FINAL ENVIRONMENTAL ASSESSMENT
FOR HYDROPOWER LICENSE

Barker's Mill Hydroelectric Project

FERC Project No. 2808-017

Maine

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

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ACRONYMS AND ABBREVIATIONS

APE	area of potential effect
CFR	Code of Federal Regulations
cfs	cubic feet per second
Commerce	U.S. Department of Commerce
Commission	Federal Energy Regulatory Commission
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
EA	environmental assessment
EFH	essential fish habitat
ESA	Endangered Species Act
°C	degrees Celsius
°F	degrees Fahrenheit
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
fps	feet per second
FR	Federal Register
FWS	U.S. Fish and Wildlife Service
GOM DPS	Gulf of Maine Distinct Population Segment
Interior	U.S. Department of the Interior
IPaC	U.S. Fish and Wildlife Service Information for Planning and Consultation
IWWH	inland waterfowl and wading bird habitat
KEI Power	KEI (Maine) Power Management (III) LLC
Maine DEP	Maine Department of Environmental Protection
Maine DIFW	Maine Department of Inland Fisheries and Wildlife
Maine DMR	Maine Department of Marine Resources
µg/L	micrograms per liter
mg/L	milligrams per liter
MW	megawatt
MWh	megawatt-hours
National Register	National Register of Historic Places
NERC	North American Electric Reliability Council
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NPCC	Northeast Power Coordinating Council, Inc.
PAD	Pre-Application Document
Park Service	U.S. National Park Service
PCE	primary constituent element
RM	river mile
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SD1	Scoping Document 1

SD2	Scoping Document 2
SHPO	Maine Historic Preservation Commission Officer
USGS	U.S. Geological Survey

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BARKER'S MILL HYDROELECTRIC PROJECT
FERC Project No. 2808-017 - Maine

1.0 INTRODUCTION

1.1 APPLICATION

On January 30, 2017, KEI (Maine) Power Management (III) LLC (KEI Power) filed an application with the Federal Energy Regulatory Commission (Commission) for a subsequent license to continue to operate and maintain the existing Barker's Mill (also known as Lower Barker) Hydroelectric Project (Barker's Mill Project or project).[1] The 1.5-megawatt (MW) project is located on the Little Androscoggin River, in the City of Auburn, Androscoggin County, Maine (figure 1). The project does not occupy federal land.

1.2 PURPOSE OF ACTION AND NEED FOR POWER

1.2.1 Purpose of Action

The purpose of the Barker's Mill 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 to KEI Power for the Barker's Mill 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 would be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and developmental purposes for which licenses are issued (such as flood control, irrigation, and water supply), the Commission must give equal consideration to the purposes of: (1) energy conservation; (2) the protection, mitigation of damage to, and enhancement of fish and wildlife resources; (3) the protection of recreational opportunities; and (4) the preservation of other aspects of environmental quality.

[1] The Commission issued the current, original license for the project on February 23, 1979 with an effective date of February 1, 1979, and a term of 40 years. *See Maine Hydroelectric Development Corporation*, 6 FERC ¶ 61,175 (1979).

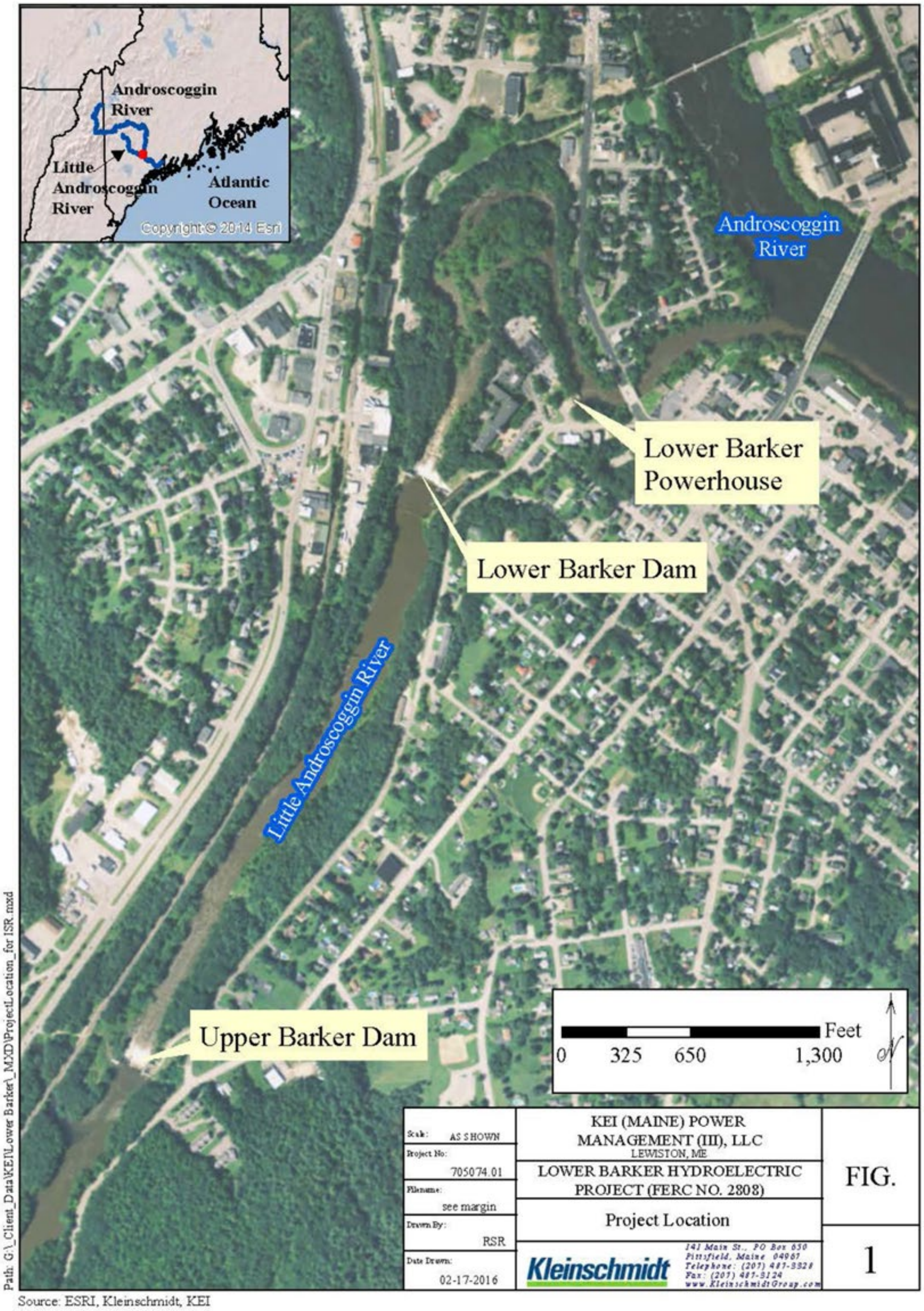

Figure 1. Location of the Barker's Mill Project. (Source: License application)

Issuing a subsequent license for the Barker's Mill Project would allow KEI Power to generate electricity at the project for the term of the license, making electric power from a renewable resource available to the regional grid.

This final environmental assessment (EA) assesses the effects associated with operation of the project, and makes recommendations to the Commission on whether to issue a subsequent license, and if so, recommends terms and conditions to become a part of any license issued.

In this final EA, we assess the environmental and economic effects of operating and maintaining the project: (1) as proposed by the applicant, (2) as proposed with staff recommended measures (Staff Alternative), and (3) the staff alternative as modified by U.S. Department of Commerce's (Commerce) and U.S. Department of the Interior's (Interior) mandatory conditions (Staff Alternative with Mandatory Conditions). We also considered the effects of the no-action alternative. The primary issues associated with relicensing the project are minimum flows in the bypassed reach and upstream and downstream passage for diadromous fish including river herring, American shad, Atlantic salmon, sea lamprey, and American eel; and recreational access and opportunities in the bypassed reach.

1.2.2 Need for Power

To assess the need for power, we looked at the needs in the operating region in which the project is located. The average annual generation of the Barker's Mill Project is 5,087 megawatt-hours (MWh). The power generated is sold to Central Maine Power.

The North American Electric Reliability Council (NERC) annually forecasts electrical supply and demand nationally and regionally for a 10-year period. The Barker's Mill Project is located within the Northeast Power Coordinating Council's New England region (NPCC-New England) of the NERC. According to NERC's 2017 Long-Term Reliability Assessment, the summer internal demand for this region is projected to decrease, but only by 0.03 percent from 2018 to 2027.

Although the demand for power over the long term is expected to decrease in the region, the power from the Barker's Mill Project would continue to help meet the need for power in the NPCC-New England region. In addition, the project provides power that can displace non-renewable, fossil-fired generation and contribute to a diversified generation mix. Displacing the operation of non-renewable facilities may avoid some power plant emissions and create an environmental benefit.

1.3 STATUTORY AND REGULATORY REQUIREMENTS

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 below.

1.3.1 Federal Power Act

1.3.1.1 Section 18 Fishway Prescriptions

Section 18 of the FPA states that the Commission is to require construction, operation, and maintenance by a licensee of such fishways as may be prescribed by the Secretaries of the U.S. Department of Commerce (Commerce) or the U.S. Department of Interior (Interior). On December 20, 2017 and December 21, 2017, Interior and the National Marine Fisheries Service (NMFS) on behalf of Commerce, respectively, each timely filed preliminary fishway prescriptions 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. NMFS and Interior filed modified fishway prescriptions on November 2, 2018, and November 21, 2018, respectively. The agencies' modified fishway prescriptions are summarized in section 2.4, *Staff Alternative with Mandatory Conditions*, and included in Appendix B (Interior) and Appendix C (Commerce).

1.3.1.2 Section 10(j) Recommendations

Under section 10(j) of the FPA, each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it is determined 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.

Interior timely filed on December 20, 2017, and NMFS and Maine Department of Marine Resources (Maine DMR) timely filed on December 21, 2017, recommendations under section 10(j). These recommendations are summarized in table 24 and are discussed in section 5.3, *Summary of Section 10(j) Recommendations*. In section 5.3, we also discuss how we address the agencies' recommendations and comply with section 10(j).

1.3.2 Clean Water Act

Under section 401(a)(1) of the Clean Water Act (CWA), 33 U.S.C. § 1341(a)(1), a license applicant must obtain either a water quality certification (certification) from the appropriate state pollution control agency verifying that any discharge from 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 December 20, 2017, KEI Power applied to the Maine Department of Environmental Protection (Maine DEP) for section 401 certification for the project. Maine DEP received this request on December 21, 2017. On December 7, 2018, KEI Power withdrew and resubmitted a new application for a water quality certification. In a December 19, 2018 filing, Maine DEP acknowledged receiving the application on December 7, 2018, but it has not yet acted on the application.

1.3.3 Endangered Species Act

Section 7 of the Endangered Species Act (ESA), 16 U.S.C. § 1536, requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered species or result in the destruction or adverse modification of the critical habitat of such species. On December 13, 2018, staff accessed the U.S. Fish and Wildlife Service's (FWS) Information for Planning and Consultation (IPaC) database to determine federally listed species that could occur in the project vicinity.[2] According to the IPaC database, the endangered Atlantic salmon Gulf of Maine Distinct Population Segment (GOM DPS) (*Salmo salar*), the threatened small whorled pogonia (*Isotria medeoloides*), and the threatened northern long-eared bat (*Myotis septentrionalis*) may occur in the project area. No critical habitat is designated in the project boundary; however, Atlantic salmon critical habitat occurs in the mainstem Androscoggin River, which the Little Androscoggin River flows into about 0.7 river mile (RM) downstream of the project's dam.[3]

Our analysis of project effects on Atlantic salmon, Atlantic salmon critical habitat, small whorled pogonia, and northern long-eared bat is presented in section 3.3.3, *Threatened and Endangered Species* and our recommendations are in section 5.1, *Comprehensive Development and Recommended Alternative*. Based on available information, we conclude that relicensing the project as proposed with staff-

[2] *See* Interior's official list of threatened and endangered species, accessed by staff using the IPaC database (https://ecos.fws.gov/ipac/) on November 3, 2017 (filed on November 8, 2017) and updated (and filed) on December 13, 2018. The updated list did not identify any new listed species.

[3] River miles were estimated based on Fontaine and Nielson (1994).

recommended measures and mandatory conditions is likely to adversely affect the Atlantic salmon GOM DPS. This is predominately due to the likelihood of some unavoidable injury that would be sustained by salmon using the new upstream fishway or modified downstream fish passage facility and/or passing over the spillway during project operation. However, operating the project in a run-of-river mode that minimizes fluctuations in the impoundment and downstream of the powerhouse, increasing minimum flows released to the bypassed reach from 20 cfs to 113 cfs from November 11 to April 30, and 175 cfs from May 1 to November 10, regulating spill releases over the dam to enhance downstream fish passage, and designing the upstream and downstream fish passage facilities consistent with FWS's 2017 Design Criteria Manual, would enhance Atlantic salmon habitat, aid in salmon migration, and minimize adverse effects of project operation on the Atlantic salmon GOM DPS. On October 4, 2018, we requested formal consultation with NMFS regarding the effects of the proposed project on the Atlantic salmon GOM DPS under the Staff Alternative with Mandatory Conditions.[4] On November 5, 2018, NMFS filed a letter stating it could not yet proceed with formal consultation due to the ongoing section 10(j) review process. We conducted a 10(j) meeting with NMFS on November 26, 2018, to attempt to resolve an inconsistency with its recommended minimum flow measure. We discuss how we address NMFS' recommendations and comply with section 10(j) in section 5.3 of this final EA, *Summary of Section 10(j) Recommendations*. Following issuance of this final EA, we will reiterate our request that NMFS provide its ESA biological opinion on Atlantic salmon.

The project's continued run of river operation would continue to provide a stable flow regime downstream of the dam, and the proposed higher minimum flows would provide a minor beneficial effect on dissolved oxygen concentrations and water temperatures in the bypassed reach during the summer months that may extend downstream into Atlantic salmon critical habitat in the Androscoggin River. Therefore, we conclude that relicensing the project under the Staff Alternative with Mandatory Conditions is not likely to adversely affect designated critical habitat for the Atlantic salmon. We requested concurrence from NMFS on our finding for Atlantic salmon critical habitat on October 4, 2018. NMFS concurred with our finding by letter filed on November 5, 2018.

The small whorled pogonia is likely not present within the project area due to its rarity and the highly developed nature of the areas surrounding the project. We, therefore, conclude that relicensing the project would have no effect on the small whorled pogonia.

[4] See section 2.4 below for a description of the Staff Alternative with Mandatory Conditions.

Construction of the prescribed upstream fishways under the Staff Alternative with Mandatory Conditions would likely require clearing vegetation and disturbing riparian habitat adjacent to the bypassed reach that could serve as summer roosting and foraging habitat for the northern long-eared bat. We recommend that any necessary vegetation clearing for fishway construction be conducted outside of the bat's active period of April 1 to October 31 to avoid disturbing roosting northern long-eared bats. Therefore, we conclude that relicensing the project under the Staff Alternative with Mandatory Conditions is not likely to adversely affect the northern long-eared bat, and would not cause prohibited incidental take. We will request concurrence from FWS on this finding using the optional streamlined consultation framework for the northern long-eared bat.[5]

1.3.4 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) of 1972, as amended, requires review of the project's consistency with a state's Coastal Management Program for projects within or affecting the coastal zone. Under section 307(c)(3)(A) of the CZMA, 16 U.S.C. §1456(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.

In a May 31, 2018 email to the applicant, the Maine Coastal Program stated that the Barker's Mill Project is not located within Maine's CZMA-designated coastal area and submission of federal consistency certification is not required.[6]

1.3.5 National Historic Preservation Act

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

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[5] See Programmatic Biological Opinion: http://www.fws.gov/midwest/endangered/mammals/nleb/bos/16_NLEBRange_Final4d01052016.pdf

[6] *See* KEI Power's letter, filed June 1, 2018, for a copy of the email.

In response to KEI Power's January 31, 2014 request, Commission staff designated KEI Power as its non-federal representative for the purposes of conducting section 106 consultation under the NHPA on March 19, 2014. Pursuant to section 106, and as the Commission's designated non-federal representative, KEI Power initiated consultation with the Maine State Historic Preservation Commission, which functions as the State Historic Preservation Officer (Maine SHPO) to identify historic properties, determine National Register eligibility, and assess potential adverse effects on historic properties within the project's area of potential effects (APE). The results of KEI Power's cultural resources investigations indicate that the project dam is eligible for listing on the National Register but that no historic resources, including the dam, would be adversely affected by the proposed relicensing of the project under KEI Power's proposed action because KEI Power's proposed action is not expected to alter the dam. The Maine SHPO concurred with these findings by a letter and emails filed with the Commission on August 29, 2017, and August 2, 2018.

Our analysis in section 3.3.5 of this final EA concludes that relicensing the project under the Staff Alternative would not affect any historic properties for the same reason. The Maine SHPO concurred with this finding by a letter filed with the Commission on November 27, 2018.

However future construction of upstream fish passage facilities, as prescribed under section 18 and included under the Staff Alternative with Mandatory Conditions, could require modifications to the dam and therefore may have an adverse effect on the properties that make the dam eligible for listing on the National Register. Until the design of the fishway is known, the effects cannot be fully determined. Preparation of a Historic Properties Management Plan (HPMP) and Programmatic Agreement (PA) to implement the plan as a condition of any license issued for the project would provide a process for mitigating any such future effects. Because the upstream fishway is mandatory under section 18 of the FPA, the fishway would be required under any license issued for the project. Therefore, staff expects to develop a PA requiring the assessment and associated HPMP to address any adverse effects.

1.3.6 Magnuson-Stevens Fishery Conservation and Management Act

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

The project area includes EFH for Atlantic salmon because it is located in Maine and on the Little Androscoggin River, which contains habitat currently accessible to Atlantic salmon up to the project's dam about 0.7 RM upstream of the confluence with the Androscoggin River. Although the project's dam currently blocks upstream fish passage, the Little Androscoggin River upstream of the dam also includes EFH for Atlantic salmon because it was historically accessible to this species. Our analysis of project effects on Atlantic salmon EFH is presented in section 3.3.3.2. We conclude that relicensing the project under the Staff Alternative with Mandatory Conditions would have minor adverse effects on EFH, but the habitat and passage improvements included in this alternative (e.g., enhanced minimum flows, water quality, and fish passage facilities) would provide a net benefit to EFH. Therefore, over the long term, aquatic habitat and EFH would be enhanced over existing conditions. On October 4, 2018, we provided NMFS with our EFH assessment and requested that NMFS provide any EFH recommendations. In its letter filed on November 5, 2018, NMFS included two EFH conservation recommendations that are identical to its section 10(j) recommendations. We discuss these measures in sections 3.3.3, *Threatened and Endangered Species*, of this final EA and make recommendations for these measures in section 5.1, *Comprehensive Development and Recommended Alternative*.

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*.), ESA, NHPA, and other federal statutes. Pre-filing consultation must be completed and documented according to the Commission's regulations.

Relicensing of the project began January 31, 2014, when KEI Power filed with the Commission a Pre-Application Document (PAD) and a Notice of Intent to license the project using the Traditional Licensing Process. The Commission issued a Notice Approving Use of the Traditional Licensing Process on March 19, 2014.

1.4.1 Scoping

Before preparing this EA, we conducted scoping to determine what issues and alternatives should be addressed. A scoping document was distributed to interested agencies and others on June 29, 2017. Scoping meetings were held in Auburn, Maine on August 29 and 30, 2017. A court reporter recorded all comments and statements made at the scoping meetings, and these are part of the Commission's public record for the project. An environmental site review was held on August 29, 2017.

In addition to comments provided at the scoping meetings, the following entities provided written comments:

Commenting Entity	Date Filed
American Whitewater	September 13, 2017
National Marine Fisheries Service	September 27, 2017
Interior	September 28, 2017
Atlantic Salmon Federation, Maine Rivers, Natural Resources Council of Maine, and Maine Council of Trout Unlimited (Environmental Groups)	September 29, 2017
City of Auburn	September 29, 2017

A revised scoping document (SD2), addressing these comments, was issued on October 19, 2017.

1.4.2 Interventions

On June 30, 2017, the Commission issued a notice accepting the application and setting August 29, 2017, as the deadline for filing protests and motions to intervene. The notice was published in the *Federal Register* on July 10, 2017. The National Marine Fisheries Service, Maine Department of Inland Fisheries and Wildlife (Maine DIFW), and Interior each filed a notice of intervention on July 31, 2017, August 7, 2017, and August 29, 2017, respectively. The City of Auburn, American Whitewater, and Androscoggin Land Trust each filed a motion to intervene on August 22, 2017, August 28, 2017, and August 29, 2017, respectively.

1.4.3 Comments on the Application

On November 2, 2017, the Commission issued a notice setting January 2, 2018[7] as the deadline for filing comments, recommendations, terms and conditions, and fishway prescriptions. The following entities commented:

Commenting Entity	Date Filed

[7] 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) (2018). Because the 60-day filing deadline fell on a holiday (i.e., January 1, 2018), the filing deadline was extended until the close of business on Tuesday, January 2, 2018.

Interior[8]	December 20, 2017
American Whitewater	December 21, 2017
Maine DMR	December 21, 2017
National Marine Fisheries Service[9]	December 21, 2017
Maine DIFW	December 28, 2017

KEI Power filed reply comments on February 15, 2018.

1.4.4 Comments on the Draft EA

On September 27, 2018, the Commission issued a draft EA for the relicensing of the Barker's Mill Hydroelectric Project. Comments on the draft EA were due October 29, 2018.[10] Comments on the draft EA were filed by the following entities:

Commenting Entity	Date Filed
Maine DIFW	October 24, 2018
National Marine Fisheries Service	October 25, 2018
American Whitewater	October 26, 2018
Maine DMR	October 26, 2018
KEI Power	October 29, 2018
Environmental Groups	October 29, 2018

KEI Power filed responses to agencies' comments on January 2, 2019.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 NO-ACTION ALTERNATIVE

Under the no-action alternative, the project would continue to operate under the terms and conditions of the existing license, and no new environmental protection,

[8] Interior's December 20, 2017 filing included its section 18 preliminary fishway prescriptions. On December 21, 2017, Interior filed the administrative record for its section 18 preliminary fishway prescriptions.

[9] NMFS's December 21, 2017 filing included its section 18 preliminary fishway prescriptions. On December 22, 2017, NMFS filed the administrative record for its section 18 preliminary fishway prescriptions.

[10] Because the 60-day filing deadline for comments fell on Saturday, October 27, 2018, the filing deadline was extended until the close of business on Monday, October 29, 2018. *See* footnote number 7.

mitigation, or enhancement measures would be implemented. We use this alternative to establish baseline environmental condition for comparison with other alternatives.

2.1.1 Existing Project Facilities

The Barker's Mill Project is located on the Little Androscoggin River in the City of Auburn, Maine, beginning about 0.7 RM upstream of the confluence of the Little Androscoggin and Androscoggin Rivers. The project facilities are shown in figure 2.

Barker's Mill Impoundment and Dam

The Barker's Mill impoundment is 0.65 mile long and extends from the project dam upstream to the tailwater of the Barker Mill Upper Project FERC No. 3562 (also known as and referred herein as the Upper Barker Project). At a normal full pool elevation of 164.7 feet,[11] the impoundment has a surface area of about 16.5 acres and a storage capacity of 150-acre feet. It is impounded by a concrete, Ambursen slab and buttress style dam that is 232 feet long and consists of the following three sections: (1) a 46-foot-long, 37-foot-high non-overflow west section with two 10-foot-long, 8-foot-high waste gates[12] at a crest elevation of 170 feet; (2) a 125-foot-long, 30-foot-high overflow spillway section with 14-inch-high flashboards at a crest elevation of 163.9 feet without flashboards installed; and (3) a 61-foot-long, 36-foot-high east section with six 7-foot-wide, 5-foot-high stop log bays and one 4-foot-wide, 5-foot-high stop log bay each at a crest elevation of 162 feet. The east section also includes a concrete deck that spans the top of the stop log bays.

Fishways

There are no existing upstream fish passage facilities at the dam. Downstream fish passage is provided by releasing flow through the 4-foot-wide stop log bay located closest to the intake canal's[13] entrance at the impoundment (this stop log bay is herein referred to as the fish bypass). Fish and flows exit the fish bypass into a plunge pool at the base of the stoplog section of the dam, cascade down a small set of bedrock falls, and enter the bypassed reach at the base of the spillway section of the dam (figure 2). The

[11] Unless otherwise noted, all elevations are referenced to the North American Vertical Datum of 1988.

[12] The two waste gates are steel bulkhead gates operated manually from the steel grating walkway.

[13] The intake canal is denoted as the "power canal" in figure 2. Both terms describe the same project feature.

Figure 2. Barker's Mill Project. (Source: License application).

fish bypass is currently operated from June 1 through November 15.

Intake Canal and Gatehouse

The 100-foot-long, 20-foot-wide, 10-foot-deep intake canal is located adjacent to the stoplog section along the east bank of the impoundment. There are two overflow spill bays on the canal wall along the bypassed reach and near the canal's entrance to route overflow to the bypassed reach and thereby prevent water from overtopping the canal wall during flood conditions or if the existing trash racks are plugged with debris. The 35-foot-long, 20-foot-wide gate house is located at the end of the canal with a single gate equipped with 19-foot-wide, 12.3-foot-high trash rack with 2-inch bar spacing. The gate remains open except for the occasional maintenance and inspection of the penstock.

Penstock and Powerhouse

The 10-foot-wide, 7-foot-high concrete penstock is buried and extends 650 feet from the intake structure to the powerhouse. The concrete powerhouse is partially buried and contains a single semi-Kaplan-type turbine/generating unit with a rated capacity of 1.5 MW. Power from the powerhouse is transmitted via a 250-foot-long, 4.2-kilovolt underground transmission line to a substation. The project generates 5,087 megawatt-hours (MWh) of electricity annually. Flows discharge from the powerhouse back into the

Little Androscoggin River, creating a 3,000-foot-long bypassed reach between the dam and the powerhouse (figure 1).[14]

Recreation Facilities

KEI Power allows public use of project land and waters for informal recreation, but does not maintain any recreational facilities or access at the project.

Project Boundary

The existing project boundary includes the Barker's Mill dam, intake canal, gate house, buried penstock, powerhouse, and short transmission line, but not the project impoundment. The Exhibit G drawings filed with its application now encloses the project impoundment up to elevation of 164.7 feet.

2.1.2 Project Safety

The Barker's Mill Project has been operating for 39 years under the existing license. During this time, Commission staff conducted operational inspections focusing on the continued safety of the structures, identification of unauthorized modifications, efficiency and safety of operations, compliance with the terms of the license, and proper maintenance.

As part of the relicensing process, the 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 will 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.

2.1.3 Current Project Operation

The project operates as a run-of-river facility and bypasses about 0.57 mile of the

[14] The bypassed reach can be viewed in figure 1. It flows north from the dam (denoted "Lower Barker Dam" in the figure) for about 1,500 feet, makes an abrupt turn south, and then flows for about 1,500 feet to the powerhouse (denoted "Lower Barker Powerhouse" in the figure). As can be seen in the figure, the bypassed reach bifurcates and converges multiple times in the first 2,300 feet of the reach and then becomes one channel over the remaining 700 feet.

Little Androscoggin River. When generating, water is conveyed through the project penstock and into the project powerhouse where it then re-enters the Little Androscoggin River through the project tailrace. The current license requires a year-round minimum flow release of 20 cubic feet per second (cfs) or inflow, whichever is less, into the bypassed reach to maintain aquatic habitat. Although not required by the current license, KEI Power tries to maintain impoundment levels as close as possible to the top of the flashboards without overtopping them while the project is generating.

From June 1 through November 15, KEI Power releases some of the required minimum flow through the fish bypass to facilitate downstream fish passage. Additional flow is passed through the other stop-log bays or over the spillway depending on inflow conditions. During the remainder of the year, KEI Power releases the minimum flow in the same manner, but prefers to pass most spill flow over the spillway to direct wood and debris away from the stop log bays and the intake canal. In addition to minimum flows, all inflow less than 170 cfs (the minimum hydraulic capacity of the turbine plus the 20 cfs minimum flow release) and greater than 520 cfs (i.e., maximum hydraulic capacity plus 20 cfs minimum flow release) is spilled at the dam in the manner described above. Because the project is operated run-of-river, there is minimal available storage behind the dam.

Turbine operation is automated and can be adjusted or shut down remotely, but startup must be done on-site.[15] Plant operators visit the site daily. At times, KEI Power draws down the project impoundment for short periods of time (usually in the summer) to conduct maintenance or for emergency operations and repairs. Complete drawdowns are rare, having only occurred about 3 times in the last 20 years.[16]

2.2 APPLICANT'S PROPOSAL

2.2.1 Proposed Operation and Environmental Measures

KEI Power proposes to:

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[15] The headpond elevation is measured by a pressure transducer and monitored via a programmable logic controller in the powerhouse, which regulates turbine flows based on the pond elevation to ensure the project operates in run-of-river mode. The automated system allows the turbine to be remotely adjusted or shutoff from KEI Power's operations and maintenance facility in Lewiston, Maine.

[16] *See* summary of teleconference between Commission staff and KEI Power filed on August 9, 2018.

- Continue to operate the project in run-of-river mode to protect aquatic resources.

- Continue to monitor impoundment levels to track compliance with run-of-river operation.

- Increase bypassed reach minimum flow releases at the dam[17] from 20 cfs to 113 cfs or inflow, whichever is less, to protect fisheries and aquatic habitat.[18]

- Continue to operate the downstream fish passage facility from June 1 through November 15 to provide downstream passage for diadromous fish species.

- Modify the existing downstream fish passage facility in consultation with FWS and NMFS to reduce entrainment of diadromous fish species.[19]

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[17] There is no stream gage for minimum flow compliance monitoring in the bypassed reach. KEI Power states that it monitors compliance with minimum flow release requirements by visually monitoring flow levels passing through a notched weir in the plunge pool.

[18] In its license application, KEI Power initially proposed to increase the minimum flow release from 20 cfs to 50 cfs. However, in its June 26, 2017 AIR response letter, KEI Power revised its proposal to increase the minimum flow to 113 cfs.

[19] KEI Power did not propose a specific design of its modified downstream passage facility in its license application. Instead, it proposed to design the facility in consultation with FWS and NMFS after license issuance. However, in response to staff's March 13, 2017 additional information request, KEI Power filed a conceptual design of the modified downstream passage facility on June 12, 2017. As shown in the filing, the conceptual design would include constructing and installing new full-depth 40-degree angled trash racks with 1-inch clear bar spacing at the upstream end of the canal adjacent to the fish bypass to guide fish into the bypass. The new trash racks would be designed to ensure a maximum approach velocity of 2 feet per second at the trash racks. A new operator deck that spans the canal above the trash racks would be constructed to facilitate manual cleaning of the trash racks. A new inclined ramp would be constructed in the impoundment beneath the fish bypass entrance to provide additional guidance into the downstream passage system. In addition to the new trash racks, KEI Power would modify the plunge pool beneath the fish bypass exit by constructing a new wall with a cut-out at the downstream end of the pool to increase the pool depth to a minimum of 4 feet and to direct flow and fish safely out of the pool through the cut-out and into the bypassed reach. The existing plunge pool would be modified and the new wall would be

- Improve the hand-carry boat launch on the impoundment upstream of the dam and the informal foot trail leading to the bypassed reach just downstream of the dam, add signage for the boat launch and trail, designate the parking area near the gatehouse, and maintain these facilities.

- Maintain portions of the Barker Mill Trail where it serves as a portage route around the project dam.

- Coordinate with the City of Auburn to schedule up to five annual recreation flow releases to the bypassed reach (e.g., up to five hours each at 500 cfs) to enhance whitewater boating opportunities.

- Automate the calculation of stream flows in the bypassed reach using real-time flow data obtained from the U.S. Geological Survey's (USGS) existing upstream South Paris Gage, and publish the calculated flows to a public website, in coordination with the City of Auburn, to help inform recreation users of current conditions for boating and fishing in the bypassed reach.

- Continue to manage historic properties within the Area of Potential Effect, including any properties eligible for listing on the National Register of Historic Properties and address tribal resources, if discovered, on a case-by-case basis.

2.3 STAFF ALTERNATIVE

Under the Staff Alternative, the project would include all of KEI Power's proposed measures as described above in section 2.2, except installing new angled trash racks in the intake canal adjacent to the existing fish bypass with 1-inch clear bar spacing, adding a permanent operator deck to enable cleaning of the new trash racks, and providing whitewater boating flow releases.

The Staff Alternative would also include the following modifications and additional staff-recommended measures:

- Expand the proposed operational season for the existing and modified downstream fish passage facility by 15 days to November 30, to better protect downstream migrating juvenile alewife.

