mobility.

The proposed impoundment drawdowns associated with the water quality plan could reduce minimum bypassed reach flows. As discussed below in section 3.3.1.2, *Environmental Effects, Minimum Flows*, the Town proposes to release 35 cfs from a notch in the flashboards. As the impoundment is drawn down over the 48-hour period from the top of the flashboards (71.25 feet NGVD29) to the crest of the dam (70.0 feet NGVD29), the amount of minimum flow that could be released through the notch in the flashboards would decrease to 0 cfs. The minimum bypassed reach flow would then gradually increase as the Town refills the impoundment, which could take up to 3.5 days, depending on project inflow.[45] Since the Town proposes to release the 35 cfs through a notch in the flashboards, it is unclear how the Town would be able to release 35 cfs during the impoundment refill, as proposed. During the drawdown and refill period, fish and other aquatic organisms in the bypassed reach could be adversely affected by stranding, desiccation, and decreasing DO concentrations in any pools that remain following the cessation of flow from the dam.

After the installation of the upstream fish passage facilities required by Interior's preliminary fishway prescription,[46] the proposed drawdown and refill process could adversely affect upstream shad and river herring passage. The upstream and downstream migration periods for alosines and American eel (collectively April 15 – November 15) coincide with the time in which drawdowns could be implemented under the plan (July 1

[45] The Town estimates that it would take between approximately 83 hours to refill the impoundment at inflow of 50 cfs, 50 hours at 60 cfs, 28 hours at 80 cfs, and 10 hours at 160 cfs.

[46] See section 3.3.1.2 *Environmental Effects, Upstream Anadromous Fish Passage*.

– September 15).[47] As described above regarding flow through the flashboard notch, the Town's proposed impoundment drawdowns and refills would reduce the impoundment elevation below the normal operating level of 71.25 feet NGVD29, which corresponds to the top of the flashboards at the dam. Reducing the impoundment elevation could reduce flow through any upstream fish passage facilities that are installed at the dam between the crest elevation of the dam (70.0 feet NGVD 29) and the top of the flashboards (71.25 feet NGVD29). As the Town draws down the impoundment to 70.0 feet NGVD29, flow would gradually decrease to as low as 0 cfs (if the sill of the weir is located at the dam crest elevation), and then gradually increase as the Town refills the impoundment to 71.25 feet NGVD29. The full 50-cfs attraction flow recommended by the FWS Design Criteria Manual for upstream passage facilities would not be available again until the impoundment returned to the normal elevation. Without sufficient attraction flow through the upstream fishways as the impoundment is drawn down and refilled, shad and river herring migrating upstream may be delayed from finding the upstream passage facilities. Further, reduced or no flow in the bypassed reach during the drawdown would restrict or eliminate zones of passage in the bypassed reach, which would prevent or delay upstream migration through the bypassed reach. Any delay that occurs while searching for and using upstream fishways would increase energy costs for shad and river herring migrating upstream, which would reduce energy reserves, spawning success, and post-spawning survival (Castro-Santos and Letcher, 2010). The proposed drawdown would take approximately 48 hours and refilling the impoundment could take between 10 hours and 3.5 days. Therefore, the adverse effects of the drawdown and refill could last for up to 5.5 days before normal flows resume.

After the installation of the downstream fish passage facilities required by Interior's preliminary fishway prescription,[48] drawing the impoundment to 70.0 feet NGVD29 could adversely affect downstream passage of shad, river herring, and American eels because flows through any downstream fish passage facility located at the dam could be reduced or stopped altogether, as described above. Reducing the attraction flow to the facility could increase the amount of time required for emigrating fish to find the facility and migrate downstream, which could make them more vulnerable to predation in the impoundment, particularly for juvenile shad and river herring. Reducing the conveyance flow through the facility could injure fish if water depth within the weir

[47] As described in section 3.3.1.2 *Environmental Effects, Upstream Anadromous Fish Passage*, Interior's preliminary fishway prescription requires the Town to operate the upstream fish passage facilities from April 15 through July 15, which overlaps with the proposed impoundment drawdown time of July 1 – September 15 in the water quality plan.

[48] See section 3.3.1.2 *Environmental Effects, Downstream American Eel and Anadromous Fish Passage*.

is too shallow. If the attraction and conveyance flows stop altogether, emigrating fish would not be able to pass downstream until the impoundment is refilled. Because the Town could not release the 25-cfs attraction flow recommend by the FWS Design Criteria Manual until the impoundment begins to refill, migration through the bypassed reach for emigrating fish would be delayed for at least a portion of the 5.5-day impoundment drawdown and refill process.

Changes in flow releases associated with the drawdown and refill would result in substantial, short-term changes in habitat availability downstream of the dam. Specifically, after seven consecutive days of low flow (80 cfs or less), the Town would begin discharging 192 cfs to the downstream reach for 48 hours to draw down the impoundment. Then, once the impoundment is drawn down, the Town would curtail generation and reduce downstream flow to 35 cfs to refill the impoundment, which could take up to 3.5 days depending on inflow. Abrupt changes to the water velocity in and near the powerhouse tailrace when the project begins generating could result in fish and other aquatic organisms being displaced downstream.

Conclusion on Effects of Water Quality Plan

The Town's proposed water quality plan could increase DO concentrations in the impoundment during the summer when low DO concentrations have been documented in the impoundment, including from July 1 – September 15, when flows are less than the minimum hydraulic capacity of the project. However, the proposed impoundment drawdowns and refills would adversely affect aquatic resources at the project in a manner that likely outweighs the benefits to water quality in the impoundment.

The impoundment drawdown and refill process would strand mussels on the shoreline of the impoundment (between elevations 70.0 – 71.25 feet NGVD29) and expose them to desiccation for up to 5.5 days, until the impoundment elevation returns to 71.25 feet NGVD29. During impoundment drawdowns, low DO water would be released into the Salmon Falls River downstream of the powerhouse for 48 hours, which would degrade aquatic habitat and adversely affect aquatic organisms in the downstream reach. The drawdown and refill process would also reduce minimum bypassed reach flows and attraction flows for fish passage because the facilities that release these flows from the dam would not be able to operate at their full capacity when the impoundment elevation is below 71.25 feet NGVD29. Reducing flow to the bypassed reach would strand fish and freshwater mussels, and limit aquatic habitat to isolated pools that would be susceptible to stagnation and low DO concentrations until minimum bypassed reach flows are restored. Disrupting attraction and conveyance flows needed for upstream and

downstream passage of American shad, river herring, and American eels would delay migration through the project area for these species.

The proposed water quality plan would adversely affect aquatic resources in the impoundment, bypassed reach, and downstream reach for up to 5.5 days, which is longer than the total duration of the low-DO events that occurred in the impoundment during 2018 (2.1 days). Based on the types of adverse effects that would be caused by the proposed water quality plan, and the duration of those effects, staff concludes that the proposed plan would likely result in a net adverse effect on aquatic organisms in the Salmon Falls River.

Water Quality Monitoring

Maine DEP's certification condition 5B requires the Town to monitor water quality for two years following license issuance. If DO falls below 5 mg/L during the monitoring period, Maine DEP requires the Town to implement the water quality plan in the third year. The 2018 water quality study documented existing low DO conditions during low flow periods between July and September. It is unclear what additional information or benefits would be gained with continued monitoring.

In the water quality plan, the Town proposes to monitor DO and temperature for three years after license issuance, from July 1 – September 15 each year, to determine the effectiveness of the proposed impoundment drawdowns and refill process. Data collected during the Town's proposed monitoring period could provide information on changes in DO during drawdowns, however as stated above, the impoundment drawdown and refill process would likely result in a net adverse effect on aquatic organisms in the Salmon Falls River.

New Hampshire DES refers to Wake et al. (2014), who state that the frequency of short-term (one to three months) and medium-term (three to six months) droughts in New Hampshire are projected to increase by the end of the century. New Hampshire DES states that the increase in temperatures and frequency of low-flow conditions could result in an increase in the frequency and magnitude of low-DO events at the project. New Hampshire DES states, therefore, the long-term water quality monitoring required by condition E-15 is necessary to evaluate if the frequency and magnitude of low-DO events increase at the project during the license term, and if additional changes in project operation are necessary to comply with New Hampshire's water quality standards. While conducting water quality monitoring at the project at 5-year intervals during the term of a subsequent license would provide data about changes in the frequency and duration of low-DO events during the license term, New Hampshire DES did not provide any information about how project operation is contributing to adverse effects on water quality or what additional measures could be implemented to enhance water quality during low-flow conditions. The Town is proposing to operate the project in a run-of-

river mode, which would continue to minimize the length of time water is retained in the impoundment and help avoid increasing water temperatures in the upper levels of the impoundment from solar heating. Without any specific enhancement measures to analyze, staff cannot evaluate the benefits of New Hampshire DES's condition on water quality at the project.

Minimum Flows

Pursuant to the December 13, 1984 amendment order,[49] the licensee must discharge a minimum flow of 10 cfs to the bypassed reach, and maintain a total project discharge of 115 cfs or inflow to the impoundment, whichever is less, to the Salmon Falls River downstream of the powerhouse. The Town releases the minimum flow through a notch in the flashboards of the dam. The Town maintains a total discharge of 115 cfs to the downstream reach through a combination of flows from the powerhouse and the notch in the flashboards of the dam.

The Town proposes to continue to discharge all inflow to the bypassed reach when inflow is less than the 80-cfs minimum hydraulic capacity of the turbines to protect aquatic resources. The Town proposes to increase the minimum bypassed reach flow to 35 cfs or inflow, whichever is less, by widening the notch in the flashboards. Beginning four years after license issuance, once the proposed downstream eel passage facility is installed, the Town proposes to alter the release point for the 35-cfs minimum bypassed reach flow from September 1 through October 31 each year. Instead of releasing the flow from the notch in the flashboards from September 1 through October 31 each year, the Town proposes to pass the 35-cfs minimum flow through a combination of flows from the proposed downstream fish passage facility (25 cfs) and the waste gate in the intake headworks structure (10 cfs).[50] The Town would continue to release the 35-cfs minimum bypassed reach flow through the notch in the flashboards from November 1 through August 31 each year.

Maine DEP's certification condition 2A and New Hampshire DES's certification condition E-10b require the Town to release minimum bypassed reach flows that vary in accordance with fish migration seasons and the installation of fish passage facilities at the

[49] *Town of Rollinsford, New Hampshire*, 29 FERC ¶ 62,282 (1984), at Article 27.

[50] See section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Proposed Downstream Eel Passage Facility*, for a detailed description of the Town's proposed downstream fish passage facility.

project. Prior to the installation of upstream fish passage facilities at the project,[51] Maine DEP and New Hampshire DES require the Town to release a year-round minimum bypassed reach of 35 cfs or inflow, whichever is less, when the project is generating. After installation of upstream fish passage facilities, and when the project is generating, Maine DEP and New Hampshire DES require the Town to release: (1) a minimum flow of 35 cfs or inflow, whichever is less, from July 16 – April 14; and (2) an unspecified minimum flow from April 15 – July 15, the quantity of which must be determined in consultation with FWS, New Hampshire DES, New Hampshire FGD, Maine DMR, Maine DIFW, and Maine DEP. When the project is not generating, Maine DEP and New Hampshire DES require the Town to release all impoundment inflow to the bypassed reach.

Under section 10(j) of the FPA, Interior recommends the following minimum flow releases to the bypassed reach: (1) when inflow is less than the 80-cfs minimum hydraulic capacity of the project and the project is not generating electricity, release 100 percent of inflow over the spillway; and (2) when the project is generating electricity, release: (a) 35 cfs into the bypassed reach from July 16 to April 14; and (b) 60 cfs into the bypassed reach during the upstream American shad and river herring migration period (April 15 through July 15). New Hampshire FGD and TU supports Interior's recommendation. Commerce recommends the same minimum bypassed reach flows as Interior but includes a July 16 through *April 30* timeframe for releasing 35 cfs and a *May 1* through July 15 timeframe for releasing 60 cfs. Commerce also recommends the Town spill all inflow at the dam during periods when the project is off-line (i.e., not generating due to reduced inflow). Maine DIFW recommends releasing a minimum flow of 82 cfs to the bypassed reach.

Our Analysis

Minimum Flows Downstream of the Powerhouse

The current license requires the Town to release a minimum flow of 115 cfs or inflow, whichever is less, from the project to the downstream reach. The Town currently

[51] The Maine DEP's certification condition 3 and New Hampshire DES's certification condition E-13 require the Town to install upstream fish passage facilities, but do not provide a schedule for installing the facilities. The Maine DEP and the New Hampshire DES state that, prior to the installation of the upstream fish passage facilities, bypassed reach flows should be released over the spillway when the project is not generating. For all other operating conditions, including when the project is generating and after the fish passage facilities are installed, the Maine DEP and the New Hampshire DES state that the Town must consult with the resource agencies to determine the manner in which flows will be released to the bypassed reach.

operates the project in a run-of-river mode voluntarily and proposes to continue to do so. As discussed above, operating the project in a run-of-river mode minimizes the effects of project operation on water quantity in the downstream reach to the greatest extent possible, and no additional benefit to aquatic resources would be expected from operating the project with a minimum flow release of 115 cfs to the downstream reach. Continuing to operate the project in a run-of-river mode would maintain water quality in the downstream reach of the Salmon Falls River during all seasons of the year.

Bypassed Reach Minimum Flow

As noted above, the bypassed reach is approximately 680 feet long and is inhabited by a fish community consisting of American eel, river herring, sea lamprey, brown trout, and longnose dace. In 2018, the Town conducted an instream flow study to characterize and map the bypassed reach, and identify a flow regime that would protect and enhance the aquatic resources in the project area.[52] The study was conducted at flow releases of 29, 43, 82, and 120 cfs.[53] The study used a Physical Habitat Simulation (PHABSIM) methodology that incorporated existing biological information, including Habitat Suitability Index model data, to determine river bed elevation, wetted widths, and water surface elevation along four transects (labeled as MDEP-1, IFIM-1, IFIM-2, and IFIM-3 in Figure 7). The hydraulic data were used to calculate habitat availability for adult brown trout, spawning and incubating fry, juvenile, and adult American shad and river herring, spawning and incubating sea lamprey, juvenile and adult longnose dace, and macroinvertebrates.

[52] *See* August 29, 2019 final license application, at Appendix C, *Instream Flow/Upstream Zone of Passage Study*.

[53] The Town intended to collect stream hydraulic data at four test flows of 10 cfs (current minimum flow), 35 cfs, 70 cfs, and 115 cfs. However, the spillway flashboards were in disrepair and not in operation during the study period and precise release of the test flows was not possible.

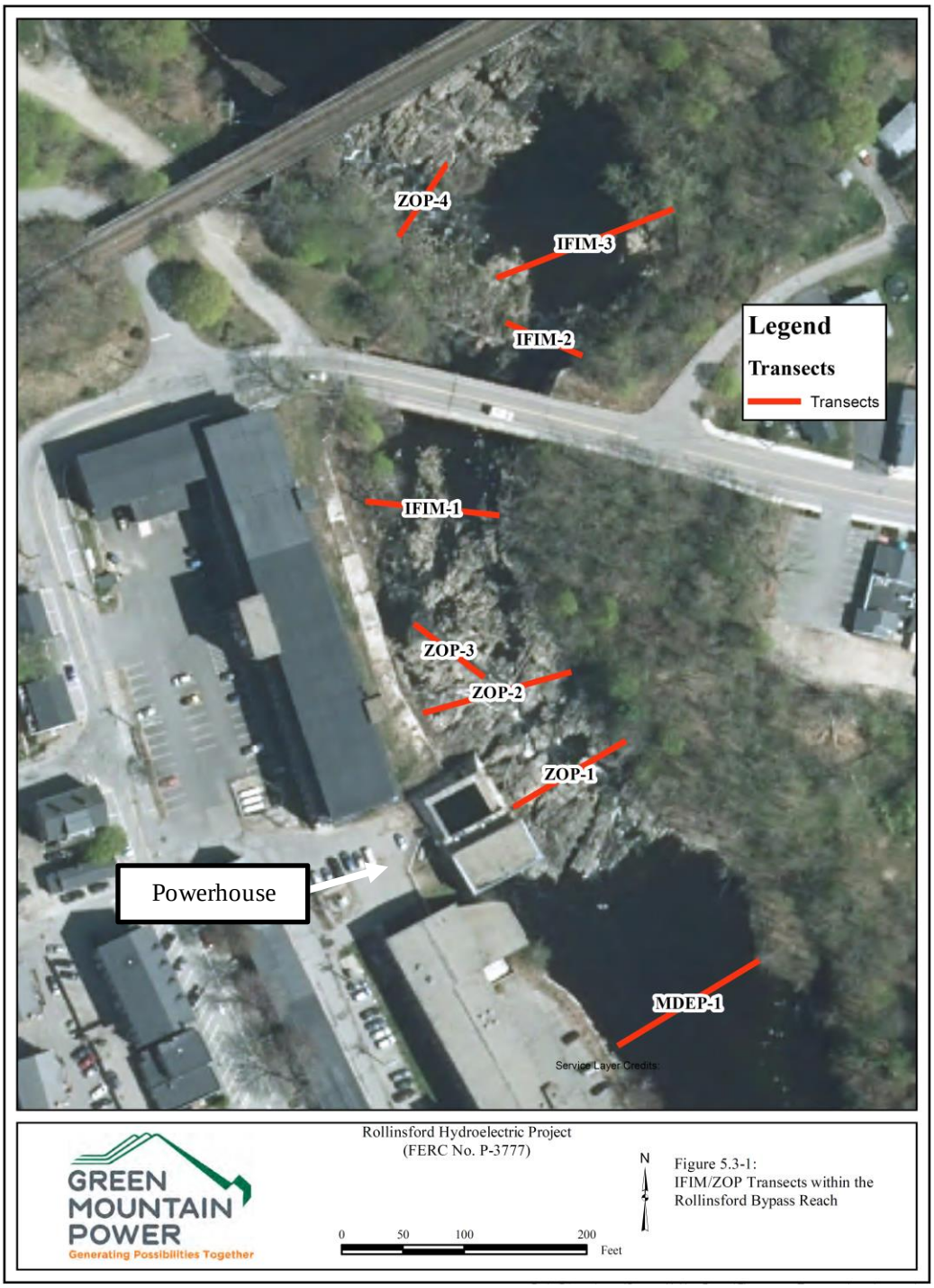

Figure 7. Transects used within the Rollinsford Project bypassed reach for the Instream Flow/Upstream Zone of Passage Study (Source: Town, 2019).

According to the study results, the total wetted area available in the bypassed reach does not change significantly as flow increases from the current minimum flow (10 cfs) to the proposed minimum flow (35 cfs), or the agency-recommended minimum flows

[including the 60 cfs recommended by Interior and Commerce during the anadromous fish upstream migration season, and the year-round 82 cfs recommended by Maine DIFW].[54] The current minimum flow release of 10 cfs provides an estimated 88.7 percent of the bank-full wetted width in the bypassed reach. In comparison, the proposed and recommended flows of 35, 60, and 82 cfs would provide 89 percent of the bank-full wetted width in the bypassed reach.

According to the study results, aquatic habitat availability in the bypassed reach, expressed in terms of the percentage of the maximum weighted usable area (WUA), increases for each species as flow increases from 10 to 82 cfs (Table 4).[55] Generally, increasing the minimum bypassed reach flow from 10 cfs to 35, 60, or 82 cfs would benefit aquatic resources in the bypassed reach by providing additional habitat for foraging, migration, and cover from predators.

Table 4. Percentage of the Maximum WUA in the bypassed reach for target species at the current, proposed, and recommended minimum bypassed reach flows.

Species	**Percentage of the Maximum WUA**				
	10 cfs	**35 cfs**	**50 cfs**	**60 cfs**	**82 cfs**
American Shad/ River Herring					
Spawning and Incubation	55	62	74	79	96
Adult	53	62	76	80	85
Adult Brown Trout	72	76	87	91	94
Adult Longnose Dace	53	62	77	82	91
Sea Lamprey (*spawning and incubation*)	28	30	46	52	100
Mayfly	80	82	92	94	96
Stonefly	50	61	76	83	88

[54] As discussed above, the Town conducted the instream flow study at flow releases of 29, 43, 82, and 120 cfs. The study did not specifically evaluate the total wetted area available in the bypassed reach at 10, 35, or 60 cfs. To obtain estimates of wetted width at the current, proposed, and recommended flows, staff extrapolated the wetted width data from the study. The equation staff used to extrapolate the wetted width data at flow releases of 10, 35, and 60 cfs is: wetted width = $0.0003*flow^2 - 0.0291*flow + 88.745$; $r^2 = 0.97$.

[55] The instream flow study did not evaluate the maximum WUA in the bypassed reach at 10 and 82 cfs. Staff extrapolated the aquatic habitat data from the study to estimate the maximum WUA available at 10 and 82 cfs. The equation staff used to extrapolate maximum WUA for adult American shad and river herring at flow releases of 10 and 82 cfs is: maximum WUA = $48.965*flow + 5145.8$; $r^2 = 0.95$.

Caddisfly	74	79	89	92	94

Source: Town, 2019, as modified by staff.

Minimum Flow when the Project is Generating

The Town's proposal to release a minimum bypassed reach flow of 35 cfs when the project is generating is consistent with Interior's and Commerce's section 10(j) recommendations, and Maine DEP's and New Hampshire DES's certifications, except during the upstream alosine migration season (April 15 – July 15). Relative to the 10 cfs minimum flow required by the current license, 35 cfs would provide an approximately 13 percent increase, on average, in suitable foraging and cover habitat for adult alosines, brown trout, and longnose dace in the bypassed reach.

During the upstream alosine migration season, Interior's and Commerce's recommendation to release a minimum flow of 60 cfs to the bypassed reach would provide 79 percent of the maximum WUA for alosine spawning and incubation in the bypassed reach, which would be a 44 percent increase in habitat relative to the current 10 cfs minimum flow. However, these habitat benefits would not be available to adult shad and river herring under current conditions because water velocity barriers and depth restrictions in the lower bypassed reach greatly restrict alosine passage to the upper bypassed reach, as discussed below in section 3.3.1.2, *Environmental Effects, Upstream Anadromous Fish Passage*. The benefits associated with the 60-cfs minimum flow would not be available to adult alosines until the barriers and restrictions in the bypassed reach are removed and alosines can access spawning and incubation habitat in the upper bypassed reach. As discussed in section 3.3.1.2, Interior prescribes the installation of upstream fish passage facilities by March 15 of the third calendar year after license issuance. Relative to Interior's recommendation to release 60 cfs from April 15 – July 15, Commerce's recommendation would provide less spawning and incubation habitat for alosines from April 15 – April 30.

Maine DEP's and New Hampshire DES's certifications do not specify a minimum bypassed reach flow during the upstream alosine migration season (April 15 – July 15) following installation of upstream fish passage facilities at the project. Instead, Maine DEP and New Hampshire DES require the Town to consult with resource agencies to determine the minimum bypassed reach flow during this time period. Without specific flows to analyze, staff cannot evaluate the benefits of Maine DEP's and New Hampshire DES's conditions.

Maine DIFW's recommended year-round 82-cfs minimum flow would provide 96 percent of the maximum WUA for alosine spawning and incubation in the bypassed reach, which would be a 75 percent increase in habitat relative to the current 10 cfs minimum flow. A minimum flow of 82 cfs would provide an approximately 43 percent increase, on average, in suitable foraging and cover habitat for adult fish and

macroinvertebrate species in the bypassed reach, relative to the 10 cfs minimum flow required by the current license.

Minimum Flow when the Project is not Generating

The Town proposes, Maine DEP's and New Hampshire DES's certifications require, and Interior recommends that the Town continue to discharge all inflow to the bypassed reach when inflow is less than the 80-cfs minimum hydraulic capacity of the turbines, and the project is not generating electricity. The Town is proposing and New Hampshire DES's certification requires the Town to continue to operate the project in a run-of-river mode, such that outflow approximates inflow at all times to protect aquatic resources. Therefore, when inflow is less than 80 cfs and the turbines are not operating, all inflow will continue to pass to the bypassed reach as spill over the dam. No inflow will be stored in the impoundment under normal operating conditions.[56] Therefore, aquatic resources in the bypassed reach would continue to have the same amount of protection under the proposed operation as they do under current operation when the project is not generating.

Location of Minimum Flow Releases

The Town proposes to continue to release minimum bypassed reach flows through a notch in the flashboards at the dam during the first three years after license issuance, and then after installing downstream eel passage facilities in the intake headworks structure, the Town proposes to release minimum bypassed reach flows through the downstream eel passage facility (25 cfs)[57] and the waste gate in the intake headworks structure (10 cfs) during the downstream eel passage season.

As discussed below in section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage,* the Town's proposed downstream passage facility would limit the number of eels, shad, and river herring that would utilize the facility for downstream passage. Based on staff's analysis of downstream eel and fish passage, a combination of nightly turbine shutdowns and installation/operation of a

[56] See section 3.3.1.2 *Environmental Effects, Water Quality,* for a discussion of atypical project operation that would occur to mitigate low DO conditions in the impoundment. See also section 3.3.1.2 *Environmental Effects, Impoundment Refill Procedure,* for a discussion of atypical project operation that would occur after an impoundment drawdown for project maintenance or emergencies.

[57] See section 3.3.1.2 *Environmental Effects, Proposed Downstream Eel Passage Facility* for a detailed description of the Town's proposed downstream fish passage facility.

downstream passage facility at the dam would provide a dedicated means of passage that would be used by eels and fish at the project. If a downstream passage facility were to be installed at the dam, then the Town's proposed 35-cfs minimum flow could be passed through the surface weir of the downstream passage facility after construction of the facility, if the facility is constructed with a hydraulic capacity of 35 cfs. Additional flow associated with a 60-cfs minimum flow during the upstream anadromous fish passage season could be released from Interior's prescribed upstream fish passage facilities after those facilities are constructed, which are discussed in section 3.3.1.2 *Environmental Effects, Upstream Anadromous Fish Passage*.

Because minimum flows could be released through the prescribed fish passage facilities that would be located at the dam, flow releases from the fish passage facilities would ensure that the entire bypassed reach receives the benefits of the minimum flow. Therefore, there is no apparent benefit associated with consulting with resource agencies about the release points of the minimum bypassed reach flow after the fish passage facilities are installed.

Drawdown Procedure for Scheduled Maintenance

Periodically, the Town draws down the project impoundment for maintenance, such as flashboard replacement. When replacing the flashboards, the Town draws down the project impoundment by increasing generation flows above inflow rates. The Town lowers the impoundment level just below the spillway crest elevation of 70.0 feet NGVD29. The Town does not provide any information about how quickly it draws the impoundment down.

New Hampshire DES's water quality certification condition E-10e requires the Town to lower the impoundment water level at a rate of no more than 6 inches per day when drawing down the water level in the impoundment for scheduled maintenance.

Our Analysis

The procedures that are used to drawdown an impoundment can significantly affect aquatic habitat and organisms in the impoundment. Dewatering aquatic habitat during a drawdown can impact the breeding, feeding, and sheltering of aquatic organisms. Stranding and desiccation can result in mortality of fish and other aquatic organisms. Freshwater mussels, given their limited mobility, may not be able to relocate to wetted habitat or burrow deeper quickly enough to avoid desiccation during drawdowns.

During the 2018 mussel survey, the Town observed hundreds of eastern elliptio, 20 eastern floaters, and 5 triangle floaters in the impoundment at a variety of depths. New Hampshire DES states that a drawdown rate of 6 inches per day would allow

adequate time for less mobile aquatic organisms (including, but not limited to mussels) to move and stay sufficiently submerged as the water level gradually recedes. The amount of protection that would be provided for mussels by a 6-inch per day drawdown limit depends on how quickly mussels can move relative to the drawdown rate, the slope of the impoundment bottom in the dewatered area, and how quickly mussels succumb to desiccation. At a rate of 6 inches per day, it would take approximately 2.5 days to drawdown the impoundment by 15 inches, which is the level required to replace the flashboards. Based on a tagging study conducted during drawdowns of Lake Sebasticook, Maine, eastern elliptio can move horizontally approximately 37.8 inches per hour (Samad and Stanley, 1986). This movement rate suggests that eastern elliptio could move into wetted habitat and avoid desiccation during a drawdown if the impoundment were drawn down at a rate of 6 inches per day. However, the movements Samad and Stanley (1986) observed were random and not necessarily in the direction of wetted habitat. Therefore, mussels may still be stranded at a drawdown rate of 6 inches per day if they move away from wetted habitat instead of towards it. Still yet, some species may burrow deeper into the substrate (Samad and Stanley, 1986; Newton et al., 2014), which could provide some protection from desiccation.

The amount of mussel habitat that would be exposed during flashboard replacement depends on the slope of the impoundment bottom. More of the impoundment bottom would be dewatered in areas with a slight slope compared to areas where depth increases rapidly with distance from shore. In areas with lower slopes, a greater area of mussel habitat would be dewatered and would require mussels to move a greater distance horizontally or into the substrate to avoid desiccation, relative to areas with higher grades.

Lastly, some mussel species are more resistant to desiccation than others (Newton et al., 2014). Regardless of how long the three mussel species found in the impoundment can survive out of water, any mussels occupying the elevations near 71.25 feet NGVD29 would have a greater risk of desiccation during an impoundment drawdown because this elevation would be the first to be dewatered and last to be rewatered.

Given the information presented in the previous paragraphs, New Hampshire DES's condition would be most protective for mussels near the maximum depth of the drawdown compared to those inhabiting elevations near 71.25 feet NGVD29 because mussels near the maximum depth of the drawdown may be able to move into habitat that has not been dewatered or burrow into wetted habitat.

Impoundment Refill Procedures for Scheduled Maintenance and Emergencies

When restoring the elevation of the impoundment after a drawdown for scheduled maintenance or emergencies, the Town currently passes the "majority of inflow" through

the turbines to allow the impoundment to slowly rise and to prevent dewatering of the river reach below the dam. During these temporary drawdowns, the Town temporarily ceases run-of-river operation and maintains a 10-cfs minimum flow to the bypassed reach by opening the waste gate in the intake headworks structure.

New Hampshire DES's certification condition E-10d would require, and Interior recommends under section 10(j) that the Town implement an impoundment refill procedure after the impoundment is drawn down for emergencies and maintenance, whereby 90 percent of inflow is passed downstream, and the impoundment is refilled on the remaining 10 percent of inflow to the project (90/10 refill procedure). Commerce recommends that the Town develop a "headpond refill plan" to ensure that flows below the project are maintained during the refilling of the impoundment after drawdowns. However, Commerce does not specify a flow percentage to pass downstream of the dam as the impoundment refills. New Hampshire FGD supports Interior's recommendation.

Our Analysis

The procedures that are used to refill an impoundment following a drawdown can significantly affect aquatic habitat and organisms in the impoundment and in the downstream reach. Dewatering aquatic habitat during a drawdown can impact the breeding, feeding, and sheltering of aquatic organisms. Stranding and desiccation can result in mortality of fish, mussels, and other aquatic organisms. Retaining all inflows to refill the impoundment would adversely affect aquatic resources by dewatering aquatic habitat in the bypassed and downstream reaches, potentially stranding fish, mussels, and other aquatic organisms. On the other hand, releasing all flows to the downstream reach would adversely affect aquatic life in the impoundment by sustaining the dewatered conditions.

Interior's recommendation and New Hampshire DES's condition requiring the Town to release 90 percent of the impoundment's inflow during refilling would ensure that flows downstream of the powerhouse are kept near project inflow levels and that the impoundment is refilled in a timely manner following drawdowns for routine maintenance, such as flashboard repair. Minimizing the length of time that the impoundment is drawn down and that flows are reduced downstream would help maintain the existing aquatic habitat for fish and other aquatic species during drawdowns for routine maintenance.

When the impoundment is lowered just below the spillway crest to replace the flashboards, the Town maintains a 10-cfs minimum flow to approximately 630 feet of the 680-foot-long bypassed reach by releasing flows through the waste gate, which is located approximately 50 feet below the dam. However, the project has no mechanism to release water into the bypassed reach when impoundment levels fall below the sill elevation of the waste gate (i.e., 69.3 feet NGVD29). Therefore, any non-routine drawdowns for

emergencies or dam maintenance that result in an impoundment elevation below 69.3 feet NGVD29, would dewater aquatic habitat along the impoundment and the full extent of the 680-foot-long bypassed reach. Assuming that the impoundment has been completely drained and that inflow equals the median annual flow of 292 cfs, we estimate that Interior's recommended refill procedure would take 7.9 days to refill the impoundment back to 71.25 feet NGVD29 by retaining 29.2 cfs and passing 262.8 cfs downstream through the powerhouse.[58] Under these circumstances, the Town could use some other means to provide minimum flow to the bypassed reach, such as pumps or siphons, until the impoundment level reaches the elevation of the waste gate.

Commerce recommends that the Town develops a "headpond refill plan" to ensure that flows below the project are maintained during the refilling of the impoundment after drawdowns. However, Commerce does not include any specific measures in its recommendation, including a flow percentage to pass downstream of the dam as the impoundment refills. Therefore, staff cannot evaluate the effects of Commerce's recommendation. However, Interior's recommended and New Hampshire's required 90/10 refill procedure would protect aquatic resource in the downstream reach following impoundment drawdowns. Staff is not aware of any additional benefits to aquatic species that would be provided by the development of a headpond refill plan.

Compliance Monitoring

The Town indicates that the project uses a pond level sensor to maintain pond levels and to regulate turbine operation but does not describe the details of its operational compliance methods. Maine DEP's certification condition 1B and New Hampshire DES's certification condition E-12 require, and Interior and Commerce recommend under section 10(j) that the Town develop a plan to monitor and maintain run-of-river operation, impoundment elevations, and minimum flow releases from the Rollinsford Project. Commerce and Interior recommend, and New Hampshire DES requires, that the plan include a description of the mechanisms and structures that will be used, the level of automatic operation, the methods for recording data on run-of-river operation and minimum flow releases, and an implementation schedule. In addition, Interior recommends, and New Hampshire DES requires, that relevant operational data, such as headpond elevation and station generation, be recorded at least hourly. Commerce recommends, and New Hampshire DES requires, that the plan include a protocol for maintaining and calibrating equipment.

New Hampshire FGD supports Interior's recommendation, and recommends that the operation compliance monitoring plan describe: (1) yearly maintenance needs and

[58] The estimated time to refill the impoundment is calculated based on an impoundment capacity of 456 acre-feet (19,863,360 cubic feet).

extreme drawdowns required to maintain project operation; (2) protocols for providing maintenance data to resource agencies; (3) maintenance schedules; and (4) measures for minimizing effects on freshwater mussels in the project boundary and bypassed reach.

Our Analysis

Although compliance measures do not directly affect environmental resources, they do allow the Commission to verify that a licensee is complying with the environmental requirements of a license. An operation compliance monitoring plan would help the Town document compliance with the operational provisions of any license for the project and provide a mechanism for reporting deviations. An operation compliance monitoring plan would also help the Commission verify that the project is operating in compliance with the license, thereby facilitating administration of the license and assisting with the protection of resources that are sensitive to deviations from normal operating conditions. The plan could be developed in consultation with the resource agencies, and include a description of the mechanisms and structures that would be used, a protocol for maintaining and calibrating equipment, and provisions for: (1) monitoring run-of-river operation, minimum flow, and impoundment elevation levels to document compliance with the operational conditions of any subsequent license; (2) standard operating procedures to be implemented: (a) outside of normal operating conditions, including during scheduled facility shutdowns, and impoundment drawdowns and refilling, and (b) during emergency conditions, such as unscheduled facility shutdowns and maintenance, in order to minimize project effects on environmental resources; (3) reporting deviations to the Commission; and (4) maintaining a log of project operation for inspection.

New Hampshire FGD's comment that the operation compliance monitoring plan should include "proposed impact minimization for freshwater mussels" does not indicate any specific project effects on mussels or measures for protecting mussels. Operating the project in a run-of-river mode with minimum bypassed reach flows, and an impoundment refill procedure, as discussed above, would protect mussels at the project and in the downstream reach. Therefore, there is no basis for including additional measures in the operation compliance monitoring plan to minimize project impact on mussels.

Upstream Eel Passage

The Town proposes to conduct a two-season upstream eel passage facility siting survey, beginning the first full passage season after the effective date of a subsequent license. The Town states it will use the results of the two-season siting survey to determine where the upstream eel passage facility will be located and how the facility will be operated. The Town proposes to install and operate an upstream American eel ramp within four years of the effective date of a subsequent license.

Interior's preliminary fishway prescription would require the Town to conduct an upstream eel passage facility siting survey from May 1 through October 31 for up to two years, starting the first passage season after the prescribed upstream anadromous fish systems are installed (i.e., after March 15 of the third calendar year after issuance of a subsequent license).[59] New Hampshire FGD recommends that the Town conduct the siting study after the new bypassed reach flow regime is established.

Interior would require the Town to consult with FWS and other resource agencies based on the results of the siting survey, to determine an optimal location for siting permanent upstream eel passage facilities. Interior would require permanent eel passage facilities to be installed by May 1 of the second calendar year after the siting survey is completed and operated and maintained from May 1 through October 31 each year thereafter.[60] Interior would require the Town to design the upstream eel passage facilities in consultation with the resource agencies, in a manner that is consistent with FWS's Design Criteria Manual. Maine DEP's and New Hampshire DES's certifications (conditions 3A and E-13, respectively) require the Town to provide upstream eel passage in a manner this is consistent with Interior's prescription. Maine DMR and TU support Interior's prescriptions.

Our Analysis

As noted above, approximately 2,362 and 1,062 American eels have been documented migrating upstream of the South Berwick Project in 2018 and 2019, respectively. There are no existing upstream passage facilities at the project for the American eel. A barrier like a dam can block upstream movement and modify flow, which could affect movement patterns. To migrate upstream past the project, juvenile eels must climb over or around the Rollinsford Dam. Climbing over or around dams is a well-documented behavior for juvenile eels (GMCME, 2007) but causes passage delay and could increase the risk of predation while eels seek a suitable route of passage over/around the dam. Providing a dedicated means of passage by installing upstream eel passage facilities at the project would reduce passage delay and improve upstream passage for American eels to access habitat upstream of the project.

Upstream Eel Passage Siting Study

[59] See section 3.3.1.2, *Environmental Effects, Upstream Anadromous Fish Passage*, for a detailed description of Interior's prescribed upstream fish passage facility.

[60] Interior's preliminary prescription would also require the upstream eelway to be completed by the fifth year after license issuance. However, this requirement appears inconsistent with the timing of the construction of the required upstream fishways and the required upstream eel siting surveys.

Juvenile eels use flow cues to orient themselves as they move upstream. There are multiple sources of attraction flow at the project that eels could use to orient themselves upstream. Eels could be attracted to flow from generation at the tailrace, spill at the project dam, and spill at the waste gate from the minimum bypassed reach flow and high flow events that exceed the turbines' maximum hydraulic capacities.

To evaluate eel migration pathways and potential eel passage facility locations, the Town conducted weekly nighttime juvenile eel surveys from May – June 2018.[61] During the survey, observers searched for eels along the downstream face of the project dam and along the length of the bypassed reach. Large numbers of juvenile eels (more than 100) were seen congregating at the confluence of the bypassed reach and the tailrace and actively climbing several of the braided channels in the bypassed reach. Juvenile eels used three to four different corridors to negotiate the steeper lower falls area in the bypassed reach and gain access to the lower gradient, middle section of the bypassed reach.[62]

During the survey, the flashboards were down[63] and the 10-cfs bypassed reach minimum flow was released from the waste gate that is located approximately 50 feet downstream of the dam instead of the notch in the flashboards that is typically used to release the minimum flow to the bypassed reach. Juvenile eels were consistently seen at the waste gate and climbing the wetted areas near the gate during the study. As the survey progressed from May to June 2018, greater numbers of eels were seen near the dam. Though much of the flow to the bypassed reach was passed through the waste gate during the study, there was some spillage/seepage over several locations along the spillway crest during the study, and eels appear to have been attracted to the main spillway area and pools at the base of the dam. However, this pattern and location was not consistent across the entire survey period due to variability of spillage/seepage patterns. Overall, eels were observed on the river right and, to a lesser extent, the center portions at the dam (Figure 8). Little to no eel activity was observed on the river left.

[61] *See* August 29, 2019 final license application, at Appendix D: *Upstream Eel Passage Assessment.*

[62] The bypassed reach is comprised of a series of pools, cascades, and falls. The elevation change from the beginning to the end of the bypassed reach is approximately 31 feet, with a stream gradient of 4.6 percent.

[63] The safety cable that is typically used by maintenance staff when replacing the flashboards was not in proper working condition and prevented flashboard maintenance and repair during the 2018 survey period.

This situation is likely due to the majority of the flow being passed on the river right, either through the waste gate or seepage/spillage at the dam.

Figure 8. Image of the Rollinsford Dam looking upstream. The red arrows indicate where the Town observed juvenile eels during the upstream eel passage survey. (Source: The Town, 2019)

Based on the results of the nighttime surveys, the Town installed a temporary eel ramp and trap at the end of the tailrace, near the confluence with the bypassed reach. The temporary ramp and trap were operated from May 30 – October 15, 2018. A total of 624 eels were caught in the temporary eel ramp. Approximately 90 percent of the total catch occurred from May 30 – August 8, 2018. After August 8, 2018, the number of trapped eels tapered off quickly and remained low through October 15, 2018. A temporary ramp was not deployed at the dam or the waste gate.