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constructed to ensure that the pool is large enough to safely pass fish entering the plunge pool through either the fish bypass, or through the other six stop-log bays. KEI Power would also pass a minimum of 25 cfs through the fish bypass to increase attraction flows for downstream migrants.

- During the downstream fish passage season of June 1 through November 30, prioritize the proposed minimum flow releases over the dam as follows to enhance downstream fish passage: (1) through the fish bypass, (2) through the remaining stop log bays, and (3) over the spillway.

- Maintain impoundment levels within 1 foot or less of the top of the flashboards when they are in place or 1 foot or less from the spillway crest when the flashboards are down, to protect nearshore aquatic habitat in the impoundment and in the Little Androscoggin River downstream of the powerhouse during operation.

- To protect Atlantic salmon that may occur in the bypassed reach, conduct any planned maintenance activities requiring the impoundment to be drawn down below the normal operating limits of the license between July and September.

- Develop an operation compliance monitoring plan that includes provisions for: monitoring and reporting compliance with the operating requirements of the license (e.g., run-of-river, minimum flows, impoundment levels, and regulating flow over the dam to enhance downstream fish passage), and reporting deviations from operating requirements to the Commission.

- Construct an upstream eel fishway and annually operate it from June 1 to September 15 to facilitate upstream passage of American eel.

- Design the new upstream eel fishway and staff-recommended modifications to the downstream fish passage facility consistent with the FWS's 2017 Fish Passage Engineering Design Criteria Manual, submit design plans and a construction schedule to the resource agencies for review, and file the plans for Commission approval prior to beginning construction.

- Operate the new upstream eel fishway for a one-season "shakedown" period following construction to ensure that the fishway is generally operating as designed, and if not, make adjustments to the facility or its operation.

- Develop a fish passage operation and maintenance plan to ensure proper operation and maintenance of the proposed modified downstream fish passage facility and the new upstream eel fishway. Include a maintenance schedule that ensures any maintenance and changes to fish passage facilities are completed 30 days prior to the start of the next migratory season.

- Reserve authority to Interior and Commerce to prescribe fishways at the project under section 18 of the FPA during the term of any subsequent license

- File with the Commission, for approval, a recreation plan, that includes the following: (1) conceptual drawings and descriptions of the improvements to the hand-carry boat ramp, the foot path to the bypassed reach immediately downstream of the dam, parking, and signage; (2) a schedule for maintaining the Barker Mill Trail where it parallels the project impoundment to below the dam, and include the trail within the project boundary; (3) a provision to monitor and report recreational use in the project area during year 6 of the license and every 10 years thereafter; and (4) include revised Exhibit G drawings identifying all of the above as project recreation facilities.

2.4 STAFF ALTERNATIVE WITH MANDATORY CONDITIONS

We recognize that the Commission is required to include all section 18 fishway prescriptions in any license issued for the project. Therefore, the Staff Alternative with Mandatory Conditions includes the following mandatory conditions provided by Interior and Commerce and would be made part of any license issued, unless modified by the conditioning agency.

Interior's Section 18 Prescriptions

Interior's modified section 18 prescriptions would require KEI Power to provide upstream and downstream passage for alosines (alewife, blueback herring, and American shad) and American eel. Specifically, Interior's prescriptions requires KEI Power to:

- Operate and maintain the existing downstream fish passage facility from June 1 to November 30 each year until a new downstream fish passage facility is operational.

- Construct a downstream fish passage facility for alosines and eel prior to the second migratory season after issuance of a new license, and operate and maintain the facility annually from June 1 to November 30. The facility would need to meet the following design specifications: (1) a full depth inclined (minimum 45 degree) bar rack with 0.75-inch spacing; (2) a minimum flow of 25 cfs; and (3) a receiving bypass flow plunge pool with a depth that is equal to 25 percent of the fall height or 4 feet, whichever is greater.

- Prioritize the spill pathways as follows: (1) through the fish bypass; (2) through the other stop log bays adjacent to the fish bypass; (3) over the spillway, and if necessary, into a newly constructed FWS-approved plunge pool beneath the spillway.

- Construct an upstream fish passage facility for American eel prior to the second migratory season after license issuance, and operate and maintain the facility annually from June 1 to September 15.

- Construct and have operational by May 1, 2024, an upstream fish passage facility for alosines, that consists of either a pool and weir fishway or a fish lift, designed to pass a maximum of about 2 million river herring, and operate and maintain the facility annually from May 1 to July 31.

- Develop a fishway operation and maintenance plan (fishway plan) within 12 months of license issuance that includes provisions for describing operation and maintenance of the new upstream and downstream fish passage facilities at the project for alosines and eels; updating the fishway plan upon request of the FWS, and on an annual basis to reflect changes in fishway operation and maintenance; and obtaining approval from FWS for any requested modification to the fishway plan.

- Design the eel and alosine fishways in a manner consistent with the FWS's 2017 Fish Passage Engineering Design Criteria Manual (FWS, 2017a) or an updated version, if available.

- Submit design plans for the eel and alosine fishways to FWS and other resource agencies for review and approval during the conceptual, 30, 60, and 90 percent design stages, submit approved design plans to the Commission for approval prior to construction, and file final as-built drawings with FWS, the Commission, and other resource agencies, after construction is complete.

- Develop and submit for FWS approval, effectiveness testing and evaluation plans within six months of license issuance for the downstream passage facility for alosines and American eel and the upstream fish passage facility for American eel, and within 36 months of license issuance for the upstream fish passage facility for alosines; conduct effectiveness testing at each fish passage facility for a minimum of two years after the facility is operational to evaluate passage success, diagnose problems, and determine if modifications to the facilities are needed.

- Meet annually with FWS and the other resource agencies in the late fall to report on fish passage maintenance, operation, and monitoring, and to review the fishway plan.

- Complete any fish passage facility maintenance and modification 30 days prior to the start of the next migratory season.

- Provide FWS personnel and FWS-designated representatives' access to the project site and to pertinent project records for the purpose of inspecting the fish passage facilities and determining compliance with the fishway prescription.

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

Commerce's Section 18 Prescriptions

NMFS's modified section 18 prescriptions would require KEI Power to provide upstream passage facilities for both anadromous fish (alewife, blueback herring, American shad, Atlantic salmon, and sea lamprey) and catadromous species (American eel) and a downstream passage facility for alewife, blueback herring, American shad, Atlantic salmon, sea lamprey, and American eel. Specifically, NMFS's preliminary fishway prescriptions would require KEI Power to:

- Construct and have operational by September 1, 2021, a new downstream fish passage facility and operate and maintain the new downstream facility from April 1 to December 31. The facility would need to meet the following design specifications: (1) entrainment prevention using a minimum 0.75-inch spaced bar racks (or equivalent); (2) impingement prevention by minimizing approach velocity and maximizing sweeping velocity components near the bar racks; (3) sufficient flow to attract emigrating fish to the bypass entrance; (4) gradually accelerating flow near the bypass entrance; (5) safe hydraulic conditions through the bypass; and (6) safe discharge conditions at the bypass outfall.

- Construct, and have operational by June 1, 2021, an upstream fish passage facility for American eel that provides passage from the downstream side of the dam to the Barker's Mill impoundment; operate the facility annually from June 1 to September 15; and complete maintenance on the facility prior to the eel migration season.

- Construct, and have operational by May 1, 2024, an upstream fish passage facility for anadromous fish. The facility would need to meet the following design specifications: (1) appropriate size to accommodate 1.7 million river herring, 37,000 American shad, about 370 Atlantic salmon, and other resident or target species; (2) design elements (e.g., slope, pool/slot size, attraction water) that ensure successful passage of river herring, American shad, Atlantic salmon, and sea lamprey; (3) operation over the full range of design flows based on the migration season for each species; and (4) a counting facility to enumerate successful passage of target species.

- Maintain fishways in proper order and keep fishways clear of trash, logs, and material that would hinder passage and perform anticipated maintenance prior to fish migration periods.

- Provide a flow in the bypassed reach sufficient for safe, timely, and effective passage to the dam during the upstream anadromous fish passage season.

- Submit design plans for the new upstream fishway and modified downstream fish passage facility to NMFS for review and approval during the conceptual, 30, 60, and 90 percent design stages, submit NMFS approved design plans to the Commission for final approval prior to construction, and file final as-built drawings with NMFS after construction is complete.

- Monitor alosines at the upstream and downstream fish passage facilities for a minimum of 2 years beginning after a "one-year shakedown period" for each fish passage facility, and prepare and file monitoring reports.

- Monitor all life stages of Atlantic salmon at the upstream and downstream fish passage facilities contingent on the presence of testable individuals, and prepare and file monitoring reports.

- Improve fishways that do not meet performance standards.

- Prepare and file annual fish passage reports that consist of data from the fish passage season including daily passage counts for each species, daily river conditions, fishway operational settings, and project operations.

- Allow resource agencies access to the fishway for inspection throughout the license term with reasonable notice.

In addition to the specific fish passage measures listed above, NMFS has reserved its authority to prescribe fishways at the project under section 18 of the FPA during the term of any subsequent license.

<u>Commission Staff's Recommended Measures</u>

This alternative would also include the following staff recommended measures:

- Continue to operate the project in run-of-river mode to protect aquatic resources.

- Maintain impoundment levels within 1 foot or less of the top of the flashboards or 1 foot or less from the spillway crest when the flashboards are down, to protect nearshore aquatic habitat in the impoundment and in the Little Androscoggin River downstream of the powerhouse during operation.

- To protect Atlantic salmon that may occur in the bypassed reach, conduct any planned maintenance activities requiring the impoundment to be drawn down below the normal operating limits of the license between July and September.

- Develop an operation compliance monitoring plan that includes provisions for: monitoring and reporting compliance with the operating requirements of the license (e.g., run-of-river, minimum flows, impoundment levels, and regulating flow over the dam to enhance downstream fish passage), and reporting deviations from operating requirements to the Commission.

- File with the Commission, for approval, a recreation plan, that includes the following: (1) conceptual drawings and descriptions of the improvements to the hand-carry boat ramp, the foot path to the bypassed reach immediately downstream of the dam, parking, and signage; (2) a schedule for maintaining the Barker Mill Trail where it parallels the project impoundment to below the dam, and include the trail within the project boundary; (3) a provision to monitor and report recreational use in the project area during year 6 of the license and every 10 years thereafter; and (4) include revised Exhibit G drawings identifying all of the above as project recreation facilities.

- Automate the calculation of stream flows in the bypassed reach using real-time flow data obtained from the U.S. Geological Survey's (USGS) existing upstream South Paris Gage, and publish the calculated flows to a public website, in coordination with the City of Auburn, to help inform recreation users of current conditions for boating and fishing in the bypassed reach.

- Conduct tree removal activities between November 1 and March 31 to protect the federally listed northern long-eared bat during summer roosting periods.

- Following the development of a conceptual design of an upstream fish passage facility, evaluate the effects that constructing the facility would have on the properties of the dam that make it eligible for listing on the National Register and file, for Commission approval, a HPMP to minimize and mitigate any adverse effects.

2.5 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

2.5.1 Decommissioning

Project retirement could be accomplished with or without dam removal.[20] Either alternative would involve denial of the relicense application and surrender or termination of the existing license with appropriate conditions.

Decommissioning Without Dam Removal

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

Decommissioning With Dam Removal

During the scoping process, several commenters expressed support for project decommissioning with dam removal for the purpose of assisting diadromous fish restoration to areas upstream of the existing project dam and impoundment. In determining whether the EA requires a detailed analysis of project decommissioning, we consider a variety of factors including the beneficial or adverse effects of licensing the project on a number of resources or interests and whether or not any adverse effects on the environmental resources can be adequately mitigated through licensing. Below we considered the resources or interests for the Barker's Mill Project and the effects of decommissioning on those resources. However, without a specific decommissioning proposal, any further discussion of the effects of project decommissioning and dam removal would be both premature and speculative.

Aquatic Resources

Removing the Barker's Mill Dam and other appurtenant structures would directly affect the flow of water through, and immediately below, the reach of the river currently impounded by the dam. Water velocity in the impoundment area would increase and slower water habitats along the edges of the impoundment would disappear as the water recedes into a more defined channel.

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[20] In the event that the Commission denies relicensing a project or a licensee decides to surrender an existing project, the Commission must approve a surrender "upon such conditions with respect to the disposition of such works as may be determined by the Commission." 18 C.F.R. § 6.2 (2018). 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.

Removing the dam would release stored sediment to the Little Androscoggin River and the mainstem Androscoggin River further downstream. Although KEI Power did not conduct studies of sediment accumulation or contaminant levels in the project's impoundment during pre-filing, the dam has been in place for 111 years, and it is likely that significant quantities of sediment have accumulated within the impoundment. Removing the dam would, at a minimum, cause significant increases in sediment transport, elevated turbidity levels, and sedimentation of aquatic habitat beginning with construction and likely continuing periodically for several years thereafter until the stream channel stabilizes. Once construction is complete and most of the accumulated sediment is passed downstream, water quality would eventually be expected to improve.

Elevated turbidity levels would temporally result in adverse effects on migratory and resident fish, including listed Atlantic salmon, by causing physiological stress (Redding *et al*., 1987) and lowered feeding success (Barrett *et al*., 1992), and diminished habitat quality (Waters, 1995). Additionally, the suspension of any contaminated sediments, if they exist, could cause long-term adverse physiologic effects on Atlantic salmon and other aquatic organisms through physical contact with contaminants or trophic interactions. The duration and severity of these effects would depend on a number of factors, including but not limited to: the volume, composition, and contaminant level of sediment accumulated behind the dam; the duration of dam breaching and removal activities; and the frequency and duration of high flow events following dam breaching and removal. Over the long-term, accumulated sediment would eventually transport downstream out of the project area, and the project reach would return to a free-flowing riverine stream segment. Transport of gravel, large woody debris, and sediment would move unencumbered downstream. However, such benefits would be small given the continued presence of the 14 other dams upstream that would continue to trap and disrupt sediment transport from the upper watershed.

Removing the dam would result in all inflow passing freely downstream which would increase and stabilize flows through the bypassed reach and support additional aquatic habitat for fish (including Atlantic salmon) and other aquatic biota. Dam removal would also create a free, unobstructed path for fish (including protected Atlantic salmon) to migrate upstream and downstream and utilize riverine habitat within the approximately 1.45-mile reach of the Little Androscoggin River downstream of Upper Barker Dam. Access to the majority of historical spawning and rearing habitat in the watershed would still be blocked, however, by 14 other dams on the Little Androscoggin River and its tributaries upstream.

Terrestrial Resources

Following dam removal, riparian vegetation along the banks of the impoundment would likely transition to a more upland habitat type such as Pine-Hemlock-Hardwood Forest or Red Oak-Northern Hardwood Forest. Over time, a new river's edge would become established, and the redevelopment and regrowth of riparian and wetland habitats would occur along its banks. Areas formerly occupied by dam structures or features would provide new aquatic, riparian, and upland habitat for wildlife.

Within the bypassed reach, there would be additional flows throughout the year, as water would no longer be diverted for generation. Higher flows would likely cause the establishment of a new riparian vegetation zone at a higher bank elevation, but composition would not likely change greatly. Sediments released from the impoundment could eventually settle into downstream wetland habitat, and cover important breeding or foraging habitat for wildlife. Over time, accumulated sediment would be transported downstream during high flows, and dam removal would allow a more natural level of sediment transport to occur within the river channel.

The diversity and abundance of wildlife species in the area is not expected to significantly change. The construction work to remove the dam would temporarily disturb and displace some wildlife. Some waterfowl and semi-aquatic wildlife that prefer the more lentic ecosystem habitat type provided by the impoundment, may move to other impoundments located upstream or to nearby lakes. As greater, more natural flows are available to the bypassed reach, species that rely on riverine habitat may utilize this stretch more often throughout the year.

Recreation and Aesthetics

Dam removal would eliminate the impoundment and associated lake-type fishing and boating opportunities currently available above the dam. These activities would be replaced with new opportunities for stream-based fishing and whitewater boating within the area occupied by the impoundment and the 0.7-mile-long bypassed reach. Boaters would no longer need to portage around the dam and public safety concerns associated with the presence of the dam and project operation (sudden increases in downstream flows) would be removed. Parking areas, signage, and formal public access trails would no longer be maintained by the licensee. A minor tailrace fishing opportunity below the powerhouse would be eliminated; however, improved aquatic habitat along the entire project reach could enhance fishing opportunities overall. Spill from the dam, which may be of aesthetic interest to some recreation users, would also be eliminated.

Cultural

Removal of the dam would result in the permanent loss of a historical resource that is eligible for listing on the National Register. This loss would require mitigation through data recovery in order to document the dam's historic properties. Removal of the dam could also result in the exposure of currently inundated and as yet unidentified cultural sites, if present. While this action could expose these resources to the public, resulting in illicit artifact collection and site vandalism, it could also have the benefit of opening up previously inundated areas to the discovery and proper collection and documentation of historic resources.

Summary

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. Restoration of diadromous fish, including the federally listed Atlantic salmon, is a goal of existing management plans for the Androscoggin River basin and several agencies and non-governmental organizations support project decommissioning for this purpose. However, as discussed in this EA, protection, mitigation, and enhancement measures can be fashioned to support the recovery of diadromous fish in the basin. Thus, decommissioning is not a reasonable alternative to relicensing.

If the section 18 fishway prescriptions are too costly for the applicant, it can opt to not accept a new license. In that case, a decommissioning plan containing the details of such action would be required and depending upon the nature of the proposed decommissioning action, may be subject to National Environmental Policy Act review at that time.

3.0 ENVIRONMENTAL ANALYSIS

This section includes: (1) a general description of the project vicinity, (2) an explanation of the scope of cumulative effects analysis, and (3) our analysis of the proposed action and recommended environmental measures. Sections are organized by resource area (aquatic, recreation, etc.). Historic and current conditions are described under each resource area. The existing conditions are the baseline against which the environmental effects of the proposed action and alternatives are compared, including an assessment of the effects of the proposed mitigation, protection 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*.[21]

3.1 GENERAL DESCRIPTION OF THE ANDROSCOGGIN RIVER BASIN

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[21] Unless otherwise indicated, our information is taken from the application for license filed by KEI Power on January 30, 2017, and responses to requests for additional information filed on June 12, 2017, June 26, 2017, August 1, 2017, October 31, 2017, and August 27, 2018.

The Barker's Mill Project is located at RM 0.7 on the Little Androscoggin River in the City of Auburn, within Androscoggin County, Maine. The Androscoggin River watershed extends from northeastern New Hampshire to the coast of Maine where it joins the Kennebec River to form Merrymeeting Bay.

The Androscoggin River watershed has a total drainage of 3,530 square miles. The Little Androscoggin River basin, where the project is located, is a sub-basin of the Androscoggin River watershed. The Little Androscoggin River basin originates in Bryant Pond in Woodstock, Maine, approximately 29 miles northwest of the project area. The Little Androscoggin drainage area is 354 square miles and covers two counties, Androscoggin and Oxford. The Little Androscoggin River is approximately 52 miles long from its headwaters to its confluence with the Androscoggin River. The project powerhouse is located about 1,320 feet upstream from the confluence of the Little Androscoggin River with the Androscoggin River.

Androscoggin County is located in southwestern Maine and has a land area of approximately 468 square miles. The major topographic feature of Androscoggin County is the Androscoggin River which divides the "twin cities" of Lewiston and Auburn. The remainder of the topography is generally moderate, varying from forested hills to flat farmlands. The project vicinity is dominated by forestland, approximately 61 percent of the total land cover, followed by agriculture at approximately 11 percent of the land cover. Overall, only a small percentage of the project vicinity is developed (8 percent) (NOAA C-CAP, 2010). As such, the major land uses in Androscoggin County are forestry, agriculture, and urban development, contained within 14 cities and towns, the largest of which is the Lewiston-Auburn metropolitan area where the project is located.

In addition to the Barker's Mill Project, there are four other FERC-regulated hydroelectric generating projects on the Little Androscoggin River. The Barker's Mill Project is the first project upstream from the Little Androscoggin's River confluence with the Androscoggin River. The other projects upstream from the Barker's Mill Project (in ascending order) are the Barker Mill Upper (FERC No. 3562), Hackett Mills (FERC No. 6398), Marcal (FERC No. 11482), and Biscoe Falls (FERC No. 9411) Hydroelectric Projects. In addition, there are two non-hydropower dams on the Little Androscoggin River mainstem, and eight dams on its tributaries, none of which are FERC-regulated projects (figure 3).

3.2 SCOPE OF CUMULATIVE EFFECTS ANALYSIS

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (40 C.F.R. § 1508.7), an action may cause cumulative effects on the environment if its impacts overlap in time and/or space with the impacts of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

Based on our review of the license application and agency and public comments, we have identified diadromous fisheries[22] as a resource that may be cumulatively affected by the proposed operation and maintenance of the Barker's Mill Project in combination with other hydroelectric projects occurring in the basin.

3.2.1 Geographic Scope

The geographic scope of analysis for cumulatively affected resources is defined by the physical limits or boundaries of: (1) the proposed action's effect on the resources, and

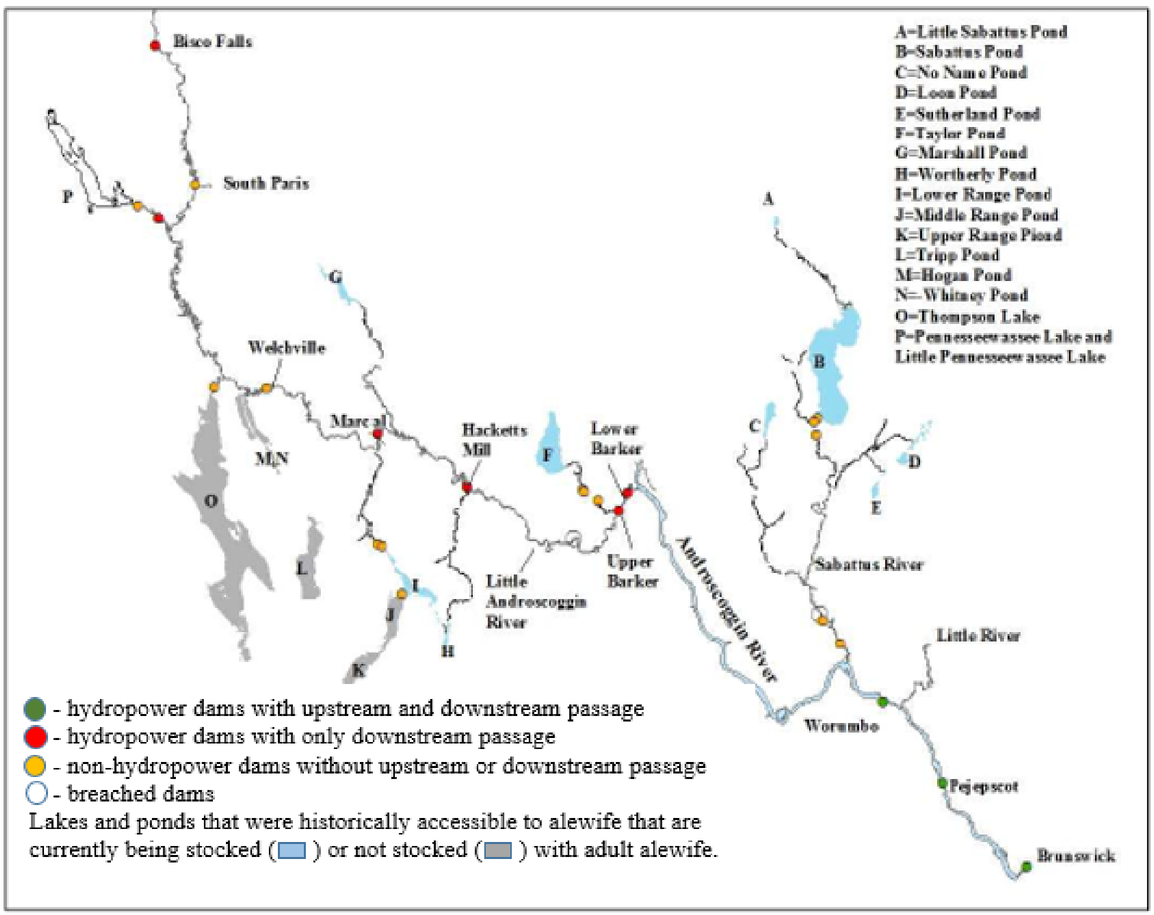

Figure 3. Dams or fish passage barriers upstream and downstream of the project, on the Little Androscoggin, Androscoggin, and Sabattus Rivers or their tributaries (Source: Maine DMR and Maine DIFW, 2017, as modified by staff).

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[22] Diadromous fisheries include species that spend portions of their life cycles in both fresh and saltwater such as: Atlantic salmon, American eel, and river herring.

(2) contributing effects from other hydropower and non-hydropower activities within the basin.

According to the draft fisheries management plan for the Little Androscoggin River, anadromous Atlantic salmon were able to historically migrate upstream to a natural barrier at Snow Falls at RM 37, while upstream migrations of river herring and American shad historically extended to either Snow Falls or Biscoe Falls (Maine DMR and Maine DIFW, 2017). Biscoe Falls is located about one mile downstream of Snow Falls. The historical range of American eel in the Little Androscoggin River is unknown, but they have been documented upstream of Snow Falls.

The geographic scope for our cumulative effects analysis for aquatic resources includes areas within the Little Androscoggin River and its tributaries downstream of Snow Falls that were historically accessible to anadromous fish. The geographic scope also includes the mainstem Androscoggin River from the confluence with the Little Androscoggin River at RM 30 downstream to Merrymeeting Bay at RM 0. We chose this geographic scope because the operation and maintenance of the Barker's Mill Project, in combination with other dams located both upstream and downstream of the project may influence fish movements and affect habitat availability and accessibility within this approximate 67-mile reach of both rivers.

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 license, the temporal scope will look 30 to 50 years into the future, concentrating on the effects on the resources from reasonably foreseeable future actions.

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 effects. We then discuss and analyze the specific cumulative and site-specific environmental issues.

Only the resources that would be affected, or about which comments have been received, are addressed in detail in this EA. We have not identified any substantive issues related to geology and soils or socioeconomics associated with the proposed action; and therefore, these resources are not addressed 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 and Use

There are currently no operating stream gages or recent gaging records available for the Little Androscoggin River at the project site. The USGS historically operated a stream gage on the Little Androscoggin River near Auburn, Maine, but that gage was discontinued in 1982. The closest operating stream gage is USGS gage no. 01057000 located about 36 RMs upstream near South Paris, Maine. To provide current data on streamflows in the project reach, staff estimated inflow at the project using 30 years of prorated data from the South Paris gage for the period of January 1, 1987 – December 31, 2017.[23] Table 1 summarizes monthly flow data for the Little Androscoggin River at the project site based on the prorated data.

Table 1. Mean, median, minimum, and maximum inflow for the project site based on prorated gage data for the period 1987-2017. (Source: Staff).

Month	Mean (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
January	475	322	86	7,632
February	390	277	85	4,397
March	979	571	96	15,312
April	2,055	1,363	207	32,448
May	918	686	72	15,936
June	628	339	36	15,600
July	335	144	15	6,384
August	257	80	4	6,960
September	187	73	3	8,688
October	531	241	12	9,360
November	771	523	62	10,272
December	748	453	90	12,096

[23] Staff's hydrology analysis was based on a proration of the USGS's South Paris gage data to take into account the larger drainage area at the project site. The drainage area at the South Paris gage site is 73.5 square miles, while the drainage area at the Barker's Mill Dam site is 353.5 square miles according to the USGS's StreamStats web application. Therefore, the data from the South Paris gage were prorated by a factor of 4.8 (i.e., 353.5/73.5=4.8).

There are no permitted water withdrawals from the project impoundment for purposes other than for hydropower generation at the project. However, in the vicinity of the project, existing water uses include hydropower generation and wastewater assimilation. There are a total of six additional dams on the mainstem Little Androscoggin River upstream of the project, including four (Upper Barker, Hackett Mills, Marcal, and Biscoe Falls) that are used for hydropower generation. Permitted wastewater discharges to the Little Androscoggin River include the Auburn Sewerage District; the Paris Utility District, the Norway municipal wastewater treatment facility, Pioneer Plastics Corporation in Auburn, the Mechanic Falls Sanitary District, and the town of Oxford.

Water Quality

Maine's water quality laws (38 M.R.S.A. §464 *et. Seq.*) establish the State's classification system for surface waters. The Little Androscoggin River from South Paris, Maine, to its confluence with the Androscoggin River, which includes the Barker's Mill Project, is classified as Class C waters. Designated uses for Class C waters include drinking water supply after treatment, fishing, agriculture, recreation in and on the water, industrial process and cooling water supply, hydroelectric power generation, navigation, and habitat for fish and other aquatic life.

For Class C waters, dissolved oxygen concentrations may not be less than 5 milligrams per liter (mg/L) or 60 percent of saturation. For identified salmonid spawning areas, dissolved oxygen concentrations must be at least 6.5 mg/L as a 30-day average based upon a temperature of 24 degrees centigrade (or 75.2 degrees Fahrenheit (°F)) or the ambient temperature of the water body, whichever is less. According to the state criteria, discharges may cause some changes to aquatic life provided that the receiving waters are of sufficient quality to support all species of fish indigenous to the receiving water and continue to maintain the structure and function of the resident biological community.

In order to meet the designated use for recreation, lakes and ponds must have a stable or decreasing trophic state, be subject only to natural fluctuations, and be free of culturally induced algal blooms[24] that impair their use and enjoyment (38 M.R.S.A. §465-A). River and streams (including impoundments classified as such) must also be

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

free of algal blooms to meet this designated use. Elevated concentrations of chlorophyll-a and/or total phosphorus in aquatic systems and low water transparency are often indicators of excessive nutrient inputs and harmful algal blooms. For Class C waters, Maine DEP's criteria for chlorophyll-a is no more than 8 micrograms per liter (µg/L) and its criteria for total phosphorus is no more than 33 µg/L. Secci disk transparency is a measure of the clarity of water and is the distance that visible light penetrates through the water column and is also an indirect measure of algal growth.[25] Maine's Secci depth criteria for Class C waters is at least two meters visibility.

Water Quality Monitoring

To characterize baseline conditions and assess the potential effects of the project on water quality, KEI Power collected water quality data in the project impoundment, bypassed reach (including an area with conditions suitable for salmonid spawning), and in the tailrace. KEI Power also sampled benthic macroinvertebrates in the bypassed reach and the tailrace. The results of KEI Power's water quality and macroinvertebrate studies are summarized below.

Impoundment

KEI Power sampled the impoundment twice a month during the period June through October 2015 at a location about 200 feet upstream from the project dam in about 13 feet of water.[26] KEI Power took a composite sample of the water column using an epilimnetic core[27] and measured chlorophyll-a and total phosphorus levels in addition to other parameters. During each sampling event, KEI Power also collected Secci disk

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

[26] The depth of the impoundment immediately upstream of the dam is about 30 feet deep; however, the sampling station was located in shallower water upstream of the boat barrier because of safety concerns.

[27] An epilimnetic core is generally comprised of small diameter tubing with a weighted end that is deployed vertically into the water column to collect a sample of water in the entire upper layer (i.e., epilimnion) of a stratified lake or reservoir; however, because no stratification was detected during sampling in the project impoundment, the entire water column was sampled.

transparency measurements and water temperature and dissolved oxygen profiles at one meter intervals from the top to the bottom of the water column.

Water temperatures in the impoundment during the sampling period ranged from a low of 48.7°F in October to a high of 76.5°F in September and averaged between 71 and 75°F during the peak summer months.[28] Even though KEI Power did not sample at the deepest point in the impoundment (30 feet), the samples that were taken at a depth of 13 feet suggested that the impoundment was not thermally stratified during the sampling period.[29]

Dissolved oxygen concentrations in the impoundment ranged from a low of 7.8 mg/L in August to a high of 10.7 mg/L in late October and percent saturation ranged from 89-104 percent over the sampling period which met state standards. Similar to water temperatures, there was little variation in dissolved oxygen concentrations throughout the sampled water column suggesting the impoundment was well-mixed and oxygenated. By letter filed on January 20, 2017, Maine DEP stated that measured dissolved oxygen concentrations throughout the water column were above 7.5 mg/L for the entire study period; however, more data would need to be collected in the deepest part of the impoundment to confirm that the impoundment meets Maine Class C standards for dissolved oxygen.

Total phosphorus concentrations ranged from 13 to 31 μg/L with an average of 21 μg/L. Chlorophyll-a concentrations ranged from 2 to 4 μg/L with an average of 3 μg/L. Secci disk transparency ranged from 1.3 to 4.1 meters with an average of 2.5 meters during the study. These results demonstrate that the impoundment met state standards for nutrients and visibility and would not impair recreational use.

Bypassed Reach and Tailrace

From July 7 to September 9, 2015, KEI Power monitored dissolved oxygen and water temperature in the bypassed reach at a location approximately 1,250 feet downstream of the dam in an area determined to be potential salmonid spawning

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[28] In Maine, there is no water quality criteria for water temperature in Class C waters.

[29] 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).

habitat.[30] KEI Power also monitored water quality in the tailrace at a location approximately 225 feet downstream of the project powerhouse.

Water temperatures in the bypassed reach ranged from 68 to 79.6°F with an average of 73.7°F across the entire study period. Water temperatures in the tailrace ranged from 63.5 to 79.6°F, with an average of 72.6°F. KEI Power observed slightly warmer temperatures (two degrees warmer) in the bypassed reach compared to the tailrace from July 7 through July 23. KEI Power attributes this slight difference in temperatures to possibly cooler water being drawn from the impoundment and being released into the tailrace, equipment error, or due to equipment vandalism when the data logger was moved.[31] For the rest of the sampling period, average water temperatures in the bypassed reach and tailrace were very similar.

Dissolved oxygen concentrations in the bypassed reach ranged from 6.4 to 9.4 mg/L with an average of 8.5 mg/L and percent saturation ranged from 75.3 to 107.7 percent with an average of 99.9 percent. Dissolved oxygen concentrations in the tailrace ranged from 7.2 to 9.7 mg/L with an average of 8.3 mg/L and percent saturation ranged from 80.9 to 108.4 percent with an average of 96.6 percent.

The results show that dissolved oxygen concentrations in the bypassed reach and tailrace consistently meet base criteria for Maine Class C waters (i.e., 5 mg/L or 60 percent saturation) during the warm, low-flow summer period. KEI Power did not calculate 30-day averages for dissolved oxygen over the study period. However, given that the lowest recorded concentration was 6.4 mg/L and concentrations averaged 8.5 mg/L through the study period, it is reasonable to expect that 30-day averages for dissolved oxygen remain well above the 6.5 mg/L 30-day average standard for salmonid spawning areas. The results show that the water quality sampling conducted in both the bypassed reach and the tailrace met state criteria for dissolved oxygen during the warm, low-flow summer period and would support salmonid spawning. By letter filed on January 20, 2017, Maine DEP concluded that the project meets applicable Class C dissolved oxygen criteria downstream of the Barker's Mill Dam.

Additional Upstream and Downstream Monitoring

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[30] Potential salmonid spawning habitat was identified based on the presence of unembedded gravel or cobble bars in riffles or pool tail-outs during the bypassed reach instream flow study conducted on July 7, 2015.

[31] KEI Power also notes that nighttime eel surveys were performed during this period which resulted in slight change in operations (i.e., slight increase in generation to reduce spill in the bypassed reach for a few hours to allow surveyors to look for eels).

In 2010, Maine DEP conducted water quality monitoring at the confluence of the Little Androscoggin River and the Androscoggin River (about 0.7 RM downstream of the Barker's Mill Project) and found concentrations of chlorophyll-a in the range of 2.5 to 3.6 μg/L and concentrations of total phosphorus in the range of 18 to 22 μg/L, which met the state criteria and were similar to KEI Power's data collected in the Barker's Mill impoundment.

In August 2014 and July 2015, Maine DEP conducted water quality sampling in the Little Androscoggin River about 8.3 RMs upstream of the Barker's Mill Dam. The results of the sampling effort indicated that waters upstream of the project met Class C criteria for dissolved oxygen and total phosphorus. The additional data collected by Maine DEP supports the conclusion that water quality both upstream and downstream of the project are similar to project waters and would support habitat for fish and aquatic life as well as recreation.

Macroinvertebrate Community

KEI Power's 2015 macroinvertebrate sampling results indicated that the benthic macroinvertebrate communities in the bypassed reach and tailrace were moderately abundant and high in taxa richness and contained species such as filter feeding caddisflies, sensitive mayflies, and stoneflies, which are generally indicators of good water quality. The sampling results indicated that the benthic macroinvertebrate community in the bypassed reach and downstream of the powerhouse attains Class C aquatic life standards and maintains the structure and function of the resident benthic macroinvertebrate community.

Aquatic Habitat

Impoundment

The Barker's Mill impoundment is relatively narrow and shallow, with depths 30 feet or less and a total volume of approximately 150 acre-feet at normal full pond with a maximum storage of 210 acre-feet. The width of the impoundment ranges from approximately 50 to 185 feet. Shoreline slopes are generally gentle along the impoundment before becoming steeper downstream of the dam. The substrate within the project boundary consists primarily of fine sandy loam soils that have low to moderate susceptibility to erosion and the shoreline is heavily forested which aids in stabilizing the banks.

Bypassed Reach

The project creates an approximately 3,000-foot-long bypassed reach of riverine habitat between the dam and the powerhouse. KEI Power conducted an instream flow study in July 2015. As part of this study, it surveyed and mapped aquatic mesohabitats in the reach based on their predominant physical and hydrologic characteristics (e.g., pool, riffles, runs). Within each mesohabitat, surveyors measured water depth and stream width, identified dominant and secondary substrate types, and looked for potential spawning gravel for salmonid species. Flow in the bypassed reach during the survey was approximately 270 cfs based on prorated data from the upstream USGS South Paris Gage. The results are displayed in table 2.

Table 2. Riverine habitat units in the bypassed reach downstream of the Barker's Mill Dam. (Source: License application).

Habitat Unit No.	**Habitat Type**	**Predominant Substrates**	**Length (feet)**	**Channel Width (feet)**	**Maximum Depth* (feet)**
1	Bedrock falls below dam	Bedrock	100	50	4
2	Plunge pool beneath dam	Bedrock	40	140	> 6
3	Riffle-moderate gradient/rapid	Bedrock and large boulder	175	110	4
4	Run	Large and small boulder	110	120	5
5	Riffle-low gradient; braided channel	Small boulder and cobble	825	130	2
6	Riffle with spawning gravels-low gradient	Cobble and gravel	280	100	2
7	Pool	Sand, fines	1,350	150	> 4
8	Riffle-low gradient	Large and small boulder	120	100	2

* As measured at the time of the survey.

The first 300 feet of the reach has a moderate to high gradient bedrock falls and pool and riffle habitat, after which the reach becomes primarily a low gradient, braided channel. The braided channel then converges in the lower third of the reach creating a large section of pool habitat. Portions of Habitat Unit 6 located in the middle, lower gradient section of the reach contain some gravel beds that may be suitable for salmonid spawning (i.e., small to medium sized gravel, approximately 0.5 inch to 2 inches in diameter, low embeddedness); however, substrate in the bypassed reach is predominantly bedrock, large and small boulders, and large cobble. Most of the habitat in the reach is riffle (46.7 percent) and pool (46.3 percent) followed by run (3.7 percent) and bedrock falls (3.3 percent).

Fish Community

The Little Androscoggin River Basin has historically supported diverse populations of resident and diadromous fish. Prior to the construction of a dam near Brunswick on the mainstem Androscoggin River in 1807, the Little Androscoggin supported large runs of diadromous fish species including alewife, blueback herring, American shad, Atlantic salmon, sea lamprey, and American eel. Many of these species ascended the Little Androscoggin River up to natural barriers at Biscoe Falls and Snow Falls, located about 35-36 RMs upstream from the confluence of the mainstem Androscoggin River. Currently, adult anadromous fish returning to freshwater to spawn can access the Little Androscoggin River up to the project's dam, about 0.7 RM upstream of the confluence with the mainstem Androscoggin River. Upstream passage is blocked by the project's dam as well as the 6 additional dams on the Little Androscoggin River upstream. Alewife are the only anadromous fish that currently exists upstream of the project because Maine DMR annually stocks them in several lakes and ponds upstream.

In addition to diadromous species, the Little Androscoggin River supports a variety of coldwater and warmwater resident fish species including brook trout, rainbow trout, smallmouth bass, pumpkinseed, yellow perch, and fallfish.

Resident Fish

No recent surveys of the resident fish assemblage in the Little Androscoggin River near the project have been conducted; however, in 2003, the Midwest Biodiversity Institute conducted fish surveys in the mainstem Androscoggin River near Lewiston-Auburn, about 0.8 mile from the confluence of the Little Androscoggin River. These fish surveys yielded a total of nine fish species including smallmouth bass, white sucker, redbreast sunfish, American eel, pumpkin seed, rainbow trout, spottail shiner, yellow perch, and fallfish. Smallmouth bass were the most abundant species collected during surveys representing about 67 percent of the total number of fish collected. White sucker, the second most abundant species collected, represented nearly 15 percent of the total number of fish collected. All other species generally represented less than 5 percent of the total number of fish collected. Because of the proximity of the sampling site to the Barker's Mill Project, it is expected that a similar resident fish community would occur in project waters.

From 2013 to 2016, Maine DIFW annually stocked approximately 4,100 brown trout and rainbow trout in the Little Androscoggin River at Mechanic Falls, Auburn, and

Minot to support angling opportunities. Maine DFIW manages these stocking areas as a put-grow-take trout fishery. Currently, no trout stocking occurs downstream of the Barker's Mill Dam; however, Maine DIFW's fishery management goal for the Little Androscoggin River, including the project bypassed reach, is to develop a seasonal trout fishery. Brook trout, the only native trout species in Maine, is not actively managed in the project reach.

Anadromous Fish

River Herring

Blueback herring and alewife[32] are anadromous fish that spend most of their lives at sea, but return to their natal (home) rivers along the eastern seaboard of North America to reproduce (Melvin *et al*., 1986; Greene *et al*., 2009). In New England, blueback herring primarily spawn in shallow areas with moderate currents in mainstem rivers, whereas alewives generally spawn in lake or pond habitats within a river basin (Loesch, 1987). Spawning runs of alewife occur earlier (May through June in Maine) than those of blueback herring (June through July) (Loesch, 1987; Saunders *et al*., 2006). Downstream migration of juvenile and post-spawn adult alewives in Maine rivers occurs from mid-July through the end of November (Mullen *et al*., 1986; Saunders *et al.*, 2006). Seaward migration of juveniles often occurs in waves that are prompted by environmental cues such as periods of increasing precipitation and discharge (Yako, 1998; Kosa and Mather, 2001; Iafrate and Oliveira, 2008). In the Little Androscoggin River, the historical distribution of American shad, blueback herring, and alewife was thought to extend up to the natural barrier at Biscoe Falls.

In the early 1980s, Maine DMR began an anadromous fish restoration program in the lower Androscoggin River with the goal of restoring American shad, alewife, and blueback herring to the mainstem and tributaries below Lewiston Falls, Maine, while increasing the restoration potential for other native migratory species such as Atlantic salmon and American eel. One strategy of the restoration includes trapping upstream migrating adult alewife at the Brunswick Project fishway and transporting them to spawning and rearing habitat areas in the Androscoggin River Basin. Since 1983, nearly 200,000 adult alewife collected at the Brunswick Project fishway have been used by Maine DMR to stock lakes and ponds in the Little Androscoggin River Basin upstream of the Barker's Mill Project. Currently, lakes and ponds in the Little Androscoggin River Basin stocked with adult alewife include Lower Range Pond, Marshall Pond, and Taylor Pond.

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

The three dams downstream of the Barker's Mill Project on the mainstem Androscoggin have upstream fish passage facilities for anadromous fish; however, of the two species of river herring that occur in the Androscoggin River Basin, only alewife have been documented passing upstream of the Brunswick Project fishway. In 2016, the upstream fishways at the Brunswick and Worumbo Projects, which are the first and third projects on the Androscoggin River downstream of the Barker's Mill Project, respectively, passed 121,010 and 12,807 alewife.

American shad

The anadromous American shad exhibit a similar life history to alewife, spending most of their lives at sea but returning to their natal river to spawn, with spawning generally occurring in a mainstem river. The spawning runs of American shad in Maine rivers generally occur from June through July and outmigration of juvenile and adult shad generally occurs from mid-July through October. In the Androscoggin River, American shad historically spawned from Merrymeeting Bay to Lewiston Falls and in the Little Androscoggin River from its confluence with the Androscoggin River to Biscoe Falls.

Because the project blocks upstream fish passage for all anadromous species, no American shad are present in the Little Androscoggin River upstream of the Barker's Mill Project. In the mainstem Androscoggin River, Maine DMR operated a hatchery rearing program to supplement the American shad population by stocking fingerlings adjacent to spawning and nursery habitat near Auburn. From 1999 to 2008, over 5.5 million juvenile American shad were stocked in the Androscoggin River. In addition, Maine DMR also transferred over 7,800 pre-spawn American shad collected from the Merrimack, Connecticut, and Androscoggin Rivers to a release point below Lewiston Falls. Since Maine DMR ceased this American shad supplementation program in 2009, the occurrence of American shad in the Androscoggin River Basin is maintained solely through natural production. Nevertheless, even with the supplementation program, the number of American shad passing the Brunswick Project fishway are low. Since 1983, a total of 1,428 American shad have been observed passing the fishway at the Brunswick Project, with most (1,123 individuals) passing in 2016, and zero passing the fishway in most of the other years during this period. At the Worumbo Project, 45 American shad were observed passing the fishway in 2016.

Underwater video and telemetry data collected below the Brunswick Project indicate that the number of shad in the river below the fishway entrance is higher than the number of shad caught in a trap at the top of the fishway (ASMFC, 2007). Also, telemetry studies of shad tagged below the dam indicate that shad make many attempts to enter the fishway, but very few are successful (ASMFC, 2007). In addition, ASMFC (2007) states that the vertical slot fishway prescribed by the FWS and constructed at the Brunswick Project is notoriously poor at passing American shad, with similar poor results reported for a similarly designed fishway on the Farmington River in Connecticut.

Atlantic Salmon

Atlantic salmon in the Androscoggin River Basin were listed as endangered on June 19, 2009, under the ESA. Because the salmon is a listed species under the ESA, we describe the species and its habitat in section 3.3.3, *Threatened and Endangered Species*.

Sea Lamprey

Sea lamprey spend most of their adult life at sea; however, unlike other anadromous species, they do not home to their natal waters to reproduce (Maine DMR and Maine DIFW, 2017). Sea lamprey move into gravel areas of tributary streams during spring and early summer to spawn (Great Lakes Fishery Commission, 2000). Immediately after spawning, females drop downstream and soon die, while the male may remain on the nest for a short period before dying. After the egg and larval life stages, sea lamprey move out to sea for the parasitic phase of its life (up to 2 years). They will parasitize fish as their source of food, and this often results in the death of the host fish.

Sea lamprey are native to coastal rivers of Maine, including the Androscoggin and Little Androscoggin. The historical abundance and distribution of sea lamprey in the Little Androscoggin River is unknown. The number of sea lamprey that annually ascend the Brunswick fishway on the Androscoggin River was low for many years (0 to 28 individuals between 1999 and 2011), but has increased in more recent years (19 to 240 individuals since 2012) (Maine DMR and Maine DIFW, 2017). Current management goals and objectives for sea lamprey in the Little Androscoggin River focuses on improving access to historical spawning and nursery habitat throughout the drainage by providing safe, timely, and effective passage at barriers.

<u>Catadromous Fish</u>

American eel

American eel is the only catadromous fish species that occurs at the project.[33] The American eel spends most of its life in fresh or brackish water before migrating to the Sargasso Sea to spawn. It occurs throughout warm and cold waters of the Atlantic Ocean and Atlantic coastal drainages in North America (Boschung and Mayden, 2004). Within its range, it is most abundant throughout the Atlantic coastal states (ASMFC, 2000).

Spawning likely occurs from February through April in the Sargasso Sea, although the act of spawning has never been observed (Boschung and Mayden, 2004). Fertilized eggs and larvae, known as the planktonic phase, drift with the Gulf Stream currents along

[33] A catadromous fish spends most of its life in freshwater and migrates to saltwater to spawn.

the east coast of the United States (Jenkins and Burkhead, 1993). Following this phase, the planktonic leptocephali, ribbon-like eel larvae, metamorphose (or transform) into what is termed a "glass" eel as it approaches coastal waters. Glass eels are completely transparent and make their way into brackish waters by the use of flood tides. Once skin pigments develop in glass eels, they are considered "elvers."

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 eel are typically sedentary during the day, often burying in mud or silt, and becoming active at night to feed (Jenkins and Burkhead, 1993). They associate with pools or backwater habitats, and often have relatively small home ranges (Gunning and Shoop, 1962). The juvenile stage can last from 5 to 40 years before finally maturing into the silver eel and out-migrating in the fall and mid-winter months to spawning grounds (i.e., Sargasso Sea) (Boschung and Mayden, 2004). In Maine, silver eels generally migrate downstream to spawning grounds from August through October (Haro *et al.*, 2003). Adult eels are presumed to die after spawning (Boschung and Mayden, 2004; Jenkins and Burkhead, 1993).

The historical range of American eel distribution in the Androscoggin River Basin is unknown; however, American eel have been documented above Rumford Falls on the Androscoggin River about 87 RMs upstream of Merrymeeting Bay, and above Snow Falls on the Little Androscoggin River about 37 RMs upstream of the confluence with the Androscoggin River (Maine DMR and Maine DIFW, 2017). In the Little Androscoggin River, American eel have been documented in lakes and ponds upstream of the Barker's Mill Project in the last 35 years (Maine DMR and Maine DIFW, 2017).

The Barker's Mill Project does not have dedicated upstream passage facilities for American eel. In the Androscoggin River Basin, the only dam downstream of the project with dedicated upstream passage for juvenile eels is the Worumbo Project. Between June 9 and August 5, 2015, KEI Power conducted a total of 11 nighttime surveys[34] of juvenile eels along the project dam and spillway, the spill gates, and bedrock outcrops downstream of the dam. During the surveys, a total of 44 eels were observed downstream of the project dam in the bypassed reach.

Freshwater Mussels

Of the ten species of native freshwater mussels known to occur in Maine, five species have been reported in the Little Androscoggin River and include Eastern elliptio, Eastern floater, Eastern lampmussel, Eastern pearlshell, and triangle floater. None of these five species are federal or state listed species.

[34] Each of the 11 nighttime eel surveys lasted between 1 and 1.5 hours.

3.3.1.2 Environmental Effects

Run-of-River Operation and Impoundment Levels

Flow fluctuations during the operation of hydropower projects can affect shoreline littoral and riverine habitat in impoundments and downstream reaches by exposing them to periodic dewatering, making them unsuitable for aquatic biota.

KEI Power proposes to continue operating the project in run-of-river mode where outflow approximates inflow, and to continue monitoring impoundment levels and regulating turbine flows based on the impoundment elevation consistent with its current practice.[35] Interior, NMFS,[36] Maine DMR, and Maine DIFW support KEI Power's proposal to minimize impoundment level fluctuations by operating the project in run-of-river mode. Additionally, NMFS and Maine DIFW recommend that KEI Power limit impoundment fluctuations within 1 foot of the top of the flashboards when the flashboards are in place, or within 1 foot of the spillway crest when flashboards are not in place. Maine DIFW also recommends that any license requirements for run-of-river operation and limits on impoundment level fluctuations include exceptions for emergency situations outside of KEI Power's control.

Our Analysis

Continuing to operate the project in run-of-river mode would minimize fluctuations in the project impoundment and in the Little Androscoggin River downstream of the powerhouse. Maintaining relatively stable impoundment levels within 1-foot of the crest of the dam or flashboards when they are in place would protect shoreline habitat and fish and other aquatic organisms (e.g., freshwater mussels and macroinvertebrates) that rely on near-shore habitat in the impoundment for spawning, foraging, and cover. Minimizing flow fluctuations downstream of the powerhouse would also protect aquatic habitat, minimize fish stranding potential, and provide stable passage routes for migratory fish downstream of the powerhouse.

KEI Power's proposal to utilize water level sensors to control and monitor the turbine and water level in the impoundment and make adjustments to project operation to

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[35] While KEI Power does not propose a specific range of impoundment elevations it would maintain as part of its proposal to operate the project in run-of-river mode, it states that it currently tries to maintain impoundment levels to within a hundredth of a foot from the crest of the flashboards.

[36] NMFS recommends this measure pursuant to section 10(j) of the FPA and also recommends it as an EFH conservation measure.

maintain stable impoundment elevations would ensure that the project continues to operate in an instantaneous run-of-river mode and maintains stable impoundment levels as recommended by the agencies.

Allowing exceptions to normal operating requirements to account for emergency situations or equipment failures outside of the control of the licensee is a typical provision in Commission licenses. Such exceptions also typically include provisions for notifying the Commission and resource agencies when these events occur.

Bypassed Reach Minimum Flows

Under the existing license, KEI Power is required to release a continuous minimum flow of 20 cfs or inflow, whichever is less, into the project's bypassed reach.[37] The minimum flow is provided through the downstream fish bypass, which consists of the 4-foot-wide 5-foot-high eastern-most stop log bay located adjacent to the intake canal. When inflow is less than 170 cfs (i.e., 150-cfs minimum hydraulic capacity of the turbine plus 20-cfs minimum flows), the powerhouse is shut down and KEI Power typically passes all inflow through a combination of the fish bypass, the other stop log bays, or over the spillway. When inflow exceeds 520 cfs (500-cfs maximum hydraulic capacity of the turbine plus 20-cfs minimum flow), excess flows are spilled into the bypassed reach over the dam through the same facilities described above.

KEI Power proposes to increase the minimum flow released into the bypassed reach from 20 cfs to 113 cfs or inflow, whichever is less, to enhance aquatic habitat.

During normal project operation (i.e., not during emergency situations or planned maintenance outages) and during the downstream fish passage season, KEI Power would meet minimum flow requirements by passing all flow up to 113 cfs through a combination of the fish bypass, other stop log bays, and over the spillway as it does under existing conditions. Outside of this season, it would pass the minimum flow through either the fish bypass and other stop log bays or the waste gates.[38] Maine DMR and

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[37] KEI Power states that an estimated 5-8 cfs of leakage flows enter the bypassed reach which are separate from and in addition to any minimum flows that are intentionally released to meet minimum flow requirements. Sources of leakage include the overflow spillway flashboards, the two waste gates, and the seven stop-log bays.

[38] KEI Power indicates in its license application that it occasionally uses the waste gates to pass flows during the winter; however, in an August 7, 2018 telephone conversation with Commission staff, KEI Power clarified that the waste gates are not

Maine DIFW support KEI Power's proposed year-round 113-cfs minimum flow release.

NMFS and Interior recommend pursuant to section 10(j) that KEI Power release a continuous minimum flow of 175 cfs or inflow, whichever is less, year-round in the bypassed reach in order to maximize aquatic habitat for target fish species (Atlantic salmon, rainbow trout, and brown trout) and provide adequate depths and attraction flows in the bypassed reach to aid in fish migration.[39]

NMFS's preliminary section 18 prescription stipulates that KEI Power provide a flow in the bypassed reach that is sufficient for safe, timely, and effective passage to the dam during the May 1 to November 10 upstream anadromous fish passage season.[40]

In its reply comments, KEI Power objects to NMFS's and Interior's recommended or stipulated minimum flow because the 175 cfs is not available during significant portions of the year. KEI Power states that its proposed minimum flow of 113 cfs is close to the naturally-occurring August median flow, would provide optimal or near optimal habitat for the early life stages of Atlantic salmon and other target fish species, and would maintain an adequate wetted width to support aquatic habitat and a zone of passage for migratory fish.

Our Analysis

Bypassed Reach Flows

Table 3 displays the median monthly inflow at the project and the anticipated bypassed reach flow under three operational scenarios (i.e., existing 20-cfs minimum flow release, applicant proposed and Maine DMR's and Maine DIFW's recommended 113-cfs minimum flow release, and NMFS's and Interior's recommended or stipulated 175-cfs minimum flow release), and assuming that KEI Power is using all remaining inflow above minimum flow requirements for generation.

Table 4 show the percent of time that there would be insufficient inflows for the powerhouse to operate under the existing condition, proposed, and agency recommended

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typically used to pass flows unless needed to perform maintenance on the other flow release facilities.

[39] NMFS also recommends this minimum flow as an EFH conservation measure.

[40] While NMFS does not include a specific flow requirement in its preliminary prescription, it indicates that a flow release of 175 cfs would be adequate based on the best available information.

or stipulated minimum flows. Whenever there is insufficient inflow to meet the minimum hydraulic capacity of the powerhouse plus the minimum flow, KEI Power would shut down the powerhouse and spill all inflow at the dam, causing bypassed reach flows to increase to inflow levels that are generally substantially higher than the proposed or recommended and stipulated minimum flows.

Under all three minimum-flow scenarios, median bypassed reach flows would be the same during April and May when inflow exceeds the combined 675 cfs needed to maximize generation and still provide the highest recommended minimum flow. Therefore, the minimum flow alternatives would have little to no effect on bypassed reach flows during these months.

The proposed or recommended and stipulated higher minimum flows would have the greatest effect on bypassed reach flows during the low flow months of July through October and February. Under existing conditions, there would be insufficient inflow for the powerhouse to operate about 40 percent of the time in October and 55-75 percent of the time during July, August, and September.

Under KEI Power's proposed and Maine DMR and Maine DIFW's recommended 113-cfs minimum flow, there would be insufficient inflow for the powerhouse to operate between about 68-83 percent of the time during July through September, and about 50 percent of the time during both October and February.

Under Interior's and NMFS's recommended and stipulated 175-cfs minimum flow, inflows would be insufficient for the powerhouse to operate and meet the minimum flow about 75-87 percent of the time during July through September, and about 50 percent or more of the time (range of 48-62 percent) during June, October, January, and February.

Effects on Aquatic Habitat Suitability

KEI Power conducted an instream flow study in the bypassed reach in 2015 to evaluate habitat suitability potential for three life stages of Atlantic salmon (i.e., fry, parr, and spawning adults), adult brown trout, and adult rainbow trout under a range of flow releases. Phase one of the study identified three river transects that were representative of the reach. Transect 1 was located in run habitat about 300 feet downstream from the dam while transects 2 and 3 were located further downstream (about 750 and 1,175 feet, respectively) from the dam within low gradient riffle habitat where the bypassed reach split into several braided channels (figure 4). Transect 3 included areas identified as potentially suitable salmonid spawning habitat. KEI Power also established a fourth transect just upstream of the powerhouse to gage river flows released from the dam; this transect was only used for stream gaging and for measuring wetted widths.

Table 3. Bypassed reach and available generation flows under existing condition and proposed or recommended minimum flow alternatives. (Source: Staff)

Month	Median inflow to Barker's Mill Dam (cfs)	Existing condition 20 cfs minimum flow		Proposed action 113 cfs minimum flow		NMFS and Interior recommended and stipulated 175 cfs minimum flow	
		Bypassed reach flow (cfs)[a]	Flow available for generation (cfs)[a]	Bypassed reach flow (cfs)[b]	Flow available for generation (cfs)[b]	Bypassed reach flow (cfs)[c]	Flow available for generation (cfs)[c]
Jan	322	20	302	113	209	322	0
Feb	277	20	257	113	164	277	0
Mar	571	71	500	113	458	175	396
Apr	1,363	863	500	863	500	863	500
May	686	186	500	186	500	186	500
Jun	339	20	319	113	226	175	164
Jul	144	144	0	144	0	144	0
Aug	80	80	0	80	0	80	0
Sep	73	73	0	73	0	73	0
Oct	241	20	221	241	0	241	0
Nov	523	23	500	113	410	175	348
Dec	453	20	433	113	340	175	278

[a] Under existing conditions, the powerhouse operates when inflow exceeds 170 cfs (150-cfs minimum hydraulic capacity plus a 20-cfs minimum flow). When inflow is less than 170 cfs, the powerhouse shuts down and all flows are passed into the bypassed reach. If inflow exceeds 520 cfs (500-cfs maximum hydraulic capacity plus 20-cfs minimum flow), the excess flow is spilled into the bypassed reach at the dam.

[b] Under KEI Power's proposed minimum flow, the powerhouse would operate when inflow exceeds 263 cfs (150-cfs minimum hydraulic capacity plus a 113-cfs minimum flow). When inflow is less than 263 cfs, the powerhouse would shut down and all flows would be passed into the bypassed reach. Flow in excess of 613 cfs (500-cfs maximum hydraulic capacity plus 113-cfs minimum flow) would be spilled into the bypassed reach at the dam.

[c] Under NMFS's and Interior's recommended minimum flow, the powerhouse would operate when inflow exceeds 325 cfs (150-cfs minimum hydraulic capacity plus a 175-cfs minimum flow). When inflow is less than 325 cfs, the powerhouse would shut down and all flows would be passed into the bypassed reach. Flow in excess of 675 cfs (500-cfs maximum hydraulic capacity plus 175-cfs minimum flow) would be spilled into the bypassed reach at the dam.

Table 4. Percent of time there is insufficient inflow for the powerhouse to operate under existing conditions and proposed and recommended minimum flows from January through December based on prorated gage data for USGS gage no. 01057000 Little Androscoggin River near South Paris, Maine (January 1, 1987 – December 31, 2017). (Source: Staff).

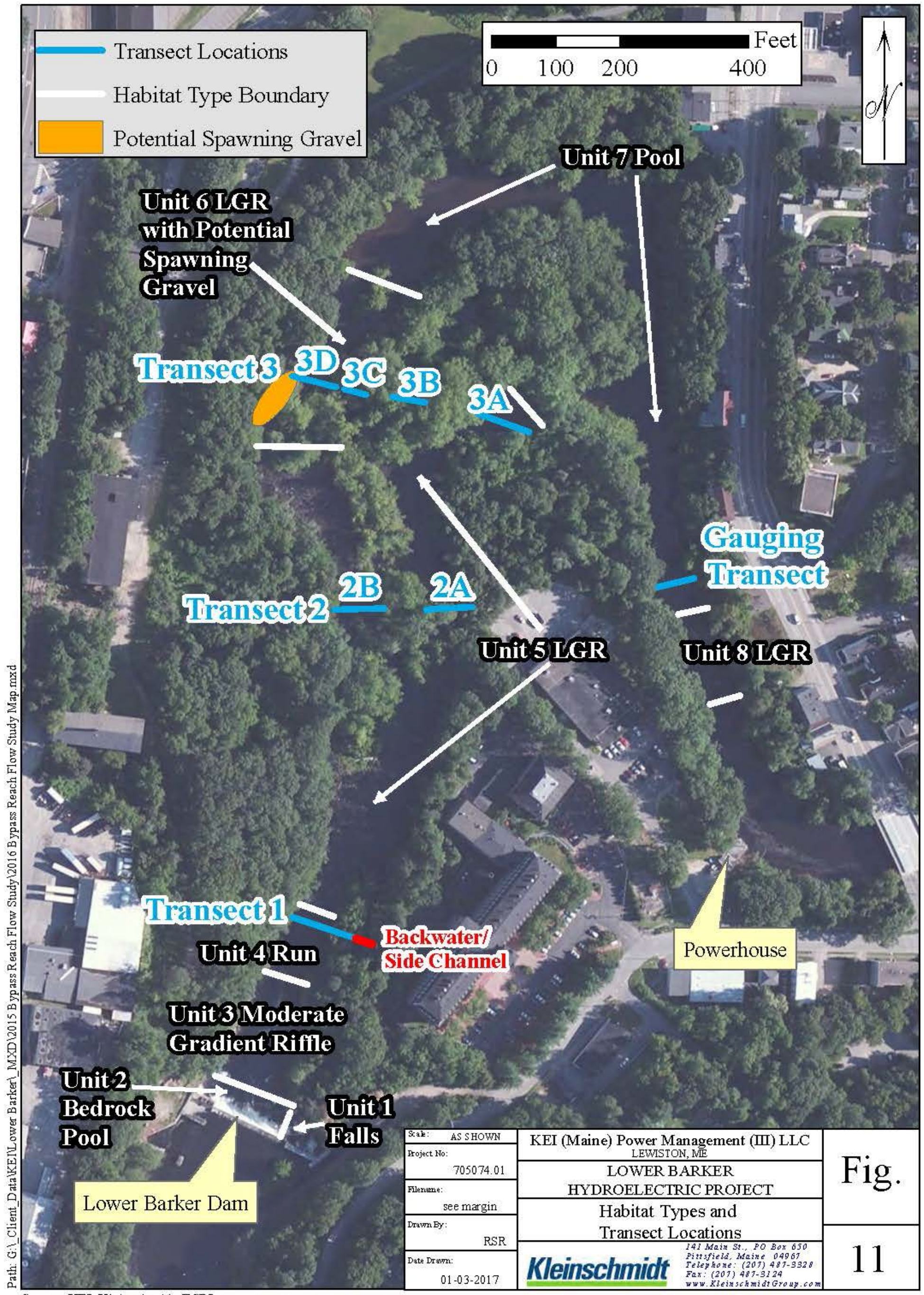
Minimum Flow/ Minimum Flow + Minimum Hydraulic Capacity (150 cfs)	**Percent of Time Inflow does not Exceed Minimum Flow + Minimum Hydraulic Capacity by Month (i.e., powerhouse is shut down)**											
	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
20/ 170	11%	10%	6%	0%	2%	20%	55%	69%	75%	39%	6%	5%
113/263	36%	46%	22%	1%	7%	37%	68%	78%	83%	52%	20%	21%
175/325	50%	62%	30%	1%	13%	48%	75%	82%	87%	61%	28%	32%

Phase two of the study involved measuring depth and velocity along each transect at 2- to 4-foot intervals at specified target flows released at the Barker's Mill Dam. The target flow releases for the study were 20, 50, 100, 175, and 300 cfs; however, the actual flows measured in the field were 35, 46, 108, 197, and 301 cfs. The discrepancy was determined to be from leakage at the dam that was in addition to the calibrated flow release from the waste gates.