The Town's proposed action and the alternative actions recommended by stakeholders would change flow conditions in the bypassed reach during the term of a subsequent license, which would affect attraction flows for eel passage in the bypassed reach, including: (1) the Town's proposal to increase the minimum bypassed reach flow

from 10 to 35 cfs; (2) Interior's and Commerce's section 10(j) recommendation to release a minimum bypassed reach flow of 60 cfs during the upstream anadromous fish migration season; and (3) Interior's prescription to install upstream and downstream fish passage facilities in the bypassed reach.

Conducting a siting survey as proposed by the Town and prescribed by Interior, would allow the Town to identify where juvenile eels congregate following any operational changes required by a subsequent license. Proper siting of upstream eel passage facilities is critical to obtaining high passage efficiency (Haro, 2013). Further, properly siting the facilities would reduce passage delay and provide eels with timely access to habitat upstream of the project. To obtain sufficient data for determining suitable locations for any eel passage facilities, temporary ramps and traps should be located in areas where eels are likely to congregate, which will increase the chance of successfully attracting and collecting juvenile eels in the trap for passage (FWS, 2019). In addition, traps should be located in areas that are protected from high flow events that could damage the trap and injure or kill eels that are utilizing the trap. The location of the eel traps should allow for suitable access to personnel to collect and transport eels to the holding tank for passage upstream. FWS's Design Criteria Manual[64] could be used to guide the design, operation, and maintenance of the ramp and trap during the study.

The distribution of flows in the bypassed reach may vary monthly and annually depending on inflow. Migrating eels may be attracted to alternate locations below the dam depending on how flow in the bypassed reach is distributed across the points of discharge (e.g., the spillway, waste gate, fish passage facilities, and powerhouse). Conducting the survey for two passage seasons, as proposed by the Town and prescribed by Interior, would help capture these variable flow conditions and provide sufficient information to identify a suitable location for upstream eel passage facilities at the project.

Timing of Eel Ramp Installation

The Town's proposal to begin the upstream eel passage facility siting survey during the first passage season after license issuance, and then install the upstream eel passage facilities within four years of license issuance, would not account for potential changes to attraction flows in the bypassed reach that would result from the construction and installation of upstream anadromous fish passage facilities in the bypassed reach that are prescribed by Interior. Interior's preliminary prescription would account for the installation of upstream anadromous fish passage facilities by requiring the Town to

[64] FWS's Design Criteria Manual was developed by the FWS's Fish Passage Engineering Team to establish, among other things, general guidance on baseline design criteria, operation, and maintenance of fishways throughout the northeastern U.S.

conduct the two-year upstream eel passage siting survey after the construction of the prescribed upstream anadromous fish passage facilities, and then complete the construction of the upstream eel passage facilities by May 1 of the second calendar year after the siting studies are completed.[65] Conducting the study and installing the upstream eel passage facilities after the installation of any upstream anadromous fish passage facilities, as prescribed by Interior, would ensure the proper siting of upstream eel passage facilities to reduce passage delay and provide eels with timely access to habitat upstream of the project.

However, Interior's preliminary prescription also requires the upstream eel passage facilities to be operational within five years of license issuance.[66] As described in section 3.3.1.2, *Environmental Effects, Upstream Anadromous Fish Passage*, Interior's prescription requires the upstream anadromous fishways to be operational by March 15 of the third calendar year after license issuance. In order to meet a five-year operational deadline, the Town would have to complete construction of the upstream eel passage facilities less than two months after the second study season of the upstream eel passage facility siting study. Such a schedule would not allow any time for consultation with resource agencies regarding the number, placement, and design of the upstream eel passage facilities. Completing construction of the upstream eel passage facilities by May 1 of the second calendar year after the siting studies are completed (i.e., May 1 of the sixth calendar year after license issuance), instead of five years after license issuance, would allow sufficient time to analyze the study results, consult with the agencies about the siting and design of the upstream eel passage facilities, and complete the construction of the facilities.

Upstream Eel Passage Facility Siting Study and Operating Period

The timing of the temporary eel ramp and trap operation during the study period (May 30 through October 15), is not entirely consistent with the upstream eel migration season (May 1 through October 31; Sorensen and Bianchini, 1986; Facey and Van Den Avyle, 1987; Martin, 1995). The Town's study period decreased the number of days eels had access to the temporary ramp by 45 days (30 days in May and 15 days in October). Conducting a two-year siting survey, as proposed by the Town and prescribed by Interior, for the entire upstream eel migration season (i.e., May 1 through October 31) would provide information on upstream movements through the bypassed reach and would help determine placement of the upstream eel passage facilities in areas where eels are known to congregate. Conducting the survey for the entire migration period would allow the Town to quantify and evaluate where eels congregate during different flow and project

[65] *See* pages 16 and 22 of Interior's preliminary prescription.

[66] *See* page 19 of Interior's preliminary prescription.

operating conditions. Using a complete set of data from the study to properly site the upstream eel passage facility would reduce passage delay and risk of predation as eels migrate upstream through the project.

Interior's prescription would require the Town to operate the upstream eel passage facility from May 1 through October 31. Interior's operating period is consistent with the spawning period reported for American eel in Maine and New Hampshire (Sorenson and Bianchini, 1986; Facey and Van Den Avyle, 1987; Martin, 1995). Therefore, providing upstream passage for eel from May 1 to October 31, as required by Interior's prescription would reduce the potential for passage delay and predation.

Upstream Anadromous Fish Passage

Our Analysis

Historically, American shad and river herring may have migrated at least as far upstream in the Salmon Falls River as Somersworth, New Hampshire (Chadbourne, 1790s; Old Berwick Historical Society, 2020), which is approximately 4 miles upstream of the Rollinsford Project, until 1847 when dams prevented anadromous fish from migrating upstream (Noon, 2002). There are no upstream fish passage facilities at the Rollinsford Project, but shad and river herring have access to the project area through the upstream fish passage facilities located at the South Berwick Project, approximately 1.1 miles downstream. While approximately 24,571 river herring in 2018 and 16,418 river herring in 2019 used the upstream fishway at the South Berwick Project to migrate upstream to the bypassed reach of the Rollinsford Project, no American shad have been recorded using the upstream fishway at the South Berwick Project or observed in the Salmon Falls River between the South Berwick and Rollinsford Projects.

The substrate in the bypassed reach is dominated by bedrock and large boulders. Under current operation, flow in the lower 250 feet of the bypassed reach moves through a series of chutes and pools in the bedrock (Figure 7). Data collected from a transect through a bedrock chute in the lower bypassed reach during the Town's 2018 zone of passage study (transect ZOP-3; Figure 7; Table 5) indicates that water velocity in the chute exceeds the water velocity recommended by FWS's Design Criteria Manual for river herring (i.e., 6 fps) at the 29, 43, 82, and 120-cfs test flows used during the 2018 bypassed reach minimum flow study. These data suggest that upstream movements of river herring through this chute may be restricted or prohibited at these flows (Table 5). The chute is passable for American shad at 29 and 43 cfs, but water velocity exceeds the burst speed of shad at 82 and 120 cfs. Separately, the water depths in an approximately 5-foot-long section of the ZOP-3 transect are less than the depth recommended by FWS's 2019 Design Criteria Manual for shad (17.5 inches). Therefore, depth may limit or restrict shad moving upstream through ZOP-3 at 29 and 43 cfs even though water velocity would not prevent shad from moving upstream at these flows.

Table 5. Summary of passage conditions during the 2018 upstream zone of passage study.

Transect	Species	29 cfs	43 cfs	82 cfs	120 cfs
ZOP-1	American Shad	Passable	Passable	Passable	Passable
	River Herring	Passable	Passable	Limited (Average cross section velocity slightly above prolonged swim speed)	Limited (Average cross section velocity above prolonged swim speed)
ZOP-2	American Shad	Passable	Passable	Limited (Average velocity above prolonged swim speed)	Limited (Average velocity above prolonged swim speed)
	River Herring	Passable	Limited (Average velocity slightly above prolonged swim speed)	Not Passable (Average velocity above burst swim speed)	Not Passable (Average velocity above prolonged swim speed)
ZOP-3	American Shad	Passable	Passable	Not passable (Velocity above prolonged swim speed for ~ 30% of chute length[67])	Not passable (Velocity above burst swim speed for ~ 10% of chute length)
	River Herring	Not passable (Velocity above burst swim speed for ~ 10% of	Not Passable (Velocity above prolonged	Not Passable (Velocity above burst swim speed	Not Passable (Velocity above burst swim speed

[67] Chute length is approximately 90 – 100 feet.

Transect	Species	29 cfs	43 cfs	82 cfs	120 cfs
		chute length)	swim speed for ~ 40% of chute length)	for ~ 30% of chute length)	for ~ 70% of chute length)
ZOP-4	American Shad	Passable	Passable	Passable	Passable
	River Herring	Passable	Passable	Passable	Passable

(Source: Town, 2019).

The Town states that river herring have been observed only in three pools located in the lower 150 feet of the bypassed reach, and that it has not observed any river herring in the pool immediately downstream of the project dam. In contrast, Interior states that New Hampshire FGD staff have observed river herring in the pool immediately downstream of the dam, which suggests that some river herring can move upstream through the bypassed reach at some flow levels. However, Interior does not provide any information about when New Hampshire FGD staff observed the river herring or what the flow conditions were at the time of observation.

Upstream Fishways

The Town proposes to construct and operate a Denil fishway at the dam and excavate the lower section of the bypassed reach to provide upstream passage for American shad and river herring, if GMP does not install, operate, and maintain a new trap and haul facility at the South Berwick Project No. 11163 (located approximately 1 mile downstream of the Rollinsford Project), to trap fish and transport them upstream to the impoundments of the Rollinsford Project, the Lower Great Falls Project No. 4451, and the Somersworth Project No. 3820.[68]

Interior's preliminary fishway prescription would require the Town to construct, operate, and maintain upstream fish passage facilities to pass anadromous fish species.

[68] If GMP files a request to install, operate, and maintain a trap and haul facility at the South Berwick Project with the Commission, and the Commission denies GMP's request, then the Town proposes to construct the Denil fishway and excavate the lower bypassed reach prior to the fourth passage season after the denial. If GMP receives authorization to install a trap and haul facility, but later discontinues the operation of the trap and haul facility during the term of a subsequent license, then the Town proposes to install a Denil fishway and excavate the lower bypassed reach four years after the cessation of the trap and haul operation. The Town defines the upstream passage season for American shad and river herring as April 15 to July 15.

Interior requires two fishways: one at the project dam and another in the lower section of the bypassed reach. Interior requires the Town to construct the fishways in one of two configurations: (1) a technical fishway at the dam and a technical fishway in the lower section of the bypassed reach, or (2) a technical fishway at the dam and a nature-like fishway in the lower section of the bypassed reach.

Interior's preliminary prescription would require the fishways to be designed in a manner that is consistent with FWS's Design Criteria Manual. Interior requires the fishways to be operational by March 15 of the third calendar year after license issuance. Interior's preliminary prescription would require the Town to operate the upstream anadromous fishways from April 15 to July 15 each year.

Maine DEP's certification condition 3B requires the Town to construct and operate a Denil fishway to provide upstream passage for anadromous fish as prescribed by Interior, "unless an exception for trap and truck operations is requested within two years of issuance of a new license, and approved by USFWS and by FERC."[69] New Hampshire DES's certification condition E-13 requires the Town to comply with Interior's prescription. Maine DMR, New Hampshire FGD, and TU support Interior's prescriptions.

The proposed action and action alternatives do not include definitive measures for constructing, operating, and maintaining upstream fish passage facilities. Instead, the proposed action and alternatives each include conditions or options that would be further specified after license issuance. The following analysis includes an evaluation of each of the proposed measures and agency conditions for providing upstream fish passage facilities, except for the trap and haul facility included in the Town's proposal. Specifically, the analysis evaluates the effects of installing a technical fishway at the dam, and either a technical fishway or a nature-like fishway in the lower section of the bypassed reach. The analysis does not evaluate a trap and haul alternative at the South Berwick Project because GMP has not submitted a request to amend the license for the South Berwick Project to provide upstream fish passage via trap and haul, and the Town has not filed any information demonstrating that a trap and haul alternative is reasonably foreseeable.

Technical Fishways

[69] Maine DEP does not specify where the trap and haul facility would be located or who would submit the request to install a trap and haul facility. Based on the similarities between condition 3 and the upstream fish passage measures included in the Settlement Agreement, staff assume that Maine DEP is referring to an exception that would occur if GMP submits a request to provide upstream fish passage via trap and haul at the South Berwick Project No. 11163.

Interior's prescription would require the construction of a "technical fishway" at the project dam and either a technical fishway or a nature-like fishway in the lower part of the bypassed reach. Interior states that the fishways should provide passage for 21,315 river herring, 2,731 American shad, and approximately 500 resident or "target species."[70] Interior states that the fishways should be constructed in a manner that is consistent with the FWS's Design Criteria Manual, and states that a 4-foot-wide Denil fish ladder installed at a slope of 1:8 (vertical:horizontal) or milder should be sufficient to pass these design populations. In addition, Interior states that the slope, pool size, slot size, and attraction flow should ensure successful passage of shad and river herring, and the fishways should operate at the full range of design flows calculated for the migratory season for each species (i.e., 5 and 95 percent exceedance flow during the migratory period; FWS, 2019).

The Town proposes to install a Denil fishway at the dam and excavate the lower section of the bypassed reach, as described in Interior's prescription, if GMP does not provide upstream fish passage via trap and haul at the South Berwick Project.

FWS's Design Criteria Manual was developed by the FWS's Fish Passage Engineering Team to establish, among other things, general guidance on baseline design criteria, operation, and maintenance of fishways throughout the northeastern U.S. For upstream shad and river herring passage, the Design Criteria Manual recommends a Denil fishway installed at a slope of 1:8 (vertical:horizontal) to 1:10. A 4-foot-wide Denil fishway would provide upstream passage for 200,000 adult river herring or 25,000 shad. It is unclear how Interior estimated the design population size for shad and river herring, but a 4-foot-wide Denil fishway would have more than sufficient capacity to pass 2,731 shad, 21,315 river herring, and approximately 500 non-target fish.[71]

[70] Because Interior provided design populations for river herring, shad, and resident fish, it is unclear what Interior means by "target species." However, FWS's 2019 Design Criteria Manual recommends including an allowance for *non*-target species of 10 to 15 percent when calculating fishway capacity. Therefore, staff assume that Interior is referring to non-target species.

[71] In its fishway prescription, Interior states that it estimated the design populations of American shad and river herring based on production rates of 350 fish per acre for river herring, 111 fish per acre for shad, and 71.7 acres of habitat between the Rollinsford Dam and the Lower Great Falls Project (FERC No. 4451) Dam. However, multiplying the available habitat by the fish per acre production rates yields design populations of 7,959 shad and 25,095 river herring.

To understand how a 4-foot-wide Denil fishway would be expected to perform at the Rollinsford Project for shad and river herring, staff examined fish passage performance for shad and river herring at the South Berwick Project. The licensee of the South Berwick Project, Consolidated Hydro, evaluated the attraction and internal efficiency of the Denil fishway in 2004 and the attraction efficiency in 2006 (Consolidated Hydro, 2007).[72] In 2004, 104 out of 332 tagged alewives entered the fishway, which is an attraction efficiency of 31.3 percent. Once in the fishway, 89 out of 104 tagged alewives successfully exited the fishway, resulting in an internal efficiency of 85.6 percent. In 2006, Consolidated Hydro released 298 tagged alewives downstream of the fishway, and 80 entered the fishway (26.8 percent attraction efficiency).[73] As mentioned earlier, approximately 24,571 river herring in 2018 and 16,418 river herring in 2019 passed upstream of the South Berwick Project. Therefore, while a large percentage of fish downstream of the South Berwick Project fishway may not enter the fishway, the fishway appears capable of providing upstream passage for the design populations described in Interior's preliminary prescription for the Rollinsford Project.

At the project dam, there would be no competing flow from the tailrace to attract migrating fish away from the prescribed fishway. If the entrance of the fishway was constructed near the project dam, the entrance could be oriented so that the discharge from the fishway and attraction water supply create an attraction jet that projects laterally across the dam to attract fish gathered near the base of the dam (FWS, 2019). This would allow the attraction efficiency of the fishway to remain high even when the project spills flow over the dam. Alternatively, the Town could construct the entrance in the pool located approximately 150 feet downstream of the dam (near the IFIM-3 transect from the instream flow study (Figure 7). At this location, the discharge from the fishway would likely be the dominant flow source, which would enhance attraction efficiency (FWS, 2019).

Regarding the placement of a technical fishway in the lower section of the bypassed reach, Interior's preliminary prescription did not include an exact location for where the fishway would be constructed in the lower bypassed reach, so it is unclear if the prescribed fishway is intended to bypass the velocity barrier only at the ZOP-3 chute (approximately 100 feet) or if the fishway is also intended to bypass the velocity barriers observed at some flows at the ZOP-1 and ZOP-2 transects (approximately 170 feet from the beginning of ZOP-1 to the end of ZOP-3; Figure 7; Table 5). Regardless of the exact

[72] Attraction efficiency is the percentage of tagged fish downstream of the fishway entrance that find and enter the fishway. Internal efficiency is the percentage of tagged fish that enter the fishway and exit the fishway at the upstream side.

[73] When corrected for tagging mortality, attraction efficiency in 2006 was 31.3 percent. No mortality correction was necessary for the 2004 study.

location and length of the fishway, constructing a Denil fishway in the lower bypassed reach would present certain design challenges. First, FWS's Design Criteria Manual states that the fishway must operate effectively at the 5 and 95 percent exceedance flow (design flow) in the bypassed reach for the upstream passage season (i.e., April 15 to July 15; FWS, 2019), which would be between 60 cfs (i.e., Interior's recommended minimum flow during the upstream fish passage season) and 3,379 cfs.[74] Since the 2018 instream flow study evaluated flows up to 120 cfs, there is no information about how the wetted area, depth, or water velocity in the bypassed reach changes at flows greater than 120 cfs. Flow in the bypassed reach exceeds 120 cfs approximately 23.3 percent of the time during the upstream fish passage season.[75] As some level of flow over 120 cfs, water likely leaves the natural chutes that occur in the bypassed reach, spreads across the width of bypassed reach. At higher flows, there may be additional chutes or channels in the bypassed reach that water flows through, and the additional flow could create competing flow sources and draw fish away from the fishway entrance, thereby reducing attraction to the fishway entrance.

According to the FWS Design Criteria Manual, the exit to the fishway would have to be designed to provide suitable depth at lower flows while also minimizing turbulence at higher flows that could discourage fish from leaving the fishway (FWS, 2019). The velocity within the exit area should be less than 1.5 fps so that fish can leave the fishway without undue exertion (FWS, 2019). To reduce the risk of fish becoming overwhelmed by the surrounding flow field near the fishway exit and to minimize debris accumulation, FWS (2019) recommends that that fishway exit be placed along the bank of the river channel in a region where water velocities are less than or equal to 4 fps. However, constructing the fishway along a bank would mean that the entrance and exit would be away from the dominant flow routes in the bypassed reach, which would add to the difficulty of attracting fish to the entrance and providing suitable conditions at the exit.

FWS's 2019 Design Criteria Manual recommends a minimum attraction flow of 50 cfs or 5 percent of the project's maximum hydraulic capacity, whichever is greater.

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[74] Based on prorated Salmon Falls River flow data from the U.S. Geological Survey (USGS) gage no. 01072100 in Milton, New Hampshire, located approximately 19.5 miles upstream of the Rollinsford Project, the 5 percent exceedance flow at the project is 3835 cfs, and the 95 percent exceedance flow is 202 cfs. Staff prorated the Passumpsic River flow by a factor of 2.15 to compensate for the difference in drainage area at the Milton gage (108 square miles) and at the project (232 square miles). However, the 5 percent exceedance flow in the bypassed reach would be 3,835 cfs minus the project's maximum hydraulic capacity of 456 cfs, 3,379 cfs.

[75] Staff used the exceedance rate for 576 cfs, which is the maximum hydraulic capacity plus 120 cfs, to estimate the exceedance rate for 120 cfs in the bypassed reach.

For the Rollinsford Project, the recommended attraction flow would be 50 cfs, which could require installing and maintaining a pump in the bypassed reach to provide the attraction flow because the 60-cfs minimum flow required by Interior would not necessarily all flow through the fishway without excavating a channel toward the fishway to ensure that the 50-cfs attraction flow released at the fishway at the dam is directed toward the fishway in the bypassed reach.

Nature-like Fishway

Interior's prescription provides the option of installing a nature-like fishway in the lower part of the bypassed reach instead of a technical fishway. Interior states that the nature-like fishway should be designed in accordance with FWS's Design Criteria Manual, including the criteria for depth, velocity, and pool size (Table 6). In addition, Interior states that the nature-like fishway should pass the minimum bypassed reach flow.[76] Interior states that additional bedrock modifications may be necessary to "extend the operating range of the nature-like fishway during periods of moderate spill."[77]

Table 6. Nature-like fishway parameters for American shad and river herring.

Fishway Parameter	American Shad	River Herring
Maximum Slope (percent)	3.3	5.0
Minimum Pool Length (feet)	30.0	10.0
Minimum Pool Width (feet)	20.0	5.0
Minimum Pool Depth (feet)	4.0	2.25
Minimum Weir Opening Width (feet)	5.0	2.5
Minimum Weir Opening Depth (feet)	2.25	1.0
Maximum Weir Opening Water Velocity (fps)	8.25	6.0

(Source: FWS, 2019)

[76] As discussed above in section 3.3.1.2, *Minimum Flows, Bypassed Reach Minimum Flow*, Interior recommends under section 10(j), a 60-cfs bypassed reach flow during the upstream American shad and river herring migration period (April 15 through July 15).

[77] Interior does not define "moderate" spill in terms of flow. Therefore, staff assume that the nature-like fishway most operate between the 5 and 95 percent exceedance flows in the bypassed reach, as described in the prescription for the technical fishways.

Based on the bed elevation and water velocity data collected for the ZOP-3 transect during the Town's 2018 instream flow study, the velocity barriers in the ZOP-3 transect appear to be associated with discrete changes in the bed elevation profile. Water velocity increases near stations 22, 65, 75, and 93 (Figure 9). In addition to the velocity barriers, the slope of the ZOP-3 transect is approximately 1:8 (or 12.5 percent), which is much steeper than the slope recommended by FWS's 2019 Design Criteria Manual for a nature-like fishway for shad and river herring (i.e., not more than 1:30 or 3.3 percent); but is similar to the recommended slope for a Denil fishway. Slopes that are too high can produce water velocities that exceed a species' swimming speed, create turbulent conditions that inhibit movement, or result in other conditions that reduce the efficiency of the fishway (FWS, 2019). Although modifying the regions of the ZOP-3 transect with the highest water velocities may reduce the velocity in those areas, the slope of the lower bypassed reach could potentially limit upstream passage for shad and river herring. Therefore, excavating or providing velocity refuges in these locations may allow shad and river herring to move through the chute.

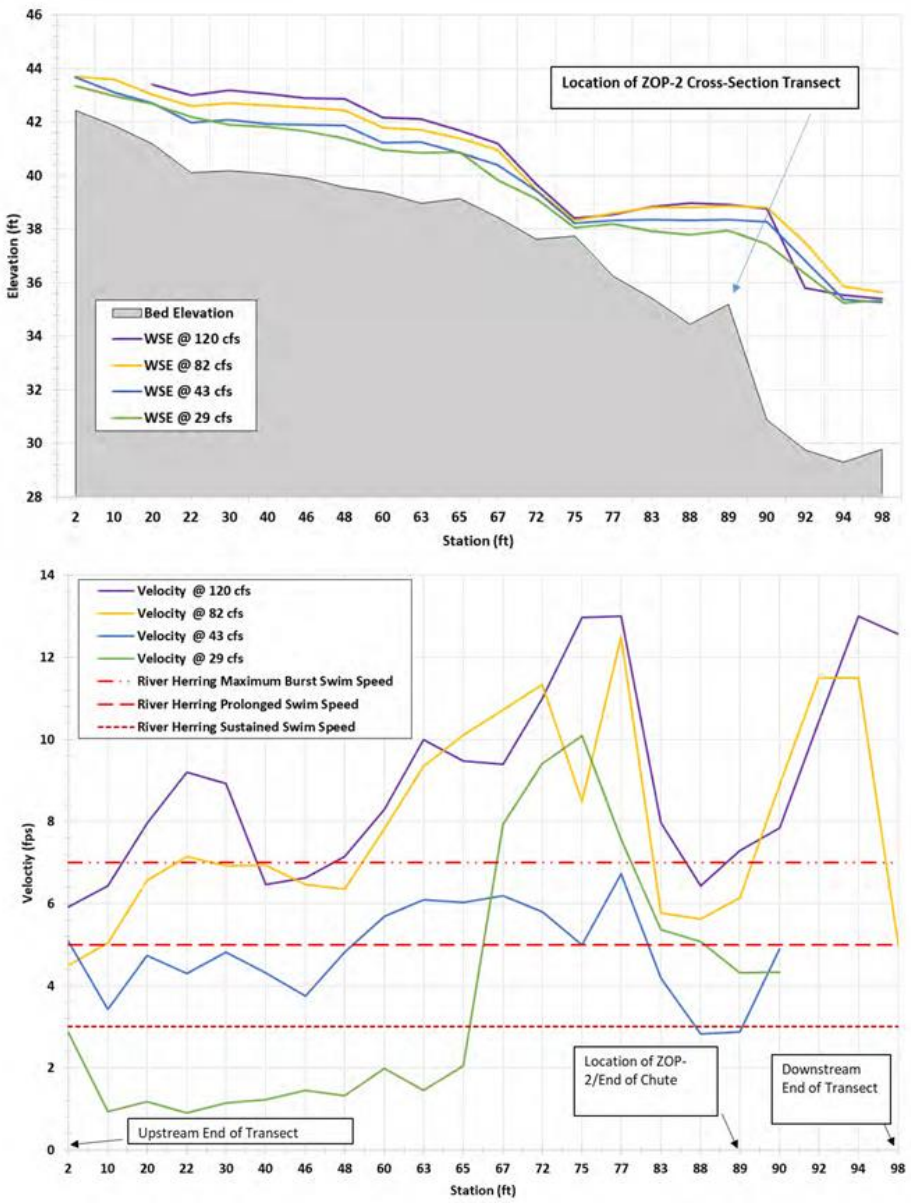

Figure 9. (A) Water surface elevation (WSE) measurements along transect ZOP-3 at the four test flows. (B) Water velocity measurements along transect ZOP-3 at the four test flows. (Source: Town, 2019)

Interior's preliminary prescription would require the Town to "modify the existing chute to provide a suitable zone of passage for adult alosines over the emergent bedrock adjacent to the powerhouse." However, the ZOP-3 transect is located in the bypassed reach at a point that is upstream of the powerhouse, and the ZOP-1 transect is located in the bypassed reach at a point that is adjacent to the powerhouse (Figure 7). Therefore, it is unclear if the prescribed fishway is intended to bypass areas of high velocity only at the chute in the ZOP-3 transect (approximately 100 feet) or if the fishway is also intended to bypass the areas with high velocity observed at flows greater than 43 cfs at the ZOP-1

and ZOP-2 transects (approximately 170 feet from the beginning of ZOP-1 to the end of ZOP-3; Figure 7; Table 5). Installing a nature-like fishway that extends from the ZOP-1 transect to the upstream end of the ZOP-3 transect would eliminate any depth or water velocity restrictions for both shad and river herring and would ensure that both species could access the Denil fishway at the project dam required by Interior's preliminary prescription.

Relatively few studies have evaluated the efficiency of nature-like fishways for shad and river herring. Raabe et al., (2019) found that between 53.3 and 65.2 percent of shad successfully ascended an approximately 300-foot-long rock ramp-style nature-like fishway on the Cape Fear River, South Carolina, that has a slope ranging from 3.5 to 5.0 percent. At a partially-removed dam on the Little River in North Carolina, 74 to 77 percent of shad successfully passed through the concrete rubble field (Raabe and Hightower, 2014). While not engineered as a nature-like fishway, the rubble field from the partially-removed dam was similar to a nature-like fishway and had a slope of 11 percent and length of 36 feet. Also, 94 percent of alewives successfully ascended a 105-foot-long rock ramp nature-like fishway with a slope of 4.2 percent on Town Brook in Plymouth, Massachusetts (Franklin et al., 2012). Based on these studies, a nature-like fishway in the Rollinsford Project bypassed reach could be designed to provide passage for shad and river herring. Given the effectiveness of nature-like fishways for shad and river herring in other rivers, modifying the lower bypassed reach from the ZOP-3 transect chute to the downstream end of the bypassed reach into a nature-like fishway, while following the recommendations included in FWS's 2019 Design Criteria Manual, including recommendations for slope, would provide a similar level of access to the upper bypassed reach as the Denil fishway.

Modifying the lower bypassed reach from the ZOP-3 transect chute to the ZOP-1 transect into a nature-like fishway may have some advantages compared to constructing a Denil fishway in the lower bypassed reach, including that there would be no need for a trashrack to prevent debris from entering the fishway, no baffles to maintain, and no need for any kind of pump for attraction flow. In addition, the ZOP-3 transect chute appears to be the dominant channel in that section of the bypassed reach and, based on satellite imagery, appears to convey the majority of flow at different streamflow levels. Therefore, there would likely be no competing flows to create false attraction that would delay migrating fish from entering the nature-like fishway. However, debris would likely need to be removed occasionally to ensure that flow in the nature-like fishway is not constricted or made turbulent by debris.

Timing of Upstream Fish Passage Installation

The Town does not definitively propose a date for installing the fishway at the dam and excavating the lower section of the bypassed reach; rather, the Town proposes a

series of prerequisite conditions that might or might not result in the Town providing upstream fish passage at the Rollinsford project.

Interior's preliminary prescription would require the upstream anadromous fishways to be operational by March 15 of the third calendar year after license issuance. Assuming that the fishways would require one year to install, there would be sufficient time to complete the design plans according the schedule described above prior to the initiation of construction. Interior's prescription would minimize the time until passage facilities are installed at the project, while allowing sufficient time to review the design plans prior to construction.

Upstream Fishway Operating Period

Interior's preliminary prescription would require the Town to operate the upstream fishways from April 15 through July 15. While river herring were not observed at the South Berwick Project until early May (Consolidated Hydro, 2007), Interior's operating period is consistent with the spawning period reported for American shad and river herring in Maine and New Hampshire (Maine DMR, 2020; New Hampshire FGD, 2020; Carpenter and Nugent, 2015; Saunders et al., 2006). Therefore, providing upstream fish passage for shad and river herring from April 15 to July 15, as required by Interior's preliminary prescription, would reduce the potential for adverse project effects on shad and river herring passage, including effects on the timeliness of passage.

Downstream American Eel and Anadromous Fish Passage

To protect eels during downstream passage from September 1 through October 31, the Town proposes to implement nighttime turbine shutdowns from 8:00 pm to 4:00 am for three consecutive nights following rain accumulation of 0.5 inch or more over a 24-hour period, within four years of the effective date of a subsequent license.

The Town proposes to install and operate a downstream eel passage facility within four years of the effective date of a subsequent license, including: (1) a surface weir that would be installed in the non-functional spillway located in the intake headworks structure; and (2) an approximately 185-foot-long, 2-foot-wide, 2-foot-tall, steel flume that would convey 25 cfs from the intake headworks structure to a 1,260-cubic foot plunge pool located in the bypassed reach, approximately 190 feet downstream of the project dam.[78]

[78] In the license application, the Town provides an estimated cost for excavating the pool in the bypassed reach, presumably to increase its depth, but does not state how deep the pool would be after excavation.

As discussed above in section 3.3.1.2, *Environmental Effects, Minimum Flows*, from September 1 through October 31, the Town proposes to provide a minimum flow of 35 cfs to the bypassed reach, including 25 cfs from the downstream fish passage facility and 10 cfs from the waste gate in the intake headworks structure, beginning four years after license issuance.

Interior requires the Town to develop a plan to provide downstream passage for American shad and river herring within three years of license issuance, including design plans for permanent downstream passage facilities that are consistent with FWS's Design Criteria Manual. Interior also requires the Town to develop a plan to provide downstream passage for American eel within three years of license issuance, including design plans for eel passage facilities and/or operational measures that are consistent with FWS's Design Criteria Manual. Interior requires the Town to obtain approval of the final plans from Interior and the resource agencies prior to filing with the Commission. Interior requires the Town to operate the passage facilities from June 1 to November 15 for anadromous fish species, and August 15 to November 15 for American eel.

To protect emigrating eels until permanent downstream passage facilities are operational, Interior's prescription requires the Town to shut down the turbines for three consecutive nights, from dusk to dawn, following rain accumulations of 0.5 inch or more over a 24-hour period from August 15 to November 15, beginning the first year of license issuance.

Maine DEP's water quality certification conditions 4A and 4B require the Town to construct and operate downstream eel and anadromous fish passage facilities in consultation with FWS, Maine DMR, New Hampshire FGD and other fish resource agencies; and "employ appropriate operational measures for the safe, timely and effective downstream passage"[79] of American eel and anadromous fish. Maine DEP requires that the facilities be constructed and operated in accordance with schedules established by the Commission and measures prescribed by Interior. New Hampshire DES's condition E-13 requires the Town to comply with Interior's prescription. Maine DMR, New Hampshire FGD, and TU support Interior's prescription.

Our Analysis

Fisheries surveys conducted upstream of the Rollinsford Project by the New Hampshire FGD (New Hampshire FGD, 2015), as well as an upstream eel passage assessment conducted 2.4 miles upstream of the Rollinsford Project at the Lower Great Falls Project (FERC No. 4451) in 2020 (Gomez and Sullivan, 2020), indicate eels are present upstream of the Rollinsford Dam. As discussed above in section 3.3.1.2,

[79] Maine DEP's condition does not provide any specific operational measures.

Environmental Effects, Upstream Anadromous Fish Passage, American shad and river herring are present downstream of the project but do not have access to the Salmon Falls River upstream of the project. To the extent that upstream passage is provided for shad and river herring at the project, as prescribed by Interior and discussed above, then shad and river herring could access the Salmon Falls River upstream of the project for spawning.

During their respective downstream migration seasons, eels, shad, and river herring could pass over the project dam during spill events, through the turbines when the project is generating, or through the waste gate located in the intake headworks structure during high flow events exceeding 466 cfs.

Potential for Entrainment and Impingement

Migratory Fish Species

Water intake structures at hydropower projects can injure or kill fish that encounter intake screens/trashracks or turbines. Fish that are wider than the clear spacing between the trashrack bars, and/or have burst swim speeds lower than approach velocities can become trapped against intake screens or bars of a trashrack. This process is known as impingement and can cause physical stress, suffocation, and death of some organisms (EPRI, 2003).

Entrainment into the intake structure occurs if fish are small enough to pass between trashrack bars, and they are unable to overcome the approach velocity, or if they choose to pass downstream through the trashrack. Even if fish are small enough to fit through trash rack bars, they are likely to behaviorally avoid entrainment if their burst swim speeds exceed the approach velocity in front of the trashracks (Knapp et al., 1982). If entrainment occurs, injury or mortality can result from collisions with turbine blades, exposure to pressure changes, shear forces in turbulent flows, or water velocity accelerations created by turbines (Rochester et al., 1984). Altogether, fish that are entrained and killed are removed from the river population and no longer available for recruitment to the fishery.

There are multiple factors that could affect the potential for fish entrainment and impingement. To determine the potential for American eel, American shad, and river herring to become impinged on the trashrack, the Town examined the correlation between fish size and trashrack bar spacing. The likelihood of a fish to become impinged rather than entrained is a function of the spacing between the bars on an intake structure, as well as the size and body shape of the fish. The Town estimated the likelihood that a fish would be physically excluded by the present trash rack configuration by using proportional measurements for American eel, American shad, and river herring as

reported by Smith (1985).[80] Previous studies in New England have documented the width of adult eels as ranging from 0.9 to 1.1 inches wide (Great River Hydro, 2016; Melong, 2014). Therefore, American eel would be able to physically pass through the 2.5-inch trashrack intake spacing. The maximum length of adult American shad is 30 inches, and river herring is 16 inches. American shad and river herring less than 19 inches long would be able to physically pass through the 2.5-inch trashrack intake spacing.

Operating a hydroelectric turbine at the maximum hydraulic capacity creates the greatest potential for turbine entrainment. When the turbine rotates at maximum speed, it draws water into the intake at a rate that can create a hydraulic signal that could attract downstream migrants. The maximum intake velocity under these conditions could be higher than fish burst speeds, which could lead to entrainment.

The burst speeds for American eel, American shad, and river herring are shown in Table 7. The Town measured intake velocities near the trashrack at the maximum hydraulic capacity (i.e., 456 cfs) during the 2019 fish entrainment and mortality study.[81] Mean water column velocities averaged 1.8 fps and ranged from 0.5 fps to approximately 3.4 fps. The Town observed a general pattern of higher velocities along the left (easterly) intake wall, and lower velocities toward the middle and the right (westerly) intake wall. The Town estimates that the project operates both turbines at full capacity approximately 25 to 30 percent of the time. The remaining 70 to 75 percent of the time the project is operated at less than full capacity, during which estimated intake velocities and entrainment risk would be lower.

Downstream migrating species (such as juvenile and adult American shad and river herring, and adult eels) that are searching for a passage route would likely encounter the penstock intake when the turbines are operating, since the attraction flow at the intake (up to 456 cfs) is significantly greater than the 10-cfs minimum bypassed reach flow through the notch in the flashboards at the dam. Downstream migrating fish may exhibit avoidance behavior when they encounter the intake and could attempt to escape entrainment if their burst speed is greater than the water velocity at the intake. Based on the burst speeds presented in Table 7, adult American shad and river herring could avoid involuntary entrainment because their burst speeds are greater than the water column velocities at the intake (ranging from 0.5 – 3.4 fps). These fish could swim away from

[80] The Town used proportional measurements to calculate a scaling factor of body width to total length (scaling factor = width/total length), and then used the scaling factor to estimate the length that would be physically excluded by the 2.5-inch trashrack.

[81] *See* August 29, 2019 final license application, at Appendix E: *Fish Entrainment and Mortality Study*.

the intake and attempt to pass downstream through the notch in the flashboard. However, because the 10-cfs minimum bypassed reach flow at the notch in the dam is significantly less than the 456-cfs maximum hydraulic capacity of the turbines, downstream migrating fish may not be attracted to the notch in the dam and may ultimately voluntarily pass downstream through the intake. Therefore, the overall entrainment potential for adult American shad and river herring is likely high. While the burst speeds of adult American eel and juvenile shad and river herring are greater than the average water velocity at the intake (1.8 fps), these fish could potentially be involuntarily entrained if they encounter water velocities at the higher end of the measured range (up to 3.4 fps); alternatively, these fish could ultimately attempt to voluntarily pass through the intake for the reasons described above. Therefore, the overall entrainment potential for these fish is also likely high.

Table 7. Burst speeds and overall entrainment potential of American eel, American shad, and river herring.

Species	Life Stage	Intake Encounter Potential	Burst Speed (fps)	Overall Entrainment Potential
American eel	Adult	High	2.6	High
American Shad	Adult	High	13.0	High
	Juvenile	High	2.5	High
River Herring	Adult	High	5.0	High
	Juvenile	High	2.0	High

(Source: Town, 2019, as modified by staff).

The Town used the results of Winchell et al. (2000) to estimate survival of entrained American eel, American shad, and river herring at the project. Winchell et al. (2000) summarized turbine passage survival data reported in the EPRI (1997) database by turbine type, turbine characteristics, and fish size (Table 8 and Table 9). The runner speed of the Rollinsford Project at the maximum hydraulic capacity is 360 revolutions per minute (rpm). Based on the results of Winchell et al. (2000), the mean immediate survival rate through the project's Francis turbines is expected to range from 19.1 to 70.1 percent, depending on fish size (Table 8). The mean 48-hour survival rate is expected to range from 6 to 72.4 percent, depending on fish size (Table 9). As applicable to juvenile life stages of shad and river herring (3.5 to 4.3 inches long), mean survival is expected to be 70.1 percent (immediate) and 72.4 percent (48-hour survival). As applicable to adult life stages of eel, shad, and river herring (maximum lengths of 46, 30, and 15 inches), mean survival is expected to be 19.1 percent (immediate) and 6 percent (48-hour survival).

Table 8. Average immediate fish survival rates for Francis turbines by rpm.

Turbine Type				N[a]	Average Immediate Survival All Species (%)

	Runner Speed (rpm)	Hydraulic Capacity (cfs)	Fish Size (in)		Minimum	Maximum	Mean
Francis	>250	275-695	<4	6	31.0	97.6	70.1
		275-695	4-8	7	34.3	82.7	60.0
		275-695	8-12	7	22.8	82.9	39. 3
		275-695	>12	3	3.5	35.4	19.1

(Source: Town, 2019; Winchell et al., 2000).
[a] Number of turbines for which survival estimates were available.

Table 9. Average 48-hour fish survival rates for Francis turbines by rpm.

Turbine Type	Runner Speed (rpm)	Hydraulic Capacity (cfs)	Fish Size (in)	N[a]	Average 48 Survival All Species (%)		
					Minimum	Maximum	Mean
Francis	>250	275-695	<4	3	63.3	86.3	72.4
		275-695	4-8	5	16.1	77.5	45.9
		275-695	8-12	5	12.3	64.5	32.3
		275-450	>12	2	3.5	8.4	6.0

(Source: Town, 2019; Winchell et al., 2000).
[a] Number of turbines for which survival estimates were available.

The Town also calculated turbine survival using the blade strike equation developed by Franke et al. (1997). Predicted survival is 0 percent for American eel and American shad, and 20.7 percent for river herring. Based on the high potential for entrainment and entrainment-related mortality, the project currently adversely affects downstream migrating eels, American shad, and river herring.

Downstream Anadromous Fish Passage Facilities

As discussed above in section 3.3.1.2, *Downstream American Eel and Anadromous Fish Passage*, adult and juvenile shad and river herring do not currently have access to the Salmon Falls River upstream of the project. However, to the extent that upstream passage is provided for shad and river herring at the project, as prescribed by Interior, then shad and river herring could access the Salmon Falls River upstream of the project for spawning. As discussed above in section 3.3.1.2, *Downstream American Eel and Anadromous Fish Passage, Potential for Entrainment and Impingement*, emigrating juvenile and adult shad and river herring could be adversely affected by project operation through turbine entrainment mortality.

Interior's preliminary prescription requires the Town to implement a "downstream passage and protection system that provides safe, timely, and effective downstream passage" for anadromous fish within three years of license issuance. Interior requires the

Town to develop a plan to construct, operate, and maintain permanent downstream anadromous fish passage facilities that are designed in a manner that is consistent with FWS's Design Criteria Manual. Interior does not include specific measures to be implemented.

FWS's Design Criteria Manual[82] could be used to guide the design, operation, and maintenance of the downstream fish passage facility. FWS's 2019 Design Criteria Manual recommends that surface-oriented bypass facilities and flumes used for downstream fish passage, such as the one proposed by the Town, provide: (1) a conveyance flow of 25 fps; (2) a water depth that is equal to 1 foot or two body depths of the largest fish, whichever is greater; and (3) a smooth, wetted perimeter within the flume. FWS's Design Criteria Manual also recommends clearing debris from flume prior to and during use. If a surface bypass weir is used to pass fish over the dam rather than a flume, FWS's Design Criteria Manual recommends that the surface bypass weir be at least 3 feet wide, provide a water depth of at least 2 feet, and discharge into a plunge pool that is the greater of 4 feet deep or 25 percent of the vertical distance between the discharge point and the pool surface.

Using the Town's Proposed Downstream Eel Passage Facility for Anadromous Fish Passage

The Town is not proposing to construct downstream passage facilities for anadromous fish. However, as described above in section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage*, the Town proposes to provide a downstream passage facility for adult eels within four years of license. Therefore, staff analyzed the benefits that the Town's proposed downstream eel passage facility would have for adult and juvenile alosines which could use the facility to swim downstream of the dam.

Below, in section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Proposed Downstream Eel Passage Facility*, staff described potential issues associated with attracting eels to the proposed downstream passage facility , including conflicting attraction flows to the penstock intake (456 cfs) that would be located in close proximity to the downstream passage facility entrance (25 feet). The Town's proposed flow of 25 cfs to the downstream eel passage facility would not likely attract alosines for downstream passage. The higher flows to the intake would likely attract alosines, and result in some injury and mortality associated with impingement and

[82] FWS's Design Criteria Manual was developed by the FWS's Fish Passage Engineering Team to establish, among other things, general guidance on baseline design criteria, operation, and maintenance of fishways throughout the northeastern U.S.

turbine entrainment, as discussed in section 3.3.1.2, *Downstream American Eel and Anadromous Fish Passage, Potential for Entrainment and Impingement*.

The Town states that providing 25 cfs through the proposed downstream eelway's 2-foot-wide, 2-foot-deep flume would result in a water depth of 1 foot. FWS's 2019 Design Criteria Manual recommends a minimum depth of 1 foot or twice the body depth of the largest fish. In the case of the Rollinsford Project, the largest fish would be an adult American shad, which FWS's 2019 Design Criteria Manual states has a maximum body depth of 8.75 inches.[83] Therefore, the 1-foot water depth in the proposed flume would be less than 17.5 inches as recommended by FWS's 2019 Design Criteria Manual. The 1-foot water depth would allow shad to remain submerged in the flume but would increase the potential for shad to contact the bottom of the flume, which could result in injury. However, a depth of 1 foot would provide more than twice the body depth of river herring (body depth of 3.1 inches) and would likely allow river herring to move downstream through the flume without contacting the bottom of the flume.

To estimate the flow required to provide a depth of 17.5 inches, staff used the Manning equation below:

$$Q = VA$$

$$V = \frac{1.49}{n}\left(\frac{A}{P}\right)^{\frac{2}{3}}\sqrt{S}$$

Where:

Q = discharge in cfs
A = flow area of the flume (2.92 square feet)
n = the Manning roughness coefficient (0.013)
P = wetted perimeter (4.92 feet)
S = slope of the flume (0.02 foot/foot)

The results of the equation indicate that 33.4 cfs would produce 17.5 inches of depth in the flume.

During September and October, the Town proposes to pass 25 cfs of the proposed 35-cfs minimum flow through the downstream passage facility. The Town proposes to pass the remaining 10 cfs through the waste gate in the intake headworks structure. As

[83] There are no site-specific data on the typical body depth of adult American shad for the Salmon Falls River. Therefore, we are using the Design Criteria Manual's value of 8.75 inches to represent the maximum body depth of adult American shad expected to use the project's fishway.

described in section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Proposed Downstream Eel Passage Facility*, discharging 10 cfs through the waste gate could result in injury or mortality because the receiving pool is only 1 foot deep. Providing the full 35-cfs minimum flow through the downstream passage facility would provide a sufficient depth to pass all sizes of shad and river herring with less injury or mortality compared to passing 25 cfs through the fishway and 10 cfs through the waste gate. However, the attraction flow from the penstock intake and the proximity of the intake to the entrance of the proposed downstream passage facility would likely substantially limit the use of the facility by shad and river herring even at a flow of 35 cfs.

Alternative Downstream Fish Passage Measures

A surface bypass weir could be placed on the southwest side of the spillway to pass migrating fish into the bypassed reach and away from the penstock intake. If the design of the surface bypass weir is based on the FWS's Design Criteria Manual, as prescribed by Interior, then the surface bypass weir would be a minimum of 3 feet wide, provide a water depth of 2 feet, and have a hydraulic capacity of 25 cfs. However, as discussed in section 3.3.1.2, *Environmental Effects, Minimum Flows*, the Town is proposing to release a minimum bypassed reach flow of 35 cfs. To avoid conflicting attraction flows that could be associated with releasing the 35-cfs flow in multiple locations at the dam (e.g., 25 cfs through the surface bypass weir and 10 cfs through a notch in the flashboards), the surface bypass weir could be constructed to pass the entire 35-cfs minimum bypassed reach flow.

Although a surface bypass weir located at the spillway would be farther away from the penstock intake than the proposed passage facility, alosines that are migrating downstream through the project impoundment would likely still encounter an attraction flow from the turbine intake. When the turbines are operating, water from the impoundment enters the intake headgate structure on the west end of the dam. The headgate structure is located about 40 feet from the spillway and the attraction flow to the gates in the headgate structure (up to 456 cfs) would be higher than the attraction flow to the surface bypass weir at the spillway (35 cfs). There is currently no screen at the headgate structure to prevent alosines from entering the intake headworks and the penstock intake. Any alosines entering the intake headworks structure would likely pass downstream through the turbines, which could result in injury or mortality. Installing protective measures, such as an 80-foot-wide, full-depth diversionary guidance boom[84] in front of the headgate structure would prevent alosines from entering the headgates,

[84] A diversionary guidance boom consists of a metal curtain or net suspended from floats.

thereby decreasing the potential for river herring and shad to become entrained in the turbines.

Diversionary guidance booms have been installed at the Weston Project No. 2325, Hydro-Kennebec Project No. 2611, and Lockwood Project No. 2574 on the Kennebec River to reduce the entrainment of Atlantic salmon smolts, which migrate near the surface similar to juvenile and adult shad and river herring. At the Weston and Hydro-Kennebec Projects, the guidance booms consist of 10-foot-tall metal punch plates with 0.31-inch perforations. The guidance boom at the Lockwood Project consists of a 4-foot-tall, 0.31-inch punch plate and a 6-foot-tall section of 0.31-inch Dyneema® netting[85] (Brookfield Renewable Energy Group, 2013; 2014; 2015; 2016). The licensee of these projects, Brookfield Renewable Energy Group (Brookfield), evaluated the effectiveness of the guidance boom at each project from 2012 to 2015 by releasing radio-tagged smolts upstream of each project.[86] The overall effectiveness of the booms at the three projects ranged from 33.1 to 69.2 percent, with an overall average effectiveness of 57.6 percent. Any alosines that escape outside of the boom curtains would essentially be trapped between the downstream side of the boom and the intake and would be prevented from utilizing any downstream passage facility located at the dam. Once on the downstream side of the boom, any alosines that could fit through the 2.5-inch clear-spaced trashrack would likely pass downstream through the turbines.

If the diversionary guidance boom is placed across the entrance of the channel that leads to the headgates (from the right abutment to the shoreline of the impoundment), then the boom could be angled toward the spillway to guide shad and river herring to a surface bypass weir at the project spillway. The surface bypass weir could discharge into a plunge pool downstream of the dam to reduce effects associated with fish passing over the weir onto a shallow, rocky substrate at the base of the dam. If the design of the plunge pool is based on the FWS's Design Criteria Manual, as prescribed by Interior, then the plunge pool would be 4 feet deep. Any debris around the surface bypass weir and plunge pool area could be removed on a routine basis to reduce the likelihood of injury to eels during downstream passage (Figure 10). In addition, the potential for shad

[85] Dyneema is an ultra-high molecular weight, nontoxic polyethylene fiber.

[86] Brookfield defined "boom effectiveness" as the percent of smolts that arrived at the project and passed downstream via the fish bypass system at the project.

and river herring to pass over the dam via spill, and the associated risk of injury and mortality associated spill passage, could increase as flow increases.[87]

Figure 10. Debris piled immediately downstream of the dam on the river right (Source: The Town, 2019).

Based on the studies described above, a diversionary guidance boom combined with a surface bypass weir and plunge pool would likely prevent the majority of alosines migrating downstream from entering the intake headworks and would provide a means of downstream passage at the project.

Downstream Anadromous Fish Passage Facility Operation Period

[87] The potential for injury and mortality associated with spill passage would likely increase until spilled flows were high enough to provide 4 feet of water depth in the bypassed reach at the toe of the dam. However, staff do not have sufficient information regarding the bathymetry at the toe of the dam to estimate the amount of flow necessary to produce a water depth of 4 feet.

Interior's preliminary fishway prescription would require the Town to operate the prescribed downstream anadromous fish passage facilities from June 1 to November 15. While the operational period for the downstream passage structure recommended by Interior for American shad and river herring (June 1 through November 15 each year) would prevent juvenile shad and river herring migrating downstream from entrainment and turbine mortality, the operating period would not protect adult shad and river herring migrating downstream after spawning. Adult shad and river herring passage at the Rollinsford Project could start as early as the second week of May, as evidenced by two upstream alewife passage studies conducted at the South Berwick Project located immediately downstream of the Rollinsford Project, and two downstream shad passage studies conducted at the Vernon Project (FERC No. 1904) on the Connecticut River.[88]

Consolidated Hydro New Hampshire, Inc. (Consolidated Hydro; 2007) conducted PIT-tagging studies in 2004 and 2006 to evaluate the upstream passage efficiency of the Denil fishway at the South Berwick Project for adult alewives.[89] In both years, Consolidated Hydro either first observed or collected alewives from the fishway on May 8. Because the South Berwick Project is only 1.1 miles downstream of the Rollinsford Project, shad and river herring would likely arrive at the Rollinsford Project shortly after passing upstream at the South Berwick Project. While Consolidated Hydro (2007) did not design the studies to evaluate downstream passage, 34 percent of the tagged fish migrated downstream through the Denil fishway one to three weeks after upstream passage. Similarly, during studies evaluating upstream and downstream adult American shad passage at the Vernon Project in 2015 and 2017, the median time for tagged shad to return to the downstream fish passage facilities at the Vernon Project was 12.3 days after release in 2015 and 7.8 days after release in 2017 (TransCanada, 2017; GRH, 2018). Assuming shad and river herring arrive at the Rollinsford Project around May 8, a large percentage of fish could begin returning downstream as soon as May 15. Therefore, Interior's prescribed operating period for downstream passage for shad and river herring (June 1 to November 15) would not protect adult shad and river herring migrating downstream after spawning from May 15 to May 31.

Timing of Downstream Anadromous Fish Passage Facility Installation

Interior's prescription would require a downstream fish passage facility to be operational within three years of license issuance. The downstream fish passage facility

[88] The Vernon Project is located at river mile 141.9 on the Connecticut River near the towns of Vernon, Vermont and Hinsdale, New Hampshire.

[89] PIT tags are very small tags that respond to radio specific radio frequencies at close range (2 feet or less) to transmit the tag identification number.

would be used by shad and river herring that pass upstream through Interior's prescribed upstream fish passage facilities, which would be operational by March 15 of the third calendar year after license issuance, according to Interior's prescription. To protect downstream-migrating anadromous fish, the downstream fish passage facility would need to be operational by the time fish are passing upstream, i.e., by the spring of the third calendar year after license issuance. As with the upstream fishways, there would be sufficient time to complete the design plans for the downstream fish passage facility prior to the initiation of construction according the schedule described above, assuming that the downstream fish passage facility would require one year to install.

Proposed Downstream Eel Passage Facility

The Town proposes to install and operate a downstream eel passage facility within four years of the effective date of a subsequent license, including: (1) a surface weir that would be installed in the spillway located in the intake headworks structure; and (2) an approximately 185-foot-long steel flume that would convey 25 cfs from the intake headworks structure to a 1,260-cubic foot plunge pool that would be located in the bypassed reach, approximately 190 feet downstream of the dam.

Attraction to the Passage Facility Entrance

When approaching a forebay at a hydroelectric facility, eels will spend a significant period of time near the bottom of the impoundment (Brown et al., 2009), and studies conducted by Durif et al. (2003) found that European eels were attracted to and used a submerged bypass more readily than a surface-oriented bypass. However, eels are not strictly bottom-oriented during migration (Haro et al., 2000) and will utilize a surface-oriented downstream fish passage facility (Brown et al., 2009), particularly when a hydropower facility is not generating.

FWS's Design Criteria Manual[90] could be used to guide the design, operation, and maintenance of the downstream eel passage facility. FWS's 2019 Design Criteria Manual provides specific recommendations for the downstream fish passage facility entrance, water depth in the flume, and receiving plunge pool. According to FWS's Design Criteria Manual, surface-oriented bypass facilities and conduits used for downstream fish passage should provide: (1) a conveyance flow of 25 fps; (2) a flow water depth that is equal to 1 foot or two body depths of the largest fish, whichever is greater; and (3) a smooth, wetted perimeter within the flume. The Design Criteria Manual recommends clearing debris from flumes prior to and during use.

[90] FWS's Design Criteria Manual was developed by the FWS's Fish Passage Engineering Team to establish, among other things, general guidance on baseline design criteria, operation, and maintenance of fishways throughout the northeastern U.S.

Although a surface-oriented passage facility could be used for eels, there are several design issues associated with the Town's proposed downstream passage facility that would significantly reduce the potential for the passage facility to be used by eels for downstream passage, both when the project is operating and when the project would be shut down according to the Town's proposal or Interior's prescription.

Attraction to the Passage Facility Entrance when the Project is Generating

FWS's Design Criteria Manual recommends orienting the entrance to a downstream passage facility parallel to flow. However, the entrance to the proposed downstream passage facility would be nearly perpendicular to flow in the intake headworks structure when the project is generating, and eels migrating downstream through the intake headworks structure may not leave the dominant flow path to enter the downstream fish passage facility (Figure 11). While the Town's proposed 25-cfs flow through the downstream passage facility is consistent with the recommended attraction flow in the Design Criteria Manual (25 cfs or 5 percent of the project's maximum hydraulic capacity), the proximity of the intake to the downstream fish passage facility (approximately 25 feet) and attraction flow of the intake at the maximum hydraulic capacity (456 cfs) would limit eel attraction to the downstream fish passage facility when the project is generating.[91] Although the Town proposes to implement nightly shutdowns during the eel passage season, eels could seek downstream passage during the day[92] or outside of the 0.5-inch precipitation events that would trigger the proposed nightly shutdowns. As discussed above, turbine entrainment would likely injure and/or kill downstream migrating eels.

[91] Although potentially insignificant relative to the attraction flow from the project intake, eel attraction to the downstream passage facility could also be affected by the Town's proposal to pass 10 cfs through the waste gate, which is located between the entrance to the proposed downstream fish passage facility and the intake. The Town's proposal to release 10 cfs through the waste gate in September and October is 40 percent of the proposed 25-cfs flow for the downstream fish passage facility.

[92] As described in section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Nighttime Turbine Shutdowns*, most eels migrate downstream at night. However, downstream eel passage studies at other hydropower projects have observed between 2 and 12 percent of eels migrating downstream during daylight hours (Black Bear Hydro, 2015; TransCanada, 2016; Boott Hydropower, 2020). Therefore, a small percentage of eels could be affected by the project if they migrate downstream during the day when the project would not be shut down.

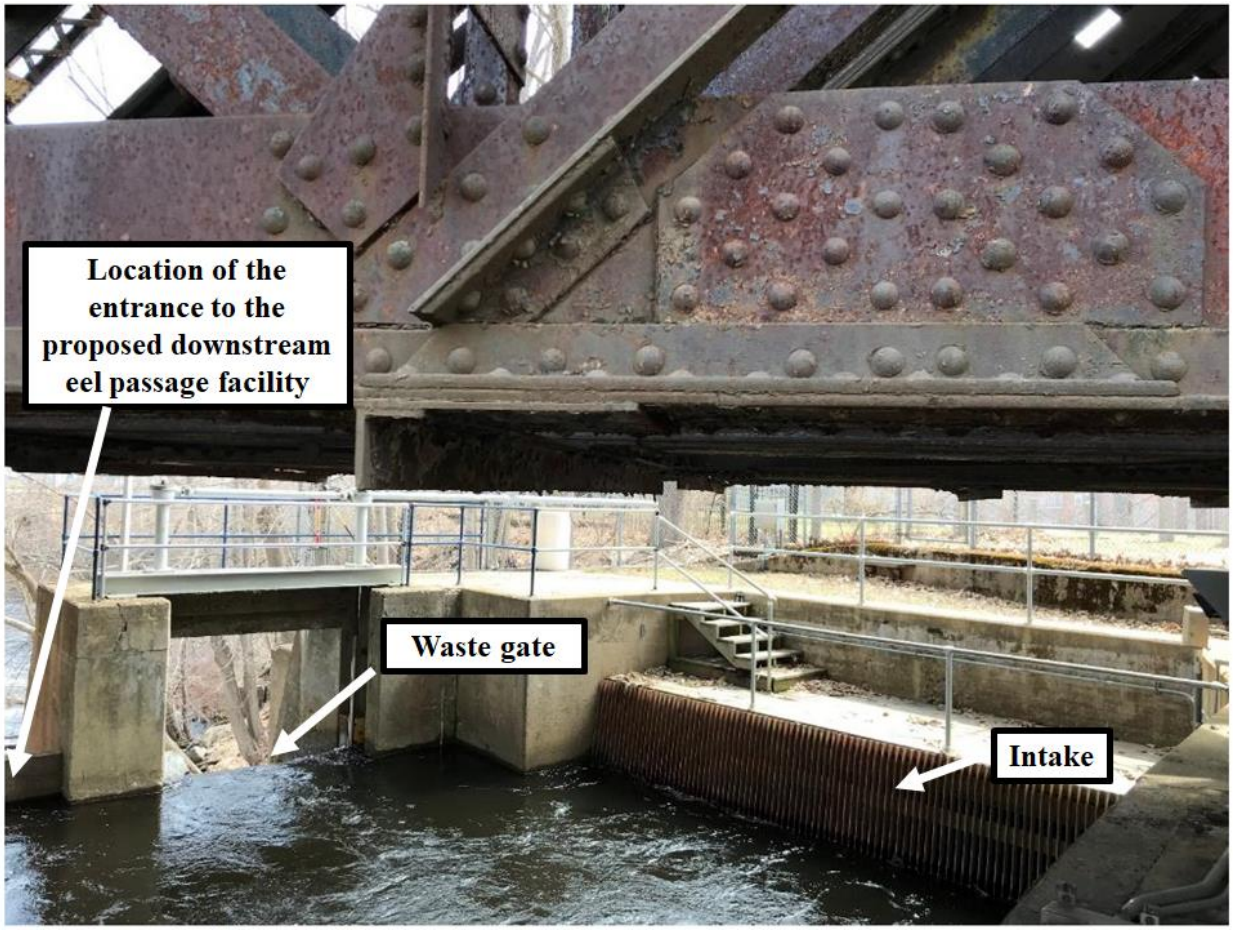

Figure 11. Photograph of the intake headworks showing the intake, waste gate, and the location of the entrance of the proposed downstream eel passage facility. (Source: Town, 2019).

Attraction to the Passage Facility Entrance when the Project is not Generating

When the project is not generating (such as during nightly turbine shutdowns and when flows are less than the combined 80-cfs minimum hydraulic capacity and minimum bypassed reach flow), then under the Town's proposal, flow would be discharged from the project through three potential means: (1) as spill over the dam (including up to 35 cfs through the notch in the dam from November through August), (2) through the proposed downstream fish passage facility (25 cfs in September and October), and/or (3) through the waste gate (10 cfs in September and October). When flow is spilling over the dam, there is the potential for eels migrating downstream to pass via spill rather than through the Town's proposed downstream passage facility. This potential to pass via spill would increase with increasing spill over the dam. For example, at the historical mean flow of 392 cfs in October (Table 2), most flow would pass over the dam (357 cfs), and downstream migrating eels would likely be attracted to the spill over the dam. As

described in section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Nighttime Turbine Shutdowns*, flows that spill over the Rollinsford Dam fall into outcrops and boulders where injury or mortality could occur. However, injury and mortality rates associated with passage via spill would likely be lower than under current operation where the primary means of passage is the turbines.

Flume Flow

During September and October, the Town proposes to pass 25 cfs of the 35-cfs minimum flow through the downstream passage facility. The Town proposes to pass the remaining 10 cfs through the waste gate in the intake headwork structure. As stated in section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Nighttime Turbine Shutdowns*, any adult eels that pass over the waste gate could be injured or killed because the pool is currently only 1 foot deep. Providing the full 35-cfs minimum flow through the downstream passage facility would eliminate the potential attraction flow associated with the waste gate and provide a greater attraction flow for the downstream eel passage facility.

Plunge Pool

The Town proposes to excavate the receiving pool for the downstream eel passage facility, but the Town did not provide any information about how deep the pool would be after excavation or the vertical distance between the pool and the discharge point of the downstream eel passage facility. FWS's 2019 Design Criteria Manual recommends a pool that it is the greater of 4 feet deep or 25 percent of the vertical distance between the pool and the downstream fish passage facility discharge point.

Alternative Downstream Eel Passage Measures

Interior's preliminary prescription requires the Town to implement permanent downstream eel passage and protection measures within three years of license issuance. Interior requires the Town to develop a plan to provide permanent downstream eel passage and protection, including passage facilities and/or operational measures that are consistent with FWS's Design Criteria Manual. Interior does not include specific measures to be implemented.

Operational protocols could include the targeted nightly shutdowns discussed above. Ceasing operation after storm events would protect out-migrating eels relative to the environmental baseline (no changes in operation during passage season) but might not mitigate project effects at all times during the passage season if eels attempt to pass through the project when the turbines are operating. For instance, some eels could migrate downstream during the day or in response to other environmental factors that do not coincide with the storm events discussed above, such as changes in water temperature

or lunar phase (Greene, 2009). To the extent that outmigration events do not coincide with the implementation of the proposed nightly shutdowns, eels could be injured or killed by entrainment at the project.

FWS's Design Criteria Manual provides guidance on different structural facilities that could be installed to provide downstream eel passage, including a surface-oriented bypass or low-level bypass. A properly designed downstream eel passage facility would provide eels with a dedicated means to pass downstream of the dam that could reduce injury and mortality relative to turbine passage and passage via spill over the dam.

However, Interior did not describe the location or design of any downstream eel passage facilities, or describe any downstream eel passage measures, that would be included in the plan. Without information about any downstream eel passage facilities or measures, staff cannot evaluate Interior's prescription.

The downstream fish passage facility described in section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Alternative Downstream Fish Passage Measures*, could provide a means of passage for eels migrating downstream. This facility would include a diversionary guidance boom to direct emigrating fish to a surface bypass weir that discharges into a plunge pool located downstream of the dam. Migrating eels are not strictly bottom-oriented during migration (Haro *et al.*, 2000) and will utilize a surface-oriented downstream fish passage facility (Brown *et al.*, 2009). When the project is shut down at night following rain events during the downstream eel passage season, eels would be attracted to the 25-cfs flow passing through the surface bypass weir and into the 4-foot deep plunge pool, which would prevent any injury or mortality associated with passage through the turbines or via spill over the dam. However, once inflow exceeds the hydraulic capacity of the weir (for example, the proposed 35-cfs minimum bypassed reach flow), flow would begin to spill over the dam. The potential for eels to pass over the dam via spill, and the associated risk of injury and mortality associated spill passage, could increase as flow increases.[93]

When the project is operating during the downstream eel passage, eels migrating downstream likely would be attracted to the flow into the intake headworks. If the diversionary guidance boom extends to the river bottom, some eels would likely be redirected toward the surface bypass weir. Because a full-depth diversionary guidance boom is unlikely to extend fully flush to the river bottom for the entire length of the

[93] The potential for injury and mortality associated with spill passage would likely increase until spilled flows were high enough to provide 4 feet of water depth in the bypassed reach at the toe of the dam. However, staff does not have sufficient information regarding the bathymetry at the toe of the dam to estimate the amount of flow necessary to produce a water depth of 4 feet.

boom, some eels may pass through gaps between the bottom of the boom and the river bottom. Any eels that pass under the boom would likely pass downstream through the turbines and be injured or killed. We analyze the benefits of nightly turbine shutdowns below.

Timing of Downstream Eel Passage Facility Installation

Interior's prescription would require the Town to implement permanent downstream eel passage and protection measures within three years of license issuance. Under this schedule, there would be sufficient time to complete the design plans for any downstream eel passage facility prior to the initiation of construction.

The Town's proposal to install and operate a downstream eel passage facility within four years of the effective date of a subsequent license would allow time for resource agency consultation, as well as final engineering and design of the downstream passage facilities. However, any adult eels that migrate downstream outside of the nightly shutdown period proposed by the Town would continue to experience residual injury and mortality when passing through the turbines when the project is generating, and eels would potentially incur injury or mortality when passing via spill over the dam. Therefore, Interior's preliminary prescription would offer greater eel protection benefits than the Town's proposal.

Nighttime Turbine Shutdowns

To reduce the potential for eel entrainment and impingement, the Town proposes nightly shutdowns after rain events. Interior's preliminary prescription also requires nightly shutdowns to protect eels until permanent downstream passage facilities are operational. By shutting down the turbines at night, all flows would be diverted from the powerhouse and would be passed as spill over the dam or through the waste gate located in the intake headworks structure. Because peak eel movements primarily occur at night following periods of increasing river flow, ceasing generation at night would significantly reduce turbine-induced injury and mortality at the project relative to current conditions.

Increasing spill over a dam by ceasing generation can be an effective means of passing eels downstream (Brown et al., 2009). When there is spill at a hydropower facility, eels are attracted to water flowing over the spillway and they will utilize spill as a route of passage (Haro et al., 2004). Eyler (2014) reports a significant reduction in project mortality during nighttime shutdowns at five hydroelectric dams on the Shenandoah River in Virginia and West Virginia. Overall, project mortality rates associated with passage over the spillway of each of the five dams in the Eyler study,

ranged from 0 percent to 6 percent during turbine shutdowns. The dams in the Eyler study ranged from 13.5 feet to 26 feet high.

The spillway at the Rollinsford Dam has a maximum height of 19 feet. Although the height of the Rollinsford Dam falls within the range of the dam heights in the Eyler study, flows that spill over the Rollinsford Dam fall into outcrops and boulders where injury or mortality could occur (Figure 8). Nonetheless, passage over the spillway would likely reduce injury and mortality relative to current operation where eels typically pass through the turbines, as discussed directly above in the entrainment and impingement analysis.

During September and October, the Town proposes to pass 25 cfs of the proposed 35-cfs minimum flow through the proposed downstream eel passage facility and proposes to pass the remaining 10 cfs through the waste gate in the intake headworks structure. However, water discharged through the waste gate lands in a pool that is approximately 8 feet wide, 4 feet long, and 1 foot deep when the waste gate is passing 10 cfs.[94] FWS's 2019 Design Criteria Manual recommends that the receiving plunge pool have a minimum depth of 4 feet or 25 percent of the vertical distance between the discharge point and the pool surface, whichever is greater, in order to prevent injury or mortality associated with contacting the bottom of the pool. The Town states that the vertical distance between the waste gate crest and the receiving plunge pool is 12 feet; given this distance, FWS's 2019 Design Criteria Manual recommends a plunge pool depth of 4 feet. While the Town does not intend for the waste gate to be used as a downstream passage route, any adult eels that pass over the waste gate could be injured or killed because the pool is currently only 1 foot deep.

As discussed above, the design of the Town's proposed downstream eel passage facility would limit the number of eels, shad, and river herring that would utilize the facility for downstream passage. If a downstream passage facility were to be installed at the dam for eel, as discussed above in *Alternative Downstream Eel Passage Measures*, then the Town could use the facility to pass the proposed 35-cfs minimum flow to the bypassed reach, instead of passing the minimum flow through a notch in the flashboards and/or the waste gate as proposed. The surface weir and 4-foot-deep plunge pool that would be part of the downstream eel passage facility described in *Alternative Downstream Eel Passage Measures*, would reduce injury and mortality associated with passage at the dam by the third year after license issuance.

Precipitation Events

[94] *See* the Town's letter filed on March 27, 2020.

Rain events can provide an important environmental cue to encourage downstream movements of out-migrating eels (EPRI, 2001; Haro et al., 2004). Ceasing turbine operation at night after a significant rainfall event would reduce turbine-induced injury and mortality at the project and would attract eels to a downstream passage route that likely has a lower injury and mortality rate than turbine passage. Significant rainfall events would also increase water depth and available habitat below the project dam, which would reduce the potential for injury as eels pass over the dam and move downstream.

The Town proposes and Interior's preliminary prescription would require nighttime turbine shutdowns (from 8:00 pm to 4:00 am) for three consecutive nights following rain accumulation of 0.5 inch or more, over a 24-hour period. Staff reviewed available precipitation data recorded approximately 11 miles downstream at the Rochester, New Hampshire airport during the downstream passage season (i.e., August through November) from 2014 to 2020 (Table 10). Precipitation during the downstream passage season is highly variable, monthly and annually. In the months and years when the 0.5-inch criterion was met, the number of days that rainfall accumulation of 0.50 inch or greater occurred ranged from 1 day per month to 5 days per month.

Table 10. Frequency of rainfall accumulation of 0.5 inch or more, and cumulative rainfall events per year of 0.5 inch or more for August, September, October, and November, from 2014 to 2020.

Year	Frequency of Rain Events > 0.5 inch in August (# days)	Frequency of Rain Events > 0.5 inch in September (# days)	Frequency of Rain Events > 0.5 inch in October (# days)	Frequency of Rain Events > 0.5 inch in November (# days)	Cumulative days/year Rain Events > 0.5 inch (# days)
2014	1	1	3	2	7
2015	2	1	2	1	6
2016	2	1	4	2	9
2017	2	2	3	1	8
2018	4	5	2	5	16
2019	2	0	4	1	7
2020	1	0	3	1	5

(Source: https://www.wunderground.com/history/monthly/us/nh/portsmouth/KPSM/date/2020-11).

Boubée et al., 2001, found that storm events that increased flow by 50 percent or more in the river cued an outmigration of European eels. In Rochester, New Hampshire, the average amount of rainfall for the downstream eel migration period is 3.94 inches per

month (U.S. Climate Data, 2021).[95] A rainfall of 0.5 inch in a 24-hour period would provide 12 percent of the average monthly rainfall during the eel passage season. On September 27, 2018, a storm event produced 0.65 inch of precipitation, which increased flow in the Salmon Falls River by 75 percent (from 102 to 135 cfs).[96] Based on this information, it appears that storms that produce 0.5 inch of rain or greater within a 24-hour period, would likely provide a significant cue to trigger an outmigration of adult eel. Ceasing generation at the project for three nights after these storm events, as proposed by the Town and prescribe by Interior, would eliminate turbine-induced injury and mortality at the project that would occur after these storm events.

Implementation of Nightly Turbine Shutdowns

Interior's preliminary prescription would require the Town to implement nighttime turbine shutdowns, as an interim measure beginning the first year of license issuance and continuing until permanent downstream passage measures are implemented at the project. The Town proposes to implement nighttime turbine shutdowns within four years of the effective date of a subsequent license. Surveys conducted by the New Hampshire FGD upstream of the Rollinsford Project (New Hampshire FGD, 2015) and at the Lower Great Falls Project 2.4 miles upstream of the Rollinsford Project (Gomez and Sullivan, 2020), indicate eels are present upstream of the Rollinsford Dam. Implementing nighttime turbine shutdowns the first passage season after license issuance would reduce injury and mortality relative to current operation, three years earlier than proposed by the Town, and therefore, the prescription would be more beneficial than the Town's proposal.

Duration of Nightly Shutdowns

The Town proposes to implement nightly turbine shutdowns for the duration of the license term once the proposed downstream eel passage facility is installed. Interior's preliminary prescription requires the Town to implement nightly shutdowns until the required downstream eel passage facility is constructed (i.e., within three years of license issuance). Therefore, the Town's proposal to implement nightly shutdowns for the duration of the license term, including before and after installation of a downstream passage facility, would offer more protection to eels migrating downstream from turbine-induced injury and mortality than the shutdowns prescribed by Interior. If a downstream passage facility were to be installed at the dam, along with a diversionary guidance boom upstream of the headgates, as discussed above in *Alternative Downstream Eel Passage*

[95] The Rochester, New Hampshire rain gage is approximately 9 miles upstream of the Rollinsford Project.

[96] Based on Salmon Falls River flow data from the USGS gage no. 01072100 in Milton, New Hampshire, located approximately 19.5 miles upstream of the Rollinsford Project,

Measures, then nightly shutdowns would reduce the likelihood of eels passing into the intake, including through any gaps between the bottom of the panels of the diversionary guidance boom and the river bottom. Eels that pass downstream using the surface bypass weir discussed above in *Alternative Downstream Eel Passage Measures*, would land in a 4-foot-deep plunge pool and be protected from injury or mortality. However, once inflow exceeds 35 cfs (i.e., the proposed minimum bypassed reach flow), eels could potentially pass via spill, which, as described in the previous paragraphs, would result in lower injury and mortality rates than passing through the turbines under current conditions.

Timing of Nightly Shutdowns

The Town proposes to conduct the proposed nightly shutdowns for downstream eel passage from 8 p.m. to 4 a.m.; whereas, Interior's preliminary prescription requires the Town to implement nightly shutdowns from dusk to dawn.[97] Maine DMR, New Hampshire FGD, and TU support Interior's prescription.

Peak movements for eels migrating downstream often occur at night during periods of increasing river flow (Richkus and Whalen, 1999). However, the Town's proposal and Interior's prescription differ in the amount of time the project would be shut down each night following rain events. To evaluate the protection for eels migrating downstream provided by the Town's proposal and Interior's prescription, staff analyzed downstream eel passage data from the Bellows Falls Project (FERC No. 1855) and Wilder Project (FERC No. 1892), located at river mile 174 and 217, respectively, on the Connecticut River (TransCanada, 2016). These projects are located at latitudes similar to the Rollinsford Project and would have nights of similar length.

TransCanada (2016) conducted a downstream eel passage study from October 27 through November 5, 2015, using radio-tagged eels and recorded the time of downstream passage for each eel at each project. Between 8 p.m. and 4 a.m., 66.7 percent of the radio-tagged eels passed downstream at the Wilder Project, and 73.1 percent of the eels passed downstream at the Bellows Falls Project. In contrast, 100 percent of the eels passed downstream at the Wilder Project from 6 p.m. until 7 a.m., and 96.7 percent of the eels pass downstream of the Bellows Falls Project during the same period.[98] Therefore,

[97] Interior did not define "dusk" or "dawn." Therefore, staff assume Interior's recommended shutdown period starts at sunset and ends at sunrise.

[98] The length of time between sunset and sunrise increases from August 15 through November 15. For the purpose of this analysis, staff used the time of sunset on

Interior's prescription would protect approximately 28.5 percent more eels, on average, than the Town's proposal.

However, the difference between the Town's proposal and Interior's prescription in the amount of time the project would be shut down increases during the downstream eel passage season. The Town's proposal would result in the project being shut down for eight hours each night. Under Interior's prescription, the project would be shut down for 10.1 hours during the night of August 15 to August 16 and 14.3 hours during the night of November 14 to November 15 for the downstream eel passage season prescribed by Interior.

Season for Implementing Downstream Eel Passage Measures

The Town proposes to implement nighttime turbine shutdowns and operate the downstream eel passage facility from September 1 through October 31. Interior's prescription would require the Town to implement downstream eel passage measures from August 15 to November 15. Available literature indicates that the downstream eel migration season extends from August through November (Oliveira and McCleave 2000; Haro et al. 2004; ASMFC 2013). Therefore, Interior's prescription would provide greater benefits to eels than the Town's proposal.

Fishway Plan

Interior's preliminary prescription condition 11.6.1, *Implementation*, would require the Town to develop design plans for upstream and downstream fishways, and to submit these plans to FWS and other resource agencies for review and approval during conceptual, 30 percent, and 90 percent design stages. Prescription condition 11.6.1 also includes specific design schedules and installation dates for each of the downstream and upstream anadromous and eel passage fishways. In addition, Interior's preliminary prescription conditions 11.10 and 11.11 require the Town to develop plans to provide permanent downstream eel and alosine passage, respectively, in conformance with the implementation schedule specified in prescription condition 11.6.1.

Under section 10(a) of the FPA, Commerce recommends that the Town develop, in consultation with the resource agencies, a fish passage implementation plan "for providing safe, timely, and effective" passage of juvenile and adult American eel, alewife, blueback herring, and American shad. Commerce recommends that the plan

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the evening of October 30 to the time of sunrise on the morning of October 31 (5:37 p.m. to 7:17 a.m.) because this time period was approximately in the middle of the TransCanada (2016) study and is still within the downstream passage season proposed by the Town.

include a phased approach that assesses: (1) the feasibility, design, and timing for construction and operation of fishways; (2) the movement and migratory behavior of target species; (3) migration seasons for each target species; and (4) procedures for ensuring effective upstream and downstream passage.

Interior's prescription requires the development, in consultation with FWS, New Hampshire FGD, Maine DIFW, and NMFS, of a fishway operation and maintenance plan that includes measures for operating and maintaining new upstream and downstream fish passage facilities. Interior requires the plan to include: (1) a schedule for routine fishway maintenance to ensure that the fishways are ready for operation at the start of the season; (2) procedures for routine upstream and downstream fishway operations; and (3) procedures for monitoring and reporting on the operation and maintenance of the facilities as they affect fish passage. Interior would require the Town to submit the fishway operation and maintenance plan to the FWS for review and approval prior to submitting it to the Commission for its approval and to update the fishway operation and maintenance plan annually to reflect any changes in operation and maintenance planned for the year.

Maine DEP's certification conditions 3E and 4E require the Town to develop a fishway operation and maintenance plan describing operation and maintenance of the upstream and downstream fish passage facilities.

Our Analysis

Developing an implementation schedule that incorporates milestones for: (1) submitting conceptual and final design plans for review and approval to the resource agencies and to the Commission; and (2) constructing and installing the upstream and downstream passage facilities would ensure there is a clear schedule in place for all of the milestones associated with data collection, consultation, and facility design and construction.

To maintain the effectiveness of fish passage facilities, fishways need to be properly operated and maintained. Most fishways require routine maintenance to ensure the fishways operate effectively. A fishway operation and maintenance plan would ensure that routine cleaning and maintenance, including debris removal, are performed so that the fishways operate as intended. In addition, the plan would ensure that any fishways constructed at the project would be operated during the appropriate times of the day and year, and with an appropriate conveyance flow.

Fishway Effectiveness Monitoring Plan

Interior's preliminary fishway prescription would require the Town develop a plan in consultation with, and requiring approval by, FWS to ensure: (1) the effectiveness of

the upstream and downstream eel and fish passage measures required by Interior; and (2) that the minimum bypassed reach flow of 35 cfs provides "safe, timely, and effective" downstream fish and eel passage (i.e., does not strand fish).

Maine DEP's certification conditions 3D and 4D require the Town to design effectiveness studies for the upstream and downstream fish passage facilities and/or measures in consultation with FWS, Maine DMR, New Hampshire FGD, and other state and federal resource agencies, and conduct the studies in accordance with the schedules established by the Commission.