KEI Power analyzed the data to determine total habitat suitability for each of the test species and life stages. The habitat suitability curves generated from the study are shown in figure 5 below. The percent of maximum suitable area in the bypassed reach under the various test flows are provided in table 5.

The results demonstrate that habitat in the bypassed reach increases for spawning adult Atlantic salmon, brown trout, and rainbow trout up to the highest tested flow of 301 cfs. For salmon fry and juveniles, available habitat maxed out at a flow of 175 cfs before beginning to deteriorate at exceedingly higher flows. The largest incremental increase in suitable habitat occurred between test flows of 46 and 108 cfs with salmon spawning habitat increasing by 42 percentage points, salmon fry and parr habitat increasing by 10-14 percentage points, and trout habitat increasing by 31-33 percentage points between these two flow releases.

Increasing minimum flows in the winter would enhance spawning habitat for salmon and provide additional habitat for both salmon parr and trout over existing conditions. KEI Power's proposal would provide approximately 62 percent of maximum salmon spawning habitat compared to the minimal spawning habitat maintained under existing conditions. NMFS's and Interior's recommended higher minimum flow would provide an even greater benefit by providing approximately 90 percent of maximum spawning habitat during these months.



Source: KEI, Kleinschmidt, ESRI

Figure 4. Habitat transect locations for the instream flow study. (Source: License application).

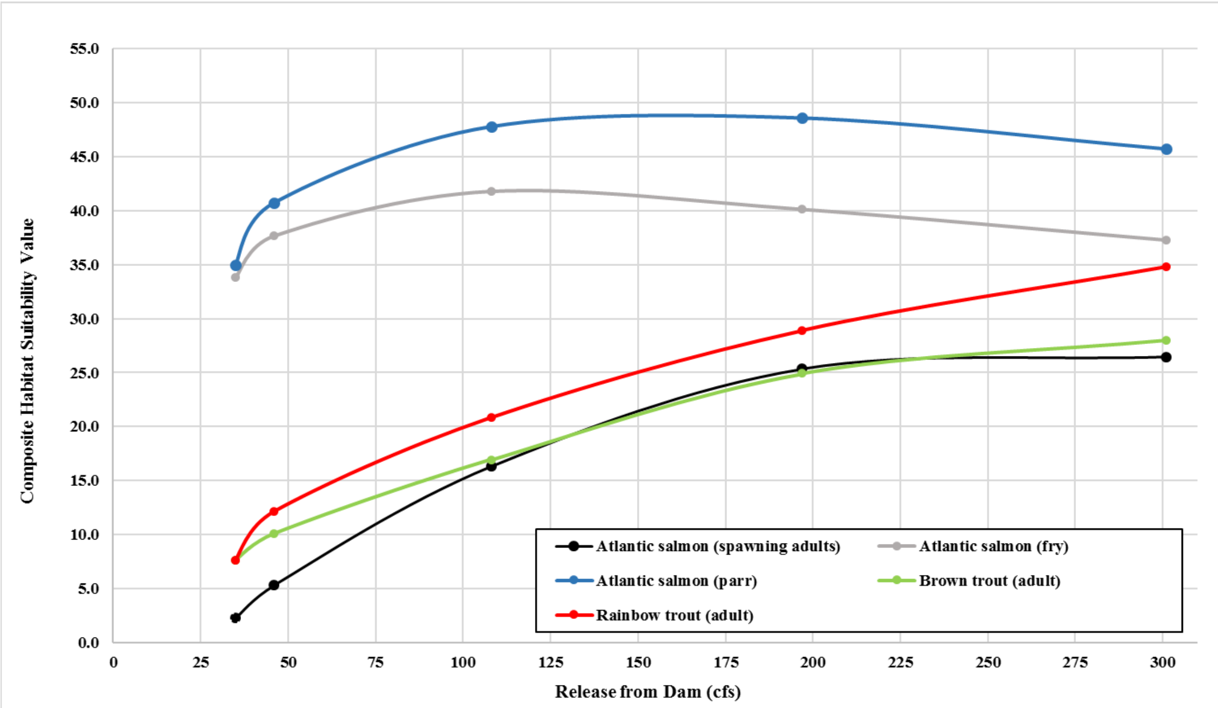


Figure 5. Habitat suitability curves for target species under a range of flow releases at the Barker's Mill Project. (Source: License application).

Table 5. Percent of maximum habitat suitability in the bypassed reach under each test flow. (Source: License application)

Species (Life Stage)	20 cfs[a]	35 cfs	46 cfs	108 cfs	175 cfs[b]	197 cfs	301 cfs
Atlantic Salmon (spawning adults)	0%	8%	20%	62%	90%	96%	100%
Atlantic Salmon (fry)	82%	81%	90%	100%	100%	96%	89%
Atlantic Salmon (parr)	70%	70%	82%	96%	100%	97%	92%
Brown Trout (adult)	21%	29%	40%	73%	89%	89%	100%
Rainbow Trout (adult)	18%	22%	35%	66%	83%	83%	100%

[a] The values for 20 cfs were extrapolated from the data obtained in the field.
[b] The values for 175 cfs were interpolated from the data obtained in the field.

Increasing minimum flows in the summer months would enhance habitat for salmon parr, brown trout, and rainbow trout over existing conditions during the relatively infrequent periods when the powerhouse is operating. Interior's and NMFS's recommended flow of 175 cfs would maintain 83-100 percent of maximum habitat for all species and life stages evaluated by the model. KEI Power's proposed and Maine DMR and Maine DIFW's recommend minimum flow would provide 66-100 percent of maximum habitat for the salmon and trout species and life stages evaluated by the model.

KEI Power also measured wetted width at two of the four transects[41] and compared these measurements to the bankfull width to determine the percentage of the river bed that was wetted during each of the scheduled test releases. The objective was to see if Maine DEP's water quality standard was met for maintaining structure and function of the resident biological community (i.e., at least 75 percent of the bankfull width of the channel is wetted).[42] Table 6 displays the percent of the bankfull wetted width determined for each transect under each of the scheduled test flows.

Table 6. Percent of the bankfull width wetted for each test flow during the instream flow study. (Source: License application)

	Flow Release (cfs)	Percent (%) Bankfull Width Wetted
Transect 2	35	73.1%
	46	78.2%
	108	90.8%
	197	92.7%
	301	93.6%
Transect 4	35	77.8%
	46	77.8%
	108	83.3%
	197	88.9%
	301	92.2%

Based on the study results, minimum flows proposed by KEI Power and recommended by Maine DMR and Maine DIFW would maintain at least 83 percent of the bankfull width in the bypassed reach. Interior's and NMFS's recommended and stipulated minimum flows would maintain a slightly higher percent of the bankfull width of about 88 percent or more. Therefore, the structure and function of aquatic habitat would be maintained under either minimum flow alternative according to Maine DEP's

[41] KEI Power states that only transects 2 and 4 were used because the geometry of the river bank was such that the bankfull elevation could only be readily determined at these two transects versus the others surveyed during the instream flow study.

[42] Maine DEP states that it has a long-standing rebuttable presumption that in order for a Class C waterway to maintain structure and function of the resident biological community, at least 75 percent of the cross section of the river must be wet at all times as measured at bankfull conditions. *See* comment letters filed by Maine DEP on July 16, 2014 and January 23, 2017.

standard.

Effects on Fish Migration

As discussed in section 3.3.1.1, *Aquatic Resources, Affected Environment*, upstream and downstream migrations typically occur from April to December for Atlantic salmon and May through November for American shad, alewife, blueback herring, and American eels.

According to FWS's 2017 Fish Passage Engineering Design Criteria (FWS, 2017a), flows that provide depths greater than or equal to two times an adult fish's body depth are sufficient for fish to swim normally. Table 7 below provides the maximum adult body depths for the migratory fish species that may be found in the project vicinity.

Table 7. Maximum body depth of migratory fish found in the project vicinity. (Source: Turek *et al*., 2016; as modified by staff)

Species	Maximum Body Depth (feet)
Sea lamprey	0.20
American eel	0.26
Blueback herring	0.26
Alewife	0.29
Atlantic salmon	0.67
American shad	0.73

The majority of fish likely to migrate through the bypassed reach are alewife which have a maximum body depth of 0.29 feet. The largest-sized migratory species that could utilize the bypassed reach are American shad which have a maximum body depth of 0.73 feet (Turek *et al*., 2016). Thus according to the FWS guidelines, a flow that provides depths of at least 0.58 feet (i.e., twice the body depth of alewife) would be adequate to pass the majority of migratory fish likely to utilize the bypassed reach, while flows that provide depths of at least 1.46 feet (i.e., 2 times the body depth of American shad) would to be adequate to pass all migratory fish species found in the project vicinity.

As part of its instream flow study, KEI Power measured water depths across each of the four habitat transects under the different test flows. While KEI Power did not sample the entire bypassed reach, these transects were chosen to represent the reach as a whole. Table 8 below displays the maximum depths recorded across each transect at test flows of 35 cfs, 108 cfs, and 197 cfs.

Table 8. Maximum depths recorded for each transect during the instream flow study. (Source: license application as modified by staff).

Transect Number (Habitat Type)[a]	Max Depth at 35 cfs (feet)	Max Depth at 108 cfs (feet)	Max Depth at 197 cfs (feet)
1 (run)	1.6	2.6	2.9
2A (low gradient riffle)	1.1	1.6	1.8
2B (low gradient riffle)	1.2	1.7	2.1
3A (low gradient riffle)	0.5	0.7	0.9
3B (low gradient riffle)	0.5	0.7	1.0
3C (low gradient riffle)	0.9	1.7[b]	1.4[b]
3D (low gradient riffle)	0.6	1.0	1.3
4 (pool)	1.8	2.4	2.6

[a] Transects 2 and 3 consist of braided channels, so KEI Power split these transects into subsections.
[b] Because water depths typically increase with increasing flows, it is unclear if the 108-cfs or 197-cfs depth values for transect 3C as reported in Appendix J of the license application were accurate or reported in error.

The results show that the existing minimum flow of 20 cfs plus leakage may provide adequate depths to pass alewives,[43] blueback herring, eel, and sea lamprey but would likely not provide adequate depths in sections to pass the larger Atlantic salmon and American shad. However, flows of at least 108 cfs would provide depths throughout the bypassed reach (transects 1, 2B, 3C, and 4) that would likely be adequate to pass all migratory fish species including the largest adult salmon and shad. This information suggests that the applicant's proposed and Maine DMR's and Maine DIFW's recommended minimum flow of 113 cfs as well as NMFS's and Interior's recommended and stipulated minimum flow of 175 cfs would provide unimpeded fish passage through

[43] NMFS's filings on January 3 and December 21, 2018, included photographic and video documentation of alewives struggling to migrate through the bypassed reach. In reply comments, KEI Power stated that it concurred that the fish identified in the photographs were "river herring" but that the location where the photographs were taken as well as the flow conditions at the time the photographs were taken could not be verified.

the bypassed reach and would represent an enhancement over existing conditions.

Minimum Flow Compliance Monitoring

Under existing conditions and during the downstream fish passage season, KEI Power monitors compliance with the 20-cfs minimum flow requirement of the license by visually monitoring a notched weir in the plunge pool that is calibrated for a 20-cfs flow release. Outside of the downstream fish passage season, KEI Power monitors compliance with the minimum flow by maintaining sufficient flow over the spillway or through a calibrated gate opening (when the waste gates are used) to ensure a 20-cfs flow release to the bypassed reach. KEI Power provides documentation of compliance with minimum flow requirements by filing annual summary reports in January for the prior year's monitoring.

KEI Power did not specify in its license application how it would monitor and report compliance with its higher 113-cfs minimum flow proposal. We therefore assume that KEI Power would continue to employ methods similar to what it has historically done for minimum flow compliance monitoring.

Our Analysis

Although compliance measures do not directly affect environmental resources, they do allow the Commission to ensure that a licensee complies with the environmental requirements of a license. Therefore, operation compliance monitoring and reporting are typical requirements in Commission-issued licenses.

While KEI Power monitors compliance with minimum flows using visual monitoring of releases or calibrated gate openings, KEI Power does not currently have formalized monitoring protocols or reporting requirements to verify compliance with minimum flow releases. Formalizing the methods for monitoring and reporting compliance with KEI Power's proposed minimum flows and any other operating requirements included in any subsequent license issued, would provide a mechanism for reporting operational data and deviations, and ensure the implementation of operational measures that are designed to protect and enhance the environmental resources of the project area.

Effects of Flow Fluctuations Due to Planned Maintenance Activities

Under existing conditions, KEI Power periodically draws down the impoundment for short periods to conduct maintenance on the dam or its flow regulating equipment (e.g., waste gates, stop log bays). There are no limits in the existing license on the timing of planned maintenance activities, but KEI Power indicates that it typically conducts these activities during the low-flow period of late summer or early fall and that it consults with and obtains the approval of the agencies prior to conducting the planned maintenance. KEI Power proposes to continue this practice under any subsequent license issued. Although KEI Power does not specify the frequency that it must complete planned maintenance activities, it did indicate in its August 7, 2018 teleconference with Commission staff that maintenance requiring complete drawdowns of the impoundment are rare, having only occurred about 3 times over the last 20 years.

No entity submitted any recommendations for limits on the timing of planned maintenance activities, but Maine DIFW recommended that KEI Power consult with Maine DIFW prior to any planned impoundment drawdowns that occur during the smallmouth bass spawning period of May 1 through June 30.

Our Analysis

Planned maintenance activities would typically include inspecting or maintaining the flow regulating equipment on the dam and would require KEI Power to shut down the powerhouse, pass all inflow to the bypassed reach, and partially or fully draw down the impoundment. In the impoundment, any drawdowns needed to perform maintenance would temporarily dewater littoral habitats that may be occupied by the resident fish community, thereby forcing any fish that occupy these habitats to seek out deeper waters to avoid desiccation or predation.

Downstream of the dam, passing all inflows to the bypassed reach during the maintenance activity would cause a temporary up-ramp and flow increase in the bypassed reach. The extent of the up-ramp and flow increase would depend on a number of factors, including the inflow conditions at the time of the maintenance activity, whether and to what extent the impoundment needs to be drawn down to complete the maintenance activity, and whether the powerhouse is operating prior to the shutdown.

Although no entity specifically recommends any limits on the timing of the activity, KEI Power indicates that it prefers to complete these activities during the low-flow time of the year (i.e., summer and early fall) and there is no reason to believe that it wouldn't continue to do so under any subsequent license issued. Conducting planned maintenance activities during the low-flow period would make it easier to complete the work when weather conditions are likely to be warmer and drier and would also coincide with the time of year when log and debris transport would likely be minimal. Scheduling planned maintenance activities during the low-flow period would also increase the likelihood that the powerhouse would already be shut down due to insufficient inflows, thereby minimizing the extent of the up-ramp and bypassed reach flow increase because KEI Power would already be spilling all inflows over the dam.

Although there is no recent documentation of Atlantic salmon spawning in the project's bypassed reach or tailrace, continuing to conduct planned maintenance activities during the late summer low-flow period would avoid intentional flow fluctuations in the bypassed reach during spring when Atlantic salmon fry, if present, would be emerging from gravels and be particularly vulnerable to adverse effects from rapid flow fluctuations. Scheduling activities during this period would also avoid any potential effects of intentional flow fluctuations on Atlantic salmon during the sensitive spawning period which occurs during October and November.

Continuing to conduct planned maintenance during the low-flow summer and early fall months as KEI Power does under its current practice would also likely avoid any potential effects of intentional impoundment fluctuations on smallmouth bass during the May through June spawning period. While Maine DIFW recommends that it be consulted prior to a planned maintenance drawdown that occurs during May or June, it does not indicate why it expects these events to occur during these months or how it would use this information. Because KEI Power has typically scheduled these events later in the summer and fall, we have no reason to believe it would not continue to do so. Nevertheless, in the unlikely event that KEI Power were to conduct a planned maintenance drawdown during the months of May and June, notifying and consulting with Maine DIFW prior to these planned drawdowns would allow Maine DIFW to track these events as they occur and provide comments to KEI Power on how to minimize effects on smallmouth bass.

Effects of Whitewater Boating Flow Releases

As discussed in detail in section 3.3.4.2, KEI Power proposes to enhance recreational opportunities in the bypassed reach by coordinating up to five releases annually with the City of Auburn. KEI Power does not define a specific flow but suggests that a release of 500 cfs for five hours may be a reasonable target.

The City of Auburn recommends at least five flow releases annually of 600 to 800 cfs for up to five hours each, on weekend days, with releases to be scheduled and coordinated with the City.

Rather than schedule a specific number of releases, American Whitewater recommends that all flows of 300 to 1,000 cfs be released to the bypassed reach on Saturdays and holidays during the boating season of April 15 through October 15 and concurs with the proposed five-hour flow duration per release.

Our Analysis

Intentionally releasing whitewater boating flows at the project would affect fisheries and aquatic habitat in the bypassed reach. The severity of the effects would vary based on, among others, inflow conditions and the specific timing of the event within the 6-month-long whitewater boating season.

Because median flow conditions are 1,363 cfs in April, KEI Power would typically be able to operate at the full 500-cfs hydraulic capacity during this month while also passing 863 cfs to the bypassed reach, which could be used by boaters. However, from May through October when inflow conditions are typically significantly lower, power generation would need to be reduced or curtailed to provide the desired flows.

Whenever KEI Power reduces or shuts down generation at the powerhouse to provide a boating release, there would be a flow decrease in the powerhouse tailrace and simultaneous increase in the bypassed reach. At the conclusion of the 5-hour-long boating event, there would be an additional decrease in bypassed reach flows and simultaneous increase in tailrace flows when the powerhouse is brought back online. In its August 27, 2018 filing of additional information, KEI Power indicates that flow increases and decreases during powerhouse startup and shutdown occur quickly. When the powerhouse shuts down, the turbine shut-off valve is closed under hydraulic pressure and flow immediately begins spilling over the dam. When the powerhouse starts up, the turbine shut-off valve is fully opened and the powerhouse returns to full generation within about 15-20 minutes. KEI Power states that there are no wicket gates to control flow through the unit so turbine flow is regulated by the pitch of the turbine blades.

Blade pitch adjustments are predominately used to increase turbine efficiency within the turbine's range of operating conditions (e.g., inflow conditions and impoundment levels), they are not designed to specifically control the rate of flow increases through the unit in an incremental fashion. Therefore, under its existing configuration, the turbine is not designed to start up or shut down by incrementally increasing or decreasing flows to slow the rate of water rise or fall in the bypassed reach or tailrace. Such incremental flow increases or decreases are typically referred to as "ramping rates" and are often implemented at hydroelectric projects to protect aquatic resources from unnatural, rapid changes in flow.

Rapid down-ramping of flows has been observed in some rivers to cause stranding of fry and juvenile salmonids along sloping bars and in side-channels and stream margin areas (Hunter, 1992). While adults can also be stranded during rapid flow reductions, younger salmonid life stages such as emergent alevins, fry, and smaller juveniles are most susceptible to stranding mortality due to their poorer swimming abilities. Flow reductions that occur between the start of the spawning period and period of fry emergence can result in dewatered redds, which can lead to egg desiccation and mortality depending on the duration of the flow reduction and whether the spawning gravel remains wetted during the period of lower flows (Reiser and White, 1983).

KEI Power is proposing and Maine DMR, Maine DIFW, Interior, and NMFS are recommending and stipulating enhanced minimum flows in the bypassed reach to improve spawning, rearing, and migration habitat for the resident and diadromous fish, including the endangered Atlantic salmon. Atlantic salmon, if present, may utilize the bypassed reach for spawning and rearing habitat, and there would be overlap between the timing of the whitewater boating releases and the periodicity of the sensitive adult spawning and fry and juvenile rearing life stages. Adult Atlantic salmon begin migrating into the Androscoggin River Basin in June and spawn from October to November. Therefore, intentionally increasing and decreasing bypassed reach and tailrace flows twice per day without limits on ramping during the beginning and ending of the 5-hour-long whitewater boating releases would, at times, affect migration habitat for adult Atlantic salmon both upstream and downstream of the powerhouse. Boating releases in October would also affect any Atlantic salmon that attempt to spawn in the bypassed reach. Although adult salmon are not typically prone to stranding and entrapment because of their large size and strong swimming ability that enables them to move when flows recede, flow fluctuations during Atlantic salmon spawning has been known to temporarily disrupt spawning behavior (Haas *et al*., 2016).

If Atlantic salmon successfully spawn in the bypassed reach, the greatest potential for adverse effects from whitewater boating releases would likely occur to Atlantic salmon fry and juveniles. Atlantic salmon alevins emerge from the gravel in mid-May and remain in rivers from 1 to 3 years before emigrating to the marine environment. Thus, the early life stages of Atlantic salmon (i.e. alevins and fry) that are the most susceptible to stranding, entrapment, and displacement by rapid flow fluctuations, as well as older fry and juveniles that are also prone to these effects, would be present in the bypassed reach throughout the duration of the April 15 to October 15 whitewater boating season. Any adverse effects of unrestricted flow ramping on juvenile or adult salmon would constitute a take under the Endangered Species Act.

Upstream and downstream migrating adult and juvenile alewife and other alosines could also be adversely affected by the abrupt fluctuating flows associated with boating releases if they are present in the bypassed reach, as the timing of their migrations would also overlap with a significant portion of the whitewater boating season. These effects would also extend to any brown or rainbow trout juveniles, should either of these species successfully spawn in the bypassed reach over the term of any subsequent license issued.

Operational Effects on Water Quality

Operating a dam on a riverine system can affect water temperature, by increasing the residence time of water in an impoundment and exposing more water at the surface to the heat of the sun. High temperatures are often associated with lower dissolved oxygen and shifts in water chemistry that can be harmful to fish and other aquatic organisms.

As discussed previously, KEI Power proposes to continue to operate the project in run-of-river mode and would increase minimum flows in the bypassed reach throughout the year from 20 cfs to 113 cfs. Maine DMR, Maine DIFW, Interior, and NMFS also recommend run-of-river operation and increased minimum flows; however, NMFS and Interior recommend and stipulate a higher minimum flow of 175 cfs. No additional water quality measures are proposed or recommended at this time.

Our Analysis

As discussed in section 3.3.1.1 *Aquatic Resources, Affected Environment*, KEI Power's sampling in 2015 demonstrated that the project impoundment meets the state standard for dissolved oxygen in Class C waters of 5 mg/L or 60 percent saturation and there was no evidence of thermal or oxygen stratification or conditions that would lead to harmful algal blooms. In addition, water quality data from locations upstream (i.e., at the Upper Barker impoundment located approximately 0.65 mile upstream) and downstream of the dam (i.e., bypassed reach and tailrace) were similar and met or exceeded Class C standards for dissolved oxygen and nutrients. Thus, current project operation does not adversely affect water quality in the Little Androscoggin River.

Water temperatures in the impoundment during the sampling period ranged from a low of 48.7°F in October to a high of 76.5°F in September and averaged between 71 and 75°F during the peak summer months. Water temperatures in the bypassed reach ranged from 68 to 79.6°F with an average of 73.7°F. Water temperatures in the tailrace ranged from 63.5 to 79.6°F, with an average of 72.6°F. Releasing higher minimum flows to the bypassed reach as proposed by KEI Power and recommended by the agencies would increase water turbulence over rocks in the bypassed reach, which would help to aerate water. The higher minimum flows may result in a very slight cooling in summer water temperatures due to the dilution of heat energy (Poole and Berman, 2001). Higher minimum flows would also increase the extent of the wetted width of the bypassed reach, which would provide additional habitat for macroinvertebrates.

Thus, continuing to operate the project in run-of-river mode and increasing minimum flows released to the bypassed reach would continue to maintain and possibly improve water quality conditions in the bypassed reach and in the Little Androscoggin River downstream of the powerhouse over the term of any license issued.

Downstream Fish Passage

Under existing conditions, KEI Power operates and maintains a downstream fish passage facility at the Barker's Mill Project to facilitate the downstream passage of juvenile and post-spawn adult alewife and adult American eel. The downstream fish passage facility consists of a fish bypass, which is the 4-foot-wide eastern-most stop log bay located adjacent to the intake canal, and a plunge pool at the base of the dam. KEI Power operates the downstream fish passage facility from June 1 to November 15 by removing the stop logs in the fish bypass bay to pass the required 20-cfs minimum flow through the bypass and into the plunge pool downstream of the dam. Fish and flow exit the bypass, enter the plunge pool, and pass through a cut-out section in the plunge pool wall where they cascade down a small set of bedrock falls and enter the bypassed reach.

KEI Power also maintains an 18.5-foot-wide by 14.5-foot-high vertical trash rack with 2-inch clear bar spacing on the powerhouse intake at the gate house. As discussed further below, although the trash rack may exclude some fish from entering the powerhouse, there is no surface bypass associated with the trash rack so any excluded fish must swim back upstream out of the intake canal to access the fish bypass or to find another downstream passage route through the dam (e.g., stop log bays, overflow spillway).

KEI Power proposes to modify the existing downstream fish passage facility to reduce turbine entrainment for outmigrating diadromous fish species. KEI Power did not describe how it would modify the downstream passage facility in its license application. Instead, it proposed to design the facility in consultation with FWS and NMFS after license issuance. However, on June 12, 2017, KEI Power filed a conceptual design of the modified downstream passage facility. The conceptual design includes new full-depth 40-degree angled trash racks with 1-inch clear bar spacing that are designed to ensure a maximum approach velocity of 2 feet per second at the trash racks. KEI Power would install the new trash racks at the upstream end of the canal adjacent to the fish bypass to guide fish into the bypass. KEI Power would construct a new operator deck that spans the canal to facilitate manual cleaning of the racks. The new trash racks would be in place from June 1 through November 15; however, final timing would be determined based on biological requirements.

To further improve guidance and attraction for downstream migrants into the fish bypass, KEI Power would also install a new inclined ramp in the impoundment beneath the fish bypass entrance and maintain a minimum conveyance flow of 25 cfs through the fish bypass.

To increase the safety of fish passing downstream through the fish bypass and other stop log bays, KEI Power would also modify and expand the existing plunge pool beneath the fish bypass and stop log bays. KEI Power would construct a new wall to increase the pool depth to a minimum of 4 feet across the entire fish bypass and stop log section of the dam. A cut-out at the downstream end of the pool would concentrate flow through the cut-out and over the bedrock falls, thus facilitating a safer egress route for fish out of the pool and into the bypassed reach.

Interior's fishway prescription stipulates that KEI Power construct a new downstream fish passage facility for alosines and American eel that is consistent with the FWS's 2017 Fish Passage Engineering Design Manual (FWS, 2017a) and includes: (1) a full-depth inclined trash rack with 0.75-inch bar spacing, (2) a conveyance flow through the fish bypass of 25 cfs, and (3) a modified plunge pool at the base of the dam to provide a pool depth that is equal to 25 percent of the fall height or four feet (whichever is greater). Interior's fishway prescription specifies that the new trash rack be in place from June 1 to November 30 of each year. Interior's fishway prescription also specifies that KEI Power prioritize how the project spills water from the dam in the following order: (1) through the fish bypass, (2) through the additional stop log bays adjacent to the fish bypass that empty into the plunge pool, and (3) over the spillway, and if necessary, into a new plunge pool at the base of the spillway that is approved by FWS.

Maine DMR recommends the same fish passage improvements as Interior, except that Maine DMR recommends that KEI Power install either an inclined or angled trash rack, rather than just an inclined trash rack as specified by Interior.

NMFS's fishway prescription stipulates that the downstream passage facility consist of a minimum of 0.75-inch spaced trash racks, approach and sweeping velocities that prevent impingement on the trash rack, sufficient attraction flows, accelerated flow near the bypass entrance, safe hydraulic conditions through the bypass, and safe discharge conditions at the bypass exit. NMFS's fishway prescription specifies that KEI Power operate the new downstream passage facility from April 1 to December 31 of each year.

Maine DIFW also recommends downstream passage for diadromous species but defers to the other agencies for the specific design and operation of the fish passage facility.

Our Analysis

Under existing conditions, adult and juvenile alewife and adult American eel migrating downstream can utilize four different passage routes to pass the dam. These include: (1) the intake canal, trash rack, and powerhouse when the project is operating, (2) the fish bypass, (3) the other stop log bays adjacent to the fish bypass, and (4) the overflow spillway.

We evaluate each of these passage routes, proposed improvements, and their effects on downstream migrating fish below.

<u>Fish Entrainment</u>

Once fish enter the 100-foot-long intake canal they may become entrained into the penstock and pass through the project's semi-Kaplan turbine. To become entrained, fish would have to pass through the existing trash rack or through the proposed or recommended trash racks. To assess the potential for turbine entrainment, we compare body size to the spacing in the existing trash rack and proposed trash racks. We estimated the body width of juvenile and adult alewife and silver phase[44] American eel in proportion to the typical lengths of these species. As shown in table 9, the existing trash rack with 2-inch clear bar spacing would not prevent juvenile or adult alewife or adult American eel from passing downstream through the intake canal and powerhouse.

Table 9. Minimum sizes of alewife and American eel (total length, inches) physically excluded from trash racks with 0.75-inch, 1-inch, and 2.0-inch bar spacing, based on the body width scaling factors in Smith (1985).

Species	Life stage[a]	Length range (inches)[b]	Minimum Length (inches) excluded		
			0.75 inch bar spacing	1.0 inch bar spacing	2.0 inch bar spacing
Alewife	Adult	9 to 13	8.7	11.6	Not Excluded
American eel	Silver	13 to 40	20.0	26.7	Not Excluded

[a] Outmigrating juvenile young-of-year alewife were not included since they range in length from about 2.5 to 3.0 inches (Bell, 1991) and average width of 0.12 inch (Lawler, Matucky, and Skelly Engineers, 1991), and would not be physically excluded using a trash rack with a minimum clear bar spacing of 0.75 inch.
[b] Length ranges for adult alewife adapted from Turek *et al.* (2016), and length range for silver phase American eel adapted from Jessop (2010).

Although the existing 2-inch bar spacing trash rack would not physically exclude any downstream migrants from entering the penstock, some individuals approaching the trash rack could be deterred by the trash rack and attempt to avoid entrainment by swimming back upstream out of the canal. To determine whether any alewife or eel could migrate back upstream after entering the canal, we compare the fishes swimming capabilities with the estimated range of approach velocities within the canal under the minimum and maximum hydraulic capacities of the turbine. At the minimum hydraulic capacity of 150 cfs, the velocity within the canal would be about 0.8 feet per second (fps), while the velocity at the maximum hydraulic capacity of 500 cfs would be about

[44] After a variable period of growth in stream or estuarine habitat, juvenile American eels metamorphose into the adult silver phase eel or migratory stage. This metamorphosis may include a ventral color change from yellow to silver.

2.7 fps.[45]

Based on available swim speeds for juvenile alewife shown in table 10, the 0.8- to 2.7-fps canal velocities are substantially higher than the cruising speed of juvenile alewife (0.03 to 0.3 fps), and only partially overlap with their range of burst speeds (0.5 to 3.0 fps). Because burst speeds can typically only be maintained for a few seconds, , juvenile alewife passing through the canal and reaching the trash rack would not be able to avoid entrainment by swimming 100 feet back upstream to exit the canal.

Adult alewife have prolonged swimming speeds of 2.5 to 5 fps, suggesting that most if not all individuals approaching the intake could avoid entrainment if they elect to swim back upstream out of the canal. Likewise, adult American eels with prolonged swimming speeds ranging from 1.9 to 3 fps could also potentially avoid entrainment if they elect to swim back upstream out of the canal after approaching the intake.

Table 10. Swim speeds of adult and juvenile alewife and adult American eel. (Source: Staff)

	Swimming Mode (fps)[a]			
Species (Lifestage)	**Cruising**	**Prolonged**	**Burst**	**Source**
Alewife (Juvenile)	0.03-0.3	--	0.5-3.0	Bell, 1991; Klumb *et al.*, 2003
Alewife (Adult)	0-2.5	2.5-5	5.0-7.0	Bell, 1991
American eel (Adult)[b]	0-1.3	1.9-3.0	4	Bell, 1991; Palstra and Thillart, 2010

[a] Cruising speed is the swim speed a fish can maintain for a long period of time (i.e., hours); prolonged speed can be maintained for minutes; and burst speed can only be maintained for a short period of time (i.e., seconds).
[b] Swim speeds based on silver phase European eel.