Our Analysis

Fishway efficiency evaluations may take many forms, including video observation, sample collection, hydro-acoustics, telemetry, or passive integrated transponder studies. A passage effectiveness study typically evaluates factors such as attraction flows, attraction efficiency, passage efficiency, passage delay, and survival rates. As stated in FWS's 2019 Design Criteria Manual, efficiency testing is typically evaluated quantitatively through a site-specific framework and performance standards are generally informed by state and federal agencies with expertise in the life history requirements of the region's fish populations. Factors to consider include the impact of all barriers within the watershed and the minimum number of fish required to sustain a population's long-term health and achieve identified management plan objectives and goals.

Interior and Maine DEP have not included any specific performance standards that would be used to test the effectiveness of the fish passage facilities. Instead, Interior would require the development of plans and performance standards post-licensing, in consultation with resource agencies. Without specific performance standards to analyze, there is no basis for assessing the benefits of effectiveness testing for fish passage and determining whether effectiveness testing would or would not provide benefits to American shad, river herring, and American eels.

Interior's preliminary fishway prescription would require new fish passage facilities to be designed with species-specific design criteria recommended by FWS's 2019 Design Criteria Manual, and that the facilities be operated and maintained in accordance with a fish passage operation and maintenance plan that is developed in consultation with the resource agencies and approved by the Commission. Since the facilities would be designed, operated, and maintained using proven design criteria and operating procedures, there is no apparent benefit to conducting effectiveness studies.

Migration Habitat Monitoring

Under section 10(j) of the FPA, Commerce recommends that the Town "prepare a plan and implement monitoring of the suitability of upstream and downstream migration

habitat for diadromous fish under the required minimum bypass flows." Commerce states that the plan should be developed according to scientifically accepted practices including but not limited to radio-telemetry, paired release, and passive integrated transponder (PIT) tags.[99]

Our Analysis

Commerce did not include specific methods for monitoring the suitability of minimum bypassed reach flows for migratory fish; specific performance standards for assessing when flows were unsuitable; or specific enhancement measures for improving suitability. Without specific measures to analyze, there is no basis for assessing the benefits or costs of Commerce's recommendation.

Information is available on physical migration habitat in the bypassed reach. As described in section 3.3.1.2, *Environmental Effects, Bypassed Reach Minimum Flow*, the Town's 2018 instream flow study describes how habitat availability for shad and river herring larvae, juvenile, adults, and spawning and incubation changes at flows ranging from 30 to 100 cfs. In addition, the Town measured water depth and velocity through several transects at 29, 43, 82, and 120 cfs to identify flows that produced depth or velocity barriers that would prevent shad and river herring from moving through the transects.

The Town's 2018 instream flow study did not evaluate habitat availability for juvenile or adult eels. However, the Town's 2018 upstream eel passage study collected juvenile eels migrating upstream near the project dam at the current 10-cfs minimum bypassed reach flow, which indicates that juvenile eels can reach the project dam under current conditions. Eels are habitat generalists, and any increase in flow over the current 10 cfs minimum flow would likely provide at least some additional habitat for juvenile and adult eels and provide additional wetted area for juvenile eels to migrate upstream through the bypassed reach.

Given the information provided above about velocity and depth in the bypassed reach, it is unclear what additional information Commerce's recommended study would provide about the suitability of the bypassed reach for upstream and downstream migration.

[99] PIT tags are very small tags that respond to specific radio frequencies at close range (2 feet or less) to transmit the tag identification number.

Climate Change

Commerce states that Hare et al. (2016) identified American shad and river herring as highly vulnerable to the anticipated effects of climate change due to their habitat specialization, dependence on both freshwater and marine resources, sensitivity to water temperatures, and complex spawning cycle. Commerce also states that the effects of climate change in New England may be compounded since the areas surrounding many river basins where shad and river herring are found are heavily populated and have been affected by the effects of agriculture, industrialization, and urbanization, including dams and hydropower development. Commerce states that, for the reasons listed above, the compounding effects of climate change should be evaluated as part of the environmental analysis of the Rollinsford Project.

Our Analysis

Historical data for the New England region shows that changes in air temperature, water temperature, precipitation, and streamflow have occurred (Rosenzweig et al. 2007; Kaushal et al., 2010; Horton et al., 2014). From 1895 to 2011, air temperature in the northeast United States (i.e., West Virginia and Maryland to Maine) has increased almost 2 °F, or 0.16 °F per decade (Horton et al., 2014). Similar to the trends observed in air temperatures, Kaushal et al. (2010) found that several rivers and streams in the United States have warmed by 0.2 to 1.4 °F per decade over the past 50 to 100 years. One watershed in the study, the Hubbard Brook watershed, in Woodstock, New Hampshire (approximately 67 miles northwest from Rollinsford, New Hampshire) did not show a trend in water temperature in its full, 40-year period of record (1966 to 2007; Kaushal et al., 2010). However, water temperature in the watershed did increase 1.9 °F from 1980 to 2007 (Kaushal et al., 2010).

Since 1895, total annual precipitation has increased by 0.63 inch per decade in New Hampshire and 0.41 inch per decade in Maine (Bradley et al., 2015; Fernandez et al., 2020). In Maine, the depth of annual snowfall has decreased by 20 percent (i.e., 2.3 inches; Fernandez et al., 2020). The Northeast has experienced a greater increase in extreme precipitation events than any other region in the United States (Horton et al., 2014). Between 1958 and 2010, the amount of precipitation falling in very heavy events, defined as the heaviest one percent of all daily events, increased by more than 70 percent (Horton et al., 2014).

Although NMFS provided general statements about the potential for climate change to affect fish species, it did not provide any specific information about how climate change would affect the species, including how passage seasons or streamflow would change in the Salmon Falls River. As stated by NMFS, "it is not possible to predict how any change in water temperature or river flow alone will affect the seasonal movements of migrating fish through the action area." Therefore, we cannot predict

whether and to what extent climate change could affect species with sufficient precision to identify and evaluate today any operational changes that could protect fish from future climate change effects. However, to the extent that the upstream and downstream migrations periods change for eels or anadromous fish, Interior's preliminary prescription allows Interior to change the prescribed fish passage operating periods based on new information, evaluation of new literature, and agency consultation.

Cumulative Effects

Water Quality

As described above in section 3.3.1.1, *Affected Environment, Water Quality*, the Salmon Falls River within the reach where the Rollinsford Project is located has several water quality impairments on the 303(d) list: *Escherichia coli,* ammonia, nutrient/eutrophication, DO, phosphorus, and biochemical oxygen demand. These impairments are attributed to upstream non-point and point source pollutants such as municipal wastewater treatment plants. These conditions are present during the low flow, warm summer months when the project is not generating electricity due to inflows being below the minimum hydraulic capacity of 80 cfs. The project is operated in a run-of-river mode, and project operation is primarily influenced by seasonal hydrologic conditions and upstream flow releases from other projects. Water temperature and DO profiles collected in the impoundment showed summer stratification conditions, as well as low DO conditions in the deepest location of the impoundment in July (3.8 mg/L) and September (3.4 mg/L) at impoundment depths between 6.56 and 9.84 feet.

If the project continues to operate as a run-of-river facility and if the minimum bypassed reach flow is increased from 10 cfs to 35 cfs, as proposed by the Town, then the effect of relicensing would be cumulatively beneficial to water quality in the bypassed reach, particularly DO. Higher DO levels could in turn improve conditions for fish and macroinvertebrates.

Migratory Fish Species

Fish Passage

Upstream Migration

As described in section 3.3.1.2, *Environmental Effects, Upstream Anadromous Fish Passage*, American shad and river herring may have migrated at least as far upstream in Salmon Falls River as Somersworth, New Hampshire (Old Berwick Historical Society, 2020). The migrations of alewife, American eel, American shad, blueback herring, and sea lamprey in the Salmon Falls were delayed and/or blocked by the construction of sawmills along the Salmon Falls River and Great Works River in the

mid to late 1600s. The sawdust the mills dumped into the river, along with sewage and agricultural runoff likely contributed to the deterioration of spawning and nursery habitat (Odell et al., 2006). By the 1790s, American shad were rarely caught near Berwick, Maine (Chadbourne, 1790s).

While there are currently 15 dams on the mainstem Salmon Falls River, only the lower five have the potential to adversely affect anadromous fish migrating to the likely historical limit of their range in Somersworth, Maine (Table 1). The installation of the upstream fishway at the South Berwick Project in 2002 provided access to approximately 1.1 miles of potential mainstem habitat for anadromous fish.[100] Similarly, the installation of upstream eel passage facilities at the South Berwick Project also improved upstream passage efficiency for eels. Providing upstream anadromous fish passage at the Rollinsford Project dam and in the bypassed reach, as discussed above in section 3.3.1.2, *Environmental Effects, Upstream Anadromous Fish Passage*, would improve eel migration and restore anadromous fish migration through the bypassed reach and past the project dam. These measures would provide access to an additional 2.3 miles of potential mainstem habitat for American shad and river herring and reduce the cumulative effects on upstream anadromous fish migration in the Salmon Falls River. Installing an upstream eel passage facility at the Rollinsford Project, as discussed above in section 3.3.1.2, *Environmental Effects, Upstream Eel Passage*, would improve upstream eel migration in the river.

Downstream Migration

Currently, upstream passage at the South Berwick Project allows river herring to migrate as far upstream as the bypassed reach of the Rollinsford Project.[101] Although downstream passage facilities exist at the South Berwick Project,[102] downstream migration delay may still occur at the South Berwick Project for juvenile shad and river

[100] The upstream fishway at the South Berwick Project is a Denil fishway, which is intended to provide upstream passage for shad and river herring. In addition, because sea lamprey have been observed using technical fishways at other hydropower projects, sea lamprey also potentially use the fishway at the South Berwick Project.

[101] American shad migrate as far upstream as the South Berwick Project, but have not been observed using the upstream passage facility at that project.

[102] A 4-foot-wide Denil fishway provides upstream and downstream passage at the South Berwick Project. For the downstream migration season, the facility is re-configured by removing the baffles from the Denil fishway and inserting stop logs at a turn pool in the ladder, which diverts and discharges fishway flow and migrants directly to the tailwater (Consolidated Hydro, 2007).

herring, and adult eels. While the trashracks at the South Berwick Project exclude adult eels, shad, and river herring, some entrainment of juvenile shad and river herring may occur, and any entrained juvenile shad and river herring may be killed during turbine passage at the project.

The Rollinsford Project currently does not have upstream eel passage facilities; however, juvenile eels are able to migrate upstream past the Rollinsford Dam and have been identified as far upstream on the Salmon Falls River as the South Milton Project (FERC No. 3984), approximately 23 miles upstream from the Rollinsford Project. Adult eels may experience downstream passage delay and mortality at each dam as they pass downstream. The Rollinsford Project does not have downstream eel passage facilities, and the current trashrack configuration allows adult eels to enter the intake, which likely results in some entrainment mortality. However, the Town proposes to install, and Interior's preliminary fishway prescription would require, the installation of a permanent downstream eel passage facility and/or operational measures. In the interim period between license issuance and the implementation of permanent measures, the Town proposes to implement, and Interior requires, nightly shutdowns for three nights following rainfall events of 0.5 inch or greater. While some adult eels may be injured passing downstream over the dam, passage via spill during the interim period, nightly shutdowns and passage via spill would decrease injury and mortality relative to downstream passage through the project turbines. Once the downstream passage facilities are installed, mortality and injury associated with passage during spill or through the turbines would likely be minimized. Therefore, the proposed and required downstream passage measures would reduce the cumulative effects on downstream migration for adult eels.

Although no shad or river herring are present upstream of the Rollinsford Project, Interior's prescribed downstream anadromous fish passage facilities would minimize the adverse effects of the project on any downstream-migrating adult shad or river herring that successfully use the upstream fish passage facilities required by Interior's preliminary fishway prescriptions, and any downstream-migrating juveniles resulting from any spawning that occurs upstream of the Rollinsford Project dam. By providing access to additional habitat upstream of the project and minimizing adverse project effects during downstream migration through the installation of prescribed upstream and downstream fish passage facilities, respectively, the project would be cumulatively beneficial for shad and river herring.

Bypassed Reach Habitat

Currently, the Town releases a minimum flow of 10 cfs into the bypassed reach through a notch in the flashboards at the dam. However, the Town proposes to increase the minimum flow to 35 cfs, which would increase the amount of habitat available for shad and river herring spawning and incubation, fry, juvenile, and adults in the bypassed

reach. These flows would also increase the amount of spawning and incubation habitat for sea lamprey. As stated in section 3.3.1.2, *Environmental Effects, Migration Habitat Study*, the Town's 2018 instream flow study did not evaluate habitat availability for juvenile or adult eels. However, eels are habitat generalists, and any increase in flow over the current 10 cfs minimum flow would likely provide at least some additional habitat for juvenile and adult eels and provide additional wetted area for juvenile eels to migrate upstream through the bypassed reach. Therefore, increasing the minimum flow would be cumulatively beneficial for anadromous fish and eels in the bypassed reach.

3.3.2 Terrestrial Resources

3.3.2.1 Affected Environment

The Rollinsford Project is located in the Gulf of Maine Coastal Lowland area of the Northeastern Coastal Zone ecoregion (Griffith et al., 2009), which is characterized by flat to irregular plains, with some low hills. Upland forested areas in the project vicinity primarily consist of Appalachian oak-pine forests with red, white, and black oaks, with occasional white pine, sugar maple, red maple, hickories, and other central or northern hardwoods.

The project facilities are located in an urban setting within the town of Rollinsford. Lands surrounding the project impoundment consist of narrow strips of forested uplands and a few areas of palustrine wetlands, surrounded by developed land.

Wetlands

According to FWS's National Wetlands Inventory system (FWS, 2017), approximately 15 acres of wetland habitat occur within the project boundary, including 8 acres of emergent wetlands, 6.5 acres of scrub-shrub/forested wetlands, and a 0.5-acre freshwater pond. The emergent wetlands are small islands located within the impoundment, while the scrub-shrub/forested wetlands and the freshwater pond are scattered along the shoreline of the impoundment.

Wildlife

Wetlands and forested upland habitat around the project support a variety of wildlife species. However, the fragmented habitat in the project vicinity limits wildlife diversity to species with small home ranges or a tolerance for human disturbance.

Mammals common to the area include whitetail deer, raccoon, opossum, and woodchucks. Numerous bird species are known to occur in the area at various times throughout the year, including resident and migratory waterfowl such as mallard, wood

duck, Canada goose, black duck, great blue heron, common and hooded mergansers, and common loon.

New Hampshire FGD identified two state-listed endangered species that could occur in the project area: Blanding's turtle (*Emydoidea blandingii*) and New England cottontail (*Sylvilagus transitionalis*). Blanding's turtle, a semi-aquatic species, uses large intact landscapes to seasonally move between wetlands, vernal pools, and sandy open areas. New England cottontail is a species of cottontail rabbit whose preferred habitat includes young forest and shrubland.

3.3.2.2 Environmental Effects

Project Operation

The Town proposes, New Hampshire DES's certification condition E-10a requires, and Interior and Commerce recommend under section 10(j) that the Town operate the project in a run-of-river mode, such that outflow approximates inflow at all times. The Town proposes, and Maine DEP's certification condition 1A and New Hampshire DES's certification condition E-10c require that the Town maintain the surface elevation of the impoundment at 71.25 feet NGVD. The Town proposes to increase minimum bypassed reach flow from 10 cfs to 35 cfs. Interior and Commerce also recommend under section 10(j) a minimum bypassed reach flow of 35 cfs, except during the upstream American shad and river herring migration period (April 15 through July 15), when they recommend a flow of 60 cfs. Maine DEP's certification condition 2A and New Hampshire DES's certification condition E-10b require the Town to release a year-round minimum bypassed reach flow of 35 cfs or inflow, whichever is less, prior to the installation of upstream fish passage facilities. After the installation of upstream fish passage facilities at the project, Maine DEP's certification condition 2A and New Hampshire DES's certification condition E-10b require the Town to release: (1) a minimum flow of 35 cfs or inflow, whichever is less, from July 16 – April 14; and (2) an unspecified minimum flow from April 15 – July 15, the quantity of which must be determined in consultation with resource agencies.

Interior recommends, and New Hampshire DES certification condition E-10d requires an impoundment refill procedure after the impoundment is drawn down for emergencies and maintenance, whereby 90 percent of inflow is passed downstream and the impoundment is refilled on the remaining 10 percent of inflow to the project. NMFS also recommends developing an impoundment refill plan but does not specify a flow percentage to pass downstream of the dam as the impoundment refills. New Hampshire FGD filed comments in support of Interior's recommendations.

To enhance water quality in the impoundment during critical low flow periods,[103] the Town proposes to implement a draft Water Quality Mitigation and Enhancement Plan (water quality plan) that includes: (1) drawing down the impoundment by 1.25 feet within a period of 48 hours if total inflow to the project has been recorded as less than 80 cfs for 7 consecutive days; (2) refilling the impoundment by retaining all inflow except the 35-cfs bypassed reach minimum flow; and (3) monitoring water temperature and DO concentrations in the impoundment.

Our Analysis

Currently, the Town voluntarily operates the project as a run-of-river facility, such that outflow from the project approximates inflow. Continuing to operate the project in a run-of-river mode would maintain stable impoundment levels and minimize effects on terrestrial habitat along the shoreline of the impoundment and the Salmon Falls River downstream of the project. There are no wetlands in the bypassed reach; therefore, none of the proposed changes to the minimum bypassed reach flows would be expected to affect wetlands.

Drawing down the impoundment during low flow periods between July 1 through September 15, or for maintenance or emergencies would dewater wetlands in the impoundment. The method in which the impoundment is refilled following the drawdown would affect the length of time in which the wetlands are dewatered. Following a drawdown event, wetlands in the impoundment would continue to be dewatered until the impoundment is refilled to 71.25 feet NGVD29. Currently, there is no requirement for the Town to use a specific procedure for refilling the impoundment after a drawdown.

Following impoundment drawdowns for maintenance or emergencies, New Hampshire DES certification condition E-10d and Interior's recommendation to release 90 percent of the inflow to the downstream reach, while retaining 10 percent of inflow to refill the impoundment, would ensure that downstream flows are kept at or near project inflow levels and would avoid dewatering wetlands downstream. This refill procedure would result in an average impoundment refill time of 7.9 days, if the impoundment were to be completely dewatered.[104] The refill procedure required by New Hampshire DES

[103] The Town defines "critical low flow periods" as when total inflow to the project has been less than 80 cfs for seven consecutive days during the months of July 1 through September 15.

[104] The estimated time to refill the impoundment to 71.25 feet NGVD29 is calculated using 10 percent of the average annual flow of 292 cfs and an impoundment storage capacity of 456 acre-feet (19,863,360 cubic feet).

and recommended by Interior would keep dewatering effects localized and refill the impoundment quickly enough to avoid long-term impacts to wetlands along the impoundment. Overall, this refill procedure would be beneficial to wetlands in the project vicinity.

During periods of low flow, the Town has proposed to "flush stagnant water from the impoundment" by drawing down the impoundment to 70.0 feet NGVD29 over a period of 48 hours and then refilling it using all inflow except the 35-cfs minimum bypassed reach flow. Under these circumstances, the impoundment refill time is estimated to take up to 3.5 days, depending on project inflow.[105] Dewatering wetlands in the project impoundment and in the Salmon Falls River downstream of the project on a short-term basis, would not be expected to result in long-term impacts to the wetland habitat.

Wildlife

The Town does not propose any specific measures for the protection of wildlife resources at the project. No agencies filed recommendations for wildlife or terrestrial resources.[106]

Our Analysis

Continuing to operate the project in a run-of-river mode would maintain stable impoundment levels and minimize effects on terrestrial habitat along the project impoundment. Maintaining a minimum flow to the bypassed reach would minimize effects to riparian habitat along the bypassed reach by providing stable hydrological conditions. A stable hydrology in the bypassed reach would reduce project effects on foraging opportunities for aquatic and semi-aquatic wildlife, including waterfowl and some mammals.

Project maintenance would be limited to routine mowing and would not be expected to significantly affect local wildlife. Because of the urban location of the project, overall impacts to wildlife would be limited. Therefore, there is no indication that any measures are needed to protect wildlife resources at this time.

[105] The Town estimates that it would take between approximately 83 hours to refill the impoundment at inflow of 50 cfs, 50 hours at 60 cfs, 28 hours at 80 cfs, and 10 hours at 160 cfs.

[106] We discuss Interior's section 10(j) recommendations for the NLEB, in section 3.3.3.2.

Species of Concern

Scrub-shrub habitat along the Salmon Falls River provides suitable habitat for Blanding's turtle. However, in the project vicinity, habitat is largely fragmented due to the more urban setting of the project and is likely a limiting factor for this species. New England cottontail's preferred habitat includes young forest and shrubland. At the project, a forested/shrub area along the impoundment could provide suitable habitat. The project does not appear to be adversely affecting these species or their habitats as currently licensed, and no activities that would be expected to adversely affect these species have been proposed. Therefore, there is no indication that any specific measures to protect these species are needed at this time.

3.3.3 Threatened and Endangered Species

3.3.3.1 Affected Environment

According to the FWS's Information for Planning and Consultation (IPaC) database, the NLEB is the only federally listed species that could occur in the project vicinity. The NLEB was listed as a federally threatened species under the ESA on May 4, 2015. The NLEB is also a state-listed endangered species in New Hampshire and Maine. In January 2016, the FWS finalized the 4(d) rule for this species, which focuses on preventing effects on bats in hibernacula associated with the spread of white-nose syndrome[107] and effects of tree removal on roosting bats or maternity colonies (FWS, 2016a). As part of the 4(d) rule, FWS proposes that take incidental to certain activities would not be prohibited, if the following criteria are met: (1) occurs more than 0.25 mile from a known, occupied hibernacula; (2) avoids cutting or destroying known, occupied maternity roost trees during the pup season (June 1 – July 31);[108] and (3) avoids cutting or destroying any tree within a 150-foot radius of a known, occupied maternity tree during the pup season.

Traditional ranges for the NLEB include most of the central and eastern U.S., as well as the southern and central provinces of Canada, coinciding with the greatest abundance of forested areas. The NLEB, whose habitat includes large tracts of mature, upland forests, typically feeds on moths, flies, and other insects. These bats are flexible in selecting roost sites, choosing roost trees that provide cavities and crevices, and trees

[107] A hibernaculum is where a bat hibernates over the winter, such as in a cave. White-nose syndrome is a fungal infection that agitates hibernating bats, causing them to rouse prematurely and burn fat supplies. Mortality results from starvation or, in some cases, exposure.

[108] Pup season refers to the period when bats birth their young.

with a diameter of 3 inches or greater at breast height.[109] Human-made structures, such as buildings, barns, bridges, and bat houses can be considered potential summer habitat. However, trees found in highly developed urban areas (*e.g.*, street trees, downtown areas) are unlikely to be suitable NLEB habitat (FWS, 2014). NLEB are generally active from April through October (FWS, 2015a, FWS, 2016b), and hibernate over the winter season. Winter hibernation typically occurs in caves and areas around them and can be used for fall-swarming[110] and spring-staging.[111]

The project is located within the white-nose syndrome buffer zone for this species.[112] Although there is no documentation of NLEB at the project, and no known NLEB hibernacula sites occur within 0.25 mile of the project, upland and wetland forest in the project vicinity may provide suitable habitat for NLEB summer roosting and foraging activities. No critical habitat has been designated for this species.

3.3.3.2 Environmental Effects

Under section 10(j), Interior recommends that the Town avoid adverse effects on NLEB by either: (1) avoiding all tree removal activities between April 1 and October 1; or (2) conducting bat "exit" surveys to confirm that no bats are present in potential roost trees slated to be removed, within 24 hours of scheduled removal. New Hampshire FGD filed the same recommendation in a comment letter.

Our Analysis

The Town has not proposed any major ground-disturbing or tree-clearing activities that would affect potential NLEB summer roosting and foraging habitat. However,

[109] Diameter at breast height refers to the tree diameter as measured about 4 to 4.5 feet above the ground.

[110] Fall-swarming fills the time between summer and winter hibernation. The purpose of swarming behavior may include: introduction of juveniles to potential hibernacula; copulation; and gathering at stop-over sites on migratory pathways between summer and winter regions.

[111] Spring-staging is the time period between winter hibernation and migration to summer habitat. During this time, bats begin to gradually emerge from hibernation and exit the hibernacula to feed but re-enter the same or alternative hibernacula to resume daily bouts of torpor (i.e., a state of mental or physical inactivity).

[112] The white-nose syndrome buffer zone encompasses counties within 150 miles of a U.S. county or Canadian district in which white-nose syndrome or the fungus that causes white-nose syndrome is known to have infected bat hibernacula.

installation of new upstream and downstream fish and eel passage facilities at the project could result in limited tree removal for construction staging that could affect NLEB habitat.

Avoiding the removal of trees with diameters that are equal to or greater than 3 inches at breast height from April 1 through October 1, as recommended by Interior, would reduce the likelihood of disturbing NLEB and their newly-born pups during the broader, active season of NLEB at the project. Conducting bat exit surveys to confirm that no bats are present in potential roost trees targeted for removal and within 24 hours of scheduled tree removal would also protect bats.

With the implementation of either tree-cutting restriction measures or bat surveys prior to tree removal, the Rollinsford Project may affect the NLEB, but any incidental take that may result is not prohibited under the 4(d) rule. Therefore, we will follow FWS's optional streamlined consultation framework that allows federal agencies to rely on the 4(d) rule to fulfill section 7(a)(2) consultation requirements for NLEB (FWS, 2016c).

3.3.4 Land Use and Recreation

3.3.4.1 Affected Environment

Land Use

Stafford and York counties are primarily forested. Commercial and residential development and agriculture account for the next largest land use, but these compose only a fraction of the total land. The counties contain many lakes that are used for recreation and as natural areas. The immediate project area is suburban and is surrounded by farms and forest (Google Maps, 2020).

The current project boundary for the Rollinsford Project as established in the Commission's 1981 License Order[113] encompasses approximately 82 acres. The current project boundary encloses: (1) a 70-acre impoundment;[114] (2) approximately 7 acres of land on the shoreline of the impoundment, above the normal maximum pool elevation of 71.25 feet NGVD29; (3) the 680-foot-long bypassed reach; (4) approximately 0.4 acre of land adjacent to the bypassed reach on the left side of the river; and (5) the project

[113] *See Town of Rollinsford, New Hampshire*, 16 FERC ¶ 62,474 (1981).

[114] The upper extent of the 84-acre impoundment that is formed at a surface elevation of 71.25 feet NGVD29 is located approximately 2.2 miles upstream of the dam. The current project boundary ends approximately 0.9 mile upstream of the dam; therefore, the project boundary includes only 70 acres of the 84-acre impoundment.

facilities listed above in section 2.1.1. No federal land occurs within or adjacent to the project boundary.

Statewide Recreation Plan

The 2019-2023 New Hampshire Statewide Comprehensive Outdoor Recreation Plan (SCORP) identifies outdoor recreation as central to the state's economic, environmental, and community health values. The SCORP identifies broad goals of using outdoor recreation to secure a future where New Hampshire residents and visitors live healthier lifestyles; wildlife, water, and natural resources are conserved; and the economic vitality of communities is sustained (New Hampshire Department of Natural and Cultural Resources, 2019). The 2020-2024 Maine SCORP identifies recreation as a major engine of economic activity and an asset as communities strive to be healthy, vibrant places where people are excited to live, work, and play (Maine Department of Agriculture, Conservation, and Forestry, 2020).

Regional Recreation Opportunities

The Salmon Falls/Piscataqua River Valley contains many opportunities for public recreation, including historical sites, boating, fishing, and hiking. The towns surrounding the town of Rollinsford contain numerous small public parks and natural areas. New Hampshire's Pawtuckaway State Park is located approximately 20 miles southwest of the project. The 5,000-acre park includes a lake, beach, trails, campground (New Hampshire State Parks, 2020a), and the geological attractions of a glacial erratic boulder field and a 275-million-year-old volcanic ring dike (Godlewski, 2003). The Great Bay National Estuarine Research Reserve, located approximately 8 miles south of the project, protects over 10,000 acres of water and shoreline and has opportunities for boating, hiking, wildlife viewing, hunting, and fishing (Great Bay National Estuarine Research Reserve, 2020). The reserve is bordered by numerous local parks and wildlife reserves that also provide opportunities for recreation. New Hampshire's Odiorne Point State Park and Maine's Fort McClary State Historic Site are located approximately 12 miles south of the project; these parks preserve seaside forts from the early and late 1800s that provide opportunities for picnicking and sightseeing. Odiorne Point State Park also provides an extensive trail system, boat ramp, and over 2 miles of beach (Maine Department of Agriculture, Conservation, and Forestry, 2013; New Hampshire State Parks, 2020b). Units of the 5,300-acre Rachel Carson National Wildlife Refuge are located approximately 12 miles southeast and east of the project along the Maine coast. The refuge provides opportunities for hiking, wildlife viewing, and boating (FWS, 2021; Trust for Public Land, 2018). Additionally, numerous public beaches are located less than 20 miles south and east of the project along the New Hampshire and Maine coasts (Google Maps, 2020).

Recreation at the Project

There are no licensed project recreation facilities. However, the Town of Rollinsford owns, operates, and maintains several recreation facilities partially within and/or adjacent to the project boundary.

- Bicentennial Park: Located just upstream of the project dam along the New Hampshire side of the project impoundment providing a gazebo, benches, parking for a few vehicles, and a gravel and concrete boat ramp that provides access to the impoundment.

- South Berwick Impoundment boat launch: Located on the New Hampshire side of the Salmon Falls River approximately half a mile downstream of the project dam. This facility provides a gazebo, parking for approximately 15 vehicles, and a concrete boat ramp that provides access to the project waters below the dam. The boat launch is adjacent to Gold Star Park, which has a baseball diamond and provides informal shoreline access to the Salmon Falls River downstream of the project.

- Scoutland: Located on the New Hampshire side of the project impoundment approximately 0.75-mile upstream of the project dam. The 88-acre property is open to the public for low-impact recreational use, including several miles of walking and hiking trails. The 1.6-mile Scoutland Trail is a multi-use trail that parallels the project impoundment and connects to Bicentennial Park. There are no restrictions to public access at the site; however, the access road to the property is gated to prevent unauthorized travel by large vehicles. There is no formal access to the impoundment from Scoutland.

- An informal trail located on the New Hampshire side of the bypassed reach that provides access within the project boundary. The trail is unmarked, primitive, and not maintained.

In addition to the recreation sites owned and operated by the Town of Rollinsford, additional recreation facilities adjacent to the project include:

- Malley Farm: Owned, operated, and maintained by the City of Somersworth, New Hampshire and located approximately 1.25 miles upstream of the project dam. This 179-acre park contains the Somersworth community gardens and primitive walking trails along the Salmon Falls River. The trails connect to the Scoutland Trail described above. The park also has two baseball diamonds and a large parking area.

- The Mills at Salmon Falls: The privately-owned mill complex located immediately downstream of the project powerhouse provides informal, unrestricted access via its parking lot to the Salmon Falls River shoreline downstream of the project powerhouse.

The Town currently operates the project as a run-of-river facility, releases a minimum flow of 10 cfs to the bypassed reach, and releases flows in excess of the maximum hydraulic capacity of 456 cfs to the bypassed reach. Although whitewater boating is possible in the 680-foot-long bypassed reach during high flows (i.e., higher than the 456-cfs maximum turbine capacity of the project), bypassed reach flows in excess of the 10-cfs minimum flow are rare in the summer boating season because median flows from July to September range from 90 to 97 cfs. Because of the short length of the bypassed reach, the rarity of whitewater flows, and the run-of-river operation of the project that precludes scheduled whitewater releases, whitewater boating occurs only rarely at the project.

3.3.4.2 Environmental Effects

Land Use

The Town proposes to modify the project boundary upstream of the project dam to follow a contour elevation of 71.25 feet NGVD29 (i.e., the flashboard crest elevation), which would result in: (1) increasing the surface area of the impoundment included in the project boundary from 70 acres to approximately 84 acres; and (2) removing approximately 7 acres of land from the project boundary that is on the shoreline of the impoundment and above 71.25 feet NGVD29.

The Town proposes to modify the project boundary by removing 0.4 acre of land adjacent to the bypassed reach on the east side of the river. The Town also proposes to remove approximately 0.3 acre of land adjacent to the project substation.

Collectively, the proposed changes would increase the amount of land and water enclosed by the project boundary from 82 to approximately 88 acres.

Our Analysis

The 0.4 acre of land proposed for removal east of the bypassed reach is steep and wooded and does not provide public access to the project. The 0.3 acre near the substation is a paved area used as a private driveway and parking area. The 0.4 acres of land along the bypassed reach and the 0.3 acre of land near the project substation do not appear to be necessary for project operation, flood control, recreation, the protection of fish and wildlife, or other developmental and non-developmental interests of the project. Therefore, inclusion of this land within the project boundary does not appear to be

warranted, and removal of these lands from the project boundary would not affect project uses or substantially affect land use.

The crest elevation of the flashboards on the dam is 71.25 feet NGVD29. Modifying the project boundary upstream of the project dam to follow a contour elevation of 71.25 feet NGVD29 would be consistent with the crest elevation of the flashboards and would increase the surface area of the impoundment contained within the project boundary from 70 to approximately 84 acres. The impoundment serves a project purpose and should be included in the project boundary.

Recreation

The Town of Rollinsford is not proposing any recreation-related measures. Maine DEP certification condition 6A requires that the Town continue to provide informal access to the project waters for the purpose of recreation, fishing, and navigation to the extent possible, for the term of any new license. Maine DEP's condition also requires that the Town consult with Maine DIFW within 6 months of license issuance about improvements to access for streamside angling, including additional signs and trails to the tailrace and bypassed reach.

Our Analysis

Informal public recreational access to the impoundment is available through Bicentennial Park, and access to the Salmon River downstream of the project is provided at the South Berwick Impoundment boat ramp and the parking lot of the Mills at Salmon Falls. In addition, the informal trail along the bypassed reach provides access to the tailrace area. The Scoutland and Malley Farm recreation areas along the impoundment provide informal access to the shoreline of the impoundment. All of the recreation areas, with the exception of the Mills at Salmon Falls, are owned and maintained by municipal governments, and there is no indication that access would cease at any of these sites over the term of a subsequent license for the project. Given the abundance of recreational opportunities in the immediate project vicinity, additional recreation facilities do not appear to be necessary to meet recreation demand in the vicinity of the project.

Maine DEP's certification condition 6A requires the Town to continue to allow access to project waters to the extent possible for the purpose of recreation in and on the water, for fishing, and for navigation. Any subsequent license would require the licensee to allow public use of the project for navigation and recreation.[115] With regard to Maine

[115] See Form L-9, 54 FPC ¶ 1792 (October 1975), entitled "Terms and Conditions of License for Constructed Minor Project Affecting Navigable Waters of the United

DEP's requirement for the Town to consult with Maine DIFW about opportunities for access in the bypassed reach and the downstream reach, Maine DEP does not identify any access issues for anglers, and no comments were received about any restrictions or barriers to public access at the project, including the need for any additional signs or foot trails to ensure access to the tailrace and bypassed reach for angling. Therefore, there is no clear benefit associated with the consultation.

3.3.5 Cultural Resources

3.3.5.1 Affected Environment

Section 106 of the NHPA requires that the Commission take into account the effects of its actions on historic properties and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the undertaking.[116] Historic properties are those that are listed or eligible for listing on the National Register. The regulations implementing Section 106 of the NHPA also require that the Commission seek concurrence with the SHPO on any finding involving effects or no effects on historic properties, and consult with interested Indian tribes or Native Hawaiian organizations that attach religious or cultural significance to historic properties that may be affected by an undertaking. In this document, we also use the term "cultural resources" for properties that have not been determined eligible for listing on the National Register. Cultural resources represent things, structures, places, or archaeological sites that can be either prehistoric or historic in origin. In most cases, cultural resources less than 50 years old are not considered historic.

States." Article 13 of Form L-9 states that "So far as is consistent with proper operation of the project, the Licensee shall allow the public free access, to a reasonable extent, to project waters and adjacent project lands owned by the Licensee for the purpose of full public utilization of such lands and waters for navigation and for outdoor recreational purposes, including fishing and hunting: Provided, That the Licensee may reserve from public access such portions of the project waters, adjacent lands, and project facilities as may be necessary for the protection of life, health, and property."

[116] An undertaking means "a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; and those requiring a Federal permit, license, or approval." 36 C.F.R. § 800.16 (2019). Here, the undertaking is the potential issuance of a subsequent license for the Rollinsford Project.

Area of Potential Effect

Under section 106 of the NHPA of 1966, as amended, the Commission must take into account whether any historic properties within the proposed project's area of potential effect (APE) could be affected by the issuance of a license for the project. The Advisory Council on Historic Preservation defines an APE as the geographic area or areas in which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist (36 C.F.R. § 800.16(d)).

In the license application, the Town defines the APE for the project to include "…the lands enclosed by the Project's boundary and lands or properties outside of the Project's boundary where Project construction and operation or Project-related recreational development or other enhancements may cause changes in the character or use of cultural properties, if any cultural properties exist."[117] As described in section 2.2.1 of this EA, the proposed project boundary covers approximately 88 acres.[118]

Pre-contact Period

The prehistory of the Northeast is generally characterized by three broad periods: the Paleoindian period (before 8,000 BC), the Archaic period (8,000 BC – 1,000 BC), and the Woodland period (1,000 BC – 1620 AD). There is evidence of the first people in New England around the year 10,000 BC. The people of this era lived in a cold tundra environment and centered their settlement and migration around a resource-rich mosaic of streams and wetlands formed in the basins of pro-glacial lakes (Bunker, 1994; Nicholas, 1983). Several Paleolithic sites have been found in Maine; however, there are few occurrences of archeological sites in New Hampshire from the Paleoindian period.

The period following the Paleoindian occupation has been designated the Archaic period by North American archaeologists. The Archaic period is further divided into at least three sub periods: Early, Middle, and Late, with the distinction between these being a marked change in tool usage and the organization of a sedentary way of life. The Early and Middle Archaic periods are defined by the use of quartz core and flake tools with fully channeled gouges made from mostly local materials. Site rarity around the region suggests a relatively low population density at this time, but their prevalence on riverine terraces indicates that river systems were still primary occupation sites for Archaic populations. The Late Archaic period was marked with a large population increase, as

[117] *See* August 29, 2019 final license application at E-151.

[118] The APE described in the February 15, 2019 Phase I Archaeology Survey[118] only included land located within the current project boundary, which encloses 82 acres, as discussed in section 2.1.2 of the EA. *See* August 29, 2019 final license application, Exhibit E, Appendix H (filed as privileged).

indicated by the greater prevalence of artifacts from this time period in the region. There is a clear shift in focus to utilizing marine resources, especially for food, with deer becoming a secondary diet supplement to fish. During the Late Archaic period, settlements in Maine and New Hampshire were common on present-day ridges and shorelines, suggesting that environmental conditions were similar to those found presently.

The use of ceramics by New England Native Americans marks the transition from the Archaic period to the Woodland period. This ability to store food for the long-term and an enhanced ability to cook increased Native Americans' ability to create settlements and a sedentary way of life. Numerous archeological sites from the Woodland period have been found in both New Hampshire and Maine. During the Early Woodland period, a cooling climate may have placed pressure on the native populations and forced smaller communities given the constraint on resources. The Middle Woodland period is marked by an expansion of settlements. There is definitive evidence of crop cultivation in the Late Woodland period, including maize, gourds, and beans.

Post-contact Period

The first European explorers to Maine were mostly Italian and French seasonal fishermen that maintained friendly relations with the Native Americans. In 1603, King Henry IV of France granted De Monts the Charter of Acadia, which entitled him to the land on the coast of America from the 40th to the 46th degree latitude. And, in 1613, De Monts and Samuel de Champlain (the founder of the city of Quebec) made a formal exploration of the area (Everts and Peck, 1880).

The English colonial history of the region began with a charter issued in 1620 by King James of England for colonists to receive grants and patents for the settlement of New England. The Thomson charter granted six thousand acres, "bordering on the south side of the Pascataqua River and its branches," and from this charter, New Hampshire and ultimately Dover, Somersworth, and Rollinsford were created (Scales, 1914). It is said that the English charter of 1620 was an infringement to the Charter of Acadia, and conflicting claims between the French and English ultimately led to the French and Indian wars (Everts and Peck, 1880).

The region now known as Somersworth was not settled until after 1700. A small village on the Salmon Falls River, once known as Newichwannock, meaning "river with many falls" (Rollinsford, n.d.), was formally incorporated to the Town of "Somersworth" in 1754. The Town of Rollinsford, named for the prominent and numerous Rollins family (Scales, 1914), was separated from Somersworth in 1849 for economic and political reasons (City of Somersworth, n.d.).

Textile mills were the primary industry when the Town of South Berwick was established in 1814. The largest mill at the time was the Portsmouth Manufacturing Company, which employed over 300 workers, although many in South Berwick traveled across the Salmon Falls River to Rollinsford to work at the Salmon Falls Mill. The mill industry in the region slowly faded as waterpower was replaced by other sources of energy and cotton product production moved south.

Cultural Resources Investigations

The project is partially located within the Salmon Falls Mill Historic District (District), which was listed on the National Register in 1980. The District is located on the New Hampshire side of the riverbank and includes four textile mill buildings and their contributing structures, including the project powerhouse, dam, and intake headwork structure. The District buildings were constructed between 1840 and 1860, and are made from red brick, a typical example of a small northern New England textile manufacturing community. Presently, the four textile mill buildings are occupied by a guild of artists, and also used for office and commercial spaces.

The Boston and Maine Railroad Bridge and the Rollinsford Dam are contributing resources to the character of the District. The Boston and Maine Railroad Bridge that spans the Salmon Falls River just downstream of the project dam, was constructed in 1888, as a lattice-deck, truss bridge with a cut-stone masonry sub-structure. The Rollinsford Dam was constructed between 1909 and 1910, replacing the original 1843 wooden dam.

An architectural survey within the Maine portion of the project APE[119] was conducted in 2018 (Gray & Pape, 2018a; Gray & Pape, 2018b). The purpose of the survey was to identify historic resources within the project APE currently listed or determined eligible for listing in the National Register. Aside from the contributing resources associated with the District, no significant historic structures more than fifty years of age were identified.

A Phase I archaeological survey within the Maine portion of the project APE was also conducted in 2018 (NEARC, 2018). The purpose of the survey was to identify known pre- and post-contact archaeological resources, and to identify additional areas within the Maine portion of the APE that were potentially sensitive for pre- and post-contact archaeological resources. The Phase I survey investigated one previously

[119] The Maine portion of the APE was identified as including the river left shoreline and adjacent areas within the current project boundary, beginning at the downstream end of the project boundary and extending approximately 0.85 mile upstream. *See* August 29, 2019 final license application, Exhibit E, Appendix H (filed as privileged).

recorded archaeologically sensitive area and six additional archaeologically sensitive areas. However, the surveys concluded that no pre- or post-contact archaeological sites are present within the Maine portions of the APE.

No architectural or archaeological surveys were requested or conducted within the New Hampshire portion of the APE.[120]

3.3.5.2 Environmental Effects

The Town proposes to modify the project boundary upstream of the project dam to follow a contour elevation of 71.25 feet NGVD29 (i.e., the flashboard crest elevation), which would result in: (1) increasing the surface area of the impoundment included in the project boundary from 70 acres to approximately 84 acres; and (2) removing approximately 7 acres of land in Maine and New Hampshire from the project boundary that is on the shoreline of the impoundment and above 71.25 feet NGVD. The Town also proposes to remove 0.4 acre of land adjacent to the left bank of the bypassed reach, and 0.3 acre adjacent to the project substation. Collectively, the proposed changes would increase the amount of land and water enclosed by the project boundary from 82 to approximately 88 acres.

The Town proposes and Interior and Commerce recommend under section 10(j), operating the project in a run-of-river mode, such that outflow approximates inflow at all times. Interior and Commerce also recommend seasonal minimum flows to the bypassed reach. The Town proposes to install and operate upstream and downstream passage facilities for American eel at the dam and intake headworks structure, respectively. Interior's preliminary fishway prescription, and Maine DEP's and New Hampshire DES's certifications would require the Town to construct upstream and downstream eel and fish passage facilities at the project, including at the dam and the intake headworks structure.

The Town proposes to consult with the New Hampshire and Maine State Historic Preservation Officers prior to conducting any land-disturbing activities or alterations to known historic structures within the project boundary, to determine whether to conduct archaeological or historical surveys or to implement avoidance or mitigation measures during the activity.

In an April 1, 2019 letter filed as part of the August 29, 2019 license application, the Maine SHPO made a determination of "no effect on historic properties" for the project based on its understanding that no alterations would be made at the project that

[120] The New Hampshire portion of the APE includes the river right shoreline and adjacent areas within the current project boundary, including the project powerhouse and associated facilities.

would alter any historic properties in the APE. However, the Maine SHPO stated that its finding is conditional on the development of an HPMP to protect historic properties throughout the term of a subsequent license. In a November 9, 2018 letter filed as part of the August 29, 2019 license application, the New Hampshire SHPO made a determination of "no adverse effect" on historic properties for the project because the Town proposed no changes to project facilities. This finding was conditional on no ground disturbance.

Our Analysis

The current project boundary encloses approximately 82 acres. As discussed in section 3.3.4.2 *Land Use and Recreation, Environmental Effects, Land Use,* changes to the existing project boundary are warranted so that the boundary only includes land this is necessary for project purposes, which would increase the total project boundary to approximately 88 acres. The land proposed to be removed, including the 7 acres, 0.4 acre, and the 0.3 acre, does not include any historical or archaeological resources. Therefore, no historical properties or archaeological sites would be affected by removing this land from the project boundary.

Since the APE must include the geographic area in which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, the APE should include the 88 acres enclosed by the proposed project boundary.

Adverse effects on the contributing resources of the District could result from continued operation and maintenance of the project and installing eel and fish passage structures. Specifically, adverse effects could occur in the event repairs are needed to maintain the structure and function of the contributing resources within the APE (e.g., the dam), or to fix structural damage that occurs in the course of project operation. Failure to protect and maintain individual contributing resources to the District could have adverse effects on the integrity of the historic district. Adverse effects could also occur if Interior's prescribed upstream and downstream eel and fish passage facilities are installed on contributing resources, as discussed in detail in section 3.3.1.2, *Aquatic Resources, Environmental Effects*. It is also possible that unknown historic properties may be discovered during project operation or other project-related activities that require ground disturbance.

The Town proposes to consult with the New Hampshire and Maine SHPOs to determine the need to conduct archaeological or historical surveys and to implement avoidance or mitigation measures before beginning any land-disturbing activities or alterations to known historic structures within the project boundary. Developing and implementing an HPMP, including provisions for consulting with the New Hampshire and Maine SHPOs as proposed by the Town, would ensure that measures are in place to protect historic properties in the APE from adverse effects related to the operation and

maintenance of project facilities and potential adverse effects related to installation of eel and fish passage structures. An HPMP would also ensure that any previously undiscovered archaeological resources within the APE are not adversely affected by the project during the term of any subsequent license.

To meet the requirements of section 106 of the NHPA, the Commission intends to execute a PA with the New Hampshire SHPO and Maine SHPO for the proposed project to protect historic properties. The terms of the PA would require the Town to develop and implement an HPMP to ensure that the project does not adversely affect historic properties in the APE.

4.0 DEVELOPMENTAL ANALYSIS

In this section, we look at the project's use of the Salmon Falls River for hydropower generation to see what effect various proposed or recommended environmental measures would have on the cost to operate and maintain the project and on the project's power generation. Under the Commission's approach to evaluating the economics of hydropower projects, as articulated in *Mead Corporation*,[121] the Commission compares the current cost to produce project power to an estimate of the cost to provide the same amount of energy and capacity[122] for the region using the most likely alternative source of power (cost of alternative power). In keeping with the policy described in *Mead Corporation*, our economic analysis is based on current electric power cost conditions and does not anticipate or estimate changes in fuel costs that could occur during a project's license term.

For each of the licensing alternatives, our analysis includes an estimate of: (1) the annualized cost of providing the individual measures considered in the EA; (2) the cost of the most likely alternative source of project power; (3) the total annual project cost (i.e., for construction, operation, maintenance, and environmental measures); and (4) the difference between the cost of the current alternative source of project power and the total annual project cost. If the difference between the cost to produce an equivalent amount of power from an alternative source and the total annual project cost is positive, the project produces power at a cost less than the cost of producing power from the most likely least-cost source of alternative power. If the difference between the alternative source of power's annual cost and the total annual project cost is negative, the project

[121] *See Mead Corporation*, 72 FERC ¶ 61,027 (July 13, 1995). In most cases, electricity from hydropower would displace some form of fossil-fueled generation, in which fuel cost is the largest component of the cost of electricity production.

[122] We use the term "Capacity benefit" to describe the benefit a project receives for providing capacity to the grid, which may be in the form of a dependable capacity credit or credit for monthly capacity provided.

costs more to produce power than the cost to produce an equivalent amount of power from the most likely least-cost source of alternative power. This estimate helps support an informed decision concerning what is in the public interest with respect to a proposed license. However, project economics is only one of many public interest factors the Commission considers in determining whether, and under what conditions, to issue a license.

4.1 POWER AND ECONOMIC BENEFITS OF THE PROJECT

Table 11 summarizes the assumptions and economic information used in the analysis. Most of this information is provided by the applicant in its license application. Some is developed by Commission staff. The values provided by the applicant are typically reasonable for the purposes of our analysis. If they are not, it is noted below. Cost items common to all alternatives include taxes and insurance; estimated capital investment required to develop the project or major modifications for relicensing; licensing costs; normal operation and maintenance cost; and Commission fees. All costs are adjusted to current year dollars.

Table 11. Parameters for economic analysis of the Project.

Parameter	Value
Installed Capacity	1.5 MW
Average annual generation (under no action alternative)	5,837.9 MWh
Period of analysis	30 years
Insurance rate	Included in the Operation and Maintenance (O&M) cost
Interest rate	5.5 %
Application cost	$285,000
Operation and maintenance	$186,658/yr
Estimated Commission annual charges [a]	$0/yr
Alternative source of power's cost (2021) [b, c]	
1) Energy cost	$49.64/MWh
2) Capacity benefit cost	$146.94/kW-yr

(Source: Applicant and Staff).

[a] Under the regulations currently in effect, projects with an authorized installed capacity of less than or equal to 1,500 kW will not be assessed an annual charge.

[b] The alternative source of power cost is based on the current cost of providing the same amount of generation and capacity from a natural gas-fired combined cycle plant, as reported by The U.S. Energy Information Administration (EIA), Annual Energy Outlook 2021, for the Division 1, New England Region. The alternative source of power cost reported in Table 12 is a combination of the cost of energy and capacity benefit.

[c] The applicant provided no estimate of the value of power.

4.2 COMPARISON OF ALTERNATIVES

Table 12 summarizes the installed capacity, annual generation, capacity benefit, alternative source of power's cost, estimated total project cost, and difference between the alternative source of power's cost and total project cost for each of the alternatives considered in this EA: no-action, the applicant's proposal, the staff alternative, and staff alternative with mandatory conditions.

Table 12. Summary of the annual cost of alternative power and annual project cost for four alternatives for the Rollinsford Project.

	No Action	Applicant's Proposal	Staff Alternative	Staff Alternative with Mandatory Conditions
Installed capacity	1.5 MW	1.5 MW	1.5 MW	1.5 MW
Annual generation	5,837.9 MWh	5,079.0 MWh	5,220.0 MWh	5,220.0 MWh
Capacity benefit [a]	1 MW	1 MW	1 MW	1 MW
Current alternative source of power cost [b]	$436,733	$399,062	$406,061	$406,061
Total annual project cost (2021) [c]	$266,688	$423,329 [d]	$428,636	$434,389[e]
Difference between the alternative source of power cost and total annual project cost [f]	$170,046	($24,267)	($22,574)	($28,327)

(Source: Staff).

[a] Staff estimated the capacity benefit based on the ratio of the median flow available for generation for each of 12 months, and the hydraulic capacity of the project. This ratio is multiplied by the authorized installed capacity to determine the capacity benefit.

[b] The alternative source of power cost for the Rollinsford Project is based on the alternative source of power for the New England Region, as identified in Table 11 above.

[c] Project costs include the cost of environmental measures listed in Table 13 in Appendix C, and the costs identified in Table 11. All project costs were adjusted to 2021 dollars.

[d] The Town's conditional proposal of constructing and operating a Denil fishway at the dam and excavating the lower section of the bypassed reach lacks specificity needed to estimate a definitive cost. However, staff used the costs provided by the Town in its April 22, 2021 response to staff's March 23, 2021 additional information request, as a worst-case cost estimate.

[e] The annual project cost under the staff alternative with mandatory conditions does not include the costs of measures that lack specificity, including developing plans for testing the effectiveness of upstream and downstream fish passage facilities for a minimum of two years after the facilities are operational.

[f] A number in parentheses denotes that the difference between the alternative source of power cost and total project cost is negative; thus, the project's cost to produce power is greater than the alternative source of power cost.

4.2.1 No-Action Alternative

Under the no-action alternative, the project has an installed capacity of 1.5 MW, a capacity benefit of 1 MW, and an average annual generation of 5,837.9 MWh. The alternative source of power's current cost to produce the same amount of energy and provide the same capacity benefit is $436,733. The total annual project cost is $266,688. Subtracting the total annual project cost from the alternative source of power's current cost, the project's cost to produce power and capacity is $170,046 less than that of the alternative source of power's cost.

4.2.2 Applicant's Proposal

Under the applicant's proposal, the project would have a total installed capacity of 1.5 MW, a capacity benefit of 1 MW, and an average annual generation of 5,079.0 MWh. The alternative source of power's current cost to produce the same amount of energy and provide the same capacity benefit would be $399,062. The total annual project cost would be $423,329. Subtracting the total annual project cost from the alternative source of power's current cost, the project's cost to produce power and capacity would be $24,267 more than that of the alternative source of power's cost.

4.2.3 Staff Alternative

Under the staff-recommended alternative, the project would have a total installed capacity of 1.5 MW, a capacity benefit of 1 MW, and an average annual generation of 5,220.0 MWh. The alternative source of power's current cost to produce the same amount of energy and provide the same capacity benefit would be $406,061. The total annual project cost would be $428,636. Subtracting the total annual project cost from the alternative source of power's current cost, the project's cost to produce power and capacity would be $22,574 more than that of the alternative source of power's cost.

4.2.4 Staff Alternative with Mandatory Conditions

Under the staff-recommended alternative with mandatory conditions, the project would have a total installed capacity of 1.5 MW and a capacity benefit of 1 MW. In addition, the project would produce 5,220.0 MWh of electricity annually, which would be 617.9 MWh less than the no action alternative and 141.0 MWh more than the applicant's proposed alternative. The alternative source of power's current cost to produce the same amount of energy and provide the same capacity benefit would be $406,061. The total annual project cost would be $434,389. Subtracting the total annual project cost from the alternative source of power's current cost, the project's cost to produce power and capacity would be $28,327 more than that of the alternative source of power's cost.

4.3 COST OF ENVIRONMENTAL MEASURES

Table 13 in Appendix C presents the cost of each of the environmental enhancement measures considered in our analysis for the Rollinsford project. All costs are in 2021 dollars. We convert all costs to equal annual (levelized) values over a 30-year period of analysis to give a uniform basis for comparing the benefits of a measure to its cost.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a)(1) of the FPA require the Commission to give equal consideration to the power development purposes and to the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife; the protection of recreational opportunities; and the preservation of other aspects of environmental quality. Any license issued shall be such as in the Commission's judgment would be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses. This section contains the basis for, and a summary of, our recommendations for relicensing the project. We weigh the costs and benefits of our recommended alternative against other proposed measures.

Based on our independent review of agency and public comments filed on the project and our review of the environmental and economic effects of the proposed project and project alternatives, we selected the staff alternative as the preferred alternative. We recommend this alternative because: (1) issuing a subsequent license for the project would allow the Town to continue operating its project as a dependable source of electrical energy; (2) the 1.5 MW of electric capacity comes from a renewable resource that does not contribute to atmospheric pollution; (3) the public benefits of the staff alternative would exceed those of the no-action alternative; and (4) the staff-recommended measures would protect and enhance aquatic resources, federally-threatened species, and cultural resources.

In the following section, we make recommendations as to which environmental measures proposed by the Town or recommended by agencies or other entities should be included in any subsequent license issued for the project. We also recommend additional environmental measures to be included in any license issued for the project. Finally, for the reasons outlined below, the staff alternative does not include: (1) Interior's prescription condition 11.7 to develop plans for testing the effectiveness of upstream and downstream fish passage facilities, which is also required by Maine DEP's certification conditions 3D and 4D and New Hampshire DES's certification condition E-13; (2) Maine DEP's and New Hampshire DES's requirement to release an unspecified minimum bypassed reach flow from April 15 – July 15 in consultation with resource agencies, after the installation of upstream fish passage facilities at the project (Maine DEP condition 2A and New Hampshire DES condition E-10b); (3) Maine DEP's condition 3B to construct and operate a Denil fishway to provide upstream passage for anadromous fish "unless an exception for trap and truck operations is requested within two years of issuance of a new license, and approved by USFWS and by FERC;" (4) the water quality plan required by Maine DEP's condition 5 and New Hampshire DES's condition E-14; (5) the long-term water quality monitoring required by New Hampshire DES's condition E-15; and (6)

Maine DEP's condition 6A to provide informal access to the project for recreation and to consult with Maine DIFW about improvements to access for streamside angling.

5.1.1 Measures Proposed by the Town

Based on our environmental analysis of the Town's proposal in section 3, *Environmental Analysis,* and the costs presented in section 4, *Developmental Analysis,* we conclude that the following environmental measures proposed by the Town would protect and enhance environmental resources and would be worth the cost. Therefore, we recommend including these measures in any license issued for the project.

- Continue operating the project in a run-of-river mode, such that outflow approximates inflow at all times to protect aquatic resources, as required by New Hampshire DES's certification (condition E-10a);

- Maintain the surface elevation of the impoundment at the flashboard crest elevation of 71.25 feet NGVD29 under normal operating conditions, as required by Maine DEP's and New Hampshire DES's certifications (conditions 1A and E-10c);

- Continue to discharge all inflow to the bypassed reach when the project is not generating, as required by Maine DEP's and New Hampshire DES's certifications (conditions 2A and E-10b);

- To enhance aquatic habitat in the bypassed reach, increase the minimum bypassed reach flow from 10 cfs to 35 cfs or inflow, whichever is less, when the turbine-generators are operating, by increasing the size of the notch in the flashboards;

- Conduct an upstream eel passage facility siting survey for two passage seasons to determine the optimal location for siting an upstream eel ramp, and install an upstream eel ramp within 2 years of the completion of the survey;[123]

- To protect eels during downstream passage, implement nighttime turbine shutdowns for three consecutive nights following rain accumulations of 0.5 inch or more over a 24-hour period; and

- Increase the amount of land and water enclosed by the project boundary from 82 to 88 acres by: (1) modifying the current project boundary upstream of the project

[123] The Town does not provide dates for when the upstream eel passage facility siting survey would occur, or when the facilities would be installed and operated on an annual basis.

dam to follow a contour elevation of 71.25 feet NGVD29 (i.e., the flashboard crest elevation), which would result in: (a) increasing the surface area of the impoundment included in the project boundary from 70 acres to approximately 84 acres; and (b) removing approximately 7 acres of land from the project boundary that is on the shoreline of the impoundment; (2) removing 0.4 acre of land adjacent to the left bank of the bypassed reach; and (3) removing 0.3 acre of land adjacent to the project substation.

5.1.2 Additional Measures Recommended by Staff

Under the staff alternative, the project would be operated with the Town's proposed measures identified above, and the following additions and modifications.

- To protect and enhance aquatic habitat in the bypassed reach, release a year-round minimum flow of 35 cfs to the bypassed reach from a notch in the flashboards when the project is generating, as proposed by the Town and required by the Maine DEP's and New Hampshire DES's certifications (conditions 2A and E-10b, respectively), but do so for only two years after license issuance, prior to the installation of fish passage facilities in the bypassed reach (instead of the full license term, as proposed by the Town);

- Beginning on April 15 of the third year after license issuance (i.e., when the staff-recommended upstream fish passage facility would be installed in the bypassed reach), release the following minimum bypassed reach flows from the staff-recommended upstream and downstream anadromous fish passage facilities: (1) 60 cfs or inflow, whichever is less, from April 15 – July 15; and (2) 35 cfs or inflow, whichever is less, from July 16 – April 14, to protect and enhance aquatic habitat in the bypassed reach;

- Develop an operation compliance monitoring plan to document compliance with run-of-river operation, impoundment elevation limits, and minimum bypassed reach flow releases, as required by Maine DEP's and New Hampshire DES's certifications (conditions 1B and E-12, respectively);

- When drawing down the impoundment for scheduled project maintenance, lower the impoundment water level no more than six inches per day as required by New Hampshire DES's certification (condition E-10e) to protect aquatic resources in the impoundment;

- Implement an impoundment refill procedure following emergency and maintenance drawdowns, whereby 90 percent of inflow is passed downstream and 10 percent of inflow is used to refill the impoundment, to protect aquatic resources

in the downstream reach, as required by New Hampshire DES's certification (condition E-10d);

- Conduct a two-season upstream eel passage siting survey, as proposed by the Town, beginning the first passage season after the upstream anadromous fish facilities are installed (i.e., three years after issuance of a subsequent license) from May 1 through October 31, as prescribed by Interior (condition 11.9) and required by Maine DEP's certification (condition 3A);

- Install the proposed upstream eel ramp by May 1 of the second calendar year after the siting survey is completed, and operate and maintain the ramp annually from May 1 through October 31, as prescribed by Interior (condition 11.9) and required by Maine DEP's and New Hampshire DES's certifications (conditions 3A and E-13, respectively);

- Install upstream fish passage facilities for American shad and river herring, consisting of a Denil fishway at the project dam and a nature-like fishway in the bypassed reach, by March 15 of the third calendar year after license issuance, and operate and maintain the facilities annually from April 15 through July 15, as prescribed by Interior (conditions 11.3 and 11.8);[124]

- Shut down the turbines from dusk to dawn for three consecutive nights following rain accumulations of 0.50 inch or more over a 24-hour period, from August 15 through November 15 annually, beginning the first passage season after license issuance and continuing until permanent downstream passage facilities are operational, as prescribed by Interior (conditions 11.3 and 11.10);

- Provide downstream passage for American eel, American shad, and river herring as prescribed by Interior (conditions 11.3, 11.10, and 11.11) and required by Maine DEP's and New Hampshire DES's certifications (conditions 4 and E-13, respectively), by installing the following facilities by March 15 of the third calendar year after license issuance and operating the facilities on an annual basis from May 15 – November 15: (1) a diversionary guidance boom in the impoundment, upstream of the headgates, that prevents downstream migrating alosines from entering the intake headworks; (2) a surface bypass weir with a hydraulic capacity of 35 cfs at the dam; and (3) a 4-foot-deep plunge pool downstream of the dam;

[124] Interior's condition 11.8 requires the Town to install a technical fishway at the project dam and gives the Town the option installing a technical or nature-like fishway in the bypassed reach. As noted here, staff recommends the nature-like fishway for upstream American shad and river herring passage.

- Develop a fishway plan for the staff-recommended upstream and downstream eel and fish passage facilities that includes the following provisions: (1) design specifications that are based on the FWS Design Criteria Manual; (2) a schedule for submitting conceptual and final design plans for review and approval to the resource agencies and the Commission; (3) construction schedules for installing the fishways by the staff-recommended installation dates; (4) annual fishway operation schedules and conveyance flows that are based on the FWS Design Criteria Manual; (5) seasonal fishway maintenance procedures, including debris management; and (6) monitoring and reporting on the operation and maintenance of the facilities as they affect fish passage, consistent with Interior's prescription (conditions 11,4, 11.10 and 11.11) and Maine DEP's certification (conditions 3 and 4);

- Avoid the removal of trees with diameters that are equal to or greater than 3 inches at breast height from April 1 through October 1, to protect NLEB; and

- Develop an HPMP in consultation with the New Hampshire SHPO and Maine SHPO to protect historic properties that are eligible for or listed on the National Register.

Below, we discuss the basis for our additional staff-recommended measures and the rationale for modifying the Town's proposal.

Minimum Bypassed Reach Flows

Pursuant to Article 27 of the current license, the Town is currently required to release a minimum flow of 10 cfs to the 680-foot-long bypassed reach. The Town releases the minimum flow through a notch in the flashboards on the dam. The Town proposes to enhance aquatic habitat in the bypassed reach by increasing the minimum flow from 10 to 35 cfs or inflow, whichever is less, by widening the notch in the flashboards.

Maine DEP's certification condition 2A and New Hampshire DES's certification condition E-10b require the Town to release minimum bypassed reach flows that vary in accordance with fish migration seasons and the installation of fish passage facilities at the project. Prior to the installation of upstream fish passage facilities at the project,[125]

[125] The Maine DEP's certification condition 3 and New Hampshire DES's certification condition E-13 require the Town to install upstream fish passage facilities,

Maine DEP and New Hampshire DES require the Town to release a year-round minimum bypassed reach of 35 cfs or inflow, whichever is less, when the project is generating. After installation of upstream fish passage facilities, and when the project is generating, Maine DEP and New Hampshire DES require the Town to release: (1) a minimum flow of 35 cfs or inflow, whichever is less, from July 16 – April 14; and (2) an unspecified minimum flow from April 15 – July 15, the quantity of which must be determined in consultation with FWS, New Hampshire DES, New Hampshire FGD, Maine DMR, Maine DIFW, and Maine DEP. When the project is not generating, Maine DEP and New Hampshire DES require the Town to release all impoundment inflow to the bypassed reach.

Under section 10(j) of the FPA, Interior recommends the following minimum flow releases to the bypassed reach: (1) when inflow is less than the 80-cfs minimum hydraulic capacity of the project and the project is not generating electricity, release 100 percent of inflow over the spillway; and (2) when the project is generating electricity, release: (a) 35 cfs into the bypassed reach from July 16 to April 14; and (b) 60 cfs into the bypassed reach during the upstream American shad and river herring migration period (April 15 through July 15). New Hampshire FGD and TU supports Interior's recommendation. Commerce recommends the same minimum bypassed reach flows as Interior but includes a July 16 through *April 30* timeframe for releasing 35 cfs and a *May 1* through July 15 timeframe for releasing 60 cfs. Commerce also recommends the Town spill all inflow at the dam during periods when the project is off-line (i.e., not generating due to reduced inflow). Maine DIFW recommends a year-round minimum flow of 82 cfs to enhance aquatic habitat in the bypassed reach.

As discussed in section 3.3.1.2, *Environmental Effects, Minimum Flows*, increasing the minimum bypassed reach flow from 10 cfs under current operation to 35, 60, or 82 cfs would benefit aquatic resources in the bypassed reach by providing additional habitat for foraging, migration, and cover from predators (Table 4). The Town's proposed 35-cfs minimum bypassed reach flow is consistent with Interior's and Commerce's section 10(j) recommendations, and Maine DEP's and New Hampshire DES's certifications, except during the upstream alosine migration season (April 15 – July 15). Relative to the 10-cfs minimum flow required by the current license, 35 cfs would provide an approximately 13 percent increase, on average, in suitable foraging and

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but do not provide a schedule for installing the facilities. The Maine DEP and the New Hampshire DES state that, prior to the installation of the upstream fish passage facilities, bypassed reach flows should be released over the spillway when the project is not generating. For all other operating conditions, including when the project is generating and after the fish passage facilities are installed, the Maine DEP and the New Hampshire DES state that the Town must consult with the resource agencies to determine the manner in which flows will be released to the bypassed reach.

cover habitat for adult fish in the bypassed reach (Table 4). As discussed below under *Upstream Anadromous Fish Passage*, Interior prescribes and Commission staff recommends that the Town provide fish passage through the bypassed reach by March 15 of the third calendar year after license issuance. The Town's proposed 35-cfs minimum bypassed reach flow would provide some attraction flow when alosines are migrating upstream from April 15 – July 15. The Town's proposed 35-cfs minimum flow would reduce annual energy production at the project by 420.3 MWh, or 7.2 percent, relative to the current 10-cfs minimum flow, for an annual lost opportunity cost of $20,940.

During the upstream alosine passage season, Interior and Commerce recommend a 60-cfs minimum bypassed reach flow to facilitate alosine passage through the bypassed reach and enhance spawning and incubation in the bypassed reach. Releasing a minimum flow of 60 cfs to the bypassed reach during the upstream anadromous passage season would provide 79 percent of the maximum WUA for alosine spawning and incubation in the bypassed reach, which would be a 44 percent increase in habitat relative to the current 10-cfs minimum flow.[126] However, these habitat benefits would not be available to adult shad and river herring under current conditions because water velocity barriers and depth restrictions in the lower bypassed reach greatly restrict alosine passage to the upper bypassed reach, as discussed in section 3.3.1.2, *Environmental Effects, Upstream Anadromous Fish Passage*. The benefits associated with a 60-cfs minimum flow would not be available to adult alosines until the staff-recommended upstream passage facilities are installed (i.e., by the third calendar year after license issuance, as discussed below under *Upstream Anadromous Fish Passage*). Following the installation of the staff-recommended nature-like fishway in the lower bypassed reach, shad and river herring would be able to access spawning and incubation habitat in the upper bypassed reach. Therefore, based on the staff-recommended schedule for installing upstream fish passage facilities, river herring would benefit, and shad would likely benefit, from a 60-cfs minimum flow in the third calendar year after license issuance.

Interior's recommendation to release a minimum flow of 60 cfs from April 15 – July 15, and a minimum flow of 35 cfs from July 16 – April 14 would reduce annual energy production at the project by 525.4 MWh, or 9 percent, relative to the current 10 cfs minimum flow, for an annual lost opportunity cost of $26,080.

Relative to the current 10-cfs minimum flow, Commerce's recommendation to release 60 cfs from May 1 – July 15 and 35 cfs July 16 – April 30, would increase habitat

[126] As discussed in section 3.3.1.2, *Environmental Effects, Minimum Flows*, Interior's recommendation to release a 60-cfs minimum bypassed reach flow from April 15 through July 15 is consistent with the spawning period reported for American shad and river herring in Maine and New Hampshire (Maine DMR, 2020; New Hampshire FGD, 2020; Carpenter and Nugent, 2015; Saunders et al., 2006).

by 44 percent and 13 percent, respectively. Compared to Interior's recommendation, the 44 percent increase in habitat associated with the 60-cfs release would occur 16 days less during the upstream alosine migration season (April 15 – July 15). Commerce's recommendation for a 60-cfs attraction flow would provide adequate attraction from May 1 – July 15. Commerce's recommendation to provide a release of 35 cfs would attract some fish to the fishway entrance. Relative to Interior's recommendation to release 60 cfs from April 15 – July 15, Commerce's recommendation would provide less spawning and incubation habitat for alosines from April 15 – April 30. Commerce's recommendation to release a minimum flow of 60 cfs from May 1 – July 15, and a minimum flow of 35 cfs from July 16 – April 30 would reduce annual energy production at the project by 507.9 MWh, or 8.7 percent, relative to the current 10 cfs minimum flow, for an annual lost opportunity cost of $25,200.

Maine DIFW's recommended year-round 82-cfs minimum flow would provide 96 percent of the maximum WUA for alosine spawning and incubation in the bypassed reach, which would be a 75 percent increase in habitat relative to the current 10-cfs minimum flow. A minimum flow of 82 cfs would provide an approximately 43 percent increase, on average, in suitable foraging and cover habitat for adult fish and macroinvertebrate species in the bypassed reach, relative to the 10-cfs minimum flow required by the current license (Table 4). Maine DIFW's recommended 82-cfs minimum flow would reduce annual energy production at the project by 1,210.5 MWh, or 20.7 percent, relative to the current 10 cfs minimum flow, for an annual lost opportunity cost of $60,100.

Maine DEP's and New Hampshire DES's conditions require the Town to consult with resource agencies to determine the quantity and release location for minimum bypassed reach flows from April 15 – July 15, after the installation of fish passage facilities at the project. As discussed in section 3.3.1.2, *Environmental Effects, Minimum Flows, Location of Minimum Flow Releases*, minimum bypassed reach flows could be released from Interior's prescribed upstream and downstream fish passage facilities. If those facilities are installed at the dam as prescribed by Interior and recommended by Commission staff, then flow releases from those facilities would ensure that the entire bypassed reach receives the benefits of the minimum flow. Since the fish passage facilities could be used to release the minimum bypassed reach flow, there is no apparent benefit associated with consulting with resource agencies about the release points of the minimum bypassed reach flow after the fish passage facilities are installed.

Conclusion

The Town's proposed year-round minimum bypassed reach flow of 35 cfs would increase foraging and cover habitat for adult fish by 13 percent relative to the current minimum flow of 10 cfs. The benefits of the Town's recommended bypassed reach flow would outweigh the lost opportunity cost of $20,940 per year during the first two years

after license issuance, and staff recommends it be implemented during the first two calendar years after license issuance, prior to the installation of the upstream fish passage facilities, as required by Maine DEP's and New Hampshire DES's certifications. Staff recommends that the minimum flow be released through a notch in the flashboards at the dam during the first two years after license issuance, as proposed by the Town.

After the staff-recommended upstream fish passage facilities are constructed (by March 15 of the third calendar year after license issuance), Interior's recommendation to release a 60-cfs minimum bypassed reach flow during the upstream American shad and river herring migration period (April 15 – July 15) would provide a benefit to alosine populations by providing a 44 percent increase in alosine spawning and incubation habitat in the bypassed reach relative to the current 10-cfs minimum flow. Staff concludes that, beginning in the third calendar year after license issuance, the benefits of Interior's recommended bypassed reach flows would outweigh the increase in the lost opportunity cost from $20,940 per year (in years 1 and 2 of the license) to $22,770 per year (starting in calendar year 3), and staff recommends implementing Interior's recommended minimum bypassed reach flows beginning April 15 of the third calendar year after license issuance.[127] Beginning in the third calendar year after license issuance, staff recommends releasing Interior's recommended minimum bypassed reach flows through the staff-recommended fish passage facilities that would be located at the dam.[128]

Commerce's recommendation to release a minimum bypassed reach flow of 60 cfs from May 1 – July 15, and 35 cfs for the remainder of the year, would increase alosine spawning and incubation habitat, and foraging and cover habitat for adult fish, by the same amount as Interior's recommendation, following the construction of the upstream fish passage facilities. However, Interior's recommendation to release 60 cfs instead of Commerce's recommended 35 cfs during the first 15 days of the upstream migration season, from April 15 through April 30, would provide greater habitat benefits during the beginning of the upstream migration season. Although the annualized cost of Interior's

[127] As explained above, Interior's recommendation to release 60 cfs from April 15 – July 15 would not provide habitat benefits prior to the installation of the nature-like fishway in the lower bypassed reach in the third calendar year after license issuance. Therefore, staff concludes that the benefits of Interior's recommended bypassed reach flows would not outweigh the lost opportunity cost of $26,081 per year prior to the installation of the upstream fish passage facility, and therefore, does not recommend implementing Interior's recommendation during the first two years after license issuance.

[128] As discussed below under *Downstream Anadromous Fish Passage*, staff recommend installing downstream fish passage facilities, including a surface weir at the dam. As discussed below under *Upstream Anadromous Fish Passage*, staff recommend installing upstream fish passage facilities, including a Denil fishway at the dam.

recommended bypassed reach flows would be $881 more than Commerce's recommended flows ($26,081 versus $25,200), the increased benefits to fish during the migration season would be worth this higher cost. Therefore, staff recommends Interior's recommended bypassed reach flows over Commerce's recommended flows.

Maine DIFW's recommendation to release a year-round minimum bypassed reach flow of 82 cfs would increase habitat for spawning and incubation alosines by 75 percent relative to the current minimum flow of 10 cfs, and would increase foraging and cover habitat for adult fish by 52 percent relative to the current minimum flow of 10 cfs. However, Maine DIFW's recommendation would have an annual lost opportunity cost of $60,100. Staff concludes that the benefits of Maine DIFW's recommended bypassed reach flow would not outweigh the lost opportunity cost, and staff does not recommend it. Instead, staff finds that Interior's recommended bypassed reach flows strike the more appropriate balance between aquatic resource protection and enhancement and generation. We, therefore, recommend Interior's bypassed reach flows.

Following the installation of Interior's prescribed and staff's recommended fish passage facilities at the dam in the third year after license issuance, minimum bypassed reach flows could be released through the passage facilities to ensure adequate aquatic habitat is available throughout the full length of the bypassed reach. Therefore, we do not recommend the certification conditions that require the Town to consult with the resource agencies about the quantity and location of minimum flow releases, because such action is unnecessary.

Drawdown Procedure for Scheduled Maintenance

Periodically, the Town draws down the project impoundment for maintenance, such as flashboard replacement. When replacing the flashboards, the Town draws down the project impoundment by increasing generation flows above inflow rates. The Town lowers the impoundment level just below the spillway crest elevation of 70.0 feet NGVD29. The Town does not provide any information about how quickly it draws the impoundment down.

New Hampshire DES's water quality certification condition E-10e requires the Town to lower the impoundment water level at a rate of no more than 6 inches per day when drawing down the impoundment for scheduled maintenance.

As discussed in section 3.3.1.2, *Environmental Effects, Drawdown Procedure for Scheduled Maintenance*, the procedures used to draw down an impoundment can significantly affect aquatic habitat and organisms in the impoundment. Freshwater mussels, given their limited mobility, may not be able to relocate to wetted habitat or burrow quickly enough to avoid desiccation during drawdowns. Based on a tagging study conducted during drawdowns of Lake Sebasticook, Maine, eastern elliptio, which

was the most common mussel encountered during the Town's 2018 mussel study, can move horizontally approximately 37.8 inches per hour (Samad and Stanley, 1986). This movement rate suggests that eastern elliptio could move into wetted habitat and avoid desiccation during a drawdown if the impoundment were drawn down at a rate of 6 inches per day.

New Hampshire DES's condition E-10e would benefit mussels by providing them enough time to avoid desiccation during an impoundment drawdown, and there would be no cost to implement condition E-10e. Therefore, we recommend it.

Impoundment Refill Procedure for Scheduled Maintenance and Emergencies

As described above, the Town may need to draw down the project impoundment for maintenance, such as flashboard replacement, or for emergencies. During these times, run-of-river operation is temporarily interrupted. New Hampshire DES's certification condition E-10d requires and Interior recommends under section 10(j) an impoundment refill procedure after the impoundment is drawn down for emergencies and maintenance, whereby 90 percent of inflow is passed downstream, and the impoundment is refilled on the remaining 10 percent of inflow to the project (90/10 refill procedure). New Hampshire FGD supports Interior's recommendation. Commerce recommends that the Town develop a "headpond refill plan" to maintain flows downstream of the project when the impoundment is refilled after a drawdown. Commerce does not specify the percentage of flows that it recommends passing downstream of the dam as the impoundment refills.

As discussed in section 3.3.1.2, *Environmental Effects, Impoundment Refill Procedures for Scheduled Maintenance and Emergencies*, releasing 90 percent of the project impoundment's inflow during impoundment refilling would minimize the length of time that the impoundment is drawn down and that flows are reduced downstream, which would help maintain the existing aquatic habitat for fish and other aquatic species. Implementing this procedure would have no cost and we recommend that it be included in any subsequent license issued for the project.

Commerce's recommendation to develop a headpond refill plan does not include any specific measures for staff to evaluate, including a flow percentage to pass downstream of the dam as the impoundment refills. Therefore, staff has no basis to recommend Commerce's plan.

Operation and Compliance Monitoring Plan

The Town proposes to continue operating the project in a run-of-river mode and to maintain the impoundment at the flashboard crest elevation of 71.25 feet NGVD under normal operating conditions. In addition, the Town proposes to increase the minimum

flow release to the bypassed reach from 10 to 35 cfs or inflow, whichever is less. As discussed above, Commission staff recommend a minimum bypassed reach flow of 35 cfs or inflow, whichever is less, from July 16 through April 14, and 60 cfs or inflow, whichever is less, from April 15 through July 15, beginning the third year after license issuance. The Town indicates that the project uses a pond level sensor to maintain pond levels and to regulate turbine operation but does not describe the details of its operational compliance methods.

Maine DEP and New Hampshire DES require (in certification conditions 1B and E-12, respectively) and Interior and Commerce recommend under section 10(j) that the Town develop a plan to monitor and maintain run-of-river operation, impoundment levels, and minimum flow releases from the Rollinsford Project. New Hampshire FGD supports Interior's recommendation, and states that the plan should include measures for minimizing effects on freshwater mussels in the project boundary and bypassed reach.

As discussed in section 3.3.1.2, *Environmental Effects, Compliance Monitoring*, an operation compliance monitoring plan would help the Town document compliance with the operational provisions of any license for the project and provide a mechanism for reporting deviations. An operation compliance monitoring plan would also help the Commission verify that the project is operating in a run-of-river mode, maintaining an impoundment elevation of 71.25 feet NGVD29, and releasing required minimum bypassed reach flows, thereby facilitating administration of the license and assisting with the protection of resources that are sensitive to deviations from normal operating conditions.

The plan could be developed in consultation with the resource agencies, and include a description of the mechanisms and structures that would be used, a protocol for maintaining and calibrating equipment, and provisions for: (1) monitoring run-of-river operation, minimum flows, and impoundment elevation levels to document compliance with the operational conditions of a subsequent license; (2) standard operating procedures to be implemented: (a) outside of normal operating conditions, including the 90/10 refill procedure and 6-inch-per-day drawdown rate recommended by staff above, and (b) during emergency conditions, such as unscheduled maintenance, in order to minimize project effects on environmental resources; (3) reporting deviations to the Commission; and (4) maintaining a log of project operation for inspection. We recommend that the Town develop an operation and compliance monitoring plan and conclude that the benefits of the plan would outweigh the estimated annual levelized cost of $340.

New Hampshire FGD's comment that the operation compliance monitoring plan should include "proposed impact minimization for freshwater mussels" does not describe any specific project effects or measures for protecting mussels for staff to evaluate. Therefore, staff has no basis to recommend New Hampshire FGD's measures. Operating the project in a run-of-river mode with minimum bypassed reach flows and an

impoundment refill procedure, as recommended by staff, would protect mussels at the project and in the downstream reach.

Upstream Eel Passage

As discussed in section 3.3.1, *Aquatic Resources, Affected Environment, Fishery Resources,* American eels have been documented upstream and downstream of the project. To migrate upstream past the project, juvenile eels must climb over or around the Rollinsford Dam. Climbing over or around dams is a well-documented behavior for juvenile eels (GMCME, 2007), but causes passage delay and could increase the risk of predation while eels seek a suitable route of passage over/around the dam.