KEI Power did not quantify the downstream passage survival of adult and juvenile alosines and adult American eel passing through the project's turbine. For American eel, estimates of survival rates of turbine passage are highly variable ranging from 0 to 94 percent (EPRI, 2001). Some of the factors that influence downstream passage survival of fish, include body size (Richkus and Dixon, 2003) and turbine design (EPRI, 2001). The Barker's Mill Project generates power using a semi-Kaplan turbine.[46] In studies of eels passing through large Kaplan turbines (>100 MW), mortality rates have ranged from 15

[45] The approach velocity was calculated by dividing the hydraulic capacity of the turbine over the cross-sectional area of the power canal (about 180 square feet at normal water surface elevation).

[46] A semi-Kaplan turbine is a Kaplan-type turbine with fixed guide vanes.

to 30 percent, and for smaller Kaplan turbines (<1 MW), eel mortality had been reported ranging from 50 to 100 percent (Dainys *et al.,* 2018). Table 11 provides survival rates for adult American and European eels using small and large propeller style turbines including Kaplan turbines. Heisey *et al.* (2017) reported 48-hour survival rates ranging from 66 to 88 percent for adult American eel passing through propeller-type turbines at four powerhouses in the United States. The 48-hour survival rates for adult European eels passing through three propeller type turbines on the Rhone and Rhine Rivers in France ranged from 79 to 93 percent. Other studies in Europe, reported survival rates of silver eels passing through Kaplan-type turbines ranging from 62 to 80 percent (Bruijs and Durif, 2009). More specifically, the smaller capacity turbines (0.17 and 2 MW capacity) reported the lowest survival rates ranging from 52 to 53 percent. Recently, Alden (2018) modeled eel survival through a 1.2-MW propeller-type turbine on the Connecticut River at turbine flows ranging from 250 to 870 cfs and found estimated survival rates ranging from 46.8 to 51 percent. Although the available information in eel mortality through similar turbine type and size as found at the Barker's Mill Project is limited, based on this information we estimate that eel mortality from turbine passage at the Barker's Mill Project would likely be about 50 percent.

Table 11. Survival rates of silver phase American and European eels passing through propeller-type turbines. (Source: Heisey *et. al.*, 2017; Buris and Durif, 2009; as modified by staff)

Location	Capacity (mW)	Turbine Type	Species	Life Stage	Average Length (inches)	%Survival
St. Lawrence R.	2,675	Propeller	American eel	Adult	40.2	73.5
Connecticut R.	19.4	Kaplan	American eel	Adult	32.3	66
Connecticut R.	32.4	Kaplan	American eel	Adult	32.0	87.5
Connecticut R.	32.4	Kaplan	American eel	Adult	31.3	74
Connecticut R.	2	Propeller	American eel	Adult	ND	53.1
Siesartis R. (Lithiuania)	0.17	Kaplan	European eel	Adult	26.8	52.4
Rhone R. (France)	210	Bulb	European eel	Adult	27.0	93
Rhine R. (France)	175	Kaplan	European eel	Adult	27.7	92.4
Rhine R. (France)	156	Kaplan	European eel	Adult	29.5	78.6

ND = no data

Little information is available that specifically describes mortality rates of post-spawn adult and juvenile alewife that pass through Kaplan turbines. However, Winchell (2000) summarized mortality data based on fish size and turbine design characteristics (table 12). Another study that measured mortality rates of juvenile alewives passing through propeller-type turbines similar to the turbine used at Barker's Mill, reported 14 percent mortality rate (Ruggles and Palmeter, 1989). Based on this information and the typical length range of alewives expected to occur at the project, turbine mortality of post-spawn adult alewife at the Barker's Mill Project could range from about 3 to 22 percent, and turbine-related mortality of juvenile alewives could range from about 2 to 20 percent.

Table 12. Immediate turbine passage survival rates of fish based on turbine type and fish size. (Source: Winchell, 2000; as modified by staff)

Turbine	Runner	Hydraulic	Fish	% Survival		
Type	Speed	Capacity	Length (in)	Min	Max	Mean
Axial-flow[a]	<300	636-1203	<4	94.1	98	95.4
"	"	636-21000	4-8	89.8	97.5	94.8
"	"	636-2200	8-12	77.4	97.4	87.2
"	"	1203-2200	>12	86.8	100	93.4
"	>300	530	<4	81.3	81.3	81.3
"	"	"	4-8	78	78	78

[a] Includes Kaplan, fixed-blade propeller, bulb, and tube turbine

To evaluate the benefits of installing and maintaining new trash racks with 0.75-inch or 1-inch clear bar spacing at the upstream end of intake canal adjacent to the fish bypass, we again compare the body widths of juvenile and adult alewife and adult American eel to the new trash rack spacing. As shown in table 9, neither the 0.75- or 1-inch bar spacing would physically exclude juvenile alewife from entering the intake canal and passing through the turbine because the body width of a typical alewife (0.12 inch) is substantially smaller than either bar spacing. For adult alewife, the 0.75-inch-spaced trash rack would physically exclude most if not all individuals from entering the turbine intake canal, while the 1-inch-spaced trash rack would exclude those individuals larger than about 11.5 inches in length. For adult American eel, the 0.75-inch-spacing would physically exclude adult eels greater than 20 inches in length, while the 1-inch-spacing would exclude those larger than about 27 inches in length. Studies in New England have documented that adult eels typically range in size from 24 to 40 inches long (ASMFC, 2000; Kleinschmidt, 2015; Haro *et al*., 2000) and 0.9 to 1.1 inches wide (Great River Hydro, 2016); therefore, a trash rack with 0.75-inch clear bar spacing could physically prevent the typical adult eel from entering the intake canal and passing through the turbine.

Although neither the 0.75-inch or 1-inch-spaced trash racks would physically exclude juvenile alewife from entrainment into the intake canal and turbine, the proposed and recommended designs of the new trash racks could provide a behavioral deterrent away from the trash rack and toward the fish bypass. FWS (2017a) states that trash racks installed at an angle[47] that is 45 degrees or less to the upstream flow field result in a sweeping velocity greater than or equal to the normal velocity, which reduces the potential for impingement and entrainment and also creates a hydraulic cue that can elicit a negative behavioral response from migrating fish and encourage downstream movement of fish toward a bypass. Similarly, inclined[48] trash racks can be designed to produce hydraulics that result in an avoidance response in some fish and aid in guiding fish up in the water column toward a surface bypass. Therefore, either of the new trash rack alternatives would likely guide juvenile alewife away from the intake canal and toward the surface bypass.

However, when comparing the benefits of the existing 2-inch spaced trash rack to that of either a new 0.75-inch or 1-inch spaced trash rack, it also important to consider the hydrology of the Little Androscoggin River and when the powerhouse would be operating during the downstream fish passage season. When the powerhouse is not operating, the turbine shut-off valve is closed and canal velocities approach zero; therefore, downstream migrating fish would be physically excluded from turbine passage and could exit the intake canal to find alternative paths downstream. Therefore, when the powerhouse is shut down, other than potentially reducing migration delay for those fish small enough to fit through the bar spacing, there would be little benefit to downstream migrating fish from installing either a 0.75-inch or 1-inch trash rack at the head of the intake canal.

As shown in table 13, during the June through November downstream fish passage season and under the existing 20-cfs minimum flow regime, the powerhouse shuts down about 44 percent of the time. Under KEI Power's proposed 113-cfs minimum flow regime, the percent of time that the powerhouse is shut down would increase to 56 percent, while NMFS's and FWS's 175-cfs minimum flow alternative would further increase the frequency of shutdowns to 64 percent of the time during the downstream passage season.

When evaluating the benefits of installing a new trash rack to reduce turbine entrainment injury and mortality, we also considered the historical occurrence of fish kills at the project. Based on the project record, there was one documented fish kill incident at both the Barker's Mill and Upper Barker Projects on November 15 and 16, 2000. The incident occurred during an unusually late-season mass migration of alewives, prompted by a sudden high-flow event after an abnormally dry fall, which overwhelmed

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[47] An angled trash rack consists of a series of vertical slats, placed along a diagonal line within a canal that directs fish to a downstream bypass.

[48] Inclined trash racks are tilted from the vertical to divert fish up or down in the water column to a downstream bypass.

Table 13. Percent of time inflow exceeds combined minimum flow and minimum hydraulic capacity of turbine for each minimum flow alternative during June 1 – November 30 downstream fish passage season. (Source: Staff)

Minimum Flow	**June through November Pooled Exceedance Values**	
	Percent of time inflow exceeds combined minimum flow and minimum hydraulic capacity (i.e., powerhouse is operating)	Percent of time inflow is less than combined minimum flow and minimum hydraulic capacity (i.e., powerhouse not operating)
20 cfs	56%	44%
113 cfs	44%	56%
175 cfs	36%	64%

the capacity of the downstream passage facilities and resulted in a large pulse of juvenile alewives passing through the project turbine over a short period. Following the incident, the licensee met with Maine DMR, Maine DIFW, Maine DEP, Maine Atlantic Salmon Commission, and FWS and agreed to establish a primary point-of-contact that has the authority to modify project operations if needed in the future to protect downstream migrating fish in the event of similar circumstances. The agencies involved in the incident response agreed at that time that the project's downstream fish passage facilities appeared to operate satisfactorily under normal flow and passage season conditions. No other fish kill incidents have since been reported at the Barker's Mill Project.

Attraction Flows

The attraction of fish to a downstream bypass depends on several factors including the hydraulic conditions in the vicinity of the bypass entrance. Generally, the volume of discharge flow in the fish bypass necessary to attract downstream migrating fish ranges from 5 to 10 percent of the turbine discharge (Larinier, 2001). Under existing conditions, KEI Power releases the 20-cfs minimum flow through the fish bypass during the June 1 to November 15 downstream fish passage season. Increasing the conveyance flow through the fish bypass to 25 cfs as proposed by KEI Power and recommended or stipulated by Interior and Maine DMR would improve attraction to the fish bypass and away from the intake canal and powerhouse. An attraction flow of 25 cfs would also be consistent with FWS's Design Criteria Manual which specifies that an adequate attraction flow should be five percent of the station's hydraulic capacity or 25 cfs, whichever is greater[49] (FWS, 2017a).

Fish Bypass Plunge Pool

Currently, flows exiting the fish bypass as well as the 6 other stop log bays on the dam's east section discharge into a plunge pool at the base of the dam. However, the existing configuration of the plunge pool may not provide adequate depths to prevent fish from striking bedrock along the base of the dam; this is especially true for several of the western-most stop log bays that discharge to areas of exposed bedrock. Additionally, once fish exit the plunge pool they may be subject to injury as they cascade over a series of bedrock falls to enter the bypassed reach.

Modifying the plunge pool by constructing a concrete wall to ensure that depths within the plunge pool are a minimum of 4 feet beneath all of the stop log bays would create a sufficient cushion to prevent injury as fish as they enter the pool. Installing a new cut out within the plunge pool wall would also provide a concentrated flow path with deeper water depths over the bedrock falls between the plunge pool and bypassed reach. Together these measures would minimize injury of fish utilizing the downstream passage system. Modifying the plunge pool in this manner would also be consistent with FWS's Design Criteria Manual which specifies that the depth of the plunge pool be 25 percent of the fall height or four feet, whichever is greater.

Overflow Spillway and Plunge Pool

Spillways often provide safe downstream passage for migrating fish provided that there is sufficient water depth beneath the spillway to cushion fish from impacting the streambed (Larinier, 2001). At the Barker's Mill Project, there is no information on fish survival rates over the spillway; however, the streambed below the spillway predominately consists of bedrock that is exposed at low water levels and may not provide sufficient depths to safely pass downstream migrating fish when the project is spilling.

Although no entity specifically recommends that KEI Power modify the spillway plunge pool, Maine DMR recommends and Interior's fishway prescription stipulates that flows released over the spillway during the downstream passage season discharge into an

[49] Five percent of the project's 500-cfs maximum hydraulic capacity is equal to 25 cfs.

"approved plunge pool".[50] Because the agencies did not specify how the existing plunge pool area beneath the overflow spillway must be configured in order for it to be "approved", we compare the characteristics of the existing plunge pool with preferred design characteristics in the FWS's Design Criteria Manual. As we said, the manual specifies that a plunge pool depth be equal to 25 percent of the fall height or four feet, whichever is greater. The spillway section of the dam is about 30 feet tall; therefore, a plunge pool at the base of the dam would need to be at least 7.5 feet deep in order to be consistent with FWS's Design Criteria Manual.

There is little existing information on the water depths beneath the spillway, but based on our review of the project record, it appears unlikely that water depths are 7.5 feet deep. In order to provide a plunge pool that is at least 7.5 feet deep beneath the entire 125-foot-length of the spillway, KEI Power would likely need to either excavate a significant amount of bedrock beneath and downstream of the dam to deepen the channel, or construct a wall similar to that proposed below the stop-log bays, to impound water beneath the spillway. Because the spillway is 125 feet long, the area to be encompassed by the plunge pool would be large and would require a significant amount of in-water work for construction. Additionally, because the pool is located close to the base of the dam, there could be significant dam safety issues associated with modifying the streambed so close to the dam's foundation.

Schedule for Downstream Fish Passage Facility Construction

Interior's fishway prescription would require the new downstream fish passage facility to be constructed and operational 30 days before the start of the second migration season following license issuance. Because Interior also requires that the downstream fish passage facility be operated from June 1 to November 30 of each year, the new downstream fish passage facility would need to be constructed and operational by May 1 of the second migration season following issuance of a subsequent license. However, in describing the requirements for the fishway design review process, Interior also requires that the downstream fish passage facility be installed and operational by September 1, 2021.

Similarly, NMFS's fishway prescriptions requires that the new downstream passage facility to be operational by September 1, 2021, but also stipulates that it be operational within two years of the license issuance date. Maine DMR recommends that

[50] Interior's fishway prescription specifies that FWS must approve the spillway plunge pool configuration. Maine DMR's recommendation does not specify which entity would be responsible for approving the plunge pool.

the new downstream passage facility be operational by September 1, 2021.

KEI Power does not specify when its proposed downstream passage improvements would be completed, but states that it would have the new trash racks in place from June 1 through November 15. However, final timing would be determined based on biological requirements of downstream migrating fish.

Our Analysis

The agencies recommendations and stipulations for completing construction of the downstream passage facility are likely to prove problematic for several reasons. First, specifying an exact date of operation (September 1, 2021) may not be feasible because the issuance date of any subsequent license is uncertain and dependent on variables beyond the control of the Commission and the licensee (e.g., timely issuance of a water quality certification and completion of endangered species consultation), and could occur after the specified deadline.

Second, the prescribed timeframes for completing construction are likely not sufficient given the required review and approval timelines for design of the facility. As discussed below in the *Fishway Design, Operation, and Maintenance* section, Interior and NMFS stipulate and Maine DMR recommends, that KEI Power provide conceptual, 30 percent, 60 percent and 90 percent design plans for the modified downstream fish passage facility for their review and approval; the 90 percent design plan must be submitted for their approval within 18 months of license issuance. The agencies would have at least 30 days to review and approve the plans. KEI Power would also be required to file a final design plan with the agencies for review prior to filing with the Commission for final review and approval. We assume review of the final design by the agencies could also take at least a month before the design plans would be ready for review and final approval by the Commission. Thus, prior to filing with the Commission, the final design could take at least 20 months to develop. Such a schedule would likely leave little time to complete construction and have the new downstream fish passage facility operational prior to the migration season as required by Interior's prescription or to complete construction within two years of license issuance as required by NMFS. Further, construction timing may not align with necessary site conditions needed to permit construction (e.g. low flow; ice-free conditions, etc.) or align with the downstream fish migration season.

Including a construction schedule in the development of the design plans would provide some flexibility based on better defined parameters (timing of license issuance, final designs, and suitable site construction characteristics, etc.) and more likely to achieve the desired operations constraints sought by the agencies (i.e., operational prior to downstream migration season).

Schedule for Downstream Fish Passage Operation

KEI Power proposes to operate the existing and modified downstream fish passage facility (once completed and put into operation) from June 1 to November 15.

NMFS and Interior's preliminary fishway prescriptions and Maine DMR's section 10(j) recommendations support KEI Power's proposed schedule for operating the existing downstream facility, but all three agencies recommend or stipulate that operation of the modified facility (once completed and put into operation) be extended to the end of November to protect downstream migrating alewife.

NMFS also specifies that operation of the new facility be expanded by two additional months in the spring (April and May) and one in the winter (December) to protect downstream migrating Atlantic smolts in the spring and post-spawn kelts in the winter.

Our Analysis

Downstream migration of juvenile and post-spawn adult alewives in Maine rivers occurs from mid-July through the end of November (Mullen *et al*., 1986; Saunders *et al.*, 2006). This time frame is also inclusive of other alosines migration periods if they were to eventually inhabit the river above the project. Thus, extending KEI Power's proposed operating schedule by 15 days as stipulated by Interior's and NMFS's fishway prescriptions and recommended by Maine DMR, would ensure that any alewife that are migrating downstream toward the end of their migration season have access to a safe downstream passage route at the project.

Expanding the seasonal operation of the facility as specified by NMFS would ensure that the facility is operated during the timing of downstream migration for Atlantic salmon juveniles and post-spawn kelts in Maine rivers (Baum, 1997). However, as discussed in more detail below in our analysis of *Upstream Passage for Anadromous Fish*, Atlantic salmon do not currently occur upstream of the Barker's Mill Project. Therefore, the benefits of operating the downstream passage facility in April, May, and December would only be realized if an upstream fish passage facility were constructed at the project by 2024 as stipulated by NMFS and Atlantic salmon used the facility and successfully spawned in habitats upstream of the project.

Spill Prioritization

Not only does Interior prescribe specific improvements to the downstream passage facility, Interior's fishway prescription also specifies that KEI Power prioritize how the project spills water from the dam in the following order: (1) through the fish bypass, (2) through the additional stop log bays adjacent to the fish bypass that empty into the plunge pool, and (3) over the spillway, and if necessary, into a new plunge pool at the base of the spillway that is approved by FWS. Maine DMR also recommends that spills be prioritized as stipulated by Interior.

KEI Power did not address this recommendation in its reply comments.

Our Analysis

Under existing conditions, adult and juvenile alewife and adult American eel migrating downstream during the fish passage season can pass through the project's powerhouse where they would be subject to injury and mortality, or they can utilize three other passage routes to pass the dam: (1) the fish bypass, (2) the other stop log bays adjacent to the fish bypass, and (3) the overflow spillway.

Of these three alternative passage routes, the fish bypass would provide the safest downstream passage route as it is specifically designed to provide safe downstream passage for diadromous fish species at the project.

With respect to the other downstream passage routes, the survival rate of fish passing through the other stop log bays and spillway are unknown; however, under existing conditions and the proposed action, the stop log bays would likely be safer than the spillway. This is because the drop height between the stop log bay exits and the water surface downstream is lower than drop height at the spillway section. Additionally, under the proposed action, KEI Power would modify the plunge pool at the base of the fish bypass and the remaining stop log bays to provide a greater cushion for fish entering the pool. Thus, it would be safer for downstream migrating fish than going over the spillway because the spillway currently lacks a sufficient plunge pool.

Therefore, prioritizing how spills are released from the dam, as required by Interior's fishway prescription and recommended by Maine DMR, would ensure that any inflows that are above the 25-cfs minimum conveyance flow for the fish bypass are first routed through the safest downstream passage routes before being routed through those that are less safe, thereby reducing the potential for fish injury or mortality. This would be particularly beneficial during periods of heavy precipitation during the summer and fall months when juvenile alewives would likely be triggered to migrate downstream of the Barker's Mill Dam.

Upstream Passage for American eel

Dams can affect American eel populations by limiting upstream movement of juveniles migrating from the marine environment to freshwater habitat necessary for growth and development (Hitt *et al*., 2012). Currently, there are no upstream fishways for juvenile eels at the Barker's Mill Project.

Interior's fishway prescription stipulates that KEI Power construct an upstream eel passage facility at the Barker's Mill Dam that is designed in consultation with the resource agencies and to be consistent with the FWS Design Criteria Manual. The fishway is to be operational before the second American eel migration season after any subsequent license is issued. Maine DMR recommends and NMFS's fishway prescription specifies that KEI Power construct an upstream eel passage facility that is designed in consultation with the resource agencies and operational by June 1, 2021.

Maine DMR's recommendation would also require the upstream eel passage facility to consist of an eel lift, eel ramp, or a helical eel ladder, and that KEI Power provide an attraction flow into the facility of approximately 50 gallons per minute (gpm).

Interior and NMFS require, and Maine DMR recommends, the upstream passage facility for American eel be operated each year from June 1 to September 15.

Maine DIFW also recommends upstream passage for diadromous species and concurs with the design and operation of the facility as recommended or stipulated by the other agencies.

Our Analysis

Currently, there are no dedicated upstream passage facilities for American eel at the Barker's Mill Project or any of the six other dams on the Little Androscoggin River upstream. In addition, only one of the three dams downstream of the project (Worumbo Dam) on the mainstem Androscoggin River has a dedicated upstream eel passage facility.[51] Despite these impediments to upstream migration, eels have been documented in the Little Androscoggin River upstream of the project within the past 35 years (Maine DMR and Maine DIFW, 2017), suggesting that some upstream movement of eels is occurring under existing conditions. There is no estimate, however, of the number of individuals that successfully pass upstream on an annual basis.

During KEI Power's 2015 eel passage study, it documented 44 juvenile eels below the dam, either in pools near the base of the dam or climbing the bedrock falls between the bypassed reach and the fish bypass plunge pool. Because there is no upstream eel passage facility at the project, eels must climb over or around the dam to access habitat in the Little Androscoggin River upstream. While climbing over or around dams is a well-

[51] An upstream eel ladder is operated at the Worumbo Project, located about 14 RMs downstream of the Barker's Mill Project.

documented behavior for juvenile eels (GMCME, 2007), the climbing ability of eels declines as they grow longer than 4 inches (Legault, 1988). Based on the results from the 2015 eel passage study, the majority of eels observed downstream of the project's dam were between 3 and 6 inches long, suggesting that any existing route over or around the dam may not be effective for all juvenile eels that reach the project. Therefore, installing and operating an upstream eel passage facility that is designed to be consistent with the criteria in the FWS's Design Criteria Manual that have been shown to provide effective upstream eel passage would improve passage conditions for all sizes of juvenile eels and improve access to habitat upstream of the project.

Designing the upstream fish passage facility for American eel in consultation with the resource agencies, would allow KEI Power and the agencies to develop effective design concepts and criteria based on the conditions and constraints at the Barker's Mill Project.

In attempt to pass barriers such as dams, upstream migrating juvenile American eels (elvers and yellow-phase juveniles) seek out low-velocity conditions along river edges and use wetted surfaces as well as small openings, voids, and crevices to climb over the barrier (Turek *et al*., 2016), thus upstream eel passage facility designs typically consist of an attraction water delivery system and wetted ramp lined with various media to aid in traction (Towler *et al*., 2013). According to FWS's Design Criteria Manual, an upstream eel passage facility generally consists of a covered metal or plastic volitional ramp lined with a wetted substrate that is 100 feet long or less, and angled at a maximum slope of 45 degrees with 1-inch-deep resting pools sized to the width of the ramp every 10 feet. The Design Criteria Manual also suggests sizing the width of the ramp to accommodate a maximum capacity of 5,000 eels per day (FWS, 2017a). Designing the eel passage facility according to these criteria and providing an attraction flow of 50 gallons per minute (0.1 cfs) should be sufficient to effectively attract and pass eels upstream of the project dam, and would meet the intent of Maine DMR's recommendation that the facility either be a lift, ramp, or helical ladder.

Operating the facility from June 1 to September 15 would encompass the time when the majority of the eels were observed near the base of the dam during the eel passage study and is consistent with upstream eel migration timing in New England.

Schedule for Upstream Eel Passage Facility Construction

Interior's fishway prescription stipulates that the new upstream eel passage facility to be installed and operational before the start of the second migration season following license issuance. However, in describing the requirements for the fishway design review process, Interior also stipulates that the upstream eel passage facility be installed and operational by June 1, 2021.

NMFS's fishway prescription specifies and Maine DMR recommends that the new upstream eel passage facility be installed and operational by June 1, 2021

Our Analysis

As discussed above in *Schedule for Downstream Fish Passage Facility Construction*, specifying an exact date of operation (June 1, 2021) may not be feasible because the issuance date of any subsequent license is uncertain and dependent on variables beyond the control of the Commission and the licensee and could occur after the specified deadline. Likewise, the prescribed timeframes for completing construction are likely not sufficient given the required review and approval timelines for design of the facility (see *Fishway Design, Operation, and Maintenance* section). Lastly, construction timing may not align with necessary site conditions needed to permit construction or align with the downstream fish migration season.

Including a construction schedule in the design plans for the fishway would provide some flexibility based on better defined parameters (timing of license issuance, suitable site construction characteristics, etc.) and more likely to achieve the desired operations constraints sought by the agencies (i.e., operational prior to upstream migration season for American eel).

Upstream Passage for Anadromous Fish

Currently, there are no upstream passage facilities for anadromous fish at Barker's Mill Dam. Any anadromous fish that successfully pass upstream through the passage facilities at the three mainstem Androscoggin River dams and enter the Little Androscoggin River can only migrate about 0.7 RM upstream before encountering the Barker's Mill Dam. The only anadromous fish currently occurring upstream of the project are alosines (predominately alewife) that are stocked in the upper watershed.

The State of Maine's fishery management goals for the Little Androscoggin River are identified in *The Draft Fisheries Management Plan for the Lower Androscoggin River, Little Androscoggin River, and Sabbatus River* (Maine DMR and Maine DIFW, 2017). The plan states that the management goals for the Little Androscoggin River (identified in the plan as "Reach 4") are to manage the reach "as a migratory pathway for alewife, American shad, blueback herring, Atlantic salmon, American eel, striped bass, sea lamprey, and wild brook trout, and for sustained production of these species consistent with habitat capacities (if known)." The plan estimates that total annual production of adult anadromous species in Reach 4 is 1,728,895 alewife; 37,694

American shad; 327,188 blueback herring; and 368 Atlantic salmon.

The plan acknowledges that there are currently no upstream fish passage facilities at any of the seven mainstem dams on the Little Androscoggin River (figure 3) and includes three phases for restoring anadromous fisheries upstream. Phase 1 of the plan, to be implemented from year 2017 until the year 2027, describes objectives for restoring upstream passage at five of the mainstem dams. The objectives specify installation of upstream passage for anadromous fish by 2025 at Barker's Mill and Upper Barker, by 2026 at Hackett's Mill, and by 2027 at Marcal and Welchville. The specific objectives for anadromous fish passage at the Barker's Mill Project are: (1) provide upstream passage with a sorting facility for anadromous fish no later than 2025, (2) develop fish passage designs, effectiveness testing studies, and operations and maintenance plans for passage facilities in consultation with the state and federal resource agencies, and (3) establish suitable minimum flows to improve habitat by 2025. Phase 2 of the plan would be initiated after fish passage is provided at Welchville Dam and would include working with the Maine DIFW, state legislature, and lake associations to develop support for restoring alewives to historic lake and pond habitat in the watershed and evaluating and monitoring interactions between alewives and lake sport fisheries. Phase 3 of the plan would be initiated after alewife restoration has been completed within the historic pond and lake habitat in the watershed and would include reevaluating concerns regarding interactions between migratory and resident sport and forage fish, exploring restoration of alewives to Thompson Lake, monitoring restored diadromous fish populations, providing recreational angling opportunities for freshwater sport fisheries and, protecting wild brook trout populations.

Interior states that its objective is to restore naturally reproducing stocks of American shad, alewife, and blueback herring to historically accessible riverine and lake habitats in basin. NMFS has similar objectives for restoring accessibility for anadromous fish throughout the basin.

To meet the restoration goals described above, Maine DMR recommends and Interior's and NMFS's fishway prescriptions specify that KEI Power design and install, in consultation with resource agencies, an upstream passage facility to provide safe, timely, and effective passage of American shad, alewife, and blueback herring. NMFS's fishway prescriptions further specify that KEI Power construct and operate an upstream passage facility that is designed to pass Atlantic salmon.

Interior's fishway prescription specifies that the upstream passage facility be designed to pass 327,188 blueback herring, 37,694 American shad, and 1,728,895 alewife; while NMFS's fishway prescription specifies that it pass 1.7 million river herring, 37,000 American shad, about 370 Atlantic salmon, and other resident or target species. Both Interior's and NMFS's fishway prescriptions stipulate that the upstream fish passage facility to be constructed and operational by May 1, 2024.

NMFS's fishway prescription also stipulates that KEI Power construct a fish counting facility as part of the upstream fish passage facility to enumerate successful passage of target species.

Maine DMR recommends that the facility be a fish lift or pool and weir fishway designed to provide a minimum attraction flow of 50 cfs during the fish passage season and to pass a maximum of about 2 million river herring. Maine DMR also recommends the new upstream fish passage facility be constructed and operational by no later than May 1, 2025.

Maine DIFW recommends upstream passage for diadromous species and concurs with the design and operation as recommended by the other agencies. However, it also recommends that KEI Power construct and operate a holding and sorting facility in conjunction with the upstream fishway that would be used to prevent invasive species such as Northern pike, rock bass, white catfish, European carp, and bluegill from gaining access to habitat in the Little Androscoggin River upstream of the dam.

KEI Power does not propose any upstream passage measures for anadromous fish. KEI Power states that it is open to developing upstream fish passage at the project at a pace and capacity that is in sync with the restoration of anadromous fish in the Little Androscoggin River. It believes that the fish run size estimates that Interior and NMFS base their prescriptions on are highly speculative and would only be possible if several other future events occur such as restoring habitat in Thompson Lake and other ponds upstream. KEI Power states that these activities likely won't be completed for several years and until they do, it believes that existing trap and truck methods currently employed in the river system[52] are an adequate and more cost-effective way to provide upstream passage than constructing a new fishway at the project.

Our Analysis

It is estimated that the Little Androscoggin River watershed upstream of the project historically provided 77 percent of alewife spawning habitat, 30 percent of American shad and blueback herring spawning habitat, and 9 percent of Atlantic salmon spawning habitat within the entire Androscoggin River Basin (Kircheis and Liebich, 2007; Maine DMR and Maine DIFW, 2017).

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[52] Maine DMR currently traps some fish (primarily alewife) at the Brunswick Project which is the dam furthest downstream on the mainstem Androscoggin River and stocks them in lakes and ponds (i.e., Taylor Pond, Marshall Pond, and Lower Range Pond) upstream of the Barker's Mill Project.

As shown in table 14, the draft fisheries management plan estimated the total annual production potential of adult anadromous fish in the Little Androscoggin River and in the Barker's Mill Impoundment. The plan estimated that the project's impoundment could support about 2,672 adult alewife, 4,935 adult blueback herring, and 569 adult American shad. The document did not estimate Atlantic salmon production in the impoundment; however, the estimated adult salmon escapement for the entire Little Androscoggin River Basin is 368 adults.

Table 14. Estimated total annual production potential of adult anadromous species in the Little Androscoggin River watershed and Barker's Mill Project impoundment. (Source: Maine DMR and Maine DIFW, 2017; as modified by staff)

	Little Androscoggin River Basin	Barker's Mill Impoundment (0.65-mile reach)	Percent of Little Androscoggin Basin Total in Barker's Mill Impoundment
Alewife[a]	1,728,895	2,672	0.2
Blueback Herring[b]	327,188	4,935	1.5
American shad[c]	37,694	569	1.5
Atlantic Salmon[d]	368	No Data	NA

[a]Production potential based on 11 acres of historically accessible spawning habitat and 234 alewife per acre.
[b]Production potential based on 11.4 acres of historically accessible spawning habitat and 434 blueback herring per acre.
[c]Production potential based on 11.4 acres of historically accessible spawning habitat and 50 American shad per acre.
[d]Adult escapement is estimated on a 1:1 sex ratio, 7,200 eggs/female and 240 eggs/unit for saturation.

Given the small size of the impoundment, the stated production potential for anadromous fish within the project impoundment is small relative to the rest of the Little Androscoggin River Basin (ranging from 0.2 percent of the total for alewife to 1.5 percent of the total for blueback herring and American shad). However, available information suggests that these estimates may not be realistically achievable in the foreseeable future based on a comparison of the estimated production potential versus the recent actual returns of these fish species to accessible habitats within the mainstem Androscoggin River downstream of Lewiston Falls.

Below we analyze the benefits of providing upstream fish passage to each of the anadromous fish species that historically occurred in the project area, taking into account the estimated production potential for the mainstem and Little Androscoggin River as well as the recent actual returns to the mainstem that are shown in tables 15 and 16.