The Town proposes to conduct a two-season upstream eel passage facility siting survey, beginning the first full passage season after the effective date of a subsequent license, to determine where to install an upstream eel passage facility at the project. The Town proposes to install an eel ramp within four years of license issuance. Interior's preliminary fishway prescription would require the Town to conduct an upstream eel passage facility siting survey from May 1 through October 31 for up to two years, starting the first passage season after the prescribed upstream anadromous fish systems are installed (i.e., after March 15 of the third calendar year after license issuance).[129] Interior would require the eel passage facilities to be installed by May 1 of the second calendar year after the siting survey is completed (i.e., by the sixth year after license issuance), and operated and maintained from May 1 through October 31 each year thereafter.[130] Maine DEP requires the Town to conduct an upstream eel passage facility siting survey, and install and operate an upstream eel passage facility in accordance with schedules established by the Commission and measures prescribed by Interior. New Hampshire FGD recommends that the Town conduct the siting survey after the new bypassed reach flow regime is established. Maine DMR and TU support Interior's prescriptions.

Installing upstream eel passage facilities at the project, as proposed by the Town, would reduce passage delay and improve upstream passage for American eels to access habitat upstream of the project. As discussed in section 3.3.1.2, *Environmental Effects,*

[129] *See* section 3.3.1.2, *Environmental Effects, Upstream Anadromous Fish Passage*, for a detailed description of Interior's prescribed upstream fish passage facility.

[130] Interior's preliminary prescription includes a conflicting provision that would require the upstream eelway to be operational within five years after license issuance (condition 11.6.1). Since a five-year operational date is inconsistent with the prescribed construction schedule and the time needed to conduct the siting surveys, staff assumes that the reference to a five-year operational date is a typographical error in the prescription.

Upstream Eel Passage, eel surveys in the bypassed reach in 2018, indicate that eels congregate at points of discharge near the tailrace, waste gate (located at the intake headworks structure, approximately 50 feet downstream of the dam), and the dam. However, attraction flows for eel passage in the bypassed reach would change if certain measures are implemented during the term of a subsequent license, including: (1) the Town's proposal to increase the minimum bypassed reach flow from 10 to 35 cfs; (2) Interior's and Commerce's section 10(j) recommendation to release a minimum bypassed reach flow of 60 cfs during the upstream anadromous fish migration season; and (3) Interior's prescription to install upstream and downstream fish passage facilities in the bypassed reach and at the dam.

As discussed in section 3.3.1.2, *Environmental Effects, Upstream Eel Passage Siting Study*, conducting a two-season upstream eel passage facility siting survey as proposed by the Town and prescribed by Interior would identify the specific locations in the immediate vicinity of the project where dedicated upstream passage facilities could be installed to reduce passage delay and provide eels with timely access to habitat upstream of the project.

The Town's proposal to begin the survey during the first passage season after license issuance, and then install the upstream eel passage facilities within four years of license issuance would not capture potential changes to eel attraction flows in the bypassed reach that would result from the construction and installation of upstream anadromous fish passage facilities in the bypassed reach and the dam that are prescribed by Interior and recommended by staff.

Interior's preliminary prescription accounts for the potential flow changes associated with the installation of upstream and downstream anadromous fish passage facilities by requiring the Town to conduct the two-year upstream eel passage siting survey after the installation of the prescribed facilities,[131] and then to install the upstream eel passage facilities by May 1 of the second calendar year after the siting studies are completed. Conducting the survey and installing the upstream eel passage facilities after the installation of upstream and downstream anadromous fish passage facilities would

[131] Interior's prescription would require upstream anadromous fish passage facilities to be installed by March 15 of the third calendar year after license issuance. Interior's prescription would require the upstream eel passage facility siting survey to begin the first eel passage season after the upstream anadromous fish passage facilities are installed, which would be May 1 of the third calendar year. As discussed below in *Downstream Anadromous Fish Passage*, staff recommends installing downstream fish passage facilities for American shad and river herring by March 15 of the third calendar year after license issuance, which would be prior to the upstream eel passage season (May 1 – October 31) in the third calendar year after license issuance.

ensure the proper siting of upstream eel passage facilities to reduce passage delay and provide eels with timely access to habitat upstream of the project.

Since Interior's prescription would delay the implementation of the survey and the facility installation by two years relative to the Town's proposal, Interior's survey would have a lower levelized annual cost than the Town's survey ($460 versus $540, respectively) and Interior's prescribed eel ramp would have a lower levelized annual cost than the Town's proposed eel ramp ($5,480 versus $9,520, respectively).

To account for changes to attraction flows for upstream eel passage in the bypassed reach associated with the installation of upstream and downstream anadromous fish passage facilities, we recommend beginning the two-season upstream eel passage siting survey by May 1 of the third year after license issuance and installing the eel ramp by May 1 of the sixth year after license issuance, as proposed by Interior.[132] Because the Town's proposal to conduct the eel passage siting survey during the first passage season after license issuance would not account for changes to attraction flows in the bypassed reach associated with the installation of upstream and downstream anadromous fish passage facilities, and therefore may not accurately identify the specific locations where dedicated upstream passage facilities could be installed to reduce passage delay and provide eels with access to habitat upstream of the project, we do not recommend the Town's proposed timing for the upstream eel survey and eel ramp installation.

The Town did not propose a specific season for conducting the two-year upstream eel facility siting survey or a yearly operation schedule for the upstream eel ramp. Interior's prescription would require the Town to conduct the upstream eel passage siting survey and operate the upstream eel passage facility from May 1 through October 31. Interior's operating period is consistent with the spawning period reported for American

[132] Interior's preliminary prescription includes a discrepancy in the prescribed timing for the installation of the upstream eel passage facilities. While prescription condition 11.9 requires the facilities to be installed by May 1 of the sixth year after license issuance, as discussed above, prescription condition 11.6.1 requires the upstream eel passage facilities to be operational within five years of license issuance. In order to meet a five-year installation deadline, the Town would have to complete construction of the upstream eel passage facilities less than two months after the second season of the prescribed upstream eel passage facility siting survey. Such a schedule would not allow for consultation with resource agencies regarding the number, placement, and design of the upstream eel passage facilities. Completing construction of the upstream eel passage facilities by May 1 of the sixth calendar year after license issuance, instead of five years after license issuance, would allow sufficient time to analyze the survey results, consult with the agencies about the siting and design of the upstream eel passage facilities, and complete the construction of the facilities.

eel in Maine and New Hampshire (Eyler et al., 2014; Martin, 1995; Facey and Van Den Avyle, 1987; Sorenson and Bianchini, 1986). Therefore, providing upstream passage for eel from May 1 to October 31, would benefit upstream passage by limiting the potential for the project to delay upstream eel passage. The cost of operating the upstream eel passage facility from May 1 to October 31 is included in the levelized annual cost of $5,480 for installing, operating, and maintaining the facility.

Upstream Anadromous Fish Passage

Fish Passage Facilities

As discussed in section 3.3.1.2, *Environmental Effects, Upstream Anadromous Fish Passage*, American shad and river herring historically migrated upstream in the Salmon Falls River to Somersworth, New Hampshire, which is approximately 4 miles upstream of the Rollinsford Dam.

Under current conditions, shad and river herring can access the Salmon Falls River downstream of the project via upstream fish passage facilities located at the South Berwick Project (FERC No. 11163), approximately 1.1 miles downstream of the dam. Although river herring have been observed at the dam by New Hampshire FGD, data collected during the Town's 2018 zone of passage study (Figure 7; Table 5) indicate that migration through the bypassed reach is restricted by high velocities and shallow depths, especially in a bedrock chute (referred to as "ZOP-3") in the lower bypassed reach. Any fish that migrate through the bypassed reach to the dam are blocked from further passage because there are no upstream fish passage facilities at the Rollinsford Project.

The Town proposes to construct and operate a Denil fishway at the dam and excavate the lower section of the bypassed reach to provide upstream passage for American shad and river herring, if GMP does not install, operate, and maintain a new trap and haul facility at the South Berwick Project No. 11163 (located approximately 1 mile downstream of the Rollinsford Project), to trap fish and transport them upstream to the impoundments of the Rollinsford Project, the Lower Great Falls Project No. 4451, and the Somersworth Project No. 3820.[133]

[133] If GMP files a request to install, operate, and maintain a trap and haul facility at the South Berwick Project with the Commission, and the Commission denies GMP's request, then the Town proposes to construct the Denil fishway and excavate the lower bypassed reach prior to the fourth passage season after the denial. If GMP receives authorization to install a trap and haul facility, but later discontinues the operation of the trap and haul facility during the term of a subsequent license, then the Town proposes to

Interior's preliminary fishway prescription would require the Town to construct, operate, and maintain upstream fish passage facilities to pass shad and river herring. Interior's preliminary prescription requires two fishways: one at the project dam and another in the lower section of the bypassed reach. Interior requires the Town to construct the fishways in one of two configurations: (1) a technical fishway at the dam and a technical fishway in the lower section of the bypassed reach, or (2) a technical fishway at the dam and a nature-like fishway in the lower section of the bypassed reach. Interior states that the fishways should provide passage for 21,315 river herring, 2,731 American shad, and approximately 500 resident species. Interior states that the fishways should be constructed in a manner that is consistent with the FWS's Design Criteria Manual, and states that a 4-foot-wide Denil fish ladder installed at a slope of 1:8 (vertical:horizontal) or milder should be sufficient to pass fish at the project. Interior requires the fishways to be operational by March 15 of the third calendar year after license issuance, and to operate from April 15 to July 15 each year.

Providing a dedicated means of upstream passage at the project for shad and river herring by installing upstream passage facilities or making passage improvements in the lower bypassed reach and at the dam, as conditionally proposed by the Town[134] and prescribed by Interior, would increase the zone of passage in the lower bypassed reach relative to current conditions and provide shad and river herring with access to habitat upstream of the dam for spawning and foraging. FWS's Design Criteria Manual[135] could be used to guide the design, operation, and maintenance of the upstream fish passage facility. The Design Criteria Manual provides specific recommendations for the upstream fish passage facility attraction flow, slope, and water velocity and depth.

As discussed in section 3.3.1.2, *Environmental Effects, Upstream Anadromous Fish Passage, Technical Fishways*, a Denil fishway installed at the dam and in the lower bypassed reach, would be capable of providing upstream passage for American shad and river herring at the Rollinsford Project. However, certain design and maintenance challenges associated with installing a technical fishway in the lower section of the

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install a Denil fishway and excavate the lower bypassed reach four years after the cessation of the trap and haul operation. The Town defines the upstream passage season for American shad and river herring as April 15 to July 15.

[134] Staff's analysis of the Town's conditional proposal is located in section 5.1.3, *Measures Not Recommended*.

[135] FWS's Design Criteria Manual was developed by the FWS's Fish Passage Engineering Team to establish, among other things, general guidance on baseline design criteria, operation, and maintenance of fishways throughout the northeastern U.S.

bypassed reach could limit the number of fish that use the fishway. For example, at higher flows, there may be additional chutes or channels in the bypassed reach that create competing flow sources and draw fish away from the fishway entrance, thereby reducing attraction to the fishway entrance. Other potential issues include minimizing turbulence at the fishway exit as flows increase, preventing debris from accumulating at the fishway exit or within the fishway, and installing a pump to deliver attraction flow.

The other alternative in Interior's preliminary prescription is to install a technical fishway at the project dam and modify the lower bypassed reach into a nature-like fishway, similar the Town's conditional proposal. This alternative may have some advantages compared to constructing a Denil fishway in the lower bypassed reach, including that there would be no baffles to maintain and no need for any kind of pump for attraction flow. The ZOP-3 chute appears to be the dominant channel in that section of the bypassed reach and, based on satellite imagery, appears to convey the majority of flow at different streamflow levels. Therefore, if ZOP-3 was modified into a nature-like fishway, there would likely be no competing flows to create false attraction that would delay migrating fish from entering the nature-like fishway. However, debris would likely need to be removed occasionally to ensure that flow in the nature-like fishway is not constricted or made turbulent by debris. Given the effectiveness of nature-like fishways for shad and river herring in other rivers,[136] modifying the lower bypassed reach from the ZOP-3 transect chute to the downstream end of the bypassed reach into a nature-like fishway would provide a similar level of access to the prescribed Denil fishway at the project dam for shad and river herring while eliminating some construction and maintenance requirements associated with installing and operating a technical fishway in the lower bypassed reach.

The levelized annual cost of installing a technical fishway at the dam and in the lower bypassed reach would be $258,550. The levelized annual cost of installing a technical fishway at the dam and a nature-like fishway in the lower bypassed reach would be $145,740. As described above, a technical fishway at the dam would provide access to spawning and nursery habitat upstream of the dam. In the lower bypassed reach, both a technical fishway and a nature-like fishway would provide a means of upstream passage and resolve the depth restrictions and velocity barriers in the lower bypassed reach. We recommend that the Town install a technical fishway at the dam and a nature-like fishway in the lower bypassed reach, because this option would provide the same benefits to shad and river herring as installing two technical fishways, and would do so at a lower levelized annual cost.

[136] *See* section 3.3.1.2, *Environmental Effects, Upstream Anadromous Fish Passage, Nature-like Fishway*.

Downstream Anadromous Fish Passage

As discussed in section 3.3.1.2, *Downstream American Eel and Anadromous Fish Passage*, adult and juvenile shad and river herring do not currently have access to the Salmon Falls River upstream of the project. To the extent that upstream passage is provided for shad and river herring at the project, as prescribed by Interior and recommended by staff above, then shad and river herring could access the Salmon Falls River upstream of the project for spawning. As discussed in section 3.3.1.2, *Downstream American Eel and Anadromous Fish Passage, Potential for Entrainment and Impingement*, emigrating juvenile and adult shad and river herring would be adversely affected by project operation through turbine entrainment mortality.

The Town did not propose any downstream anadromous fish passage measures. Interior's preliminary prescription requires the Town to implement a "downstream passage and protection system that provides safe, timely, and effective downstream passage" for anadromous fish within three years of license issuance. Interior requires the Town to construct, operate, and maintain permanent downstream anadromous fish passage facilities that are designed in a manner that is consistent with FWS's Design Criteria Manual. Interior requires the Town to operate the passage facilities from June 1 to November 15 for anadromous fish species. However, Interior's prescription does not include any specific measures regarding the passage facilities, including where the facilities would be located and what type of facility would be installed. Maine DMR, New Hampshire FGD, and TU support Interior's prescription. Maine DEP's and New Hampshire DES's certifications require downstream passage facilities to be constructed and operated in accordance with the schedules established by the Commission, and as prescribed by Interior.

Providing a downstream fishway at the project for shad and river herring would reduce entrainment mortality for downstream migrating adult and juvenile alosines, to the extent that upstream passage is first provided to alosines for spawning upstream of the project, which would occur by the third calendar year after license issuance according to Interior's prescription, as discussed above. However, without specific measures in Interior's prescription regarding the passage facilities, including where the facilities would be located and what type of facility would be installed, staff cannot assess the costs and benefits of Interior's prescription, and therefore, has no basis for recommending Interior's prescription as a license condition.

As discussed in section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Downstream Anadromous Fish Passage Facilities*, the following specific measures for the design, operation, and maintenance of a surface-oriented downstream fish passage facility could benefit American shad and river herring at the project: (1) a full-depth diversionary guidance boom placed upstream of the headgates; (2) a 3-foot-wide surface weir at the dam that has a hydraulic capacity of 35

cfs and provides a water depth of 2 feet; and (3) a 4-foot-deep plunge pool located downstream of the dam. In section 4 of the EA, staff estimates that installing this downstream passage facility by March 15 of the third calendar year after license issuance would have a levelized annual cost of $29,980, and concludes that the benefits of the downstream passage facility to alosines would be worth the levelized annual cost of $29,980.

Timing of Downstream Anadromous Fish Passage Facility Installation

Interior's prescription would require a downstream fish passage facility to be operational within three years of license issuance. The downstream fish passage facility would be used by shad and river herring that pass upstream through Interior's prescribed upstream fish passage facilities, which would be operational by March 15 of the third calendar year after license issuance, according to Interior's prescription. To protect downstream-migrating anadromous fish, the downstream fish passage facility would therefore need to be operational by the third calendar year after license issuance. The costs of installing the downstream fish passage facility within three years of license issuance are included in the levelized annual cost of $29,980 for installing the facility.

Downstream Anadromous Fish Passage Facility Operation Period

Interior's preliminary fishway prescription would require the Town to operate the prescribed downstream anadromous fish passage facilities from June 1 to November 15. However, based on studies conducted at the South Berwick Project, located downstream of the Rollinsford Project, and the Vernon Project (FERC No. 1904), located on the Connecticut River, downstream passage for post-spawning adult shad and river herring could start as early as May 15.[137] Interior's prescribed operating period for downstream passage for shad and river herring would not protect adults migrating downstream from May 15 to May 31. Operating the downstream passage facility annually from May 15 through November 15 would protect alosines for an extra 17 days relative to Interior's prescribed June 1 through November 15 operating period. There would be no additional cost associated with beginning downstream passage facility operation on May 15 instead of June 1, since only 25 cfs is needed to attract fish to the downstream passage facilities, and 35 cfs would already be released at the dam during this time to provide minimum

[137] For additional details, see section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Downstream Anadromous Fish Passage Facility Operation Period*.

bypassed reach flow.[138] Therefore, staff recommends operating the facility from May 15 through November 15, based on the additional protection provided to downstream migrating alosines, and does not recommend beginning operation on June 1, as prescribed by Interior.

Downstream American Eel Passage

As discussed in section 3.3.1, *Aquatic Resources, Affected Environment, Fishery Resources*, American eels have been documented upstream and downstream of the project. As discussed in section 3.3.1.2, *Downstream American Eel and Anadromous Fish Passage, Potential for Entrainment and Impingement*, emigrating juvenile and adult shad and river herring would be adversely affected by project operation through turbine entrainment mortality.

Interim Nighttime Turbine Shutdowns

To protect downstream migrating eels, Interior's prescription requires the Town to implement nightly turbine shutdowns as an interim measure for the first two passage seasons until permanent downstream passage facilities are installed at the project. Specifically, Interior would require the Town to shut down the turbines for three consecutive nights, from dusk to dawn, following rain accumulations of 0.5 inch or more over a 24-hour period from August 15 to November 15, beginning the first year of license issuance.

Surveys conducted by the New Hampshire FGD upstream of the Rollinsford Project (New Hampshire FGD, 2015) and at the Lower Great Falls Project 2.4 miles upstream of the Rollinsford Project (Gomez and Sullivan, 2020), indicate eels are present upstream of the Rollinsford Dam. Any eels migrating downstream could attempt to pass downstream through the powerhouse and be injured or killed. As discussed in Section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Nighttime Turbine Shutdowns*, increasing spill over a dam by ceasing generation can benefit downstream eel passage (Brown et al., 2009) and can provide a significant reduction in downstream passage mortality (Eyler, 2014). Passage over the spillway at the Rollinsford Project, although not ideal given the presence of bedrock outcrops and boulders at the base of the dam, would provide a downstream passage route with a lower likelihood of injury and mortality than turbine passage.

[138] The cost associated with operating the facility from May 15 – November 15 is included in the levelized annual cost of $29,980 for installing, operating, and maintaining the facilities.

Interior's prescription to provide downstream passage measures from August 15 through November 15 is consistent with the reported downstream eel migration season (Oliveira and McCleave 2000; Haro et al. 2004; ASMFC 2013) and would protect emigrating eels beginning the first migration season following license issuance until staff's recommend downstream passage facilities are operational. Therefore, staff conclude that the benefits of Interior's prescription to emigrating eels outweigh the annual loss of energy production of 832.3MWh (opportunity cost of $5,250 per year).

Downstream Eel Passage Facilities

The Town proposes to install and operate a downstream eel passage facility within four years of the effective date of a subsequent license, including: (1) a surface weir that would be installed in the spillway located in the intake headworks structure (see Figure 11); and (2) an approximately 185-foot-long, 2-foot-wide, 2-foot-tall, steel flume that would convey 25 cfs from the intake headworks structure to a 1,260-cubic foot plunge pool located in the bypassed reach, approximately 190 feet downstream of the project dam.[139]

Interior requires the Town to provide downstream eel passage from August 15 to November 15 within three years of license issuance, including eel passage facilities and/or operational measures that are consistent with FWS's Design Criteria Manual. Interior's prescription does not include any specific measures regarding the passage facilities, including where the facilities would be located or what type of facility would be installed. Maine DMR, New Hampshire FGD, and TU support Interior's prescription. Maine DEP's and New Hampshire DES's certifications require downstream passage facilities to be constructed and operated in accordance with the schedules established by the Commission, and as prescribed by Interior.

As discussed above, implementing nightly turbine shutdowns would significantly reduce turbine-induced injury and mortality at the project. However, eels that pass over the dam via spill during a nightly shutdown would still be susceptible to injury and mortality if they fall into outcrops and boulders that are located at the base of the dam (Figure 8; Figure 10).

As discussed in section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Proposed Downstream Eel Passage Facility*, the Town's proposed facility would not likely be used by eels for downstream passage. The Town's proposed facility would be located in the intake headworks structure. If the turbines are shutdown at night during the downstream eel passage season, as proposed by the Town, then the only flow provided to the intake headworks structure would be the 35 cfs

[139] The Town does not state how deep the pool would be after excavation.

associated with the Town's proposed 25-cfs downstream eel passage facility flow and 10-cfs waste gate flow. All other flow would be discharged as spill over the dam. Based on mean inflow from August through November (ranging from 138 – 446 cfs) at the project, spillage flows at the dam would likely be the main source of attraction flow for eels migrating downstream. For example, at the historical mean flow of 392 cfs in October (see Table 2), most flow would pass over the dam via spill (357 cfs), and downstream migrating eels would likely be attracted to spill over the dam instead of the 25 cfs for the downstream eel passage facility. Because the proposed downstream eel passage facility would not likely be used for downstream passage, the benefits of the facility do not outweigh the estimated levelized annual cost of $21,990, and staff does not recommend it.

Interior's preliminary prescription would require the Town to provide downstream passage for eels within three years of license issuance, including eel passage facilities and/or operational measures that are consistent with FWS's Design Criteria Manual. However, Interior does not describe any operational measures, or the location or design of passage facilities. Without specific measures in Interior's prescription regarding the passage facilities, staff cannot assess the costs and benefits of Interior's prescription, and therefore cannot recommend including measures associated with Interior's prescription in a license.

As discussed in section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Alternative Downstream Eel Passage Measures*, the downstream anadromous fish passage facility that staff recommends for alosines (discussed above in *Downstream Anadromous Fish Passage*) would provide passage for eels migrating downstream. The recommended measures are as follows: (1) a full-depth diversionary guidance boom placed upstream of the headgates; (2) a 3-foot-wide surface weir at the dam that has a hydraulic capacity of 35 cfs and provides a water depth of 2 feet; and (3) a 4-foot-deep plunge pool located downstream of the dam. Because migrating eels are not strictly bottom-oriented during migration (Haro *et al.*, 2000), they will utilize a surface-oriented downstream fish passage facility (Brown *et al.*, 2009). The full-depth diversionary guidance boom would prevent eels from entering the intake headworks and guide eels to the surface bypass weir, thereby preventing injury and mortality associated with turbine passage.

As described above, staff recommend that the Town operate the downstream anadromous fish passage facility from August 15 to November 15, as prescribed by Interior, rather than from September 1 to October 31, as proposed by the Town. Operating the facility according to Interior's prescription would protect eels migrating downstream from entrainment mortality for an additional 30 days during the downstream eel passage season. There would be no additional cost associated with providing downstream eel passage through the downstream anadromous fish passage facilities recommended above.

Fishway Plan

Interior's prescription requires the development of a fishway operation and maintenance plan that includes measures for operating and maintaining the prescribed upstream and downstream anadromous fish and eel passage facilities. Interior requires the plan to include: (1) a schedule for routine fishway maintenance to ensure fishways are ready for operation at the start of the season; (2) procedures for routine upstream and downstream fishway operations; and (3) procedures for monitoring and reporting on the operation and maintenance of the facilities as they affect fish passage. Interior's prescription also requires the Town to develop design plans for upstream and downstream fishways, specific design schedules and installation dates for each of the fishways, and plans for providing permanent downstream eel and alosine passage.

Commerce recommends that the Town develop, in consultation with the resource agencies, an implementation plan for passage of juvenile and adult American eel, alewife, blueback herring, and American shad. Commerce recommends that the plan include: (1) feasibility, design, and timing for construction and operation of fishways; (2) movement and migratory behavior of target species; (3) migration seasons for each target species; and (4) procedures for ensuring effective upstream and downstream passage.

Developing a fishway design, installation, operation, and maintenance plan for all downstream and upstream fish and eel passage facilities, including the provisions prescribed by Interior and recommended by Commerce, would ensure: (1) the staff-recommended passage facilities are designed in a manner that considers FWS's Design Criteria Manual; (2) there is a clear schedule in place for submitting conceptual and final design plans for review and approval to the resource agencies and to the Commission, and for constructing the facilities by the staff-recommended installation dates; (3) routine fishway cleaning and maintenance, including debris removal, is performed so the fishways operate as intended and in a manner that considers the FWS Design Criteria Manual; and (4) fishways are operated in accordance with the staff-recommended schedules and conveyance flows that are based on with the FWS Design Criteria Manual. We recommend that the Town develop a fishway design, installation, operation, and maintenance plan for all downstream and upstream fish and eel passage facilities and conclude that the benefits of the plan would outweigh the estimated levelized cost of $340.

Northern Long-Eared Bat Protection

Under section 10(j), Interior recommends that the Town avoid adverse effects on NLEB by either: (1) avoiding all tree removal activities between April 1 and October 1; or (2) conducting bat "exit" surveys to confirm that no bats are present in potential roost

trees slated to be removed, within 24 hours of scheduled removal. New Hampshire FGD also recommends these measures.

As discussed in section 3.3.3, *Threatened and Endangered Species*, the federally threatened NLEB has the potential to occur in the project area and could be affected by the installation of new upstream and downstream fish and eel passage facilities at the project, as prescribed by Interior. Installation of these facilities could result in limited tree removal for construction staging that could affect NLEB habitat. Construction activities have the potential to disturb bats if tree cutting or thinning were to occur during roosting or other phases in their reproductive life cycle. Avoiding the removal of trees with diameters that are equal to or greater than 3 inches at breast height from April 1 through October 1, as recommended by Interior, would reduce the likelihood of disturbing NLEB and their newly-born pups during the broader, active season of NLEB at the project. This measure would ensure that NLEB is protected from project-related activities, at no additional cost to the Town, and staff recommends it.

Cultural Resources

As discussed in section 3.3.5.2, *Cultural Resources, Environmental Effects*, relicensing the project could have adverse effects on contributing resources of the National Register-listed Salmon Falls Mill Historic District if there are no protective measures in place. The District includes the project powerhouse, dam, and intake headwork structure. Adverse effects could also occur if the staff-recommended upstream and downstream fish and eel passage facilities are installed at the dam, as discussed above. Adverse effects could also occur in the event repairs are needed to maintain the structure and function of contributing resources within the APE, or to fix structural damage that occurs in the course of project operation. Failure to protect and maintain individual contributing resources to the District could have adverse effects on the integrity of the District. It is also possible that unknown historic resources may be discovered during project operation or other project-related activities within the APE.

The Town proposes to consult with the New Hampshire and Maine SHPOs to determine the need to conduct archaeological or historical surveys and to implement avoidance or mitigation measures before beginning any land-disturbing activities or alterations to known historic structures within the project boundary. Developing and implementing an HPMP, including provisions for consulting with the SHPOs as proposed by the Town, would ensure that measures are in place to protect historic properties in the APE from adverse effects related to the project. Accordingly, we recommend that the Town develop and implement an HPMP in consultation with the New Hampshire SHPO, Maine SHPO, and federally recognized tribes to protect the project's historic properties that are eligible for or listed on the National Register. We estimate that the levelized annual cost of developing an HPMP would be $340 and conclude that the benefits of an HPMP outweigh the cost.

5.1.3 Measures Not Recommended

Some of the measures proposed by the Town and recommended by other interested parties would not contribute to the best comprehensive use of Salmon Falls River water resources, do not exhibit sufficient nexus to the project environmental effects, or would not result in benefits to non-power resources that would be worth their cost. The following discussion includes the basis for staff's conclusion not to recommend such measures.

Permanent Nighttime Turbine Shutdowns

To protect downstream migrating eels, the Town proposes to implement nighttime turbine shutdowns for the duration of the license term, from September 1 through October 31, from 8:00 pm to 4:00 am for three consecutive nights following rain accumulation of 0.5 inch or more over a 24-hour period, within four years of the effective date of a subsequent license.

As discussed in Section 3.3.1.2, *Environmental Effects, Downstream American Eel and Anadromous Fish Passage, Nighttime Turbine Shutdowns*, increasing spill over a dam by ceasing generation can benefit downstream eel passage (Brown et al., 2009) and can provide a significant reduction in downstream passage mortality (Eyler, 2014). Passage over the spillway at the Rollinsford Project would provide a downstream passage route with a lower likelihood of injury and mortality than turbine passage. However, any eels migrating downstream during the day could be attracted by the flow into the intake headworks and injured or killed if they pass downstream through the turbines.

Starting four years after license issuance, the Town proposes to implement nightly turbine shutdowns and operate the downstream eel passage facility from September 1 through October 31. Available literature indicates that the downstream eel migration season extends from August through November (Oliveira and McCleave 2000; Haro et al. 2004; ASMFC 2013). Although the Town's proposal would protect eels during their peak migration periods (i.e., September through October), the Town's proposal would not protect eels during the months of August or November.

As discussed above in section 5.1.2, *Additional Measures Recommended by Staff, Downstream American Eel Passage*, staff's recommended downstream eel passage facility would consist of a full-depth diversionary guidance boom, surface bypass weir at the spillway, and 4-foot-deep plunge pool downstream of the dam. The staff-recommended facility would provide downstream passage for eels and prevent injury and mortality from turbine passage day and night throughout the downstream eel migration season, while allowing the project to generate. Because staff's recommended downstream eel passage facility would prevent injury and mortality for the entire downstream eel passage period, the Town's proposal to shut down the turbines at night

for the duration of the license term would not provide any significant benefit to downstream migrating eels, and staff does not recommend it.

Water Quality Plan

As discussed in section 3.3.1.1, *Affected Environment, Water Quality*, during the 2018 water quality study, the Town observed low DO concentrations in the impoundment (i.e., below 5.0 mg/L) that may not be adequate to sustain aquatic life. As discussed in section 3.3.1.2, *Environmental Effects, Water Quality*, the low DO concentrations in the impoundment appear to be the result of natural biochemical processes occurring in the impoundment during periods of low inflow during the summer (i.e., when flow is less than the minimum hydraulic capacity of the project).

The Town proposes to implement a draft water quality plan[140] to improve DO conditions in the impoundment during low flow periods. The draft plan includes the following provisions: (1) draw down the impoundment by 1.25 feet by releasing flow for project generation during "critical low flow periods" to "flush stagnant water from the impoundment;"[141] (2) refill the impoundment by retaining all inflow except for the proposed 35-cfs bypassed reach minimum flow; and (3) monitor water temperature and DO concentrations in the impoundment, bypassed reach, and tailrace from July 1 through September 15 for three years after license issuance to determine the effectiveness of the impoundment drawdown procedures in improving the water quality within the impoundment.

New Hampshire DES's certification condition E-14 requires the Town to consult with New Hampshire DES within 60 days after license issuance to finalize the proposed water quality plan, and to implement the plan to improve water quality in the Salmon Falls River during low flow periods. Maine DEP's certification requires the Town to consult with it and New Hampshire DES to finalize the proposed water quality plan within 60 days of license issuance (condition 5A). Then, for two years following license issuance, Maine DEP's certification requires the Town to monitor DO in the impoundment following seven days of inflow less than 80 cfs, between July 1 and September 15 (condition 5B). If monitoring indicates that DO is below 5.0 mg/L, the certification requires the Town to implement the draft water quality plan in the third year following license issuance (condition 5B).

[140] *See* Commission staff's June 22, 2021 Memorandum, which includes the Town's proposed draft water quality plan as Enclosure B.

[141] The Town defines "critical low flow periods" as when total inflow to the project has been less than 80 cfs for seven consecutive days during the months of July 1 through September 15.

As stated in section 3.3.1.2 *Environmental Effects, Water Quality,* during the 2018 water quality study, thermal stratification was evident beginning at approximately 6.56 feet from the surface. Based on the depth of the intake gates (i.e., 7.92 to 12.42 feet below the surface), the proposed drawdowns to remove stagnant water during critical low flow periods in the summer would pull low-DO water from the hypolimnion and release it downstream. Because the water discharged downstream would likely have much lower DO concentrations than water flowing into the impoundment, the composite DO concentration in the impoundment (i.e., average DO concentration across the full depth of the impoundment) should increase as the impoundment refills, resulting in an improvement to water quality in the impoundment.

The benefits to water quality in the impoundment would be offset by adverse effects on aquatic resources. During impoundment drawdowns, low DO water would be released into the Salmon Falls River downstream of the powerhouse for 48 hours, which would decrease DO in the downstream reach and in the South Berwick Project impoundment. The drawdown and refill process would also reduce minimum bypassed reach flows and attraction flows for fish passage because the facilities that release these flows from the dam would not be able to operate at their full capacity when the impoundment elevation is below 71.25 feet NGVD29. Reducing flow to the bypassed reach would reduce the availability of aquatic habitat in the bypassed reach until minimum bypassed reach flows are restored. Reducing the amount of flow through the fish passage facilities at the dam would reduce attraction and conveyance flows for upstream and downstream passage of American shad, river herring, and American eels and could delay migration through the project area for these species. Collectively, releasing low DO water to the downstream reach, reducing minimum bypassed reach flow, and reducing attraction flows for fish passage would likely adversely affect fish and aquatic resources in the downstream reach.

The proposed water quality plan would likely adversely affect aquatic resources in the bypassed reach and downstream reach for up to 5.5 days, which is longer than the total duration of the low-DO events that occurred in the impoundment during 2018 (2.1 days). Based on the types of adverse effects that would be caused by the proposed water quality plan, and the duration of those effects, staff concludes that the proposed plan would likely result in a net adverse effect on aquatic organisms in the Salmon Falls River. Accordingly, we do not recommend it. For similar reasons, we do not recommend New Hampshire DES's or Maine DEP's requirement to finalize and implement the proposed plan. Similarly, we do not recommend Maine DEP's requirement to monitor water quality for two years prior to implementing the plan. The 2018 water quality study documented existing low DO conditions in the impoundment during low flow periods

between July and September. It is unclear what additional information or benefits would be gained with continued monitoring.

Long-term Water Quality Monitoring

New Hampshire DES's certification condition E-15 requires the Town to monitor DO and temperature in the impoundment, tailrace, and bypassed reach every five years beginning the fifth year after license issuance, and ending five years prior to the expiration of the license, to determine the effects of project operation on water temperature and DO, and determine if additional changes to project operation are necessary to comply with New Hampshire DES's surface water quality standards.

New Hampshire DES refers to Wake et al. (2014), who state that the frequency of short-term (one to three months) and medium-term (three to six months) droughts in New Hampshire are projected to increase by the end of the century. New Hampshire DES states that the increase in temperatures and frequency of low-flow conditions could result in an increase in the frequency and magnitude of low-DO events at the project. New Hampshire DES states, therefore, the long-term water quality monitoring required by condition E-15 is necessary to evaluate if the frequency and magnitude of low-DO events increase at the project during the license term, and if additional changes in project operation are necessary to comply with New Hampshire's water quality standards.

Monitoring water quality the project at 5-year intervals would provide data about changes in the frequency and duration of low-DO events during the license term. However, New Hampshire DES does not provide any information about how project operation is contributing to adverse effects on water quality. The Town is proposing to operate the project in a run-of-river mode, which would continue to minimize the length of time water is retained in the impoundment and minimize project effects on water quality. Separately, New Hampshire DES does not provide any measures that would be implemented to enhance water quality if monitoring shows that the frequency and magnitude of low-DO events increases at the project during the term of a subsequent license. Because monitoring itself would not provide any benefits to water quality during the term of a license and because New Hampshire DES's condition does not include any enhancement measures to benefit water quality, there is no apparent benefits to water quality associated with New Hampshire DES's condition. Therefore, we do not recommend it.

Upstream Anadromous Fish Passage

The Town proposes to construct and operate a Denil fishway at the dam and excavate the lower section of the bypassed reach to provide upstream passage for American shad and river herring, if GMP does not install, operate, and maintain a new trap and haul facility at the South Berwick Project No. 11163 (located approximately 1

mile downstream of the Rollinsford Project), to trap fish and transport them upstream to the impoundments of the Rollinsford Project, the Lower Great Falls Project No. 4451, and the Somersworth Project No. 3820.[142] Maine DEP's certification condition 3B also requires the Town to construct and operate a Denil fishway to provide upstream passage for anadromous fish "unless an exception for trap and truck operations is requested within two years of issuance of a new license, and approved by USFWS and by FERC."[143]

As discussed above in section 5.1.2, *Additional Measures Recommended by Staff, Upstream Anadromous Fish Passage*, Commission staff recommends the installation of a technical fishway at the dam and a nature-like fishway in the lower bypassed reach to provide upstream passage for shad and river herring, as conditionally proposed by the Town. Since GMP has not submitted a request to amend the license for the South Berwick Project to provide upstream fish passage via trap and haul at the South Berwick Project No. 11163, and the Town has not filed any information demonstrating that a trap and haul alternative is reasonably foreseeable, Commission staff cannot evaluate the trap and haul alternative on the merits in this EA and does not recommend it.[144]

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[142] If GMP files a request to install, operate, and maintain a trap and haul facility at the South Berwick Project with the Commission, and the Commission denies GMP's request, then the Town proposes to construct the Denil fishway and excavate the lower bypassed reach prior to the fourth passage season after the denial. If GMP receives authorization to install a trap and haul facility, but later discontinues the operation of the trap and haul facility during the term of a subsequent license, then the Town proposes to install a Denil fishway and excavate the lower bypassed reach four years after the cessation of the trap and haul operation. The Town defines the upstream passage season for American shad and river herring as April 15 to July 15.

[143] Maine DEP does not specify where the trap and haul facility would be located or who would submit the request to install a trap and haul facility. Based on the similarities between Maine DEP's certification condition 3 and the upstream fish passage measures included in the Settlement Agreement, staff assumes that Maine DEP is referring to an exception that would occur if GMP submits a request to provide upstream fish passage via trap and haul at the South Berwick Project No. 11163.

[144] In addition to requiring the Town to comply with Interior's section 18 prescription, New Hampshire DES condition E-13 requires the Town to comply with "any modifications made to the preliminary prescriptions that are acceptable to FWS, including, but not limited to, any modifications made to be consistent with the Settlement

Migration Habitat Monitoring

Commerce recommends under section 10(j) of the FPA, that the Town "prepare a plan and implement monitoring of the suitability of upstream and downstream migration habitat for diadromous fish under the required minimum bypassed reach flows." Commerce states that the plan should be developed according to scientifically accepted practices including but not limited to radio-telemetry, paired release, and PIT tags.

Commerce did not include specific methods for monitoring the suitability of minimum bypassed reach flows for migratory fish; specific performance standards for assessing when flows were unsuitable; or specific enhancement measures for improving suitability. Without specific measures to analyze, there is no basis for assessing the benefits or costs of Commerce's recommendation.

As discussed in section 3.3.1.2, *Environmental Effects, Migration Habitat Monitoring*, information is available on migration habitat in the bypassed reach. As described in section 3.3.1.2, *Environmental Effects, Bypassed Reach Minimum Flow*, the Town's 2018 instream flow study describes how habitat availability for shad and river herring larvae, juveniles, adults, and spawning and incubation changes at flows ranging from 30 to 100 cfs. In addition, the Town measured water depth and velocity through several transects at 29, 43, 82, and 120 cfs to identify flows that produced depth or velocity barriers that would prevent shad and river herring from moving through the transects. The study showed that the depth along transects ZOP-3 and ZOP-4 is not suitable for downstream passage for shad, river herring, and adult eels at certain flows. Separately, the Town's 2018 upstream eel passage study collected juvenile eels migrating upstream near the project dam at the current 10-cfs minimum bypassed reach flow, which indicates that juvenile eels can reach the project dam under current operation.

As discussed in section 5.1.2, *Additional Measures Recommended by Staff*, Commission staff recommends installing upstream and downstream passage facilities for eel, shad, and river herring, and operating and maintaining those facilities (including providing attraction flows to those facilities), in a manner that considers the FWS Design Criteria Manual and Interior's prescription. As part of the recommendation to install upstream passage facilities for shad and river herring, staff recommends modifying the lower bypassed reach into a nature-like fishway to increase the zone of passage during upstream migration, consistent with Interior's prescription. Also, consistent with Interior's section 10(j) recommendation, staff recommend a minimum bypassed reach

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Agreement by and between" the Town, GMP, and FWS. To the extent that any future section 18 prescription includes constructing a trap and haul facility at the South Berwick Project No.11163, staff would not recommend New Hampshire DES Condition E-13 for the same reasons that staff is not recommending the Town's proposal.

flow of 60 cfs or inflow, whichever is less, from April 15 – July 15, and a minimum flow of 35 cfs or inflow, whichever is less, from July 16 – April 14, to protect and enhance aquatic habitat in the bypassed reach, beginning on April 15 of the third year after license issuance, when the staff-recommended passage facilities are installed at the project.

Given the information available on habitat suitability in the bypassed reach (including velocities and depths), and staff's recommended minimum bypassed reach flows and fish passage facilities, it is unclear what additional information Commerce's recommended monitoring would provide about the suitability of the bypassed reach for upstream and downstream migration or how that information would benefit migratory species. Based on the lack of apparent benefits and lack of specific measures, staff does not recommend the development of Commerce's habitat monitoring plan.

Effectiveness Testing

Interior's preliminary fishway prescription would require the Town to develop a plan to ensure: (1) the effectiveness of the upstream and downstream eel and fish passage measures required by Interior; and (2) that the minimum bypassed reach flow of 35 cfs provides "safe, timely, and effective" downstream fish and eel passage (i.e., does not strand fish). New Hampshire's certification condition E-13 requires the Town to comply with Interior's prescription. Maine DEP's certification conditions 3D and 4D require the Town to design effectiveness studies for the upstream and downstream fish passage facilities.

Fishway efficiency evaluations may take many forms, including video observation, sample collection, hydro-acoustics, telemetry, or passive integrated transponder studies. A passage effectiveness study typically evaluates factors such as attraction flows, attraction efficiency, passage efficiency, passage delay, and survival rates. Efficiency testing could be evaluated quantitatively through a site-specific framework, and performance standards could be informed by state and federal agencies with expertise in the life history requirements of the region's fish populations. Factors to consider could include the impact of all barriers within the watershed and the minimum number of fish required to sustain a population's long-term health and achieve identified management plan objectives and goals.

Interior, Maine DEP, and New Hampshire DES have not included any specific performance standards that would be used to test the effectiveness of the fish passage facilities. Instead, Interior would require the development of plans and performance standards post-licensing, in consultation with resource agencies. Without specific performance standards to analyze, there is no basis for assessing the benefits of effectiveness testing for fish passage and determining whether effectiveness testing would or would not provide benefits to American shad, river herring, and American eels. Therefore, there is no justification for recommending the effectiveness studies.

Interior's preliminary fishway prescription would require new fish passage facilities to be designed in accordance with species-specific design criteria from FWS's 2019 Design Criteria Manual, and that the facilities be operated and maintained in accordance with a fish passage operation and maintenance plan that is developed in consultation with the resource agencies and approved by the Commission. Since the facilities would be designed, operated, and maintained in a manner already shown to be effective, there is no apparent benefit to conducting effectiveness studies. Accordingly, there is no basis for recommending license conditions that would require effectiveness testing and potential modification of the passage facilities.

Northern Long-Eared Bat Survey

Interior recommends under section 10(j) that the Town implement a protocol to avoid adverse effects on the NLEB by either: (1) avoiding any tree removal activities at the project between April 1 and October 1; or (2) conducting bat exit surveys within 24-hours of scheduled tree removal to ensure that no bats are utilizing potential roost trees at the project.

Although bat exit surveys could be used to determine the presence or absence of NLEB at the project, restricting tree removal activities between April 1 and October 1 for trees with diameters that are equal to or greater than 3 inches at breast height , as recommended by staff in section 5.1.2, *Additional Measures Recommended by Staff*, would provide a similar level of protection to this species at no cost. Therefore, we conclude that this measure is not necessary and not worth the approximate levelized annual cost of $1,410.

Notification of Future Project Effects on Federally Listed Species and Future Amendments

Interior recommends under section 10(j) of the FPA that the Town be required to notify the resource agencies and the Commission of any activity that may affect a federally listed species in a manner not considered in any new license issued by the Commission. Interior also recommends that the Town be required to notify Interior if it files with the Commission an amendment or appeal of any fish and wildlife-related license conditions or if it files an extension of time request for project construction or implementation of license articles.

If issues related to federally listed species were to arise during the term of a subsequent license, either based on new listings or availability of new information, post-licensing procedures developed by the Commission and resource agencies (FERC et al., 2000) provide a framework for identifying issues, information gaps, and the need for

protection measures.[145] In addition, a license for the project would include a standard article[146] requiring the licensee to construct, maintain, and operate facilities, and modify project structures and operation for the conservation and development of fish and wildlife resources, if ordered by the Commission upon its own motion, or upon the recommendation of the Secretary of the Interior or the fish and wildlife agencies of any state in which the project is located, after notice and opportunity for hearing. Further, a licensee must file an application to amend the license and receive Commission authorization before substantially modifying project works or operation.[147] Before filing an amendment application, the licensee must consult with any resource agency whose interests would be affected by the amendment,[148] such as the FWS if federally listed species would be affected by the amendment. Since Form L-9 and the Commission's regulations, along with the interagency task force report referenced above, already provide post-license ESA consultation procedures, there is no need for, and we do not recommend that, Interior's measure be included in a license for the project.

Recreation Access

Maine DEP's certification condition 6A requires the Town to continue to provide informal access to the project for recreation and navigation. Maine DEP also requires the Town to consult with Maine DIFW within 6 months of license issuance about improvements to access for streamside angling, including additional signs and trails to the tailrace and bypassed reach.

As discussed in section 3.3.4.2, *Environmental Effects, Recreation*, informal public recreational access to the impoundment and the Salmon River downstream of the project is available through multiple non-project recreation sites, all but one of which are owned and maintained by municipal governments. There is no indication that access would cease at any of these sites over the term of a subsequent license for the project. Further, a subsequent license would include a standard article requiring the licensee to

[145] *See Interagency Task Force Report on Improving Coordination of ESA Section 7 Consultation with the FERC Licensing Process*, Work Group on the Coordination of Federal Mandates (Dec. 8, 2000), https://www.ferc.gov/sites/default/files/2020-04/ImprovingCoordinationofEndangeredSpeciesActSection7ConsultationwiththeFERCLicensingProcess.pdf (accessed Nov. 27, 2020).

[146] *See Standardized Conditions for Inclusion in Preliminary Permits and Licenses Issued Under Part I of the Federal Power Act*, Order No. 540, 54 F.P.C. 1792, at 1855-56 (1975) (providing Form L-9, Article 11).

[147] *See id.*, at Article 2.

[148] *See* 18 C.F.R. §§ 4.38(a)(6) and 4.201.

allow public use of the project for recreation and navigation.[149] Because informal public access is already provided at the project and there is no reason to believe that it would not remain so during the term of a subsequent license, and because the license would include an article requiring the Town to allow public use of the project, we do not recommend Maine DEP's measure for providing informal access.

With regard to Maine DEP's requirement for the Town to consult with the Maine DIFW about opportunities for angler access, Maine DEP has not identified any access issues for anglers and no comments were received about any restrictions or barriers to public access at the project, including the need for signs or trails to ensure access to the tailrace and bypassed reach for angling. Because recreation access is currently available in the downstream reach of the Salmon Falls River and there is no indication of any restrictions to access for angling, there is no clear benefit associated with Maine DEP's measures and we do not recommend it.

5.1.4 Conclusion

Based on our review of the agency and public comments filed for the project and our independent analysis pursuant to sections 4(e), 10(a)(1), and 10(a)(2) of the FPA, we conclude that licensing the Rollinsford Project, as proposed by the Town with the additional staff-recommended measures, would be best adapted to a plan for improving the Salmon Falls River Basin.

5.2 UNAVOIDABLE ADVERSE IMPACTS

Although fish kills have not been documented at the project, any adult eels migrating downstream through the impoundment prior to the completion of downstream fish passage facilities could attempt to pass downstream through the project's turbine and could be injured or killed. In addition, shad, river herring, or adult eels that pass downstream via spill could be injured or killed if they strike the bedrock at the toe of the dam.

5.3 FISH AND WILDLIFE AGENCY RECOMMENDATIONS

Under the provisions of section 10(j) of the FPA, each hydroelectric license issued by the Commission shall include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project.

Section 10(j) of the FPA states that whenever the Commission finds that any fish and wildlife agency recommendation is inconsistent with the purposes and the

[149] See Form L-9, 54 FPC ¶ 1792, at Article 13.

requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of the agency.

In response to our April 29, 2020, notice accepting the application to relicense the project and soliciting motions to intervene, protests, comments, recommendations, preliminary terms and conditions, and preliminary fishway prescriptions, Interior filed six section 10(j) recommendations on June 25, 2020, and Commerce filed seven section 10(j) recommendations on June 29, 2020. Appendix D lists the recommendations filed pursuant to section 10(j), and indicates whether the recommendations are included under the staff alternative, as well as the basis for our preliminary determinations concerning measures that we consider inconsistent with section 10(j). Environmental recommendations that we consider outside the scope of section 10(j) have been considered under section 10(a) of the FPA and are addressed in the specific resource sections of this document.

5.4 CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2)(A) of the FPA, 16 U.S.C. § 803(a)(2)(A), requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. Appendix E lists the comprehensive plans that are applicable to the Rollinsford Project. No inconsistencies were found.

6.0 FINDING OF NO SIGNIFICANT IMPACT

If the Rollinsford Project is issued a subsequent license as proposed with the additional staff-recommended measures, the project would continue to operate as it does today, while providing enhancements to fish and wildlife resources, protection of threatened species, and protection of cultural and historic resources in the project area.

Based on our independent analysis, we find that the issuance of a license for the Rollinsford Project, with additional staff-recommended environmental measures, would not constitute a major federal action significantly affecting the quality of the human environment.

7.0 LITERATURE CITED

The literature cited in this EA is presented in Appendix F.

8.0 LIST OF PREPARERS

The list of preparers of this EA is presented as Appendix G.

APPENDIX A

STATUTORY AND REGULATORY REQUIREMENTS

Federal Power Act

Section 18 Fishway Prescriptions

Section 18 of the Federal Power Act (FPA), 16 U.S.C. § 811, states that the Commission is to require construction, operation, and maintenance by a licensee of such fishways as may be prescribed by the Secretaries of the U.S. Department of Commerce (Commerce) or the U.S. Department of the Interior (Interior).

On June 25, 2020, Interior timely filed a preliminary fishway prescription for the project and requested that the Commission include a reservation of authority to prescribe fishways under section 18 in any license issued for the project. On June 29, 2020, Commerce timely requested that the Commission include a reservation of authority to prescribe fishways under section 18 in any license issued for the project. Interior's preliminary fishway prescriptions are summarized in section 2.3, *Modifications to Applicant's Proposal – Mandatory Conditions*, and included in Appendix H for informational purposes.

Alternative Section 18 Fishway Prescriptions under the Energy Policy Act of 2005

The Energy Policy Act of 2005 (EPAct) provides parties to this licensing proceeding the opportunity to request trial-type hearings regarding issues of material fact that support the prescriptions developed under FPA section 18. EPAct also provides parties the opportunity to propose alternatives to preliminary prescriptions. On July 24, 2020, in accordance with section 241 of EPAct, the Town requested a hearing regarding issues of material fact pertaining to Interior's preliminary fishway prescription. The primary issue raised by the Town is that it is premature to require upstream fish passage because: (1) the bypassed reach appears impassable to river herring based on the 2018 instream flow study, and (2) American shad have not been observed using the upstream fish passage facility at the South Berwick Project located 1.1 miles downstream.

On February 8, 2021, the Town withdrew its request for a trial-type hearing and stated that it has entered into a settlement agreement with Interior. On March 5, 2021, GMP filed an Offer of Settlement for Modified Prescription for Fishways (Settlement Agreement) on behalf of itself, the Town, and Interior. The Settlement Agreement purports to resolve, among the settling parties, disagreements over the appropriate terms of a prescription for fishways for American shad and river herring to be included in the subsequent license for the Rollinsford Project pursuant to Section 18 of the Federal Power Act.

The Town also filed an alternative prescription under which it would construct and operate a Denil fishway at the dam and excavate the lower section of the bypassed reach to provide upstream passage for American shad and river herring, if GMP does not install, operate, and maintain a new trap and haul facility at the South Berwick Project No. 11163 (located approximately 1 mile downstream of the Rollinsford Project), to trap fish and transport them upstream to the impoundments of the Rollinsford Project, the Lower Great Falls Project No. 4451, and the Somersworth Project No. 3820.

As discussed in section 3.3.1.2, *Environmental Effects, Upstream Anadromous Fish Passage*, Commission staff's analysis of upstream anadromous fish passage includes an evaluation of the potential benefits of installing a Denil fishway at the dam and excavating the lower section of the bypassed reach. However, GMP has not submitted a request to amend the license for the South Berwick Project to provide upstream fish passage via trap and haul at the South Berwick Project No. 11163, and the Town has not filed any information demonstrating that a trap and haul alternative is reasonably foreseeable. Therefore, Commission staff's analysis of upstream anadromous fish passage does not evaluate the merits of a trap and haul alternative at the South Berwick Project. As discussed in section 5.1.2, *Additional Measures Recommended by Staff, Upstream Anadromous Fish Passage*, Commission staff recommends that the Town install a technical fishway at the dam and a nature-like fishway in the lower bypassed reach to provide upstream passage for shad and river herring through the project.

Section 10(j) Recommendations

Under section 10(j) of the FPA, 16 U.S.C. § 803(j)(1), each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions in any subsequent license unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

On June 25, 2020, Interior filed timely recommendations under section 10(j). Commerce filed timely recommendations under section 10(j) on June 29, 2020. These recommendations are discussed in section 5.1, *Comprehensive Development and Recommended Alternative*, and Appendix D, *Fish and Wildlife Agency Section 10(j) Recommendations*.

Clean Water Act

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

On June 12, 2020, the Town applied to the Maine Department of Environmental Protection (Maine DEP) and the New Hampshire Department of Environmental Services (New Hampshire DES) for section 401 certification for the Rollinsford Project. Maine DEP and New Hampshire DES received the respective requests on June 12 and 15, 2020. Maine DEP and New Hampshire DES timely issued section 401 certifications on June 11, 2021. The conditions of the certifications are described under section 2.3.2, *Modifications to Applicant's Proposal—Mandatory Conditions, Water Quality Certification Conditions,* and discussed in section 5.1, *Comprehensive Development and Recommended Alternative*. The certifications are included in Appendices I and J for informational purposes.

Endangered Species Act

Section 7 of the Endangered Species Act (ESA), 16 U.S.C. § 1536, requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. On June 16, 2021, we accessed the U.S. Fish and Wildlife Service's (FWS) Information for Planning and Consultation (IPaC) database to determine whether any federally listed species could occur in the project vicinity. According to the IPaC database, the federally threatened northern long-eared bat (*Myotis septentrionalis*) (NLEB) could occur in the project vicinity.[150] No critical habitat has been designated for the NLEB.

Our analysis of project impacts on the NLEB is presented in section 3.3.3.2, *Threatened and Endangered Species, Environmental Effects,* and our recommendations are included in section 5.1, *Comprehensive Development and Recommended Alternative*. The Town has not proposed any major ground-disturbing or tree-clearing activities. However, Interior's preliminary fishway prescription requires the installation of new upstream and downstream fish and eel passage facilities at the project that could result in

[150] *See* Interior's official list of threatened and endangered species, accessed by staff using the IPaC database (https://ecos.fws.gov/ipac/) on June 16, 2021, and placed into the record for Docket No. P-3777-011 on June 16, 2021.

limited tree removal that could affect NLEB. Avoiding the removal of trees with diameters that are greater than or equal to 3 inches at breast height from April 1 through October 1 would reduce the likelihood of disturbing NLEB and their newly born pups during the broader, active season of NLEB at the project. We conclude that licensing the project with tree-cutting restrictions from April 1 through October 1 may affect the NLEB, but any incidental take that may result is not prohibited by the final 4(d) rule of the ESA.[151]

Coastal Zone Management Act

Under section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA), 16 U.S.C. § 1456(c)(3)(A), the Commission cannot issue a license for a project within or affecting a state's coastal zone unless the state's CZMA agency concurs with the license applicant's certification of consistency with the state's CZMA Program, or the agency's concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant's certification.

On January 5, 2021, the Town submitted a consistency certificate to the Maine Department of Marine Resources and the New Hampshire Coastal Program for compliance with the Coastal Zone Management Act. In its January 5, 2021 submittals, the Town certified that the proposed activities for the Rollinsford Project comply with the New Hampshire and Maine Coastal Zone Management Programs. By letter dated July 1, 2021 and filed with the Commission on July 2, 2021, Maine DMR concurred with the Town's consistency certification. By letter dated July 6, 2021 and filed with the Commission on July 9, 2021, New Hampshire DES states that the proposed activity complies with the New Hampshire approved Coastal Management Program, conditioned on the Town complying with Interior's section 18 fishway prescription.

The Commission is required to include all section 18 fishway prescriptions and water quality certification conditions in any license issued for the project. Therefore, we conclude that the Rollinsford Project would be consistent with the Maine and New Hampshire Coastal Management Programs.

National Historic Preservation Act

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

[151] 81 Fed. Reg. 1900-22 (Jan. 14, 2016).

engineering, and culture that are eligible for inclusion in the National Register of Historic Places (National Register).

In response to the Town's August 31, 2016 request, Commission staff designated the Town as its non-federal representative for the purposes of conducting section 106 consultation under the NHPA on October 11, 2016. Pursuant to section 106, and as the Commission's designated non-federal representative, the Town initiated consultation with the New Hampshire State Historic Preservation Officer (New Hampshire SHPO), the Maine State Historic Preservation Officer (Maine SHPO), and federally recognized tribes to identify historic properties, determine the eligibility of cultural resources for listing on the National Register, and assess potential adverse effects on historic properties within the project's area of potential effect (APE).

Our analysis of the project's effects on historic properties is presented in section 3.3.5.2, *Cultural Resources, Environmental Effects.* Historic properties occur in the project's APE, including contributing resources of the Salmon Falls Historic District (i.e., the project powerhouse, dam, and intake headwork structure), which is a listed property on the National Register. We conclude that licensing the project could have an adverse effect on the Salmon Falls Mill Historic District in the event repairs are needed to maintain the structure and function of contributing resources within the project's APE, or to fix structural damage that occurs in the course of project operation. Adverse effects could also occur if the eel and fish passage structures prescribed by Interior are installed on contributing resources, such as the Rollinsford Dam.

To meet the requirements of section 106 of the NHPA, we intend to execute a Programmatic Agreement (PA) with the New Hampshire SHPO and the Maine SHPO for the protection of historic properties from the effects of proposed project modifications, operation, and maintenance. Federally recognized tribes and the Town will be invited to concur with the terms of the PA. The terms of the PA would ensure that the Town protects all historic properties identified within the project's APE through the implementation of a Historic Properties Management Plan.

APPENDIX B

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

Project decommissioning was considered as an alternative to the project but has been eliminated from further analysis because it is not reasonable in the circumstances of this case.

As the Commission has previously held, decommissioning is not a reasonable alternative to relicensing a project in most cases, when appropriate protection, mitigation, and enhancement measures are available.[152] The Commission does not speculate about possible decommissioning measures at the time of relicensing, but rather waits until an applicant actually proposes to decommission a project, or there are serious resource concerns that cannot be addressed with appropriate license measures, making decommissioning a reasonable alternative to relicensing.[153] This is consistent with NEPA and the Commission's obligation under section 10(a) of the FPA to issue licenses that balance developmental and environmental interests.

Project retirement could be accomplished with or without dam removal.[154] Either alternative would involve denial of the license application and surrender or termination of the existing license with appropriate conditions.

The Town does not propose decommissioning, nor does the record to date demonstrate there are serious resource concerns that cannot be mitigated if the project is

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

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

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

relicensed; as such, there is no reason, at this time, to include decommissioning as a reasonable alternative to be evaluated and studied as part of staff's NEPA analysis.

APPENDIX C

SUMMARY OF COST OF ENVIRONMENTAL MEASURES

Table 13. The cost of environmental measures considered in assessing the environmental effects of constructing and operating the Rollinsford Project.

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Project Operation				
Continue operating the project in a run-of-river mode, such that outflow approximates inflow at all times.	Town, Interior,[c] Commerce,[c] New Hampshire FGD, New Hampshire DES,[d] Staff	$0	$0	$0
Maintain the impoundment at the flashboard crest elevation of 71.25 feet NGVD29 under normal operating conditions.	Town, Maine DEP,[d] New Hampshire DES,[d] Staff	$0	$0	$0
When drawing down the water level in the impoundment for scheduled maintenance, lower the impoundment water level no more than six inches per day.	New Hampshire DES,[d] Staff	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Implement an impoundment refill procedure following emergency and maintenance drawdowns, whereby 90 percent of inflow is passed downstream, and 10 percent of inflow is used to refill the impoundment, to protect aquatic resources in the downstream reach.	Interior,[c] New Hampshire DES,[d] New Hampshire FGD, Staff	$0	$0	$0
Develop a headpond refill plan to protect fish and aquatic habitat.	Commerce,[c]	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost
Develop an operation compliance monitoring plan to document compliance with run-of-river operation and minimum flow releases.	Interior,[c] Commerce,[c] Maine DEP,[d] New Hampshire DES,[d] New Hampshire FGD, Staff	$5,000	$0	$340

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Aquatic Resources				
Implement a draft water quality plan that includes: (1) drawing down the impoundment by 1.25 feet during "critical low flow periods;" (2) refilling the impoundment by retaining all inflow except for the proposed 35-cfs bypassed reach minimum flow; and (3) monitoring water temperature and DO concentrations in the impoundment, bypassed reach, and tailrace from July 1 through September 15 for three years after license issuance.	Town	$5,000	$1,860[e]	$2,200
To protect water quality in the impoundment during low flow periods: (1) finalize the proposed water quality plan within 60 days of license issuance, in consultation with the New Hampshire DES and Maine DEP; (2) for two years following license issuance, monitor DO in the impoundment following seven days of inflow less than 80 cfs, between July 1 and September 15; and (3) if monitoring indicates that DO is below 5.0 mg/L, then implement the water quality plan in the third year following license issuance.	Maine DEP[d]	$5,000	$1,270[e]	$1,610

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Finalize the proposed water quality plan in consultation with the New Hampshire DES, and monitor DO and temperature in the impoundment, tailrace, and bypassed reach every five years, including five weeks of monitoring during "periods of relatively low flows and high temperatures" and "when the Project is, and is not, generating."	New Hampshire DES[d]	$5,000	$2,300[g]	$2,650
Monitor water quality every five years to determine whether changes in project operation are necessary to comply with New Hampshire DES's water quality standards during the term of a subsequent license.	New Hampshire DES[d]	$0	$1,470[f]	$1,470
Continue to discharge all inflow to the bypassed reach when the project is not generating.	Town, Interior,[c] Commerce,[c] Maine DEP,[d] New Hampshire DES,[d] Staff	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
To enhance aquatic habitat in the bypassed reach, increase the minimum flow release to the bypassed reach from the current minimum flow of 10 cfs to 35 cfs or inflow, whichever is less, when the turbine-generators are operating, by increasing the size of the notch in the flashboards.[g]	Town	$1,000[h]	$20,870[i]	$20,940
Release a minimum bypassed reach flow of 35 cfs from July 16 - April 14, and 60 cfs from April 15 - July 15.	Interior,[c] New Hampshire FGD	$0	$26,080[j]	$26,080
Release a minimum bypassed reach flow of 35 cfs from July 16 - April 30, and 60 cfs from May 1 - July 15.	Commerce[c]	$0	$25,200[k]	$25,200
Release a minimum bypassed reach flow of 82 cfs.	Maine DIFW	$0	$60,100[l]	$60,100

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
After the installation of upstream fish passage facilities at the project, and when the project is generating, release to the bypassed reach: (1) a minimum flow of 35 cfs or inflow, whichever is less, from July 16 – April 14; and (2) an unspecified minimum flow from April 15 – July 15, the quantity of which must be determined in consultation with resource agencies.	Maine DEP,[d] New Hampshire DES[d]	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost
Consult with the resource agencies to determine the manner in which flows will be released to the bypassed reach.	Maine DEP[d]	$0	$0	$0
Release a year-round minimum flow of 35 cfs to the bypassed reach from a notch in the flashboards when the project is generating, as proposed by the Town, for two years after license issuance.	Staff	$0	$2,650[m]	$2,650

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Beginning on April 15 of the third year after license issuance, release the following minimum bypassed reach flows from the staff-recommended upstream and downstream anadromous fish passage facilities: (1) 60 cfs or inflow, whichever is less, from April 15 – July 15; and (2) 35 cfs or inflow, whichever is less, from July 16 – April 14, to protect and enhance aquatic habitat in the bypassed reach.[n]	Staff	$0	$22,770[o]	$22,770
Upstream Fish Passage				

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Construct and operate a Denil fishway at the dam and excavate the lower section of the bypassed reach to provide upstream passage for American shad and river herring, if GMP does not install, operate, and maintain a new trap and haul facility at the South Berwick Project No. 11163 (located approximately 1 mile downstream of the Rollinsford Project), to trap fish and transport them upstream to the impoundments of the Rollinsford Project, the Lower Great Falls Project No. 4451, and the Somersworth Project No. 3820.[p]	Town, Maine DEP[d]	$1,439,010[q]	$18,800[q, r]	$117,810
Install upstream fish passage facilities for American shad and river herring, consisting of a Denil fishway at the project dam and a nature-like fishway in the bypassed reach, by March 15 of the third calendar year after license issuance, and operate and maintain the facility annually from April 15 - July 15.[s]	Interior,[v, t] New Hampshire DES,[d] Staff	$1,518,160[q]	$20,150[q, u]	$124,610

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Conduct an upstream eel passage facility siting survey for two passage seasons, beginning the first full passage season after license issuance, to determine the optimal location for siting an upstream eel ramp.	Town	$7,870	$0	$540
Conduct a two-season upstream eel passage siting survey, as proposed by the Town, beginning the first passage season after the upstream anadromous fish facilities are installed (i.e., three years after issuance of a subsequent license) from May 1 through October 31.	Interior,[v] Maine DEP,[d] Staff	$6,700[w]	$0	$460
Install and operate an upstream eel ramp within 2 years of the completion of the upstream eel ramp siting survey.	Town	$52,790[x]	$5,890[x], [y]	$9,520
Install the proposed upstream eel ramp by May 1 of the second calendar year after the siting survey is completed, and operate and maintain the ramp annually from May 1 - October 31.	Interior,[v] Maine DEP,[d] Staff	$44,960[z]	$2,390[z], [y]	$5,480

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Downstream Fish Passage				
Install a downstream eel passage facility within 4 years of license issuance, and operate the facility annually from September 1 - October 31.	Town	$293,790	$1,780[aa]	$21,990
Implement permanent downstream alosine passage and protection measures within 3 years of license issuance.	Interior[v]	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Provide downstream passage for American eel, American shad and river herring by installing the following facilities by March 15 of the third calendar year after license issuance and operating the facilities on an annual basis from May 15 – November 15: (1) a diversionary guidance boom in the impoundment, upstream of the headgate, that prevents downstream migrating alosines from entering the intake headworks; (2) a surface bypass weir with a hydraulic capacity of 35 cfs at the spillway; and (3) a 4-foot-deep plunge pool downstream of the dam.[bb]	Staff	$305,050[cc]	$4,650[cc, dd]	$25,640
To protect eels during downstream passage from September 1 through October 31, implement nighttime turbine shutdowns from 8 p.m. to 4 a.m. for three consecutive nights following rain accumulations of 0.5 inch or more over a 24-hour period, within 4 years of license issuance and continue shut downs for the duration of the license.	Town	$0	$16,800[ee]	$16,800

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Implement permanent downstream eel passage and protection measures within 3 years of license issuance.	Interior[v]	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost
Shut down the turbines from dusk to dawn for three consecutive nights following rain accumulations of 0.50 inch or more over a 24-hour period, from August 15 through November 15 annually, beginning the first passage season after license issuance and continuing until permanent downstream passage facilities are operational.[ff]	Staff, Interior[v]	$0	$5,250[gg]	$5,250
Additional Fish Passage Measures				

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Develop a fishway plan for the staff-recommended upstream and downstream eel and fish passage facilities that includes the following provisions: (1) design specifications that are based on the FWS Design Criteria Manual; (2) a schedule for submitting conceptual and final design plans for review and approval to the resource agencies and the Commission; (3) construction schedules for installing the fishways by the staff-recommended installation dates; (4) annual fishway operation schedules and conveyance flows that are based on the FWS Design Criteria Manual; (5) seasonal fishway maintenance procedures, including debris management; and (6) monitoring and reporting on the operation and maintenance of the facilities as they affect fish passage.	Interior,[v] Commerce, Maine DEP,[d] New Hampshire DES,[d] Staff	$5,000	$0	$340
Develop plans for testing the effectiveness of upstream and downstream fish passage facilities for a minimum of two years after the facilities are operational.	Interior,[v] Maine DEP,[d] New Hampshire DES[d]	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Design upstream and downstream eel passage facilities in a manner that considers the FWS's Design Criteria Manual.	Interior,[v] Staff	$0	$0	$0
Develop a plan for assessing the suitability of habitat for diadromous fish under the required minimum bypassed reach flows.	Commerce[c]	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost
Threatened and Endangered Species				
Avoid the removal of trees with diameters that are equal to or greater than 3 inches at breast height from April 1 through October 1 to protect NLEB.	Interior,[c] Staff	$0	$0	$0
Conduct bat surveys 24 hours prior to any scheduled tree removal to ensure that no NLEB are utilizing potential roost trees at the project.	Interior[c]	$5,000	$1,000	$1,410

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Notify the resource agencies and the Commission of any activity that may affect a federally listed species in a manner not considered in any subsequent license issued by the Commission.	Interior[c]	$0	$0	$0
Recreation Resources				
Continue to provide informal access to the project for recreation and navigation; and consult with Maine DIFW within 6 months of license issuance about improvements to access for streamside angling, including additional signs and trails to the tailrace and bypassed reach.	Maine DEP[d]	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital Cost (2021$)	Annual Cost [a] (2021$)	Levelized Annual Cost [b] (2021$)
Cultural Resources				
Consult with the New Hampshire and Maine State Historic Preservation Officers prior to conducting any land-disturbing activities or alterations to known historic structures within the project boundary, to determine whether to conduct archaeological or historical surveys or to implement avoidance or mitigation measures during the activity.	Town	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost	Unknown – recommendation lacks specificity needed to estimate a cost
Develop an HPMP in consultation with the New Hampshire SHPO and Maine SHPO to protect historic properties that are eligible for or listed on the National Register.	Staff	$5,000	$0	$340

(Source: Town and Staff).

[a] Annual costs typically include operational and maintenance costs and any other costs that occur on a yearly basis.
[b] All capital and annual costs are converted to equal annual costs over a 30-year period to give a uniform basis for comparing costs.
[c] Section 10(j) recommendation.
[d] Water quality certification condition under section 401(a)(1) of the Clean Water Act (CWA), 33 U.S.C. § 1341(a)(1).
[e] The annual cost of this measure would be $10,000. However, the cost is discounted to account for the implementation schedule.
[f] The cost of implementing the measure would be $10,000 for every five years of water quality monitoring. However, the cost is discounted to account for the implementation schedule.
[g] See section 2.2.2 for details regarding the proposed point of discharge for the minimum bypassed reach flow.
[h] The cost is associated with increasing the size of the notch in the flashboards.
[i] This amount is an estimate of the cost that would result from providing the minimum flow (opportunity cost). The minimum flow would reduce generation by 420,329 kWh per year. Using an energy cost of $49.64/MWh from Table 11 as a proxy for the value of foregone generation, 420,329 kWh of foregone generation would be valued at $20,870/yr.
[j] This amount is an estimate of the cost that would result from providing the minimum flow (opportunity cost). The minimum flow would reduce generation by 525,411 kWh per year. Using an energy cost of $49.64/MWh from Table 11 as a proxy for the value of foregone generation, 525,411 kWh of foregone generation would be valued at $26,080/yr.
[k] This amount is an estimate of the cost that would result from providing the minimum flow (opportunity cost). The minimum flow would reduce generation by 507,898 kWh per year. Using an energy cost of $49.64/MWh from Table 11 as a proxy for the value of foregone generation, 507,898 kWh of foregone generation would be valued at $25,200/yr.
[l] This amount is an estimate of the cost that would result from providing the minimum flow (opportunity cost). The minimum flow would reduce generation by 1,210,548 kWh per year. Using an energy cost of $49.64/MWh from Table 11 as a proxy for the value of foregone generation, 1,210,548 kWh of foregone generation would be valued at $60,100/yr.
[m] This amount is an estimate of the cost that would result from providing the minimum flow (opportunity cost). The minimum flow would reduce generation by 420,329 kWh per year. Using an energy cost of $49.64/MWh from Table 11 as a proxy for the value of foregone generation, 420,329 kWh of foregone generation would be valued at $26,870/yr. However, the cost is discounted to account for the implementation schedule.

[n] See section 2.4 for details regarding the recommended the point of discharge for the minimum bypassed reach flow.

[o] This amount is an estimate of the cost that would result from providing the minimum flow (opportunity cost). The minimum flow would reduce generation by 210,165 kWh per year. Using an energy cost of $49.64/MWh from Table 11 as a proxy for the value of foregone generation, 210,165 kWh of foregone generation would be valued at $26,080/yr. However, the cost is discounted to account for the implementation schedule.

[p] The Town's proposal lacks specificity needed to estimate the actual cost. However, staff used the costs of the Denil fishway at the dam and excavation of the lower section of the bypassed reach, provided by the Town in its April 22, 2021 response to staff's March 23, 2021 additional information request, as a worst-case cost estimate. The Town has not filed any information demonstrating that a trap and haul alternative is reasonably foreseeable. Therefore, staff's analysis of upstream anadromous fish passage does not evaluate a trap and haul alternative at the South Berwick Project. Staff assumes that the measure would be implemented approximately 4 years after the license issuance.

[q] The capital cost of this measure would be $1,782,680, which includes $1,573,880 for the Denil fishway and $208,800 for the nature-like fishway. The annual cost of the measure would be $23,080, which includes $22,030 for the maintenance of the Denil fishway and $1,050 for maintenance of the nature-like fishway. However, the costs are discounted to account for the implementation schedule.

[r] The lost generation associated with operating the facility is included in the annual cost of the Town's proposed minimum bypassed reach flow measure.

[s] Staff assumes that the measure would be implemented approximately 3 years after the license issuance.

[t] Interior has provided an option of a Denil fishway or a nature-like fishway in the lower section of the bypassed reach. The capital cost, annual cost, and levelized annual cost of using Denil fishways both at the dam and the bypassed reach would be $3,147,770, $41,970, and $258,550, respectively. However, staff recommends the least-cost option in the lower section of the bypassed reach (nature-like fishway).

[u] The lost generation associated with operating the facility is included in the annual cost of staff's minimum bypassed reach flow recommendation.

[v] Section 18 preliminary fishway prescription.

[w] Staff assumes that the measure would be implemented approximately three years after the license issuance. The capital cost of this measure would be $7,870. However, the cost is discounted to account for the implementation schedule.

[x] Staff assumes that the measure would be implemented approximately two years after the license issuance. The capital cost of this measure would be $58,760 and the annual cost would be $6,300. However, the costs are discounted to account for the implementation schedule.

[y] Staff did not assign any lost generation associated with operating the upstream eel ramp because the operational flow would be less than the minimum flow over the dam to the bypassed reach under the current project operation.

[z] Staff assumes that the measure would be implemented approximately five years after the license issuance. The capital cost of this measure would be $58,760 and the annual cost would be $3,150. However, the costs are discounted to account for the implementation schedule.

[aa] The Town proposes to release a portion of the minimum flow to the bypassed reach through the facility from September 1 through October 31. The cost of lost generation associated with the operational flow of the facility is included in the annual cost of the Town's minimum bypassed reach flow proposal.

[bb] Staff assumes that the measure would be implemented at the beginning of the third year after the license issuance.

[cc] The capital and annual costs of the measure are $358,200 and $5,330, respectively. However, the costs are discounted to account for the implementation schedule.

[dd] The lost generation associated with operating the facility is included in the annual cost of the Staff's minimum bypassed reach flow recommendation.

[ee] This amount is an estimate of the cost that would result from implementing the nighttime turbine shutdowns (opportunity cost). Implementing the nighttime turbine shutdowns would reduce generation by 338,598 kWh per year. Using an energy cost of $49.64/MWh from Table 11 as a proxy for the value of foregone generation, 338,598 kWh of foregone generation would be valued at $16,800/yr.

[ff] Staff assumes that the measure would be implemented for two years after the license issuance.

[gg] This amount is an estimate of the cost that would result from implementing the nighttime turbine shutdowns (opportunity cost). Implementing the nighttime turbine shutdowns would reduce generation by 832,317 kWh per year. Using an energy cost of $49.64/MWh from Table 11 as a proxy for the value of foregone generation, 832,317 kWh of foregone generation would be valued at $41,316/yr. However, the cost is discounted to account for the implementation schedule.

APPENDIX D

FISH AND WILDLIFE AGENCY SECTION 10(J) RECOMMENDATIONS

Analysis of Fish and Wildlife Agency Recommendations for the Rollinsford Project

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Operate the project in a run-of-river mode.	Commerce, Interior	Yes	$0	Yes
Discharge all inflow to the bypassed reach when the project is not generating.	Commerce, Interior	Yes	$0	Yes

Analysis of Fish and Wildlife Agency Recommendations for the Rollinsford Project

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Release a minimum bypassed reach flow of 35 cfs or inflow, whichever is less, from July 16 - April 30, and 60 cfs or inflow, whichever is less, from May 1 - July 15.	Commerce	Yes	$25,200	In part. Staff recommends a year-round minimum bypassed reach flow of 35 cfs for two years after license issuance, until the staff-recommended upstream fish passage facilities are constructed in the third calendar year of license issuance. During the first two calendar years after license issuance, access to the upper bypassed reach would be severely limited for anadromous fish, and a 60-cfs minimum flow would not significantly benefit spawning and incubation habitat in the bypassed reach prior to the installation of an upstream passage facility in the lower bypassed reach. Staff concludes that the benefit of a 60-cfs minimum flow recommendation does not outweigh the cost during the first two calendar years, and the recommendation is inconsistent with section 10(a) of the FPA for the first two years after license issuance. Beginning on April 15 of the third year after license issuance, when the upstream fish passage facility is installed in the lower bypassed reach, staff recommends releasing a minimum flow of 60 cfs to the bypassed reach from April 15 – July 15, and 35 cfs from July 16 – April 14.

Analysis of Fish and Wildlife Agency Recommendations for the Rollinsford Project

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Release a minimum bypassed reach flow of 35 cfs or inflow, whichever is less, from July 16 to April 14, and 60 cfs or inflow, whichever is less, from April 15 - July 15.	Interior	Yes	$26,080	In part. See explanation on Commerce's recommendation for minimum bypassed reach flows, located in the previous row.
Implement an impoundment refill procedure for emergency and maintenance drawdowns whereby 90 percent of inflow is passed downstream and 10 percent of inflow is used to refill the impoundment, to protect aquatic resources in the downstream reach.	Interior	Yes	$0	Yes
Develop a headpond refill plan to protect fish and aquatic habitat.	Commerce	Yes	Unknown – lacks specificity needed to	No. Commerce provides no specific measures to be included in the plan for staff to evaluate. The staff alternative includes Interior's recommendation to implement an impoundment refill procedure

Analysis of Fish and Wildlife Agency Recommendations for the Rollinsford Project

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
			estimate a cost	whereby 90 percent of inflow is passed downstream and 10 percent of inflow is used to refill the impoundment (90/10 refill procedure). With a 90/10 refill procedure in place, staff is not aware of any benefits to aquatic species that would be provided by the development of a separate headpond refill plan, and concludes that the recommendation is inconsistent with section 10(a).
Develop an operation compliance monitoring plan.	Commerce, Interior	Yes	$340	Yes
Develop a plan for assessing the suitability of habitat for diadromous fish under the required minimum bypassed reach flows.	Commerce	No, this measure constitutes a pre-licensing study.	Unknown – lacks specificity needed to estimate a cost.	No. Adequate information on habitat suitability in the bypassed reach is available from the Town's 2018 instream flow study and staff used that information in this EA. There is no need for additional information to conduct staff's NEPA analysis.

Analysis of Fish and Wildlife Agency Recommendations for the Rollinsford Project

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Implement a protocol to avoid adverse effects on NLEB by undertaking one of the following measures:	Interior	Yes		Yes. Staff recommends Interior's tree removal restrictions, which would protect NLEB at no cost.
(1) avoid the removal of trees with diameters that are equal to or greater than 3 inches at breast height from April 1 through October 1, to protect NLEB; or			$0	
(2) conduct bat surveys 24 hours prior to any scheduled tree removal to ensure that no NLEB are utilizing potential roost trees at the project.			$1,410	

Analysis of Fish and Wildlife Agency Recommendations for the Rollinsford Project

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Notify the resource agencies and the Commission of any activity that may affect a federally listed species in a manner not considered in any subsequent license issued by the Commission.	Interior	No, this is not a specific fish and wildlife measure.	$0	No. Post-licensing procedures are in place to protect federally listed species in the event unforeseen issues arise that affect federally listed species, including a framework for identifying issues and the need for protection measures (FERC et al., 2000), standard license articles (Form L-9, Article 11), and regulations for consultation with resource agencies in the event of license amendments (18 C.F.R. §§ 4.38(a)(6) and 4.201). Based on the lack of apparent benefits and the lack of specific measures, staff concludes that the recommendation is inconsistent with section 10(a).

APPENDIX E

LIST OF COMPREHENSIVE PLANS

Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. (Report No. 35). April 1999.

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APPENDIX F

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APPENDIX G

LIST OF PREPARERS

William Connelly – Project Licensing Coordinator, Aquatic Resources (Fish Biologist; B.S, Forestry and Wildlife Science; M.S., Marine Science; Ph.D., Marine, Estuarine, and Environmental Science).