Table 15. Counts of upstream migrating anadromous fish at the Brunswick Hydroelectric Project fishway (2007-2016). (Source: License application; as modified by staff)

Year	Alewife	American Shad	Atlantic Salmon
2007	60,662	6	21
2008	92,359	1	18
2009	44,725	0	24
2010	39,689	22	9
2011	54,886	0	44
2012	170,191	11	0
2013	69,104	0	2
2014	68,749	0	4
2015	71,887	53	2
2016	121,010	1,123	7
Average	79,326	122	13
Median	68,927	4	8

Table 16. Counts of upstream migrating andadromous fish at the Worumbo Hydroelectric Project fish lift (2007-2016). (Source: Staff)

Year	Alewife	American Shad	Atlantic Salmon
2007	19,078	0	7
2008	46,746	0	2
2009	14,961	0	1
2010	11,952	0	5
2011	136	0	3
2012	58,654	0	1
2013	28,714	0	1
2014	32,030	0	2
2015	59,200	18	0
2016	12,807	45	0
Average	28,428	6	2
Median	23,896	0	2

American Shad

According to the draft fisheries management plan, the production potential for the mainstem Androscoggin River of 50 shad per acre should equate to an annual production of 84,178 adult American shad for the entire accessible reach between the river mouth and Lewiston Falls. Yet, current run sizes of adult shad counted at the Brunswick Project fishway (the lowermost dam on the Androscoggin River) are considerably lower than the estimated potential, with a 10-year mean and 10-year median count at Brunswick Dam for 2007 to 2016 of 122 and 4 individuals, respectively, and a peak count of 1,123 adult shad in 2016. Comparing the average number of shad returning to accessible habitats within the Androscoggin River over the last 10 years to the production potential of 84,178 for the same river segment, actual returns are less than one percent of the estimated production potential. These data suggest that available habitats are not being fully utilized, such that, even if fish passage were fully restored throughout the basin, actual production of shad in the Little Androscoggin River would likewise be significantly lower than the estimate provided in the draft fisheries management plan.

Blueback Herring

For blueback herring, the available habitat in the mainstem downstream of Lewiston Falls is 1,684 acres and according to the management plan has a production potential of 434 fish per acre, which should equate to an annual production of over 730,000 blueback herring; however, no blueback herring have been counted passing upstream through the Brunswick Project fishway, meaning that actual returns to the basin upstream of Brunswick Dam are essentially zero.[53] These data suggest that actual returns to the Little Androscoggin River would be significantly lower than the estimate provided by the draft fisheries management plan, with annual returns to the river likely approaching zero.

Atlantic Salmon

There is no available information on the production potential for Atlantic salmon in the project's impoundment. Given that it is only 0.65-mile-long, contains no major tributaries, and extends to the tailwater of the Upper Barker Dam, it is likely that the Little Androscoggin River between the project dam and Upper Barker Dam contains no viable spawning habitat for Atlantic salmon. This is because Atlantic salmon are reliant

[53] Maine DMR and Maine DIFW (2017) reported that blueback herring have been observed spawning below the Brunswick Project, but biological sampling indicated that no blueback herring use the fishway at the Brunswick Project to reach historical spawning areas.

on flowing waters with clean aerated gravel for spawning success, and there is no reason to believe that such habitats exist within the lacustrine environment of the project's impoundment.

As previously discussed, the Upper Barker Project does not have any upstream fish passage facilities. Although Interior and NMFS indicate that it is their intent to prescribe fishways at the Upper Barker Project and Hackett Mills Project when their relicensing is expected to be completed in 2023 and 2024, respectively, there are four additional dams on the mainstem farther upstream that also lack upstream passage.[54] Therefore, under existing conditions if upstream passage for Atlantic salmon were provided at the project, immediate benefits would be limited to providing access to an additional 0.65 mile of lacustrine migration habitat between the project's dam and the Upper Barker Dam.

Based on the counts of Atlantic salmon at the Brunswick and Worumbo fishways, the run sizes of adults returning and successfully migrating upstream in the Androscoggin River Basin are also low. Between 2007 and 2016, the number of Atlantic salmon counted passing the Brunswick fishway ranged from 0 to 44 individuals per year, while upstream counts at the Worumbo fishway during the same time period ranged from 0 to 7 individuals. Comparing these returns to the estimated production potential of 182 adult Atlantic salmon for the currently accessible habitats within the Androscoggin River downstream of Lewiston Falls, again suggests that Atlantic salmon are not fully using available habitats and that actual returns would be significantly lower than those estimated by the draft fisheries management plan for the foreseeable future.

Alewife

The number of alewife passing both the Brunswick and Worumbo Dams is significantly higher than all other anadromous species attempting to migrate upstream, with actual recent median returns to the Brunswick fishway that are about 18 percent of the estimated production potential for currently accessible habitat downstream of Lewiston Falls. Nevertheless, in the Little Androscoggin River, with the exception of those adult alewife that are stocked by Maine DMR in historic habitats upstream, alewife are unable to access any upstream habitats due to the lack of upstream fish passage at the

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[54] One of the dams is associated with the Marcal Hydroelectric Project FERC No. 11482, which is required by the existing license to provide upstream fish passage for anadromous fish after Maine DMR produces a fishery management plan for the Little Androscoggin River. Another dam is associated with the Biscoe Falls Hydroelectric Project FERC No. 9411, which is currently operating under a hydropower licensing exemption. The other two dams (Welchville and South Paris) are private dams that are not regulated by FERC.

project's dam as well as 14 other dams throughout the watershed. This includes existing blockages at Taylor Brook (three dams) and Range Brook (one dam); these two tributaries provide alewife access to the most-productive habitats for this species in the basin. These four dams are not under FERC jurisdiction and it is unclear when or if these dams would ever provide passage. Therefore, even with effective upstream fish passage facilities installed at the Barker's Mill Project, alewife would still be unable to reach their most-productive historic spawning habitat. Accordingly, the benefits of providing upstream passage for alewife at the project would currently be limited to the additional 11 acres of spawning habitat provided by the project's impoundment.

Sea Lamprey

The historical abundance of sea lamprey upstream of the project is not known. Further, the relative abundance and importance of upstream habitat to the historical and existing sea lamprey population is not known. Because the abundance and importance of upstream habitat is not known, the benefit to passing sea lamprey upstream of the project also is not known and cannot be determined based on the available information.

Summary of Anadromous Fish Upstream Passage Effects

Overall, because of existing low run-sizes of blueback herring, American shad, and Atlantic salmon in the Androscoggin River Basin; the low amount of potential habitat upstream of the project in the 0.65–mile-long impounded reach between the project's dam and the Upper Barker Dam; the continued blockage of upstream passage throughout the Little Androscoggin River due to a lack of fish passage facilities at 14 additional dams throughout the basin, installing upstream fish passage facilities for anadromous fish at the Barker's Mill Project would provide minimal benefits to these species at this time. Furthermore, because of the continued lack of alewife access to its most-productive natural lake and pond habitats in Taylor Pond and Lower Range Pond, providing upstream passage for alewife would also provide minimal benefits.

<u>Counting Facility at the Upstream Fish Passage Facility</u>

NMFS's fishway prescription would require KEI Power to construct a fish counting facility as part of the required upstream fish passage facility for anadromous fish to enumerate successful passage of target species. The count data could provide resource managers with information on the number of fish that successfully pass the project and are accessing habitat upstream of the dam. Further, abundance estimates derived from the counts can help determine whether fish populations are increasing or decreasing.

Holding and Sorting Facility at the Upstream Fish Passage Facility

Northern pike have been present in the Androscoggin River basin since they were introduced into the Belgrade Lakes in the 1970's, and additional illegal introductions are responsible for an expanding distribution within central and southern Maine (Brautigam, 2001). Currently, northern pike are known to inhabit sections of the Androscoggin River mainstem, particularly downstream of the Brunswick Hydroelectric Project (Yoder et al., 2006; Maine DMR and Maine DIFW, 2017) and have also been found in Taylor Pond within the Little Androscoggin River Basin upstream of the Barker's Mill Project (Brautigam, 2001). Northern pike are voracious and opportunistic predators and are known to feed on juvenile salmonids (Brautigam, 2001). In addition to Northern pike, there are other non-indigenous fish such as rock bass, white catfish, carp, and bluegill that are known to inhabit segments of the Androscoggin mainstem or the estuary downstream of Barker's Mill Dam (Yoder et al., 2006; Maine DMR and Maine DIFW, 2017); however, there is no documentation of these species in areas upstream of Barker's Mill Dam.

Constructing and operating a holding and sorting facility in conjunction with any upstream fishway that is constructed at the project could help reduce the numbers of non-indigenous aquatic fish that enter the project impoundment from downstream areas where they would prey on and/or compete with native migratory and resident fish for habitat and food resources. However, even with installation of such a facility, as we said above, invasive northern pike already occur upstream of the project and could still access the project's impoundment by migrating downstream through the upstream dams' downstream passage facilities, turbines, or spillways. Therefore, a holding and sorting facility installed in an upstream passage facility at the project would be unlikely to remove all non-native species as they would continue to recruit from habitats upstream.

Fish Passage Design, Operation, and Maintenance

KEI Power has not finalized the design of its proposed modifications to the project's downstream fish passage facility and instead proposes to consult with the resource agencies prior to doing so.

Interior's and NMFS's fishway prescription stipulates that KEI Power submit design plans for the new upstream eel fishway and the downstream fish passage facility for diadromous fish to the respective agency for review and approval according to the following schedule: (1) submit the conceptual design plans within 6 months of license issuance; (3) submit the 30 percent design plan within 9 months of license issuance; (4) submit the 60 percent design plan, and basis of design report, if requested, within 12 months of license issuance; and (5) submit the 90 percent design plan within 18 months of license issuance. For the upstream fish passage facility for anadromous fish, Interior's and NMFS's fishway prescription stipulates that KEI Power submit design plans to the respective agency for review and approval according to the following schedule: (1) submit the conceptual design plans within 36 months of license issuance; (3) submit the 30 percent design plan within 39 months of license issuance; (4) submit the 60 percent design plan within 42 months of license issuance; and (5) submit the 90 percent design plan within 48 months of license issuance. Interior and NMFS also specify that KEI Power submit the final design plan to the Commission for approval prior to the commencement of fishway construction activities and to file as-built drawings with the respective agency after construction of the fishway is complete. Interior's fishway prescription further specifies that KEI Power design the fishways consistent with FWS's Design Criteria Manual.

Interior's prescription also specifies that KEI Power develop a fishway operation and maintenance plan (fishway plan) within 12 months of license issuance that includes measures for operating and maintaining the upstream and downstream fish passage facilities that are in operation at the time. Specific provisions of the plan would include: (1) a schedule for routine fishway maintenance to ensure fishways are ready for operation at the start of migration 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 stipulates that KEI Power submit the fishway plan to FWS for review and approval prior to submitting it to the Commission for its approval, and to update the fishway plan annually to reflect any changes in operation and maintenance planned for the year. The prescription also stipulates that, if FWS requests a modification to the fishway plan, KEI Power must amend the plan within 30 days and receive FWS approval prior to implementing any other modifications to the plan. KEI Power would also be required to provide FWS with information on fish passage operation and any project operating conditions that may affect fish passage within 10 days of any such request from FWS.

NMFS's fishway prescription includes specific provisions for maintaining the upstream and downstream fish passage facilities, including: (1) the licensee must keep the downstream and upstream passage facilities in proper order and clear of trash, logs, and material that would hinder flow and passage; and (2) anticipated maintenance must be performed in sufficient time before a migratory period such that fishways can be tested and inspected and will operate effectively prior to the migratory periods.

Maine DMR's section 10(j) recommendation also includes provisions for fish passage operations and maintenance, including:

1. KEI Power must operate each fish passage facility for a one-season "shakedown" period to ensure that it is generally operating as designed and to make minor adjustment to the facilities and operation. At the end of the

"shakedown" period, KEI Power must have a licensed engineer certify that the facility is constructed and operating as designed in all material respects. Further, KEI Power must provide Maine DMR, FWS, and NMFS with a copy of the as-built fishway drawings as submitted to the Commission, along with the licensed engineer's letter of certification.

2. KEI Power must keep the fishways in proper working order and maintain fishway areas clear of trash, logs, and material that would hinder passage. KEI Power must perform routine maintenance sufficiently before a migratory period such that fishways can be tested and inspected, and will be operational during the migratory periods.

3. KEI Power must draft, in consultation with Maine DMR, Interior, and NMFS, and maintain written fishway operating procedures for the Barker's Mill Project. These operating procedures would include: (1) general schedules of routine maintenance; (2) procedures for routine operation, monitoring, and reporting on the operation of each fish passage facility or measure; (3) schedules for procedures for annual start-up and shutdown; and (4) procedures for emergencies and project outages significantly affecting fishway operations.

4. KEI Power must maintain and operate permanent fishways during the upstream and downstream migration periods for alewife, blueback herring, American shad, Atlantic salmon, and American eel (see table 17). Maine DMR's recommendation includes provisions for modifying the schedule for fishway operation based on new information regarding the timing of migration, river conditions, maintenance requirements, or annual variability in fish migration patterns, in consultation with Maine DMR, Interior, and NMFS.

Table 17. Migration periods for alosines and American eel at the project. (Source: Maine DMR section 10(j) recommendation comment letter, filed December 21, 2017)

Species	**Upstream Migration Period**	**Downstream Migration Period**
Alewife, blueback herring, and American shad[a]	May 1-July 31	June 1-November 30
American eel	June 1-September 15	August 15-November 15

[a] Although Maine DMR recommends that KEI Power maintain and operate fishways during the migration period for Atlantic salmon, it did not specify an upstream or downstream migration period for this species.

Our Analysis

Fish Passage Design

The installation or modification of fish passage facilities, such as the proposed modifications to the project's existing downstream fish passage facility would require careful design to ensure these facilities are able to pass fish in a safe, timely, and effective manner. The downstream fish passage facility improvements would require modifications to the bypass entrance and the plunge pool. The new upstream passage facilities for American eel and anadromous fish that are stipulated by the preliminary fishway prescriptions would be new structures at the project that would require considerations such as proper placement along the dam and necessary attraction flows to provide adequate passage for the target species. KEI Power's proposal to consult with the resource agencies on the design of the modified downstream fish passage facility, and general provisions for the design of fishways from Interior's and NMFS's fishway prescriptions and Maine DMR's section 10(j) recommendation, would help guide the design process and ensure fishways are constructed to operate effectively.

Submitting the conceptual, 30, 60, and 90 percent design drawings to NMFS, Interior, and Maine DMR would provide the resource agencies with a way to review and comment on design issues and provide KEI Power with an opportunity to adjust the design of any fish passage facility based on comments from the resource agencies to ensure that fish passage facilities are constructed to operate effectively. Submitting the design drawings in this manner would also ensure that fish passage facilities are constructed in a timely manner. However, it is the Commission's sole responsibility to ensure that project facilities are designed and constructed according to the terms of the license; therefore, there would be no benefits from requiring other agency approval of design plans for project facilities.

Shakedown Period

Maine DMR recommends operating each new or modified fish passage facility for a one-season "shakedown" period to ensure that the these facilities are generally operating as designed, and if not, to make adjustments. Ensuring that new and modified fish passage facilities are operating as designed would increase the likelihood of safe, timely, and effective passage. To prevent interference with operation of the fish passage facilities during the migration season, any necessary adjustments could be timed so that they are completed prior to the relevant fish passage season.

As-Built Drawings

As-built drawings provide documentation that fishways are constructed as designed. However, because it is the responsibility of the Commission to approve and ensure the proper design of fishways, there would be little benefit to providing certified as-built drawings to the resource agencies. Further, as-built drawings could be accessed by the agencies, through the Commission.

Fishway Operation and Maintenance Plan

Fish passage facilities need to be sufficiently maintained to ensure the proper operation and effectiveness. A good operation and maintenance plan would include procedures and a schedule for routine cleaning and maintenance, including debris removal, and for operating the facility (i.e.,. appropriate times of the day and year, and with an appropriate conveyance flow). The fishway operation and maintenance plan should also include procedures for documenting operation and maintenance. Such information would provide resource agencies and the Commission a way to review the maintenance and operation history for all fish passage facilities at the project and adjust procedures as appropriate.

As new and better information becomes available from operating the fish passage facilities, operating schedules may need to be refined as suggested by Maine DMR. Such modifications could improve the effectiveness of the facilities. However, any such change would require amending the license, at which time the Commission would consider the benefits and costs of the recommended changes.

Fishway Effectiveness Testing

Interior's fishway prescription would require KEI Power to test the effectiveness of new upstream and downstream eel and alosine passage facilities. Interior's fishway prescription specifically requires KEI Power to: (1) develop fishway effectiveness testing and evaluation plans within six months of license issuance; (2) submit the effectiveness testing and monitoring plan to FWS for review and approval; (3) implement the measures in the plan at the start of the first migratory season after a fishway is operational; (4) conduct effectiveness testing and evaluation for a minimum of two years; (5) meet with FWS and other resource agencies in the late fall to review fishway maintenance, operation, monitoring results, and to review the fishway operation and maintenance plan; and (6) implement changes and planned maintenance 30 days prior to the start of the next migratory season. Interior also prescribes that KEI Power provide FWS personnel, and its designated representatives, access to the project site and to pertinent project records for the purpose of inspecting the fish passage facilities and to determine compliance with its prescription.

NMFS's fishway prescription would require KEI Power to: (1) develop study design plans in consultation with NMFS and state and federal resource agencies; (2) seek resource agency approval of the study design prior to filing with the Commission for final approval; (3) complete all monitoring with scientifically accepted practices; (4) conduct a minimum of two years of quantitative monitoring for the new upstream and downstream measures for alosines; (5) begin monitoring of alosines after a one-year operational shakedown period for each fish passage facility with another year of monitoring during the project license in consultation with resource agencies; (6) conduct upstream and downstream monitoring of all life stages of Atlantic salmon contingent on agency consultation and presence of testable individuals; (7) prepare annual fish passage reports that consist of data from the fish passage season including passage counts for each species, daily river flow conditions, fishway operational settings, and project operations; (8) provide reports of the monitoring studies to the resource agencies for a minimum 30-day review and consultation, prior to submittal to the Commission for final approval; (9) include resource agencies' comments in the annual reports submitted to the Commission for final review; (10) continue monitoring biennially if performance standards are not met; (11) improve fishways that do not meet performance standards; and (12) provide resource agencies access to the fishway for inspection throughout the term of the license with reasonable notice.

KEI Power does not propose to conduct effectiveness testing.

Our Analysis

Fishway efficiency evaluations can 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 the FWS 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 NMFS have not included any specific performance standards that would be used to test the effectiveness of the new downstream fish passage facility. Instead, they would require the development of plans and performance standards post-licensing, in consultation with resource agencies. Without specific performance standards to evaluate, there is no information to analyze and no information to determine whether effectiveness testing would or would not provide benefits to anadromous fish and American eels.

Interior states in its fishway prescription that effectiveness testing is critical to evaluating passage success, diagnosing problems, and determining when fish passage modifications are needed and what modifications are most likely to be effective. Interior also states that effectiveness testing is essential to ensuring the effectiveness of fish passage facilities over the term of the license, particularly in cases where the changing size of fish populations may also change fish passage efficiency or limit effectiveness. However, the fishway prescriptions also would require that the new fish passage facilities be designed through a detailed agency design-review process and in accordance with proven, species-specific design criteria from the FWS's Design Criteria Manual. The fishway prescriptions also specify that the facilities be operated and maintained in accordance with a fish passage operation and maintenance plan that is to be developed in consultation with the resource agencies and approved by the Commission. Since the facilities would be designed, operated, and maintained in accordance with proven fish passage standards and operating procedures, there is no apparent benefit to conducting effectiveness studies. As discussed above, however, Maine DMR's recommendation to operate each new or modified fish passage facility for a one-season "shakedown" period to ensure that these facilities are generally operating as designed, and if not, to make adjustments would increase the likelihood of safe, timely, and effective passage.

Interior's preliminary fishway prescription would require KEI Power to meet with FWS and other resource agencies in the late fall to report on fish passage maintenance and operation, report on monitoring results, and to review the operation and maintenance plan. Likewise, Maine DMR recommends KEI Power meet with resource agencies annually in March to review fish passage operation data, draft an annual report, and develop an operational plan for the upcoming year. Interior and Maine DMR do not identify a specific need or benefit of meeting annually or reviewing fish passage operational data and monitoring results. Further, KEI Power would operate and maintain all fish passage facilities by following specific operation and maintenance plans that are developed in consultation with the resource agencies, and approved by the Commission. With proper operation and maintenance, there is no reason to believe that the fish passage facilities would not perform as designed. Thus, there would be no benefit to meeting annually.

For the same reasons, there would also be little benefit to Interior's fishway prescription that would require KEI Power to provide access to the project site and to information on fish passage operation and project generation to FWS upon written request. Ensuring compliance with the terms of the license is the Commission's responsibility and the Commission's standard terms and conditions for a hydropower license already require the licensee to provide employees of the U.S. Government access to project land and works in performance of their official duties.

3.3.1.3 Cumulative Effects

The Barker's Mill Project, in combination with other dams and hydroelectric projects on the Androscoggin River and its tributaries, have adversely affected diadromous fish populations by impounding riverine habitat, reducing streamflows in bypassed reaches, impeding or disrupting sediment transport, fragmenting aquatic habitat, blocking access to historical spawning habitat, and causing mortality of downstream migrants due to unsafe passage through turbines and other flow regulating equipment (e.g., sluice gates, spillways) within the geographic scope (i.e., 67-mile reach from the historic upstream limit for anadromous fish at Snow Falls on the Little Androscoggin River downstream to mouth of the mainstem Androscoggin River at Merrymeeting Bay).

Man-made barriers have been present throughout the Androscoggin River drainage for over 200 years (Maine DMR and Maine DIFW, 2017). Upstream and downstream fish passage is currently provided on the Brunswick, Pejepscot, and Worumbo Projects on the mainstem Androscoggin River, thus allowing diadromous fish access to the lower 0.7 mile of the Little Androscoggin River below the Barker's Mill Dam. However, none of the seven dams on the Little Androscoggin River or the eight additional dams on its tributaries currently provide upstream passage, which prevents anadromous fish and limits catadromous eels from accessing historical spawning and rearing habitat upstream of these dams. Additionally, only 4 of the 15 dams have dedicated downstream fish passage facilities (Maine DMR and Maine DIFW, 2017).

Adding upstream fish passage facilities at the Barker's Mill Project would provide access to an additional 0.65-mile reach of lacustrine habitat within the project's impoundment. License Article 408 for the Marcal Project (located approximately 14 RMs upstream of Barker's Mill) requires upstream passage for anadromous fish after Maine DMR and Maine Atlantic Salmon Authority (now part of Maine DMR) prepare a fisheries management plan for the Little Androscoggin River.[55] The state's draft management plan for the Little Androscoggin River and Interior's and NMFS's fishway prescriptions indicate that upstream and downstream fish passage facilities will be required at the four lower-most FERC-licensed dams on the Little Androscoggin River by 2027 (i.e., Barker's Mill, Upper Barker, Hackett's Mill, and Marcal Projects). Additional restoration objectives for non-hydroelectric dams in the basin include providing upstream

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[55] Article 408 of the Marcal Project license order states that "As warranted, the licensee shall install, operate, and maintain upstream fish passage at the Marcal Project, or provide an alternative fish passage plan, to facilitate passage of anadromous fish past the project to the watershed's upstream habitat." The article also states that no fish passage measures shall be required until the state agencies produce a fish restoration and management plan for the Little Androscoggin River, and requires the licensee to file a report that includes any agency recommendations for fish passage and a discussion of the benefits and costs of such recommendations within 180 days after the state completes the fish restoration and management plan. The article also reserves authority to the Commission to direct the licensee to amend the license for the purposes of modifying project structures and/or operations, as appropriate, to implement any required fish passage measures (S*ee* 80 FERC ¶ 62,038 (1997)).

and downstream fish passage at the following facilities by 2027: (1) three dams on Taylor Brook – the tributary draining Taylor Pond that discharges to the Upper Barker Project impoundment; (2) one dam on Range Brook – a tributary draining Lower Range Pond; and (3) Welchville Dam, the next dam upstream of the Marcal Project on the Little Androscoggin River. If accomplished and successful, anadromous fish and American eels would again have access to most of the mainstem habitat in the basin.

However, even if upstream passage is added to the Barker's Mills Project and the three additional FERC-licensed hydroelectric projects by 2027, predicting whether and when fish passage would be installed at the 11 non-FERC licensed dams on the mainstem and tributaries to the Little Androscoggin River is uncertain and speculative. Thus, we expect that existing passage barriers would continue to limit access to historical spawning habitat throughout much of the Little Androscoggin River Basin over the next 30 to 50 years.

Maine DMR currently traps alewife at the Brunswick Project on the mainstem Androscoggin River and stocks them in several lakes and ponds upstream of the Barker's Mill Project which aids in restoration efforts. Also, the four FERC-licensed hydroelectric projects in the basin seasonally operate downstream passage facilities for diadromous fish, which allows some migrating juvenile anadromous fish and adult eels to pass downstream to complete their life history. We expect these efforts would continue to benefit some American eel and stocked alewife throughout the basin over the next 30 to 50 years.

Relicensing the project would result in the implementation of several proposed measures (i.e., run-of-river operation, higher minimum flow releases, and modifications to the downstream fish passage system) that would benefit diadromous fish by increasing aquatic habitat and enhancing migratory routes in the bypassed reach, enhancing water quality conditions in the bypassed reach and downstream of the powerhouse, and enhancing survival of downstream migrating fish. Overall, KEI Power's proposed and the agencies' recommended and prescribed measures would cumulatively benefit diadromous fish in the basin.

3.3.2 Terrestrial Resources

3.3.2.1 Affected Environment

The project is located in the Central Interior ecoregion of Maine. Situated between the foothills of the White Mountains and the lowlands of the lower Penobscot River Valley, this ecoregion is characterized by flat to gently rolling terrain. The region is a transition zone from an Appalachian forest dominated by oak, pine, and mixed hardwoods in southern Maine to a spruce-fir-northern hardwood forest in northern and eastern Maine (Maine DIFW, 2005).

Botanical Resources

Upland habitats occurring in the project vicinity include deciduous and mixed forest, coniferous forest, grassland, agriculture and old fields, and urban and suburban areas. The project itself is dominated by deciduous forest and areas of urban and suburban development. Botanical habitats that occur in the project area include Laurentian-Acadian Large River Floodplain, Laurentian-Acadian Red Oak-Northern Hardwood Forest, Laurentian-Acadian Pine-Hemlock-Hardwood Forest, and Developed.[56]

The Large River Floodplain habitat type is a complex of wetland and upland vegetation on floodplains. Typical overstory species include silver maple, green ash, American elm, red maple, and musclewood, with sugar maple and red oak on floodplain terraces. The herb layer includes various ferns and plants such as bottlebrush grass and hare figwort (Anderson *et al*., 2013). Within the project boundary, this habitat type is present on islands within the bypassed reach and narrow fringes along the east and west banks of the impoundment approximately 2,000 feet upstream from the Barker's Mill Dam.

The overstory of the Red Oak-Northern Hardwood Forest habitat type is dominated by red oak with other hardwoods such as sugar maple, American beech, and yellow birch. Understory plants include species such as broad beech fern, flowering dogwood, and American squawroot (Anderson *et al*., 2013). Small patches of this habitat type exist on the eastern shoreline of the Little Androscoggin River adjacent to the Barker's Mill Dam, and approximately 300 feet above the dam on the west bank of the impoundment.

The Pine-Hemlock-Hardwood Forest habitat has white pine, eastern hemlock, and red oak as typical canopy dominants, with red maple and other hardwoods often present. Plants in the understory can include Appalachian barren strawberry and mountain laurel (Anderson *et al*., 2013). This habitat is found along the western shoreline of the Little Androscoggin River throughout much of the project boundary, and along the east bank of the impoundment just downstream from the Upper Barker Dam.

Developed areas surrounding the project are mainly residential developments and urban/suburban areas including an active railroad track along the northern shore and the New Auburn community to the south and east.

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[56] http://maps.tnc.org/nehabitatmap/

Wetlands

According to FWS's National Wetlands Inventory system (FWS, 2017b), the predominant wetland type at the project is riverine, with approximately 4.8 acres of freshwater forested/shrub wetlands also present in the bypassed reach and adjacent to the impoundment. As described above for the Large River Floodplain habitat, common dominant species in these forested/shrub wetlands include red maple, American elm, and green and black ash.

Wildlife

Freshwater wetlands provide habitat for a variety of reptiles and amphibians such as the green frog, bullfrog, American toad, painted turtles, and snapping turtles. The shoreline habitats of the Little Androscoggin River likely provides habitat for mammal species such as muskrat, striped skunk, mink, raccoon, and bird species such as eastern phoebe, green heron, and yellow-throated vireo during summer months. Waterfowl species that can be found in the littoral zone of the Little Androscoggin River include common goldeneye, common merganser, American black duck, Canada goose, mallard, and wood duck. Other bird species foraging in the nearby rivers and water bodies can include ring-billed gulls, belted kingfishers, double-crested cormorants, and common loons.

Within forested areas, common mammals likely found with the project area and immediate vicinity include red fox, opossum, eastern chipmunk, eastern gray squirrel, red squirrel, white-footed mouse and various bat species. Birds inhabiting these forests include the black-capped chickadee, American goldfinch, white-breasted nuthatch, song sparrow, blue jay, downy woodpecker, sharp-shined hawk, and broad-winged hawk. Other transient bird species can use this habitat during spring or fall migratory periods.

Sensitive Species and Maine Significant Wildlife Habitat

Bald eagles are known to forage and nest within the project vicinity. The bald eagle was delisted from the ESA in 2007 and from Maine's state list in 2009, but remains federally protected under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act (FWS, 2007). According to 2013 aerial survey nesting data (FWS, 2014), three bald eagle nests are within the vicinity of the project along the Androscoggin River. One nest, approximately one mile north of the project, could not be located by Commission staff when they visited the area in August 2017. The other two nests are just over two miles to the south of the project (FWS, 2014).

According to Maine DEP data[57], no “Significant Wildlife Habitats,” as defined by Maine’s Natural Resource Protection Act are within the project boundary. Three habitat types are present about 1.5 to 2.5 miles from the project: inland waterfowl and wading bird habitat (IWWH), deer wintering areas, and significant vernal pools. IWWH areas are defined as wetland complexes surrounded by a 250-foot-wide upland zone buffer or is an inland wetland complex that has documented outstanding use by waterfowl or wading birds. Deer wintering areas are forested areas that provide shelter for deer when deep snow restricts their mobility and food availability. Significant vernal pools are natural, temporary to semi-permanent bodies of water occurring in shallow depressions that typically fill during the spring or fall and may dry during the summer.

3.3.2.2 Environmental Effects

Effects of Project Operation and Increases to Minimum Flow

KEI Power proposes to continue to operate the project in a run-of-river mode and increase the minimum flow from 20 cfs to 113 cfs.

Under section 10(j), Interior, NMFS, and Maine DMR recommend that the project be operated in run-of-river mode. Interior and NMFS recommend that KEI Power provide a continuous minimum bypass flow of 175 cfs, or inflow, while Maine DMR recommends a 113 cfs minimum bypass flow. NMFS recommends that the impoundment be maintained within one foot of the top of the flashboards on a regular basis, or within one foot of the permanent crest when replacing flashboards, while Maine DMR recommends that impoundment fluctuations be kept to a minimum.

In its comments, Maine DIFW supports a 113 cfs minimum bypass flow, and recommends that any water level drawdowns to be limited to one foot or less from full pond elevation or from the spillway crest when flashboards are down.

Our Analysis

Continuing to operate the project in a run-of-river mode would continue to limit impoundment water level fluctuations and associated effects such as shoreline erosion and changes to wetland composition, structure, and function. Maintaining the impoundment within one foot or less of the top of the flashboards, as recommended by NMFS and as currently being done by KEI Power, would continue to maintain the vegetation and habitats established along the impoundment.

[57] https://www.maine.gov/dep/gis/datamaps/

Increasing the minimum bypassed reach flow release would increase the amount of habitat available for semi-aquatic species (i.e., turtles, muskrat) during the summer season, and should improve foraging and reproductive conditions and opportunities for shorebirds, amphibians, and dabbling ducks. Increasing the minimum flow would create longer periods of inundation for forested wetlands and riparian areas; however, species composition and structure would not likely change dramatically because these attributes are more often driven by much higher channel-forming flows.

Effects of Construction Activities

The applicant proposes to upgrade the existing downstream fish passage facility, which would include modifications to existing structures (i.e., power canal, stop log bay, and plunge pool). Resource agencies (NMFS, Interior, and Maine DMR) have prescribed or recommended downstream fish passage for diadromous species, as well as upstream passage for anadromous and catadromous species. Recommended or proposed designs for fish passage facilities are described in more detail above, under section 3.3.1.2

The applicant also proposes to improve public access to the Little Androscoggin River for recreational activities. The applicant proposes to provide signage, parking, and foot access to the bypassed reach area and improve the hand-carry boat launch at the impoundment.