Arash Barsari – Need for Power, Engineering, and Developmental Analysis (Civil Engineer; M.S., Civil Engineering).

Amy Chang – Terrestrial Resources, Wetlands, ESA, and Cultural Resources (Wildlife Biologist, B.S., Biology, M.S., Environmental Science and Policy).

Taconya Goar – Aquatic Resources (Fish Biologist; B.S., Environmental Science; M.S., Marine, Estuarine, and Environmental Science; Ph.D., Fisheries Science and Management).

Nicholas Palso – Recreation and Land Use; (Environmental Protection Specialist; B.S., Wildlife Biology; M.P.A, Masters of Public Administration; Ph.D., Recreation, Park, and Tourism Management).

APPENDIX H

U.S. DEPARTMENT OF THE INTERIOR'S SECTION 18 PRELIMIARY FISHWAY PRESCRIPTIONS

PRELIMINARY PRESCRIPTION FOR FISHWAYS

Pursuant to Section 18 of the FPA, as amended, the Secretary 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 is the result of consultation among the Service, NHFGD, and MEDIFW. Fishways shall be constructed, operated, and maintained to provide safe, timely, and effective passage for river herring (alewife and blueback herring), American shad, and American eel at the Licensee's expense.

11.1 UPSTREAM AND DOWNSTREAM PASSAGE

The Licensee shall construct, operate, maintain, monitor, and periodically test the effectiveness of fishways for river herring, American shad, and American eel (collectively, the "target species") as described below. The fishways will be designed, constructed, maintained, and operated (which includes project operations) to safely, timely, and effectively pass the target species upstream and downstream of the Project.

11.2 DESIGN POPULATIONS

The American eel is a panmictic species; therefore, there are no subpopulations. All individuals are genetically, behaviorally, and physically representative of the entire worldwide population and offspring spawned in the Sargasso Sea have the same random chance of ending up in any watershed between Florida and Maine. However, based on monitoring data at the downstream South Berwick eelway, we expect thousands of juvenile eels to use upstream facilities at the Rollinsford Dam. The type of eelways likely to be used at the site has been shown to be capable of passing nearly 20,000 eels;[155] therefore, the Service expects it can accommodate the annual movement of eels on the Salmon Falls River.

[155] In 2016, over 18,000 juvenile eels were counted passing an eel ramp at the Holyoke Project (FERC No. 2004).

As noted in Section 4.4.2, the anticipated alosine population for the Rollinsford impoundment is estimated to be approximately 2,731 American shad and 21,315 river herring. A standard 4-foot- wide Denil fish ladder is estimated to have an annual biological capacity of 25,000 adult American shad, 12,000 Atlantic salmon, or 200,000 adult river herring (USFWS 2019). Given these capacities, a single 4-foot Denil ladder (or equivalent), installed at a slope of 1:8 (vertical:horizontal) or milder, should be sufficient to pass the design populations of target species.

11.3 FISH PASSAGE OPERATING PERIODS

Fishways shall be operational during the migration windows for target species present. The migratory season for diadromous fish has been studied for the major rivers of the Northeast (Facey and Van Den Avyle 1987, page 7; Mullen et al. 1986; Weiss-Glanz et al. 1986; Loesch 1987; ASMFC 2000, page 8; Saunders et al. 2006, page 539; ASMFC 2009, page 9; Shepard 2015; Eyler et al. 2016). The season depends on geographic location, water temperature, river flow, and other habitat cues. These dates may change based on new information, evaluation of new literature, and agency consultation. Based on data from nearby watersheds, approved fish passage protective measures shall be operational during the migration windows identified in Table 1 (below).

Table 1. Summary of migration periods for which fish passage will be provided.*

Species	**Upstream Migration Period**	**Downstream Migration Period**
Alosines: American shad, River herring	April 15–July 15	June 1 – November 15
American eel	May 1–October 31	August 15 – November 15

11.4 FISHWAY OPERATION AND MAINTENANCE PLAN

Within 12 months of license issuance, the Licensee will prepare and provide to the Service, the NHFGD, the MEDIFW, and NOAA Fisheries, 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; and
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. 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.

The Licensee shall provide information on fish passage operations and project generating operations that may affect fish passage, upon written request from the Service or other resource agencies. 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 access to the project site and to pertinent project records to Service personnel and its designated representatives, for the purpose of inspecting the fish passage facilities and to determine compliance with the Prescription.

11.6 SCHEDULING

Timely construction, operation, maintenance, and measures for upstream and downstream fish passage, including studies and evaluations, are necessary to ensure their effectiveness and to achieve restoration goals. Therefore, the Licensee shall notify, and obtain approval from, the Service for any extension to comply with prescribed conditions.

11.6.1 IMPLEMENTATION

The Licensee shall develop design plans for fishways and submit these plans to the Service and other resource agencies for review and approval during conceptual, 30 percent, and 90 percent design stages. This will ensure safe, timely, and effective fishway passage is designed and constructed on a timely schedule to meet the implementation dates indicated below. Designs shall be consistent with the 2019 Fish Passage Engineering Design Criteria Manual (USFWS 2019, entire) or updated version.

The Licensee shall adhere to the following dates for installing fishways:

a. The upstream anadromous fish systems are to be operational no later than March 15 of the third calendar year after license issuance.
b. The downstream anadromous fish and downstream eel passage system is to be operational within 3 years of license issuance.

c. The upstream eel passage systems are to be operational after the upstream anadromous fish systems are installed, within 5 years of license issuance.

For upstream and downstream anadromous fish and downstream eel passage systems, the Licensee shall adhere to the following design milestone schedule:

1. conceptual designs 15 months prior to the start of construction;
2. 30 percent design 12 months prior to the start of construction; and
3. 90 percent design and Basis of Design Report 3 months prior to the start of construction.

The Licensee shall adhere to the following design milestone schedule for the upstream eel passage system(s):

a. 30 percent designs 4 months prior to the start of construction, and following delivery of the eelway siting survey report; and
b. 90 percent designs 2 months prior to the start of construction.

Following approval by the Service and 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 fishways are constructed, final as-built drawings that accurately reflect the Project as constructed shall be filed with the Service, the other resource agencies, and the Commission.

11.7 FISH PASSAGE EFFECTIVENESS MEASURES

Effectiveness testing of both upstream and downstream American eel and anadromous fish passage is critical to evaluating passage success, diagnosing problems, determining when fish passage modifications are needed, and what modifications are most likely to be effective over the term of the license.

11.7.1 FISHWAY EFFECTIVENESS MONITORING PLAN

The Licensee will develop a Fishway Effectiveness Monitoring Plan (FEMP) in consultation with, and requiring approval by, the Service. The FEMP will contain plans for ensuring (1) the effectiveness of the upstream anadromous, upstream eel, downstream anadromous, and downstream eel passage measures required pursuant to Sections 11.8 through 11.11; and (2) that the minimum bypass flow of 35 cfs provides safe, timely, and effective downstream passage to emigrating diadromous species (i.e., does not strand fish). The FEMP shall be submitted to FERC for approval 6 months prior to the implementation dates for installing upstream anadromous fish systems specified in Section 11.6.1.

The Licensee shall begin implementing effectiveness testing measures at the start of the first migratory season after the fishway(s) are operational and shall conduct quantitative fish passage effectiveness testing and evaluation for a minimum of 2 years. If the Service requests a modification of the FEMP, the Licensee shall amend the FEMP within 30 days of the request and send a copy of the revised FEMP to the Service and resource agencies. Any modifications to the FEMP by the Licensee will require approval by the Service prior to implementation.

The Licensee will submit yearly interim study reports to the Service following the conclusion of each study year. The interim reports for upstream passage studies will be submitted to the Service by February 15 following each study year. The final study report will be submitted to the Service within 6 months after the completion of the study. The final study report will include methods, data analysis, results, an assessment of any factors or potential problems hindering passage effectiveness, and provide recommended modifications to achieve safe, timely, and effective passage. In conjunction with submitting the final study report, the Licensee will also provide electronic copies of all data collected from studies to the Service.

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 accomplished 30 days prior to the start of the next migratory season.

11.8 UPSTREAM ANADROMOUS PASSAGE

1. The Licensee shall construct, operate, and maintain upstream fish passage facilities that pass anadromous fish species in a safe, timely and effective manner. Based on the best scientific information available at this time, one of the following types of fishway could satisfy the standard of safe, timely, and effective: (a) two technical fishways (one fishway at the dam and one fishway through the lower section of the bypass reach); or (b) one technical fishway at the dam and one nature-like fishway (NLF)[156] through the lower section of the bypass reach. The NLF should modify the existing chute to provide a suitable zone of passage for adult alosines over the emergent bedrock adjacent to the powerhouse. At the lowest end of its operating range, the NLF should be designed to meet Service criteria for depth, velocity, and pool size (USFWS 2019) while passing the

[156] Nature-like fishways (NLF) are structures designed to mimic the natural functions and/or aesthetics of river; NLF can include, but are not limited to, simple bedrock modification, weir placement, rock ramps, etc.

minimum required flows in the bypass (i.e., the sum of the minimum bypass release and discharge from the technical fishway at the dam); additional bedrock modifications may be necessary to extend the operating range during periods of moderate spill.

2. The size of the fishway(s) shall accommodate the anticipated production potential of the Rollinsford impoundment: 21,315 river herring, 2,731 shad, and approximately 500 resident or target species. A standard 4-foot-wide Denil fish ladder is estimated to have an annual biological capacity of 25,000 adult American shad, 12,000 Atlantic salmon, or 200,000 adult river herring (USFWS 2019). Given these capacities, a single 4-foot Denil ladder (or equivalent), installed at a slope of 1:8 (vertical:horizontal) or milder, should be sufficient to pass the design populations of target species.

3. The design elements (e.g., slope, pool/slot size, attraction water) of the fishway(s) shall ensure successful passage of river herring and American shad. 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 11.3.

4. The fishways shall be constructed and operational by March 15 of the third calendar year after license issuance.

Justification

The Salmon Falls River, in the vicinity of the Project, once supported runs of diadromous species including alosines (Odell et al. 2006; Old Berwick Historical Society 2020) and existing FMPs call for restoring access to historical spawning and rearing habitat. Currently, alosines are provided freshwater access to the Salmon Falls River via the South Berwick Dam at the head-of- tide. Approximately 16,418 river herring passed South Berwick in 2019, and 24,571 river herring passed South Berwick in 2018 (M. Dionne, NHFGD, personal communication, May 22, 2020).

The Upstream Zone of Passage Study (Rollinsford Final License Application, Appendix C) suggests that the areas associated with ZOP-2 and ZOP-3 "…appears to prevent the movement of River Herring and limit the movement of American Shad to the upper portion of the bypass reach, due to excessive water velocity," however alosines have been observed circling in the large pool below Rollinsford Dam (M. Dionne, NHFGD, personal communication, February 21, 2020). These observations verify alosine movement into the upper portion of the bypass reach is not prevented but impacted by this heavily modified section of the River.

The Rollinsford Dam was constructed in 1910, drastically altering the hydraulics of the River. In 1923, the powerhouse and penstock were built, diverting the natural flow around the bypass reach, focusing and returning the diverted water to the tailrace on river right. In addition to these hydrologic changes, the powerhouse itself was built upon the emergent bedrock in ZOP-2 and ZOP-3, constricting the cross-sectional area of the natural river channel. Finally, as noted in Section 1.2.4 of the Final License Application, construction included significant excavation of the tailrace area. These accumulated project effects have altered the natural stage-discharge-velocity relationships in the vicinity of the powerhouse. Prior to construction, the river flow would have engaged both banks over the natural regime of river flow conditions. Now this area experiences only minimum flow through the bedrock chute or spill conditions. More natural conditions would have been characterized by diverse hydraulics and areas of lower velocity, qualities routinely associated with favorable fish passage. To mitigate these project impacts and make the bypass reach more passable, modifications to the emergent bedrock (i.e., a NLF) or a technical fishway is needed.

Fish passage at Rollinsford, along with the implementation of passage measures at the two dams upstream of Rollinsford (which are currently undergoing relicensing) will provide approximately 13.7 river miles of available habitat to sea run migratory fish in the Salmon Falls River.

11.9 UPSTREAM AMERICAN EEL PASSAGE

1. The Licensee shall construct, operate, and maintain upstream fish passage facilities that provide safe, timely, and effective upstream passage for American eels.
2. In order to determine proper siting of the upstream eelway(s), the Licensee shall conduct an upstream eel siting survey the first passage season after the upstream anadromous fish systems are installed. Based on results of that survey, the Licensee shall, in consultation with the Service and other resource agencies, determine optimal locations for siting permanent upstream eelway(s).
3. Permanent eelways shall be operational no later than May 1 of the second calendar year after the siting surveys are completed.
4. The upstream facilities shall be designed in consultation with the resource agencies, and the resource agencies shall review the 30 percent and 90 percent drawings.
5. The designs shall be consistent with the Service's 2019 Fish Passage Engineering Design Criteria Manual (USFWS 2019, entire) or updated version.

Justification

Dedicated upstream eel passage is necessary to provide access to rearing habitat upstream of the Project throughout the migratory eel passage season. Count data at South Berwick, as well as a study performed as part of this relicensing proceeding (Gomez and Sullivan 2019), document eels are downstream of Rollinsford Dam. Upstream migrating juvenile eels can be effectively passed at hydroelectric projects (Solomon and Beach 2004, entire).

Because the Project includes a bypass reach that will have a continuous flow, there are two potential areas of attraction for up-migrating eels: in the vicinity of the powerhouse and at the base of the dam. Therefore, more than one eelway may be needed to provide effective passage. The most suitable locations for permanent eelways should rely on empirical data which will be collected during the siting surveys.

11.10 DOWNSTREAM AMERICAN EEL PASSAGE

1. The Licensee shall construct, operate, and maintain a downstream eel passage and protection system that provides safe, timely, and effective downstream passage for American eels.
2. The Licensee shall implement, as an interim measure, targeted nighttime turbine shutdowns to protect emigrating eels during the first year of license issuance. Turbine shutdowns shall occur from dusk to dawn for three consecutive nights following rain accumulations of 0.50 inch or more over a 24-hour period. Turbine shutdowns should occur during the duration of the downstream eel passage season in accordance with provisions of Section 11.3.
3. The Licensee shall implement permanent downstream eel passage and protection measures within 3 years of license issuance.
4. Pursuant to the conditions provided herein, the Licensee shall develop a plan to provide permanent downstream eel passage and protection, in conformance with the Downstream Implementation Schedule specified in 11.6.1. The plan, including the design of permanent eel passage facilities and/or operational measures, shall be developed in consultation with, and require approval by, the Service. The designs shall be consistent with the Service's 2019 Fish Passage Engineering Design Criteria Manual (USFWS 2019, entire) or updated version. The Licensee must have the Service's prior approval before filing the final plan with the Commission.

Justification

Dedicated downstream fish passage facilities are necessary to protect diadromous species emigrating past the Project. State-led fisheries surveys as well as an upstream eel passage assessment performed at Lower Great Falls in 2020 (Gomez and Sullivan

2020) indicate eels are present upstream of the Rollinsford Dam. Numbers of eels inhabiting the River upstream of the Project will increase over time after the upstream eelways become operational, and absent passage and protection measures, outmigrating silver eels will be susceptible to impingement and/or entrainment. Estimated project-specific survival rates indicate eels would sustain high mortality rates should they pass through the Project's turbines (Rollinsford Final License Application, Appendix E, Fish Entrainment and Mortality Study). Facilities and/or measures to provide safe downstream passage for eels are needed as they migrate through the Project on their way back out to sea. Downstream migrating adults and juvenile diadromous fish can effectively be protected from project operation impacts that result in injury and mortality (NMFS 2012; USFWS 2019).

11.11 DOWNSTREAM ANADROMOUS FISH PASSAGE

1. The Licensee shall construct, operate, and maintain a downstream passage and protection system that provides safe, timely, and effective downstream passage for both spent juvenile and adult anadromous fish.
2. The Licensee shall implement permanent downstream alosine passage and protection measures within 3 years of license issuance.
3. Pursuant to the conditions provided herein, the Licensee shall develop a plan to provide permanent downstream alosine passage and protection, in conformance with the Downstream Implementation Schedule specified in 11.6.1. The plan, including the design of permanent downstream passage facilities, shall be developed in consultation with, and require approval by, the Service. The designs shall be consistent with the Service's 2019 Fish Passage Engineering Design Criteria Manual (USFWS 2019, entire) or updated version. The Licensee must have the Service's prior approval before filing the final plan with the Commission.

Justification

Dedicated fish passage facilities are necessary to protect diadromous species emigrating past the Project. Downstream migrating adult and juvenile alosines are exposed to project-related impacts (Franke et al. 1997). Estimated project-specific survival rates indicate alosines would sustain a high level of entrainment and mortality should they pass through the Project's turbines (Gomez and Sullivan 2019). Unless the Project is in spill, or fish utilize the minimum flow cutout in the flashboards as a means of passage, there is no alternative downstream route of passage.

APPENDIX I

MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION WATER QUALITY CERTIFICATION

DECISION AND ORDER

THEREFORE, the Department APPROVES the water quality certification of THE TOWN OF ROLLINSFORD and CERITIFIES pursuant to Section 401 (a) of the Clean Water Act that there is a reasonable assurance that the continued operation of the ROLLINSFORD HYDROELECTRIC PROJECT, as described above, will not violate applicable Class C water quality standards and the discharge from the proposed Project will comply with water quality requirements, SUBJECT TO THE FOLLOWING CONDITIONS:

1) WATER LEVELS

a. Except as temporarily modified by 1) approved maintenance activities, 2) extreme hydrologic conditions,[157] 3) emergency electrical system conditions,[158] or 4) agreement between the Applicant, the Department, and appropriate state and/or federal agencies, daily Project impoundment water levels shall be maintained at the flashboard crest elevation of 71.25 feet NGVD 1929. Agreement among the Applicant and agencies to temporarily modify water levels, as described in 4), above, includes temporary, short-

[157] For the purpose of this certification and Order, extreme hydrologic condition mean the occurrence of events beyond the Licensee's control such as, but not limited to, abnormal precipitation, extreme runoff, flood condition, ice conditions, drought, or other hydrologic conditions such that operational restrictions and requirements contained herein are impossible to achieve or are inconsistent with the safe operation of the Project.

[158] For the purpose of this certification and Order, emergency electrical system conditions mean operating emergencies beyond the Licensee's control which require changes in flow regimes to eliminate such emergencies which may in some circumstances include, but are not limited to, equipment failure or other temporary abnormal operating conditions, generating unit operation or third-party mandated interruptions under power supply emergencies, and order from local, state, or federal law enforcement or public safety authorities.

term water level adjustments to implement a Water Quality Mitigation and Enhancement Plan as needed.[159]

b. The Applicant shall, within six months of issuance of a New License for the Project by FERC or upon such other schedule as established by FERC, submit a Final Operation Monitoring Plan for Department review and approval for providing and monitoring Project impoundment water levels required by Part A of this condition.

c. This condition is necessary to ensure that the discharge from the Project will comply with water quality requirements, including 38 M.R.S. § 465(4)(A) and (C) as discussed above at section 4(A), (D) and (E). The water levels of the impoundment, which are determined by the discharge, affect, among other things, the water quality requirements of the designated uses of fishing; recreation in and on the water; navigation; and habitat for fish and other aquatic life.

2) MINIMUM FLOWS

A. Except as temporarily modified by 1) approved maintenance activities, 2) extreme hydrological conditions (see footnote 17), 3) emergency electrical system conditions (see footnote 18), or 4) agreement between the Applicant, the Department and appropriate state and/or federal agencies, when the Project is generating power from July 16 to April 14, annually, a continuous minimum flow of 35 cfs, or inflow, whichever is less, shall be released to the bypass reach; when the Project is generating power from April 15 to July 15 prior to implementation of volitional upstream alosine passage at the Project, a continuous minimum flow of 35 cfs or inflow, whichever is less, shall be released to the bypass reach. When the Project is generating power from April 15 through July 15 after implementation of volitional upstream alosine passage at the Project, the bypass reach flow and the manner it is released to the bypass reach, shall be determined after consultation with USFWS, New Hampshire Department of Environmental Services (NHDES), NHFGD, MDMR and MDIFW and the Department. When the Project is not generating power prior to implementation of

[159] See Condition 5.

downstream fish passage facilities, 100 percent of inflow shall be passed over the spillway and into the bypass reach. When the Project is not generating power after implementation of downstream fish passage facilities, 100 percent of inflow shall be released to the bypass reach. The manner the inflow is released to be bypass reach shall be determined after consultation with USFWS, NHDES, NHFGD, MDMR, MDIFW and the Department.

B. This condition is necessary to ensure that the discharge from the Project will comply with water quality requirements, including 38 M.R.S. § 465(4)(A) and (C) as discussed above at sections 4(B), (D), and (E). The flow of the discharge affects, among other things, whether the receiving waters are of sufficient quality to support all species of indigenous fish and maintain the structure and function of the resident biological community. The flow of the discharge also affects the water quality requirements of the designated uses of fishing; recreation in and on the water; navigation; and habitat for fish and other aquatic life.

3) UPSTREAM PASSAGE

A. The Applicant shall, in accordance with the schedules established by FERC, conduct an upstream eel siting survey. Based on the results of the eel siting survey, the Applicant shall construct, operate, maintain, monitor, and periodically test the effectiveness of upstream passage facilities and, as appropriate, employ appropriate operational measures for the safe, timely and effective upstream passage of American eel, in accordance with schedules established by FERC and as prescribed by the Department of Interior USFWS in Section 11 of its June 25, 2020 fishway prescriptions and as required by Section 18 of the Federal Power Act.

B. The Applicant shall, on a schedule established by FERC and in accordance with preliminary fishway prescriptions and any modifications of such fishway prescriptions approved and agreed to by Department of Interior USFWS, construct and operate a Denil Fishway for the safe, timely and effective upstream passage of anadromous fish as described by the Department of Interior USFWS in Section 11 of its June 25, 2020 fishway prescriptions, unless an Exception for Trap and Truck Operations is requested within two years of issuance of a New License, and approved by

USFWS and by FERC in accordance with the provisions of the Modified Prescription.

C. The Applicant shall, in accordance with the schedules established by FERC, submit final design and operational plans for all interim and permanent upstream fish passage facilities and/or operational measures required by this approval. These fish passage facilities and/or operational measures shall be designed in conformance with applicable USFWS Fish Passage Engineering Design Criteria, and in consultation with MDMR, USFWS, NHFGD, NHDES and the Department which shall be provided review of the 30% and 90% design drawings.

D. The Applicant shall, in accordance with the schedules established by FERC, conduct effectiveness studies and shall design such effectiveness testing plans in consultation with USFWS, MDMR, NHFGD and other state and federal resource agencies.

E. The Applicant shall, in accordance with the schedules established by FERC, submit a final Fishway Operation and Maintenance Plan describing all operations and maintenance of the upstream fish passage facilities and/or operational measures at the Project.

F. This condition is necessary to ensure that the discharge from the Project will comply with water quality requirements, including 38 M.R.S. § 465(4)(A) and (C) as discussed above at sections 4(A), (B), (D), and (E). The nature of the Project's discharge affects, among other things, whether the receiving waters are of sufficient quality to support all species of indigenous fish, including anadromous fish and American eel, and maintain the structure and function of the resident biological community. The discharge also restricts the passage of such fish, which in turn affects water quality requirements, including the designated uses of fishing and as habitat for fish and other aquatic life.

4) DOWNSTREAM PASSAGE

A. The Applicant shall construct, operate, maintain, monitor and test the effectiveness of downstream passage facilities and, as appropriate and in coordination with USFWS, MDMR, and NHFGD and other fish resource

agencies, employ appropriate operational measures for the safe, timely and effective downstream passage of American eel, in accordance with schedules established by FERC and as prescribed in Section 11 of the Department of Interior USFWS Fishway Prescriptions, dated June 25, 2020, as required by Section 18 of the Federal Power Act.

B. The Applicant shall construct, operate, maintain, monitor and test the effectiveness of downstream passage facilities and, as appropriate and in coordination with USFWS, MDMR, and NHFGD and other fish resource agencies, employ appropriate operational measures for the safe, timely and effective downstream passage of anadromous fish, in accordance with schedules established by FERC and as prescribed in Section 11 of the Department of Interior USFWS June 25, 2020 Fishway Prescriptions, as modified pursuant to the Settlement Agreement, as required by Section 18 of the Federal Power Act.

C. The Applicant shall, in accordance with the schedules established by FERC, submit final design and operational plans for all interim and permanent downstream passage facilities and/or operational measures required by this approval. Such facilities shall be designed in consultation with MDMR, USFWS, NHFGD, NHDES and the Department, which shall be provided review of the 30% and 90% design drawings.

D. The Applicant shall, in accordance with the schedules established by FERC, conduct effectiveness studies and shall design such effectiveness studies in consultation with USFWS, MDMR, NHFGD and other state and federal resource agencies, as appropriate.

E. The Applicant shall, in accordance with the schedules established by FERC, submit a final Fishway Operation and Maintenance Plan describing all operations and maintenance of the downstream fish passage facilities and/or operational measures at the Project.

F. This condition is necessary to ensure that the discharge from the Project will comply with water quality requirements, including 38 M.R.S. § 465(4)(A) and (C) as discussed above at sections 4(A), (B), (D), and (E). The nature of the Project's discharge affects, among other things, whether the receiving waters are of sufficient quality to support all species of

indigenous fish, including anadromous fish and American eel, and maintain the structure and function of the resident biological community. The discharge also restricts the passage of such fish, which in turn affects related water quality requirements, including the designated uses of fishing and as habitat for fish and other aquatic life.

5) DISSOLVED OXYGEN

A. The Applicant shall, in consultation with NHDES and the Department and as reviewed and approved by the Department, within 60 days of the issuance of a New License for the Project by FERC submit a final Water Quality Mitigation and Enhancement Plan for the Project designed to mitigate DO conditions that can develop in the impoundment during some critical low flow periods.

A. The Applicant shall, during low flow periods between July 1 and September 15, annually, monitor DO in the impoundment following seven days of inflow less than 80 cfs for two years following issuance of a New License by FERC. If during the prescribed monitoring DO is determined to fall below 5.0 mg/L, in the third year following New License issuance and in consultation with the Department, NHDES and appropriate state and federal agencies as required in Condition 1 and 2 of this certification, the Applicant shall implement a Water Quality Mitigation and Enhancement Plan required by part A of this Condition. During implementation of the Water Quality Mitigation and Enhancement Plan, the Applicant shall release a continuous minimum flow to the Project bypass reach in compliance with Condition 2 of this certification.

B. This condition is necessary to ensure that the discharge from the Project will comply with water quality requirements, including 38 M.R.S. § 465(4)(B) as discussed above at section 4(C). Because the nature of the discharge affects, among other things, the water levels and levels of DO in the impoundment, it has a direct effect on the growth of indigenous fish. Absent this condition, the DO levels in the Project area as a result of its operations and discharge would be unable to meet statutory requirements for DO in the impoundment, which would also affect the water quality requirements of the designated uses of fishing and habitat for fish and other aquatic life and would render the impoundment of insufficient quality to

support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community.

6) RECREATIONAL ACCESS AND USE

A. The Applicant shall continue to provide informal access to the Project waters for the purpose of recreation in and on the water, for fishing, and for navigation to the extent possible, for the term of the New License. The Applicant shall consult with MDIFW within 6 months of issuance of a New License by FERC regarding opportunities for improvements to access streamside angling opportunities, including additional signs and foot trails to the tailrace and bypass reach.

B. This condition is necessary to ensure that the discharge from the Project will comply with water quality requirements, including 38 M.R.S. § 465(4)(A) and (C), as discussed above at section 4(D) and (E). Because the discharge affects, among other things, the water level of the impoundment and the flow downstream of the dam, it necessarily affects the water quality requirements of the designated uses of fishing; recreation in and on the water; and navigation, among others.

APPENDIX J

NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL PROTECTION WATER QUALITY CERTIFICATION

CERTIFICATION CONDITIONS

Unless otherwise authorized or directed by NHDES, the following conditions shall apply:

E-1. **Effective Date and Expiration of Certification:** This certification shall become effective on the date of issuance and shall remain effective for the term of the federal license or permit. Should the federal authority deny a license or permit, the certification becomes null and void.

E-2. **Conditions in Federal License or Permit:** Conditions of this certification shall become conditions of the federal license or permit (U.S.C. § 1314(d)).

E-3. **Compliance with Water Quality Standards:** The Activity shall not cause or contribute to a violation of New Hampshire surface water quality standards.

(For an explanation and citations, see Fact C-7 and C-8, and C-53.)

E-4. **Proposed Modifications to the Activity:** The Applicant shall consult with and receive prior written approval from NHDES regarding any proposed modifications to the Activity that could have a significant or material effect on the findings or conditions of this certification, including any changes to operation of the Activity. If necessary, to assure compliance with New Hampshire surface water quality standards and associated management objectives, the New Hampshire Department of Environmental Services (NHDES) may alter or amend this certification in accordance with condition E-5.

(For an explanation and citations, see Fact C-7 and Finding D-11.)

E-5. **Modification of Certification**: The conditions of this certification may be altered or amended at any time by NHDES to assure compliance with New Hampshire surface water quality standards and associated management objectives, when authorized by law, and, if necessary, after notice and opportunity for hearing.

(For an explanation and citations, see Fact C-7 and Finding D-11.)

E-6. **Reopening of License**: NHDES reserves the right to request, at any time, that FERC reopen the license to consider modifications to the license to assure compliance with New Hampshire surface water quality standards.

E-7. **Compliance Inspections:** In accordance with applicable laws, the Applicant shall allow NHDES to inspect the Activity and affected surface waters to monitor compliance with the conditions of this certification.

(For an explanation and citations, see Fact C-7 and Finding D-11.)

E-8. **Transfer of Certification:** Should this certification be transferred to a new owner, contact information for the new owner (including name, address, phone number and email) shall be provided to NHDES within 30 days of the transfer.

E-9. **NHDES Water Use Registration and Reporting:** The Applicant shall register, measure, and report all withdrawals and discharges with the NHDES Water Use Registration and Reporting program (WURRP) in accordance with RSA 488:3 and its supporting regulations in Env-Wq 2102 and submit, if necessary, a water conservation plan in accordance with Env-Wq 2101.24.

(For an explanation and citations, see Finding D-35.)

E-10. **Flow / Impoundment Management:** The following requirements (items a. through e.) may be temporarily modified if required by operating emergencies beyond the control of the Applicant and/or as specified below.

a. **Instantaneous Run-of-River Flow:** The Applicant shall operate the Activity in an instantaneous run-of-river mode whereby inflow to the Project equals outflow from the Project at all times and water levels above the dam are not drawn down for the purpose of generating power. Run-of-river operation may be temporarily modified if required by operating emergencies beyond the control of the Applicant or for short periods upon mutual agreement between NHDES, the New Hampshire Fish and Game Department (NHFGD), the U.S. Fish and Wildlife Service (USFWS), the Maine Department of Environmental Protection (MEDEP), the Maine Department of Marine Resources (MDMR) and the Maine Department of Inland Fisheries and Wildlife (MEDIFW).

(For an explanation and citations, see Finding D-37.)

b. **Bypass Reach Conservation Flows:** The Applicant shall comply with the following bypass reach conservation flow requirements (items 1-7).

1. Bypass reach conservation flows and the manner in which flows are

released to the bypass reach, shall be determined by the USFWS in accordance with the USFWS's fish passage design guidelines [160], and after consultation with the NHDES, NHFGD, MEDEP, MEDMR and MEDIFW.

2. The method and supporting information for passing the bypass conservation flows into the bypass reach, including any future modifications, shall be included in the Flow / Impoundment Compliance Monitoring Plan (Condition E-12).
3. When the Project is not generating power prior to implementation of downstream fish passage facilities, 100 percent of inflow shall be released over the spillway and into the bypass reach.
4. When the Project is not generating power after implementation of downstream fish passage facilities, 100 percent of inflow shall be released to the bypass reach. The manner the inflow is released to they bypass reach (i.e., the amount of inflow over the spillway, through the downstream passage facilities, and/or through volitional upstream passage facilities) shall be determined in accordance with item 1 above.
5. When the Project is generating power from July 16 through April 14, a continuous conservation flow of at least 35 cfs or inflow, whichever is less, shall be released to the bypass reach.
6. When the Project is generating power from April 15 through July 15, prior to implementation of volitional upstream alosine passage at the Project, a continuous conservation flow of at least 35 cfs or inflow, whichever is less, shall be released to the bypass reach.
7. When the Project is generating power from April 15 through July 15, after implementation of volitional upstream alosine passage at the Project, the bypass reach flow and the manner it is released to the bypass reach, shall be in accordance with item 1 above.

(For an explanation and citations, see Finding D-41.)

c. **Impoundment Water Level:** The target impoundment water elevation shall be the top of the 15-inch flashboards (elevation 71.25 feet NGVD 29) plus any additional elevation required to pass the bypass reach conservation flows. The Applicant shall minimize the magnitude and frequency of fluctuations in the impoundment to the maximum extent practicable and shall not draw the water level in the impoundment down for the purpose of generating power. This

[160] USFWS (U.S. Fish and Wildlife Service). 2019. Fish Passage Engineering Design Criteria. USFWS, Northeast Region R5, Hadley, Massachusetts. 135 pages + Appendices.

requirement may be modified upon mutual agreement between NHDES, NHFGD, USFWS, MEDEP, MDMR and MEDIFW.

(For an explanation and citations, see Finding D-38**Error! Reference source not found.**.)

d. **Impoundment Refill:** When refilling the impoundment after drawdown for maintenance or emergencies, the Applicant shall release 90 percent of the inflow downstream to the Salmon Falls River and utilize the remaining 10% of inflow to refill the impoundment. This refill procedure may be modified upon mutual agreement between NHDES, NHFGD, USFWS, MEDEP, MDMR and MEDIFW.

(For an explanation and citations, see Finding D-39.)

e. **Drawdown Procedure for Scheduled Maintenance:** When drawing the water level in the impoundment down for scheduled maintenance, the Applicant shall lower the impoundment water level no more than six (6) inches per day. This drawdown procedure may be modified with prior approval of NHFGD.

(For an explanation and citations, see Finding D-40.)

E-11. **Flow/Impoundment – Notification and Annual Report:** The Applicant shall comply with the following notification and reporting requirements:

a. If the Activity causes a deviation from the flow/ impoundment management requirements in Condition E-10, the Applicant shall notify NHDES, NHFGD, USFWS, MEDEP and MEDIFW no later than 24 hours after each such incident. The notification shall include, to the extent known, an explanation as to why the deviations occurred, a description of corrective actions taken, and how long it will take until operations will comply with Condition E-10.

b. Within 45 days after each incident, the Applicant shall submit a report to NHDES, NHFGD, USFWS, MEDEP, MDMR and MEDIFW that contains, to the extent possible, the cause, severity and duration of the incident, any observed or reported adverse environmental impacts from the incident, pertinent data and a description of corrective measures.

c. By April 1 of each year (beginning the first April after the date the FERC license is reissued), the Applicant shall submit to NHDES, NHFGD, USFWS, MEDEP, MDMR and MEDIFW a summary report for the previous calendar year with appropriate tables, graphs, text and supporting documentation that demonstrates compliance with the flow/ impoundment management

requirements in Condition E-10. Where excursions occurred, the summary shall indicate when the excursion occurred, the duration of the excursion and a description of corrective actions taken to prevent such excursions from reoccurring.

(For an explanation and citations, see Finding D-11)

E-12. F**low/Impoundment Compliance Monitoring Plan (FICMP):** Within 120 days of license issuance the Applicant shall develop, file and implement a flow and impoundment level monitoring and compliance plan (FICMP) that, as a minimum, includes the following:

a. a description of the level of manual, automatic, on-site and remote operation;
b. a detailed description of how the Project will be operated under all conditions (i.e., under normal operating conditions as well as during low flow, high flow, maintenance and emergency conditions) to maintain compliance with the flow and impoundment level management requirements in Condition E-10;
c. a description of how conservation flows will be maintained during scheduled drawdowns and the minimum impoundment level that will pass the conservation flows (including calculations);
d. a description of the mechanisms and structures (i.e., type, location and accuracy of all flow and impoundment elevation monitoring equipment and gages) to be used for maintaining compliance with operational requirements;
e. set point elevations for turning turbines on and off [161];
f. procedures for maintaining and calibrating monitoring equipment;
g. rating curves and calculations for all methods of releasing flow downstream (including a working excel spreadsheet if requested by NHDES);
h. procedures for collecting and recording continuous data (i.e., no less frequent than hourly and preferably every 15 minutes) on inflow, flow releases at the project (conservation flows in the bypass reach, spillage and turbine discharge), and impoundment levels.

The FICMP, including any proposed revisions, shall be developed in consultation with NHDES, NHFGD, USFWS, MEDEP, MDMR and MEDIFW, and shall be subject to NHDES review and approval. The FICMP shall be kept up-to-date so that it reflects current operation. The Applicant shall implement the approved FICMP.

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[161] Set point elevations for providing conservation flows should account for the accuracy of the pond level sensor equipment. For example, if the accuracy is +/- 0.01 feet, the sensor should be set 0.01 feet above the elevation determined to provide the conservation flow in order to assure that the conservation flow will be provided at all times.

(For an explanation and citations, see Finding D-11 and D-42.)

E-13. **Fish Passage:** The Applicant shall comply with all of section 11 of the USFWS' "Preliminary Prescription for Fishways" **Error! Bookmark not defined.** (Finding D-47), (which includes prescriptions for upstream and downstream passage for anadromous fish and American eel), and any modifications made to the preliminary prescriptions that are acceptable to the USFWS, including, but not limited to, any modifications made to be consistent with the "Settlement Agreement" **Error! Bookmark not defined.** by and between the Town of Rollinsford, Green Mountain Power and the U.S. Department of Interior Fish and Wildlife Service (Finding D-48).

(For an explanation and citations, see Findings D-43 through D-49.)

E-14. **Water Quality Mitigation and Enhancement Plan (WQMEP):** Within 60 days of License issuance by FERC, the Applicant shall consult with NHDES regarding finalization of the draft Water Quality Mitigation and Enhancement Plan (WQMEP) received by NHDES on March 22, 2021 to implement and monitor the effectiveness of measures to improve water quality in the Salmon Falls River during low flow. The NHDES approved plan shall then be implemented.

(For an explanation and citations, Facts C-2 and C-7, and Findings D-11 and D-33.)

E-15. **Long Term Water Quality Monitoring and Reporting:** Unless otherwise authorized by NHDES, the Applicant shall conduct water quality monitoring in the Salmon Falls River every five years beginning the fifth year after the FERC license for the Project is reissued, and ending five years prior to the expiration of the reissued license. Should monitoring be conducted within the first five years after the FERC license for the Project is reissued, the Applicant may submit a written request to NHDES to delay the start date for long term monitoring under this Condition and shall comply with NHDES' written decision on the request. The purpose of the monitoring is to 1) determine the future effects of Project operation during the duration of the reissued license, both spatially and temporally (in terms of flow, impoundment elevation and power generation) on water temperature and dissolved oxygen (mg/L and percent saturation), 2) to compare results to New Hampshire surface water quality standards, and 3) to determine if additional changes in Project operation are necessary to comply with surface water quality standards.

At least 90 days prior to monitoring in each year monitoring is conducted, the Applicant shall submit a monitoring and reporting plan to NHDES for review and approval that describes, in detail, how, when and where monitoring will be conducted and results reported. The Applicant shall then implement the NHDES approved plan. Unless otherwise authorized by NHDES, the plan shall specify that monitoring that year shall last for at least five weeks and include periods of relatively low flows and high temperatures as well as times when the Project is, and is not, generating. Continuous (i.e., every 15 minutes) monitoring of temperature and dissolved oxygen (mg/L and percent saturation) shall be conducted at the deep spot of the Project impoundment, the Project tailrace and the Project bypass reach and vertical profiles for temperature and dissolved oxygen shall be conducted each week at the deep spot of the impoundment. Continuous (i.e., every 15 minutes) estimates of impoundment elevation, inflow, tailrace flow, bypass reach flow and generation shall also be provided.

By December 31st of each year that monitoring is conducted, the Applicant shall submit a report and supplemental information that clearly demonstrates via text, tables and plots, the spatial and temporal effect of project operation (in terms of inflow and flow in the bypass reach and tailrace, impoundment elevation and power generation) on surface water quality and if New Hampshire surface water quality standards are met. Results of quality assurance/quality control checks (calibration, hand-held meter checks, duplicates, etc.) and identification of any deviations from the monitoring and reporting plan shall be clearly identified. In addition to the report, water quality (including uncorrected and any corrected data), continuous impoundment elevation, and continuous flow data (including calculations) should be provided in a working MS Excel workbook or other database acceptable to NHDES. The Applicant shall also enter all data into the NHDES Environmental Monitoring Database (EMD) within 120 days of when monitoring is completed in each year monitoring is conducted.

Should monitoring indicate that water quality standard exceedances persist, the Applicant shall consult with NHDES regarding changes to Project operation to improve water quality, and then implement the NHDES approved revisions to Project operation. Any NHDES approved changes to Project operation shall be included in the Flow/Impoundment Compliance Monitoring Plan (Condition D-12) and submitted to NHDES for approval within 60 days of learning that revisions are necessary.

(For an explanation and citations, see Facts C-2 and C-7 C-3 and Findings D-11, D-33 and D-34)