There have been no proposed or recommended measures for the protection or enhancement of wetland, botanical, or terrestrial wildlife resources by the applicant, resource agencies, or any other entity.

Our Analysis

All proposed downstream fish passage designs involve modifying or adding to the existing structures. Dewatering of certain areas (i.e., the power canal, plunge pool) during construction will be necessary, and sediment mobilization during in-water work activities could occur, resulting in reduced water quality and sediment accumulation in downstream wetland habitats. KEI Power does not describe how it would access power canal and plunge pool to install its proposed downstream fish passage improvements, but we presume that the applicant could use the dirt access road to the project's gate house and the dirt parking area adjacent to the gate house for access and staging of equipment. Removal of top soil and erosion could occur during site access, as well as the introduction or spread of noxious weeds and invasive plants through the use of large construction equipment.

Construction the agency-prescribed upstream fishways for anadromous species would also likely require some vegetation removal and soil disturbing activity in riparian areas adjacent to the bypassed reach. However, the amount of habitat loss and potential disturbance that might occur is unknown, as it would depend on the design type (e.g., pool and weir fishway or fish lift) and location for upstream fishways. However, if the facilities are built on the opposite bank from the downstream fish passage facility, as shown in a hypothetical pool and weir fishway drawing,[58] they would permanently displace northern hardwood forested habitat. Temporary displacement of forested habitat could also be required for site access, staging equipment, and placement of spoil material.

The applicant's proposed improvements for public access to the Little Androscoggin River from the Barker Mill Trail for recreational activities would require minor construction work within the existing northern hardwood forested habitat and at the river shoreline. KEI Power does not specify specific work activities, but proposes to improve the hand-carry boat launch on the impoundment upstream of the dam and the foot trail leading to the bypassed reach just downstream of the dam. In addition to these recreational access improvements, American Whitewater and the U.S. National Park Service (Park Service) recommend that the licensee construct and maintain a walking path along the bypassed reach from the dam to the powerhouse. For the applicant's proposed improvements to the boat launch and foot path, we would not expect the need for significant soil disturbance or vegetation clearing activities because informal pathways currently exist. However, the grade in certain sections of the foot path may need to be adjusted to provide a gentler slope to accommodate visitors with limited physical ability.

Constructing a trail in the riparian area along the bypassed reach, as recommended by American Whitewater and the Park Service, would affect terrestrial resources as there could be extensive soil disturbance and the potential for erosion. Assuming the construction of a 5-foot-wide pathway about 0.34 mile long from the dam to the powerhouse, approximately 0.25 acre of land would need to be cleared and graded. Clearing would likely require the removal of large rocks and vegetation, including some small trees. Future project maintenance for all recreational trails and access areas could require occasional pruning of surrounding vegetation or clearing of fallen trees or branches.

During construction of these facilities, some wildlife would likely be temporarily displaced due to the increase in noise and human activity in the project area. Species that are mobile enough to flee or avoid the areas of activity would leave and forage in other available nearby habitats until activity subsides. Mortality of less mobile species (e.g., reptiles and amphibians) could occur, and depending on season, work could disrupt bird

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[58] *See* figure 7 in FWS's memorandum dated December 15, 2017 evaluating potential upstream and downstream passage design alternatives for the project. The memorandum was filed with the Commission on December 21, 2017 as part of Interior's administrative record in support of its preliminary Section 18 fishway prescription.

reproductive activities such as nest building or egg-laying. After construction, such noise and human presence would lessen, but would likely increase over the levels that occurred prior to construction due to increases in recreational use.

Bald eagles are unlikely to be significantly affected by project activities as all known nests are over one mile away. While the project area does provide some foraging habitat, construction would not disrupt eagles from foraging along the mainstem of the Androscoggin, where the nests are located. Significant Wildlife Habitats are not expected to be affected by project-related activities as they are all located over a mile from the project and beyond the developed, residential areas that immediately surround the project.

3.3.3 Threatened and Endangered Species

3.3.3.1 Affected Environment

The federally endangered Gulf of Maine Distinct Population Segment (GOM DPS) of anadromous Atlantic salmon currently occupies the Androscoggin River Basin and has been observed in the project bypassed reach. Additionally, two federally listed threatened species, the small whorled pogonia and northern long-eared bat could occur in Androscoggin County, Maine.

Atlantic Salmon

The GOM DPS of Atlantic salmon were initially listed as endangered on November 17, 2000, in eight coastal Maine watersheds by NMFS and the FWS (65 Federal Register 69459). NMFS and FWS later expanded the listing to include Atlantic salmon that inhabit large Maine rivers (Androscoggin, Kennebec, and Penobscot) that were partially or wholly excluded in the initial listing (74 Federal Register 29344; June 19, 2009). Currently, the GOM DPS includes Atlantic salmon that occupy freshwater from the Androscoggin River to the Dennys River, as well as anywhere Atlantic salmon occur in the estuarine and marine environments. Specifically, in the Androscoggin River basin, the historical freshwater upstream limit of Atlantic salmon is delimited by impassable falls including Rumford Falls in the town of Rumford on the mainstem Androscoggin River and Snow Falls in the town of West Paris on the Little Androscoggin River. Atlantic salmon found in the project area are part of the Merrymeeting Bay Salmon Habitat Recovery Unit.[59]

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[59] The Atlantic Salmon GOM DPS is separated into three salmon habitat recovery units to ensure that Atlantic salmon are well distributed across the range of the DPS. The separation is based on life history characteristics, as well as demographic and environmental variation. This type of separation is designed to buffer the DPS from

Life History

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

Atlantic salmon spend the majority of their adult life (about 2 to 3 years) in marine environments before returning to freshwater rivers and streams to spawn. Adults are able to return to their natal habitat using olfactory cues (i.e., odors) that they imprinted on while rearing in natal habitat, especially during the smolt stage (McCormick *et al.*, 1998). Approximately 86 percent of adults return after 2 years, about 10 percent (primarily males) return after 1 year, and the remaining 4 percent are repeat spawners, or spend 3 years at sea (NMFS and FWS, 2009). Most adult Atlantic salmon enter Maine rivers during the spring and early summer (May-July), but upstream migrations can occur from April to early November (Baum, 1997). Returning adults will spawn in clear, coldwater streams and rivers having relatively unobstructed passage to the ocean. Suitable spawning habitat is characterized by coarse gravel or rubble bottom with suitable well-oxygenated, clean water. Anadromous Atlantic salmon usually spawn in late fall or early winter months (Fay *et al.*, 2006). After spawning, some adults known as kelts survive the downstream migration to the ocean and return to spawn again. From 1967 to 2003, approximately 3 percent of the wild and naturally reared adult anadromous Atlantic salmon returning to U.S. rivers were repeat spawners (USASAC, 2004).

Abundance and Distribution in the Project Area

Most of the production of Atlantic salmon in the Androscoggin River is the result of fry stocking in the Little River, a tributary to the mainstem Androscoggin River (NMFS, 2017). The Little River enters the Androscoggin downstream of the Worumbo Hydroelectric Project (FERC No. 3428) which is first of three dams on the mainstem Androscoggin River downstream of the Barker's Mill Project. The fish lift at the Worumbo Project was designed to pass anadromous fish including Atlantic salmon. Between 2003 and 2015, an average of two (range from 0 to 7) Atlantic salmon individuals successfully passed upstream of the Worumbo fish lift (NMFS, 2017). NMFS (2017) characterized these individuals as primarily strays either from tributaries

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adverse demographic and environmental events that could negatively affect recovery of the species.

downstream or from other river systems. After passing upstream of Worumbo Dam, Atlantic salmon have the ability to move into the following areas: (1) up to Lewiston Falls on the mainstem (and possibly further upstream if they traverse the falls); (2) into the Little Androscoggin River up to the Barker's Mill Dam; or (3) into the Sabattus River up to the Farnsworth Mill Dam located near Lisbon, Maine.

During 2011, Maine DMR conducted a tagging and telemetry study of 20 adult Atlantic salmon collected at the Brunswick Hydroelectric Project (FERC No. 2284), which is the third dam downstream of the project on the mainstem Androscoggin River and the first dam on the mainstem. Two of the tagged salmon were detected above the Worumbo Project. One male Atlantic salmon was regularly in the Barker's Mill bypassed reach during the spawning season; however, electrofishing conducted the following year failed to locate any young-of-the-year salmon (NMFS, 2017). As indicated in section 3.3.1.1, *Aquatic Resources*, *Affected Environment*, some suitable spawning habitat does occur in the project bypassed reach (low gradient riffle with unembedded gravel/cobble bars) located approximately 1,250 feet downstream of the project dam. While no redds were found during surveys conducted by KEI Power, this spawning habitat is currently available to the limited numbers of salmon that pass upstream of the Worumbo fish lift.

Recovery Plan

The 2005 Final Recovery Plan for the GOM DPS of Atlantic Salmon (NMFS and FWS, 2005) presented a strategy for recovering Atlantic salmon under the original 2000 listing rule. An updated draft recovery plan was recently published for public comment, which addresses recovery within the expanded range of the GOM DPS described in the 2009 listing rule (NMFS and FWS, 2016). The 2016 draft recovery plan (NMFS and FWS, 2016) reflects a new recovery planning approach (termed the Recovery Enhancement Vision) that focuses on the three statutory requirements in the ESA, including: site-specific recovery actions; objective, measurable criteria for delisting; and time and cost estimates to achieve recovery and intermediate steps. The main objective of the draft recovery plan is to maintain self-sustaining, wild populations with access to sufficient suitable habitat in each salmon habitat recovery unit, and ensure that necessary management options for marine survival are in place. In addition, the plan seeks to reduce or eliminate all threats that either individually or in combination might endanger the GOM DPS (NMFS and FWS, 2016).

The draft recovery plan recommends the following major actions:

- Improve connections between the ocean and freshwater habitats important for salmon recovery;
- Maintain genetic diversity of Atlantic salmon populations over time;

- Increase the number of reproducing adults through the conservation hatchery program;
- Increase the number of reproducing adults through the freshwater production of smolts;
- Increase Atlantic salmon survival by improving our understanding of marine ecosystems and the factors that affect salmon in the ocean; and
- Collaborating with partners and involving interested parties in recovery efforts.

Critical Habitat

Critical habitat was designated for Atlantic salmon on June 19, 2009.[60] The critical habitat designation includes 45 specific areas occupied by the GOM DPS of Atlantic salmon that comprise approximately 12,161 miles of perennial river, stream, and estuary habitat and 197,437 acres of lake habitat. Within the occupied areas there are known physical and biological features that are essential to the conservation of the species, known as primary constituent elements (PCEs). Atlantic salmon critical habitat PCEs include sites for spawning, incubation, and juvenile rearing, and sites for migration.

Physical and biological features of the spawning and rearing PCE include:

- PCE 1: deep, oxygenated pools and cover (e.g., boulders, woody debris, and vegetation), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall;
- PCE 2: freshwater spawning sites that contain clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support spawning activity, egg incubation, and larval development;
- PCE 3: freshwater spawning and rearing sites with clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support emergence, territorial development, and feeding activities of Atlantic salmon fry;
- PCE 4: freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr;
- PCE 5: freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parr's ability to occupy many niches and maximize parr production;
- PCE 6: freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr; and
- PCE 7: freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.

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[60] *See* 74 Federal Register 29300-29341 (June 19, 2009).

Physical and biological features of the migration PCE include:

- PCE 8: freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations;
- PCE 9: freshwater and estuary migration sites with pool, lake, and instream habitat that provide cool, oxygenated water and cover items (e.g., boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon;
- PCE 10: freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation;
- PCE 11: freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment;
- PCE 12: freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration; and
- PCE 13: freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

Critical habitat on the Androscoggin River includes the mainstem and all tributaries from Merrymeeting Bay up to the confluence with the Little Androscoggin River, but not including the Little Androscoggin River (NMFS, 2009). Therefore, the project does not occupy any critical habitat; critical habitat is located in the Androscoggin mainstem approximately 0.13 RM downstream of the project's powerhouse. Habitat in the Androscoggin River mainstem is considered critical habitat for upstream and downstream migration of Atlantic salmon (migration PCEs listed above).

Essential Fish Habitat

Essential fish habitat (EFH) refers to those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity and covers a species' full life cycle.[61] EFH for Atlantic salmon has been defined as, "all waters currently or historically accessible to Atlantic salmon within the streams, rivers, lakes, ponds, wetlands, and other water bodies of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut." The project area constitutes EFH for Atlantic salmon because it is located in Maine and on the Little Androscoggin River, which contains habitat currently accessible to Atlantic salmon up to the project's Barker's Mill Dam at RM 0.7. Although the project's dam currently blocks upstream fish passage, the Little Androscoggin River upstream of the dam also constitutes EFH for Atlantic salmon because it was historically accessible to this species.

[61] 50 C.F.R. § 600.10 (2018).

The following describes EFH for each Atlantic salmon life stage from the New England Fishery Management Council's Final Omnibus Essential Fish Habitat Amendment 2 document (NEFMC, 2016):

- Eggs: Bottom habitats with a gravel or cobble riffle above or below a pool of rivers. Generally, the following conditions exist in the egg pits (redds): water temperatures below 10°C, and clean, well-oxygenated fresh water. Atlantic salmon eggs are most frequently observed between October and April.
- Larvae: Bottom habitats with a gravel or cobble riffle (redd) above or below a pool of rivers. Generally, the following conditions exist where Atlantic salmon larvae, or alevins/fry, are found: water temperatures below 10°C, and clean, well-oxygenated fresh water. Atlantic salmon alevins/fry are most frequently observed between March and June.
- Juveniles: Bottom habitats of shallow gravel/cobble riffles interspersed with deeper riffles and pools in rivers and estuaries. Generally, the following conditions exist where Atlantic salmon parr are found: clean, well-oxygenated fresh water, water temperatures below 25°C, water depths between 10 centimeters (cm) and 61 cm, and water velocities between 30 and 92 cm per second. As they grow, parr transform into smolts. Atlantic salmon smolts require access downstream to make their way to the ocean. Upon entering the sea, "post-smolts" become pelagic and range from Long Island Sound north to the Labrador Sea.
- Adults: For adult Atlantic salmon returning to spawn, habitats with resting and holding pools in rivers and estuaries. Returning Atlantic salmon require access to their natal streams and access to the spawning grounds. Generally, the following conditions exist where returning Atlantic salmon adults are found migrating to the spawning grounds: water temperatures below 22.8°C, and dissolved oxygen above 5 parts per million. Oceanic adult Atlantic salmon are primarily pelagic and range from the waters of the continental shelf off southern New England north throughout the Gulf of Maine.
- Spawning Adults: Bottom habitats with a gravel or cobble riffle (redd) above or below a pool of rivers. Generally, the following conditions exist where spawning Atlantic salmon adults are found: water temperatures below 10°C, water depths between 30 cm and 61 cm, water velocities around 61 cm per second, and clean, well-oxygenated fresh water. Spawning Atlantic salmon adults are most frequently observed during October and November.

Small Whorled Pogonia

The small whorled pogonia is an herb in the orchid family that grows to about 10 to 14 inches high in acidic, humus-rich soils, among mature beech, birch, maple, oak, hickory and sometimes hemlock and other softwood trees. It prefers forests with an open understory and thick leaf litter on the forest floor, and is often found near logging roads, streams, or other features that create breaks in the forest canopy. Light could be a limiting factor (FWS, 1992). This species is named for the five- to six-leaf whorl topping the stem just below its greenish yellow flower(s) which bloom between mid-May to mid-June. The primary threat to the species is habitat loss due to residential and commercial development, with some forestry practices also eliminating habitat (FWS, 1994). Although it is widely distributed among eastern states from northern Georgia to southern Maine and into Ontario, Canada, it is rare throughout its range. In Maine, it has been documented in nineteen towns in five western counties, including Androscoggin County (Maine DACF, 2018). There are no known occurrences of the small whorled pogonia within the project vicinity, and the FWS does not believe that the project area provides suitable habitat for the pogonia.[62]

In 1994, FWS reclassified the small whorled pogonia from endangered to threatened under the ESA (FWS, 1994). No critical habitat for this species has been designated.

Northern Long-eared Bat

The northern long-eared bat is a medium-sized bat species (3 to 3.7 inches in body length) with longer ears than other species in the *Myotis* genus (FWS, 2015). The traditional range for the northern long-eared bat includes large forested areas in the central and eastern U.S., as well as the southern and central provinces of Canada. They generally forage under the canopy of mature, upland forests, but they are also known to forage in open areas at forest clearings or over water or roads (FWS, 2015). Summer roosting sites include caves and mines, buildings and other man-made structures, or under the bark of trees and snags. Tree species that provide cavities and crevices for roosting are generally hardwoods such as northern red oak, silver maple, and American beech, with the diameter-at-breast height of roost trees being most commonly 4 to 10 inches (FWS, 2015). Northern long-eared bats are generally active from April through October (FWS, 2015, FWS, 2016b), and hibernate over the winter season. Hibernation typically occurs in caves or mines, and the areas around them can be used during the fall-swarming season and during spring-staging before migration to summer habitat. Their diet is primarily comprised of spiders and flying insects such as moths and beetles. Several factors affect the persistence of this species, such as loss of forest habitat and disturbance

[62] See FWS's letter to the Commission filed on November 2, 2018.

during hibernation, but the most severe and predominant threat to this species is the disease white-nose syndrome (FWS, 2015).[63]

The northern long-eared bat is listed as threatened under the ESA (FWS, 2015) and is state-listed as endangered. FWS has not designated critical habitat (FWS, 2016b), but in January 2016, FWS finalized the 4(d) rule for this species which provides regulatory provisions to protect vulnerable life stages (i.e., while in hibernacula or maternity roost trees) within the white-nose syndrome zone (FWS, 2016a).[64] According to the 4(d) rule, activities occurring within the white-nose syndrome zone that could result in incidental take caused by tree removal are not prohibited as long as two conservation measures are followed: (1) application of a 0.25 mile (0.4 km) buffer around known occupied hibernacula; and (2) the activity does not cut or destroy known occupied maternity roost trees, or any other trees within a 150-foot (45-m) radius around the maternity roost tree, during the pup season (June 1 through July 31).[65]

The project is located within the northern long-eared bat species range and within the white-nose syndrome zone (FWS, 2018). There are no known hibernacula or maternity roost sites occurring in the project vicinity;[66] however, small areas of suitable habitat for summer roosting and foraging activities are present along and proximate to the project boundary.

3.3.3.2 Environmental Effects

The following discussion addresses environmental effects on threatened and endangered species and designated EFH that may result from relicensing the Barker's Mill Project under the Staff Alternative with Mandatory Conditions for the purposes of

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[63] White-nose syndrome is a fungal disease that agitates hibernating bats, causing them to rouse prematurely and burn fat supplies. Mortality results from starvation or, in some cases, exposure.

[64] Hibernacula is where a bat hibernates over the winter, such as in a cave or abandoned mine. The white-nose syndrome zone encompasses counties within the range of the northern long-eared bat and within 150 miles of a U.S. county or Canadian district in which white-nose syndrome or the fungus that causes white-nose syndrome has been detected.

[65] Incidental take is defined as any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, an otherwise lawful activity. Pup season refers to the period when bats birth their young.

[66] *See* telephone memo filed to the project on November 30, 2018.

consultation under section 7 of the ESA and under section 305 of the Magnuson-Stevens Fishery Conservation and Management Act. This alternative includes relicensing the project with all staff-recommended environmental measures and modifications to KEI Power's proposal as outlined in section 2.3 of this EA, as well as all mandatory measures that the Commission is required to include in any license issued for the project as outlined in section 2.4 of this EA.

Our Analysis

Atlantic Salmon

In section 3.3.1.2, *Aquatic Resources*, *Environmental Effects*, we evaluated the effects of KEI Power's proposed and the agencies' recommended and prescribed environmental measures on aquatic resources, including ESA-listed Atlantic salmon. Our analysis indicates that most of these measures would likely benefit Atlantic salmon during the term of any license issued compared to existing conditions.

Continuing to operate the project in run-of-river mode where outflow approximates inflow and maintaining impoundment levels within 1 foot or less from the full pond elevation or 1 foot or less from the spillway crest when the flashboards are down would minimize unnatural fluctuations in the Little Androscoggin River downstream of the powerhouse, maintain aquatic habitat and stable passage routes for Atlantic salmon, and help maintain and possibly improve water quality conditions to support salmon spawning and rearing.

Complete drawdowns of the reservoir are relatively rare, having occurred only about three times during the past 20 years. Nevertheless, staff's recommendation to restrict the timing of planned maintenance drawdowns to July through September would avoid intentional flow fluctuations in the bypassed reach when the most-sensitive life stages of Atlantic salmon are present (i.e., fry in the spring and early summer, spawning adults later in the fall).

Increasing minimum flows released at the dam under the Staff Alternative with Mandatory Conditions would enhance habitat conditions over existing condition for all life stages of Atlantic salmon that utilize the bypassed reach. Staff's recommended minimum flow of 113 cfs would apply from November 11 to April 30, while NMFS's stipulated 175-cfs minimum flow would apply during the upstream anadromous fish migration season from May 1 to November 10. The higher minimum flows would predominately affect habitat during the lower flow months of June through October and January and February. The higher minimum flows would provide 100 percent of maximum fry and 96-100 percent of maximum juvenile salmon habitat. For spawning adults, the higher minimum flows would provide between 62 and 90 percent of maximum spawning habitat. The higher flows would equate to an 18 percentage point increase in fry habitat, 26-30 percentage point increase in juvenile habitat, and 62-90 percentage point increase in spawning habitat compared to the current 20-cfs minimum flow (*see* table 5 in section 3.3.1.2, *Bypassed Reach Minimum Flows*). Staff's recommended and NMFS's stipulated minimum flows would also aid upstream and downstream migration by providing adequate depths (i.e., at least two times the body depth of the largest adult salmon) in sections of the bypassed reach that currently do not support passage for the largest adult salmon under existing minimum flow conditions (*see* table 8 in section 3.3.1.2, *Bypassed Reach Minimum Flows*).

As discussed in section 3.3.1.2, *Upstream Passage for Anadromous Fish*, constructing and operating an upstream fish passage facility as specified by Interior and NMFS would allow the limited numbers of salmon passing upstream of the Worumbo Project (0 to 7 individuals per year) to access a 0.65-mile reach of the Little Androscoggin River (11-acre project impoundment) that is currently blocked by the presence of the Barker's Mill Dam. However, there is likely no suitable spawning habitat in the lacustrine environment within the project's impoundment; therefore, other than improving habitat connectivity in the event that upstream passage facilities are constructed in the future at the six other mainstem dams upstream, there is no apparent benefit to providing Atlantic salmon access to the project's impoundment. As discussed in section 3.3.1.3, *Cumulative Effects*, predicting whether these other dams would eventually include upstream fish passage facilities capable of passing adult salmon either through license conditions or other means is currently speculative. Nevertheless, designing the upstream anadromous fish passage facility consistent with FWS's 2017 Design Criteria Manual and in consultation with the resource agencies as stipulated by Interior's and NMFS's fishway prescriptions would help guide the design process and ensure the upstream fishway is likely to be effective in timely passing any adult salmon returning to the base of the project's dam upstream.

If salmon begin accessing and potentially spawning in habitats above Barker's Mill, post-spawned adults (kelts) and smolts would need safe and timely passage past Barkers Mill to complete their life cycle. As discussed in section 3.3.1.2, *Downstream Fish Passage*, modifying the existing downstream fish passage facility as specified by Interior's and NMFS' fishway prescriptions (e.g., seasonally install a minimum of 0.75-inch spaced bar racks, provide adequate approach and sweeping velocities that prevent impingement on the bar racks, provide sufficient attraction flows, provide accelerated flow near the bypass entrance, provide safe hydraulic conditions through the bypass and safe discharge conditions at the bypass outfall, etc.) would enhance downstream fish passage past the dam.

Even though the downstream passage would be designed to meet agency criteria and thus would minimize the potential impingement and entrainment, some smaller smolts would still be subject to potential injury and mortality because they could still pass through the prescribed 0.75-inch bar spacing on the new trash racks (table 18). However, appropriate sweeping velocities should direct most migrating smolts to the fish bypass and safe entry into the redesigned plunge pool.

Prioritizing how spills are released from the dam, as stipulated by Interior and recommended by staff, would ensure that downstream migrating smolts and kelts are first passing through the safest downstream passage route (i.e, fish bypass and other stop log bays) before being passed over the spillway where they may be subject to injury or mortality due to insufficient depths in the spillway plunge pool.

Implementing a fishway operation and maintenance plan that includes Interior's and NMFS's stipulations for operating and maintaining the fish passage facilities would provide KEI Power with procedures necessary to ensure that the project fish passage facilities are maintained in proper working order before and during the migratory fish season. The fishway operation and maintenance plan would also provide resource agencies a way to review the maintenance and operation history for all fish passage facilities at the project and adjust procedures as appropriate, after obtaining prior Commission approval.

Overall, the Staff Alternative with Mandatory Conditions would maintain and improve aquatic habitat in the project area and enhance fish passage over the long term, which would cumulatively benefit Atlantic salmon in the basin and would not conflict with the recovery goals for the species.

Table 18. Minimum sizes of downstream migrating Atlantic salmon life stages (total length, inches) physically excluded from trash racks with 0.75-inch, 1-inch, and 2-inch spacing, based on the body width scaling factors in Smith (1985).

Species	Life stage	Length range (inches)[a]	Minimum Length (inches) excluded		
			0.75 inch bar spacing	1 inch bar spacing	2 inch bar spacing
Atlantic salmon	Adult (kelt)	27-37	7.2	9.6	19.2
Atlantic salmon	Juvenile (smolt)	5-8	7.2	Not Excluded	Not Excluded

[b] Length ranges for adult Atlantic salmon kelts adapted from Turek *et al.* (2016), and length range for Atlantic salmon smolts adapted from NMFS (2009).

Atlantic Salmon Critical Habitat

Critical habitat for Atlantic salmon occurs in the mainstem Androscoggin River which is approximately 0.13 mile downstream of the powerhouse. As discussed in section 3.3.1.2, *Impoundment Levels*, and section 3.3.1.2, *Operation Effects on Water Quality*, run of river operation would continue to provide a stable flow regime downstream of the dam and powerhouse, and the proposed higher bypassed reach minimum flows would provide a minor beneficial effect on dissolved oxygen concentrations and water temperatures in the bypassed reach during the summer months that may extend downstream into the Androscoggin River. Thus, because proposed operations are likely to result in beneficial effects to water quality downstream of the powerhouse, the proposed project is not likely to adversely affect PCE's for Atlantic salmon critical habitat in the Androscoggin River.

Essential Fish Habitat

Essential fish habitat for Atlantic salmon is present in the Little Androscoggin River including the project area, and one Atlantic salmon has recently been documented in the bypassed reach. In its letter filed on November 5, 2018, NMFS included the following EFH conservation recommendations[67] to minimize adverse effects to EFH from future operation of the project: (1) maintain a continuous minimum flow in the bypassed reach of 175 cfs or inflow, whichever is less, to minimize adverse effects to Atlantic salmon habitat in the Little Androscoggin River downstream of the Barker's Mill project, and (2) operate the project in a run-of-river mode in which outflow from the project impoundment is equal to inflow to the impoundment to the extent possible and minimize fluctuations of the reservoir, within one foot of the top of the flashboards on a regular basis, or within one foot of the permanent crest when replacing flashboards.

KEI Power's proposal to continue to operate the project in a run-of-river mode coupled with staff's recommended limits on impoundment fluctuations would minimize the frequency of flow fluctuations in the bypassed reach under normal project operation. KEI Power's proposal to increase minimum flows to 113 cfs and NMFS's fishway prescription stipulation that minimum flows be further increased to 175 cfs during the May 1 to November 10 upstream fish passage season would enhance aquatic habitat availability for all life stages of Atlantic salmon and improve migration conditions in the bypassed reach for adults compared to existing conditions. The higher minimum flows would also provide a minor benefit of increasing dissolved oxygen and reducing water temperatures during the summer when flows are low and water temperatures typically reach their highest levels of the year. Installing and operating a new upstream fish passage facility for anadromous fish and modifying the existing downstream fish passage facility as stipulated by NMFS and Interior would improve downstream fish survival and enhance migration conditions at the project. Overall, these measures would enhance Atlantic salmon EFH over the term of any license issued.

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[67] These recommendations are identical to NMFS' section 10(j) recommendations.

Small Whorled Pogonia

Given the rarity of the pogonia and the lack of suitable habitat, it is unlikely that the pogonia occurs in the project area. Therefore, we conclude that relicensing the project would have no effect on the small whorled pogonia.

Northern Long-Eared Bat

The applicant's proposal to provide signage, parking, and foot access to the Little Androscoggin River from the Barker Mill Trail and to improve the existing hand-carry boat launch at the impoundment would result in some minor soil and vegetation disturbance. While the construction details for proposed upgrades to the downstream fish passage facility have not been finalized, we do not expect that installation of the downstream improvements to require significant land-clearing activities because the existing road and parking area for the gate house could be utilized for construction vehicle access and equipment staging. Thus, construction of these recreation and downstream passage improvements are not expected to necessitate the removal of large trees that might be used as summer roosting habitat for the northern long-eared bat.

However, as discussed above under section 3.3.2.2, designs for upstream passage are in the conceptual stage. The building of agency-prescribed upstream fishways (e.g., pool and weir fishway, fish lift) would likely result in the removal of riparian habitat on the west bank of the river below the dam. However, until the upstream fishway is selected and sited, a full assessment of potential effects cannot be fully evaluated.

There are no known hibernacula near the project; so construction would not be likely to disturb wintering bats. However, if upstream fishways are built on the opposite bank from the downstream fish passage facility, some removal of large trees is likely to be required, which could disturb or destroy summer roosting habitat. Staff's recommendation to conduct necessary vegetation clearing for fishway construction outside of the bat's active period of April 1 to October 31 would avoid disturbing roosting northern long-eared bats. Therefore, we conclude that relicensing the project as proposed with staff-recommended measures and mandatory conditions is not likely to adversely affect the northern long-eared bat, and would not result in prohibited incidental take.

3.3.4 Recreation and Aesthetic Resources

3.3.4.1 Affected Environment

Local and Regional Recreation Resources

The project is located on private land within the City of Auburn in Androscoggin County, Maine, and within the Lewiston-Auburn metropolitan area, the state's second largest population center. Extensive recreation sites, facilities, and opportunities exist within both cities (Auburn and Lewiston) and the surrounding areas, including a number of state and regional parks, conservation sites, and river access areas located within a ten mile radius of the project. Sherwood Forest, a 78-acre conservation area with trails, is located less than a mile south of the project.

vicinity of the project, including the 0.6-mile-long Barker Mill Trail which passes through the project boundary along the impoundment and ends within the project boundary about 200 feet below the dam (figure 6). Moulton and Rodney Bonney Parks are located just north of the bypassed reach, along the terminus of the Auburn Riverwalk, a paved multi-use trail that mostly follows the west shore of the Androscoggin River. Little Andy Park provides parking and boat access to the Androscoggin and Little Androscoggin Rivers near their confluence, less than one-quarter mile downstream from the project.

In its comments on the project, the City of Auburn expressed an interest in developing new recreation opportunities for its 23,000 residents, particularly in the New Auburn area adjacent to the project.[68] The City of Auburn Comprehensive Plan (City of Auburn, 2010), the New Auburn Village Center Study (City of Auburn, 2014), and the Androscoggin River Greenway Plan (Wright-Pierce, 2013) all include goals for additional trails, open space, and river access in areas along both the Androscoggin and Little Androscoggin Rivers. More specifically, the Androscoggin River Greenway Plan proposes new walking and biking trails along the Little Androscoggin River, including a southerly extension of the Barker Mill Trail to Sherwood Forest, and a pedestrian bridge across the river, possibly near the Barker's Mill Dam, to link the Barker Mill Trail to Moulton Park and the Auburn Riverwalk.

[68] *See* City of Auburn comment letters filed on May 5, 2017 and August 2, 2017.

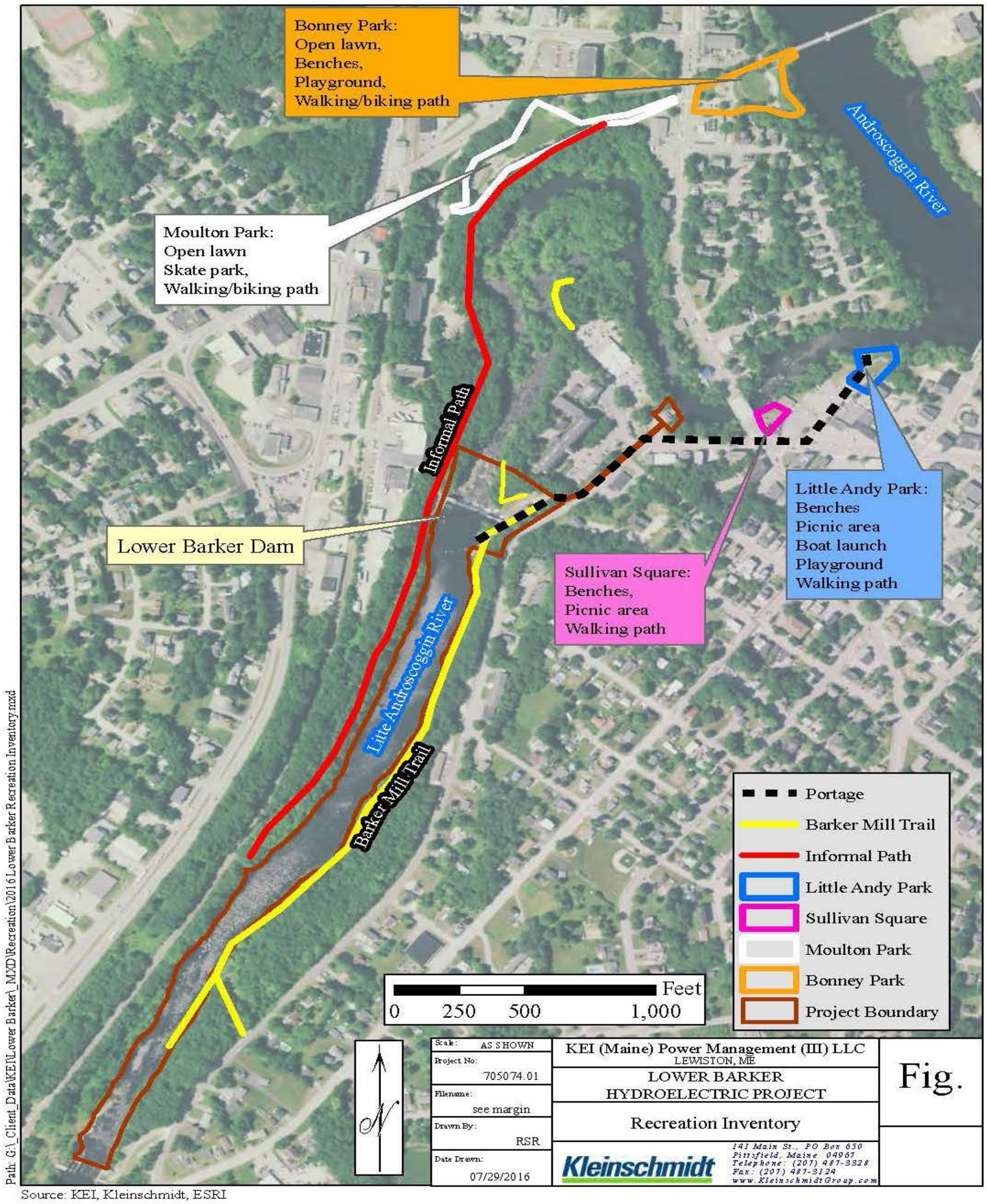

Figure 6. Recreational sites in the project area. (Source: License application)

The Maine Statewide Comprehensive Outdoor Recreation Plan 2014-2019 (SCORP) (Maine DACF, 2015) identified hiking, walking, boating, and fishing as among the more popular outdoor recreation activities in the state. Two-thirds of Maine's population enjoys hiking, with more than 25 percent using non-motorized trails at least weekly, based on SCORP surveys. The SCORP seeks to support both local and regional trails, including local trail planning that increases "access to key community attributes." Surveys indicate that the greatest need is for easy trails in natural settings. Interest in marine and freshwater boating access and water trails for canoeing and kayaking has increased in recent years, while the demand for fishing opportunities is considered strong but not increasing. Whitewater boating is not specifically addressed by the SCORP.

Recreation Resources at the Project Site

KEI Power does not maintain developed recreational facilities at the project, but does allow public use of project land and waters for informal recreation. Public recreational use of the project site includes fishing, boating (hand-carry only), hiking, and wildlife viewing. Fishing and occasional boating occur in both the impoundment and the bypassed reach. The 16.5-acre impoundment is accessed via the Barker Mill Trail and an informal launch located approximately 150 feet upstream of the dam and intake canal. The Barker Mill Trail also serves as part of an informal, 0.3-mile-long canoe portage between the launch and Little Andy Park. From the dirt parking area near the gatehouse, a short, primitive path leads downslope toward the base of the dam and provides access to the bypassed reach for fishing and other passive recreation, and limited whitewater boating. Occasional shore fishing also occurs downstream near the tailrace, although access is difficult due to a steep slope below the powerhouse.

Overall recreational use at the project appears to be relatively low, although limited use data is available. Based on the licensee's observations and Form 80 reports filed with the commission in 2015,[69] KEI Power estimates that a total of 520 annual recreation days could be attributed to the project site, with approximately 60 percent occurring from April through October, and the remaining 40 percent using the area between November and March.[70] The estimated use includes fishing, hiking, dog-

[69] The most recent Form 80 was filed with the Commission on March 31, 2015, for activities in 2014.

[70] *See* license application at page 4-79. The City of Auburn and Androscoggin Land Trust argue that the Form 80 data is inadequate to evaluate recreation demand at the project. Form 80 data is reviewed in combination with other sources, stakeholder information, and staff observations to ensure that a project adequately addresses recreation needs and effects on resources. Collectively, and as applied here, the data helps to identify the types of recreational use at a licensed project, as well as trends toward increased or decreased use and the demand for new opportunities.

walking, and sightseeing.

Fishing is common along the project's bypassed reach. However, boating (e.g., canoeing and kayaking) is infrequent because low flows and shallow water during the summer months makes boat navigation difficult. Nevertheless, KEI's Whitewater Flow Study, conducted in May 2017, determined that whitewater boating in the bypassed reach is possible when sufficient flows are available.

Aesthetic Resources

The project is located in a transition area between more densely developed urban land to the north and east, and areas comprising forested open space and lower-density residential development to the south and west. A forested riparian zone fronts the Little Androscoggin River within and adjacent to most of the project. This natural corridor along the river is relatively free of development above and below the dam. Views of the dam and impoundment are easily attained from the Barker Mill Trail, while views of the dam, impoundment, and bypassed reach from surrounding roads and properties are mostly obscured by trees, structures, and slightly hilly terrain.

3.3.4.2 Environmental Effects

Recreational Access

To enhance recreation opportunities at the project, KEI proposes to improve the hand-carry boat launch on the impoundment upstream of the dam and the informal foot trail leading to the bypassed reach just downstream of the dam, add signage for the launch and trail, and designate and maintain the parking area near the gatehouse. In addition, KEI Power would provide funds to the City of Auburn or the Androscoggin Land Trust to maintain the portion of the Barker Mill Trail that is used as a portage around the dam and is within the project boundary. KEI Power contends that the remaining portion of the trail does not serve a project purpose.

The City of Auburn recommends that KEI Power make annual payments to the City of Auburn or to the Androscoggin Land Trust to maintain the Barker Mill Trail to ensure that the trail is kept in good condition. The City, however, does not specify the amount needed for such maintenance.

American Whitewater, with support from the Park Service, recommends that the licensee construct and maintain a walking path along the bypassed reach from the dam to the powerhouse and design it to be accessible. They state that putting in such a path would enhance recreational opportunities in the project area and allow easier access for residents of a nearby senior housing complex. The recommended path would lie mostly outside of the current project boundary.

Our Analysis

The proposed access improvements and signage would make it easier for the public to safely access these areas for boating and fishing. Improving the hand-carry boat launch would make it easier for boaters to launch or take out boats so that they can portage around the dam. Designating and maintaining a parking area and improving the existing foot path leading from the parking lot to the Little Androscoggin River immediately below the dam would improve access to the bypassed reach not only for anglers, but also whitewater boaters when flows are favorable for such boating.

It is not clear, however, how KEI Power intends to improve the foot path to the river, what it would include in the proposed signage, or how it would improve the boat launch. Additional detail describing the location of the trail, content of the directional and safety signage, and design of the trail and boat launch improvements would be needed before installation could be authorized. For example, some special considerations could be needed along steep parts of the trail to ensure safe access to the bypassed reach.[71] Conceptual drawings of the trail and boat launch improvements included as part of a project recreation plan would help to ensure that the improvements are built appropriately. As project recreation facilities they should be identified on the Exhibit G drawings.

In general, when funds are proposed to be paid to a non-licensee entity for a measure, staff analyzes the actual measure itself to determine whether the measure addresses an identified project effect or would enhance a resource affected by the project. Here, neither KEI Power nor the City of Auburn describe what is needed to maintain the trail or how much such maintenance would cost, but both agree that at least portions of the trail should continue to be maintained. Rather, the disagreement is over what portion of the trail serves a project need and should be maintained by the project.

The 0.6-mile-long Barker Mill Trail passes through the project boundary along the impoundment and ends within the project boundary about 200 feet below the dam (figure 6). While there is little data on its overall use, the public likely uses the trail to either access the project impoundment for fishing or to enjoy the scenic attributes of the water and shoreline. The portion of the trail along the impoundment is in good condition. KEI Power's proposed improvements to the 300-foot long portage portion of the trail would enhance recreation at the project. Thus, the portion of the trail that follows the project

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[71] *See* telephone conversation between Andy Qua, Environmental Consultant, Kleinschmidt and Suzanne Novak, Outdoor Recreation Planner, FERC, dated June 6, 2018 and filed on June 14, 2018.

impoundment as well as the portion used as a portage around the dam serves a project purpose. Maintaining this section of the trail would ensure that these recreation benefits continue.

As a project recreation facility, the entire trail would need to be brought into the project boundary and the Exhibit G drawings modified to incorporate the trail. As a project recreation facility, KEI Power would ultimately be responsible for its maintenance, but could provide operation and maintenance through another entity via an off-license agreement.

Currently there is no formal access below the dam to the bypassed reach of the Little Androscoggin River; the portage from the take out on the impoundment follows local roads to Little Andy Park at the confluence of the Little Androscoggin and Androscoggin Rivers. Constructing the proposed walking path along the 0.34-mile-long bypassed reach from the dam to the powerhouse would enhance access to the reach for hiking, fishing and boating. A trail in this area might also benefit future recreational activity associated with the higher minimum flows and recommended whitewater boating flows (discussed below) in the bypassed reach. If constructed with accessibility for the disabled in mind, it could benefit nearby senior citizen residents, as suggested by American Whitewater and Park Service. However, given the relatively light recreational use in the project bypassed reach, it is not clear how much use such a trail would receive.

Fishing

KEI Power proposes to improve access to the impoundment and below the dam as discussed above. The proposed and recommended instream flows (113 to 175 cfs) and whitewater boating flows (300 to 1,000 cfs) could also affect fishing opportunities.

Our Analysis

Fishing opportunities would be enhanced by KEI Power's proposed measures to enhance recreational access to the impoundment and in the bypassed reach. As discussed in section 3.3.1.2, higher minimum flows would likely benefit fish and fish habitat, which could indirectly improve fishing success and enhance recreation experiences in the bypassed reach.

However, the proposed and recommended boating flows discussed below could exceed the flows desired by wading anglers. KEI Power's Whitewater Flow Study (discussed below) included an angler wading analysis to determine how various flow increments might impede or benefit fishing "wadeability" in the bypassed reach. The analysis utilized water depth and velocity data from Transect 1 of the 2016 instream flow habitat study, as well as a "Rule of Ten" wading index to assess how the flows might influence wade fishing. Transect 1 is located about 300 feet downstream of the dam and is considered an attractive area for angling. The wading index is a commonly used rule of thumb to determine safe wading conditions developed by Abt *et al*. (1989) and states that the product of water depth (in feet) and velocity (in feet per second) should not exceed 10 square feet per second.

At 300 cfs, wading scores suggest that the river margins and about 80 percent of the river channel are suitable for safe wading. At 300 cfs the main channel (approximately 3 feet deep and 40 to 50 feet wide) approaches a score of 9.5 feet per second. As the flow increases, so does the depth, velocity and the wading score. At higher flows (e.g. 600 cfs), the main channel becomes unsafe, and angler wading is generally limited to the river margins. Volunteer boaters in the Whitewater Flow Study were asked to rate "wadeability" of the entire project reach at the two study flows (350 and 590 cfs). Their opinions were consistent with the results of the Rule of Ten index, in that wading was generally rated as "good" at 350 cfs and "poor" to "neutral" at 590 cfs. This suggests that Transect 1 is reasonably representative of the bypassed reach.

Whitewater Boating

Project operation limits the availability of flows that would support whitewater boating in the bypassed reach. To enhance whitewater boating opportunities, the City of Auburn recommends that KEI Power provide at least five flow releases of 600 to 800 cfs for up to 5 hours each on a weekend day (a total of 25 hours) and that KEI Power coordinate and schedule these flow releases with the City to coincide with scheduled recreational boating events.

Rather than schedule a specific number of releases as the City recommends, American Whitewater recommends that all flows of 300 to 1,000 cfs be released on Saturdays and holidays during the boating season (defined as April 15 through October 15) for a 5-hour duration.[72] American Whitewater estimates that flows between 300 cfs and 1,000 cfs would likely be available on average approximately 13 Saturdays and holidays annually during the boating season[73] which would equate to 85 hours annually.

KEI Power states that it is willing to coordinate flow releases with the City, but notes that flow releases are dependent on available inflows and that advanced scheduling of releases can be difficult. KEI Power instead proposes to provide up to five releases through turbine shutdowns on an annual basis, provided that sufficient flow is available

[72] Federal holidays between April 15 and October 15 are Memorial Day (May), 4th of July, Labor Day (September), and Columbus Day (October).

[73] American Whitewater bases this estimate on hydrological data collected from the South Paris gage for water years 1914 – 2017.

to do so. KEI Power states that it is impractical to stipulate a specific flow on a certain date for a defined period of time because of the variability of inflow to the project, the limitations of the project's run-of-river operation, and the inability to utilize headpond fluctuations to supplement downstream flows. While KEI Power does not propose a specific flow scenario for these reasons, it does indicate that setting up a target duration of flow releases would be reasonable, and provides as an example a flow scenario of 500 cfs for a duration of 5 hours. KEI Power, however, indicates that maintaining a flow duration of 5 hours may not always be attainable given that the level of inflow to the project can drop significantly over the course of several hours, putting KEI Power at risk of not being able to maintain headpond levels. KEI Power argues that spilling more water than what they propose to release into the bypassed reach during the boating season unreasonably diminishes an already limited generating opportunity.

Our Analysis

Results from KEI Power's Whitewater Flow Study indicate that optimal whitewater boating flows occur between 600 and 1,000 cfs, with the minimum preferrable flow being 300 cfs. Flows in the range of 350 cfs to 590 cfs[74] were rated by study participants as poor to good with advanced or expert boaters giving lower ratings than novices or intermediate skill-level boaters (Kleinschmidt, 2017). As shown in table 19, inflows to the project between 300 and 1,000 cfs do occur on the Little Androscoggin River over much of the year, though much less frequently in the summer months which encompass much of the whitewater boating season.[75] In July, August, and September, median inflows are below 150 cfs. Higher flows sometimes occur in summer. Inflows above 300 cfs occur from 14 to 28 percent of the time from July through September, less often above 500 cfs (7 to 16 percent of the time) and 600 cfs (6 to 13 percent of the time), and rarely above 1,000 cfs (3 to 7 percent of the time).

The project currently operates when flows exceed 170 cfs (150 cfs minimum hydraulic capacity of the turbine plus 20 cfs minimum instream flow). Thus the diversion of flows for power generation substantially limits the availability of boatable flows in the bypassed reach during the boating season (April thru October). These effects vary by month but are most pronounced during May and June when most of the available flows that could meet the needs of whitewater boating are diverted to the turbine. Although April is also part of the whitewater boating season, project effects are much less due to the frequent availability of flows well above the 500-cfs capacity of the turbine. At the median flow of 1,363 cfs during April of a typical year, a maximum of

[74] Flows of 350 cfs and 590 cfs were examined in KEI Power's whitewater boating study because only these flows were available during the study period.

[75] The basis for our flow analysis is described in section 3.3.1.2.

500 cfs could be diverted for power generation, leaving 863 cfs that would be spilled to the bypassed reach, which is within the optimal range of boating flow identified during the boating study. From July through September, the project is shut down between 55 and 75 percent of the time (table 4), leaving a flow of 170 cfs or less in the bypassed reach for boating, which is below what is acceptable for boating.

Table 19. Percent of time by month that inflows exceed 300 cfs, 500 cfs, 600 cfs, and 1,000 cfs. (Source: License application; as modified by staff)

Month	Median Inflow	Minimum Inflow	Maximum Inflow	Percent of Time >300 cfs	Percent of Time >500 cfs	Percent of Time >600 cfs	Percent Of Time >1,000 cfs
January	322	86	7,632	55%	22%	17%	8%
February	277	85	4,397	43%	14%	10%	5%
March	571	96	15,312	72%	55%	48%	29%
April	1,363	207	32,448	99%	94%	91%	33%
May	686	72	16,144	89%	67%	57%	28%
June	339	36	15,936	55%	32%	32%	14%
July	144	15	6,384	28%	16%	13%	7%
August	80	4	6,960	19%	12%	10%	5%
September	73	3	8,688	14%	7%	6%	3%
October	241	12	9,360	42%	27%	23%	12%
November	523	62	10,272	76%	52%	44%	21%
December	453	90	12,096	73%	45%	37%	18%

Under KEI Power's proposed, and the state's recommended, minimum flow of 113 cfs and Interior's and NMFS's recommended minimum flows of 175 cfs, the powerhouse would be shut down more frequently (table 4). With a minimum flow of 113 cfs, there would be insufficient inflow for the powerhouse to operate between about 68-83 percent of the time during July through September, and about 50 percent of the time during October. This would result in bypassed reach flows of 263 cfs or less most of the time during the summer and fall. At a minimum flow of 175 cfs, inflows would be insufficient for the powerhouse to operate and meet the minimum flow about 75-87 percent of the time during July through September, and about 50 percent or more of the time (range of 48-61 percent) during June and October. Thus, flow in the bypassed reach would be 325 cfs or less most of the summer and fall. When available, these flows would be acceptable for boating, but at the low end of the acceptable range.

To achieve the City of Auburn's preferred boating flow of at least five flow releases of 600 to 800 cfs for up to five hours, the project would likely need to reduce or forego generation for each event during the months of May through October because of insufficient flow to meet both generation and boating flows, particularly if trying to schedule flows in the summer and fall. To provide American Whitewater's recommended boating flows of 300 to 1,000 cfs, the project would typically need to shut down for the five-hour period on every Saturday that flows exceed 300 cfs, adding to the lost generation from KEI's proposed and the agencies recommended minimum flows.

Using the historical daily flows from January 1, 1987 to December 31, 2017, staff calculated the number of weekend days that flows exceed 300 cfs, 500 cfs, 600 cfs and 1,000 cfs (table 20). On average, about 32 weekend days between April 1 and October 31 exceeded 300 cfs; 24 exceeded 500 cfs, 20 exceeded 600 cfs, and 12 exceeded 1,000 cfs. As noted above, given the higher inflow, most of the weekend days occurred during April and May, followed by June and October. Hence, there would likely be opportunities to provide boating flows in the bypassed reach each year if boating flows are given a priority over generation.

Due to lower flows in summer (July through September), it would be difficult to coordinate, or schedule in advance, reliable boating releases as requested by the City of Auburn. Releasing all flows between 300 cfs and 1,000 cfs on Saturdays and holidays, when available, as suggested by American Whitewater, would avoid the need to schedule releases on specific dates when there is no assurance that inflows would be sufficient.

Table 20. Total number of weekend days flows exceeded 300 cfs, 500 cfs, 600 cfs, and 1,000 cfs between April 1 and October 31 (January 1, 1987 - December 31, 2017). (Source: Staff).

	≥300 cfs		≥500 cfs		≥600 cfs		≥1,000 cfs	
Month	Sat.	Sun.	Sat.	Sun.	Sat.	Sun.	Sat.	Sun.
April	132	131	126	126	125	121	95	91
May	119	121	89	93	78	76	31	38
June	70	73	42	41	30	36	16	23
July	41	37	22	19	18	18	10	11
August	28	28	18	17	12	13	7	7
Sept.	20	27	13	14	11	12	4	3
Oct.	63	61	45	40	39	34	15	18
Annual Average	16	16	12	12	10	10	6	6

Relative to existing conditions, providing either KEI Power's, the City of Auburn's or American Whitewater's proposed boating flows would benefit recreation by increasing the average number of days per year of boating flows by between 5 and 11 days[76] depending on the time of year that the flows are scheduled. However, each flow regime would reduce generation, reduce desirable angler wading flows, and cause rapid fluctuations in river levels in the bypassed reach. As discussed in section 3.3.1.2, such fluctuations could adversely affect aquatic resources, including potentially stranding or displacing fry and juvenile Atlantic salmon if successful spawning and rearing occur as a result of the higher minimum flows.

Because the whitewater reach below the dam is short relative to other whitewater boating resources in the region, even if flows are increased, the reach would likely be used primarily by local whitewater enthusiasts and would not attract those outside of the Auburn area. As noted by the whitewater study volunteers, there are better paddling opportunities during the summer months within a 2-hour drive from the project site. Such opportunities can be found on the Androscoggin, Kennebec, Dead, Magalloway, and Rapid Rivers which all have significantly longer runs and offer a diversity of whitewater experiences for all skill levels (ELC Outdoors, 2018a,b,c; Northern Outdoors, 2018; Maine DIFW, 2018).

Online Flow Information

American Whitewater and the City of Auburn recommend that KEI Power install a flow gage in the bypassed reach to provide real time flow data on line to the public. Instead of installing a stream gage to provide real-time flow data which KEI Power contends would be expensive, KEI Power proposes to automate the calculation of streamflow in the bypassed reach using the existing upstream South Paris gage data and publishing it to a public website in coordination with the City of Auburn.

Our Analysis

Installing an automated gage as recommended by American Whitewater and the City of Auburn would provide detailed, accurate, and instantaneous readings of flows in the bypassed reach, which would allow boaters to better plan their trips and avoid flows that they are not comfortable boating. However, such gages are expensive, requiring an estimated $20,000 to install and an additional $20,000 a year to maintain.

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[76] Our estimate of 11 days is based on the average number of Saturdays and holidays when flows are between 300 and 1,000 cfs (10 Saturdays plus one holiday day). This estimate differs from American Whitewater's estimate of 13 days when flows are in this same range because our estimate is based on a 30-year flow record whereas American Whitewater's estimate is based on a 100-year record.

KEI Power's proposal to provide automated online flow data to the public would also serve this purpose and would be less costly if the data can be properly gathered and disseminated to the public. KEI has not explained how it would calculate flows in the bypassed reach based on data from the South Paris gage and to distribute it to the public.

KEI Power could develop and maintain a website that includes links to available gauges, applicable conversions or calculations to derive real-time flow information, and relevant forward-looking operational information. To be effective, the data would need to provide the dates, times, and flow levels of the scheduled recreation releases as well as a forecast for river levels from one to three days out. Providing this information to the public would inform river users as to what is occurring in the bypassed reach. This in turn would help river users to make well-informed decisions on whether the river level is optimal, too high, or too low to safely and responsibly boat that day. The flow notification website would provide river users with a central location for flow information that is currently not available.

Including such details in a final recreation plan would be needed before the Commission could approve the plan. Having such flow data available would also benefit other recreationists using the bypassed reach, such as anglers.

Monitoring Recreational Use

Improvements in recreational access and increased fishery flows at the project combined with expected population growth in Androscoggin County (Maine DAFC, 2015).[77] could lead to an increase of recreational use of the project area. KEI Power does not indicate how it would monitor such use to ensure that future recreational needs are met. No one has recommended monitoring recreation.

Our Analysis

Periodic monitoring of the level and type of recreational use at the project would help to determine whether existing recreational facilities are accommodating recreational needs. Conducting the initial monitoring in year 6, given the expected short-term change in recreational use, would help determine whether proposed recreational improvements, along with any near-term rise in population in Androscoggin County, has created a demand for additional recreational enhancements. Monitoring every 10 years thereafter would ensure that recreational needs are being met throughout the license term. To be

[77] The 2015 Maine SCORP indicates that, unlike most other regions in Maine where population remains relatively stable, Androscoggin County is expected to experience a population increase.

effective, the project recreation plan should include a schedule that comports with the above timeline and culminates in a report that (1) identifies the level of recreational use in the project area, (2) evaluates the adequacy of recreation measures, and (3) includes any proposals for additional recreational access measures to meet current needs. The plan would need to define the methods to be used to monitor recreation at the project and evaluate the conditions of the project's recreation facilities. Developing the monitoring strategy in consultation with the Maine Department of Agriculture, Conservation and Forestry, Bureau of Parks and Lands (Maine Bureau of Parks and Lands); Maine DIFW; Park Service; American Whitewater; and the City of Auburn, would allow them to share their expertise and ensure that their users concerns are addressed.

Aesthetic Resources

Aesthetic resources at the project are, for the most part, integral to recreational enjoyment of the Little Androscoggin River, including fishing and boating in the bypassed reach and impoundment. To the extent that fishing and boating would be enhanced by proposed recreation measures, aesthetic enjoyment of the river would also be enhanced. Except for minor, temporary disturbance of soils and vegetation during construction of the trail and boat launch the natural character of the riparian corridor along both the river and impoundment would not change or be adversely affected by the continued operation of the project.

3.3.5 Cultural Resources

3.3.5.1 Affected Environment

Section 106 of the National Historic Preservation Act requires that the Commission evaluate the potential effects on properties listed or eligible for listing in the National Register. Such properties listed or eligible for listing in the National Register are called historic properties. In this document, we also use the term "cultural resources" for properties that have not been evaluated for eligibility for listing in the National Register. Cultural resources represent things, structures, places, or archeological sites that can be either prehistoric or historic in origin. In most cases, cultural resources less than 50 years old are not considered historic. Section 106 also requires that the Commission seek concurrence with the Maine State Historic Preservation Commission Officer (SHPO) on any finding involving effects or no effect to historic properties, and allow the Advisory Council on Historic Preservation an opportunity to comment on any finding of effects to historic properties. If any Native American (i.e., aboriginal) properties have been identified, section 106 also requires that the Commission consult with interested Indian tribes that might attach religious or cultural significance to such properties.

Area of Potential Affect

Pursuant to section 106, the Commission must take into account whether any historic property could be affected by the issuance of a proposed subsequent license within a project's area of potential affect (APE). The APE is determined in consultation with the SHPO and is defined as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist.

The APE for this relicensing includes all lands within the proposed project boundary and any lands outside the project boundary where cultural resources may be affected by project-related activities. This includes both private land and a public waterway within the City of Auburn as well as lands around the impoundment, dam, intake structure, penstock, the powerhouse, tailrace, parking areas, and associated property. The SHPO concurred with the APE by letter dated June 26, 2017, filed on August 29, 2017.

Cultural Historic Context[78]

The Little Androscoggin River is tributary to the Androscoggin River which served as a major waterway for Native American Tribes throughout much of the Pre-Contact period and continued as such for both tribes and EuroAmerican settlers after contact. In the Post-Contact period, the Androscoggin River was used for travel and trade and eventually for industrial purposes. The following information provides a description of the archeological and historical record for the Androscoggin River area.

Maine's archeological record dates back more than 11,000 years before the present. Archeologists have divided the Pre-Contact segment of this record into three major cultural periods: the Paleoindian, Archaic and Ceramic cultural period. Traditions within these cultural periods represent subdivisions that can be made based on similarities in artifact forms and cultural adaptations (Spiess, 1990, 1994). Post-Contact history can also be divided into broad time periods reflecting the cultural integration of EuroAmerican cultural lifeways and practices into the history of Maine.

<u>Paleoindian Period (11,500-8,000 B.P.)</u>

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[78] The cultural historic context is from Gray and Pape (2016a,b) and the pre-application document for the Pejepscot Hydroelectric Project, (FERC No. 4784), filed with the Commission on August 31, 2017.

Evidence for the earliest period of human occupation in Maine is rare. Most sites of this period have been identified from isolated finds in the collections of amateur archeologists, with excavations of Paleoindian sites limited to only a handful in the state. The Paleoindian Cultural Period is the first known period in which humans inhabited the Northeast region. Evidence from the greater Northeast indicates that the Paleoindians first settled in the area not long after the retreat of the Late Pleistocene Wisconsin glacial ice, which had left New England by around 13,000 B.P. Paleoindians living in these post-glacial environments have traditionally been characterized as hunters and gatherers who subsisted primarily on several large species of animals known to herd in the Northeast, including the mastodon and mammoth; however more recent interpretations have focused on smaller species, such as caribou and elk as primary food sources (Curran, 1987; Curran and Dincauze, 1977; Dincauze and Curran, 1984; Gramly, 1982). Fluted projectile points of this period are lanceolate in shape and possess a long, groove-like scar caused by a flake struck from their base; they are considered the diagnostic artifact type of this period. Archeological evidence indicates that during the later Paleoindian period, fluted spear points were replaced by smaller, unfluted points or by long, slender lanceolate points with a distinctive parallel flaking technology (Doyle *et al*., 1985; Cox and Petersen, 1997; Will and Moore, 2002). These changes appear to coincide with the succession towards a closed forest environment.

No house features, burials, or ceremonial objects have been recovered from Paleoindian sites in the Northeast. Based on ethnographic analogy, it is assumed that peoples of this time were seasonally nomadic, following the movement of game with the changing weather conditions of the year. Raw materials utilized by Paleoindians came from only a few, often distant, sources (Spiess *et al.,* 1998) which indicates there might have been a high degree of mobility, established trade networks, and/or a high frequency of interaction among units of population. Sites of this period are sometimes found on hilltops, possibly because of their vantage points.

<u>Archaic Period (8,000 to 3,000 BP)</u>

The Archaic Period is the time period following the Paleoindian occupation, but predating the use of pottery and horticulture. During the Early Archaic Period, profound environmental changes continued in New England, as the landscape adjusted to warmer post-glacial conditions and a mixed pine-hardwood forest came to dominate the landscape. Research indicates that Early Archaic social groups moved within smaller territories than their Paleoindian ancestors, practicing an increasingly generalized subsistence strategy based on river and lake systems and particularly wetland mosaic physiographic zones. The megafauna of the late Pleistocene had disappeared, leaving smaller mammalian species, such as moose and beaver. Environmental conditions would have made seasonally available natural food resource somewhat more predictable and abundant than they had been during the Ice Age, allowing human populations to exploit a wider range of territories.

While bifurcate base projectile points are the traditional hallmark artifact of the Early Archaic period in southern New England, cultural adaptations in the region of Maine focused on the manufacture of simple unifacial tools from quartz, crude "chopping tool" of other local stone, and the development of ground stone technology. This early culture is referred to as the Gulf of Maine Archaic tradition, based on its initial association with deeply-buried sites in Maine (Peterson and Putnam, 1986). A complex burial aspect has been identified for this culture (Robinson, 1992). The Gulf of Maine Archaic tradition continued to develop in northern and eastern Maine through the Middle Archaic period.

Late Archaic Period sites in New England are much more numerous than sites in previous periods and a significant diversity in site type and function is documented. Modern environmental conditions were present by then and the wild resources available were the same as those observed by the early European settlers and explorers. Population densities may have been sufficient to result in the development of multiple ethnic groups in the Northeast (Dincauze, 1974). Three cultural traditions have been identified based on artifact materials: the Laurentian, Susquehanna, and Small Stemmed.

It is thought that people of the Late Archaic period in New England developed a more locally-focused subsistence economy than during previous times. Some degree of transition from a nomadic existence to living permanently in one location is suggested by at least the end of the period, based on changes in subsistence strategy. Shell middens dating to this cultural period begin to appear in some coastal locations, indicating increased use of shoreline resources (Bourque, 1976, 1995, 2001).

Woodland Period (3000 – 500 B.P.)

The cultural period following the Archaic Period and before the Contact Period is generally referred to as the Woodland Period throughout most of the eastern United States. However, in Maine, the same period is called the Ceramic Cultural Period (Sanger, 1979). While both of these cultural adaptations are signified by the advent of ceramic technology around 3,000 years ago, they differ in their subsistence strategies. Woodland cultures developed a reliance on horticulture and a tendency toward larger, more permanent settlement patterns, while the Ceramic culture continued a hunting and gathering lifestyle.

Ceramic period sites are found along both the coast and interior of Maine (Sanger, 1979); however, the coast may have been the main area of occupation as the diet of this period indicates a heavy reliance on marine fish (Bourque, 2001). Coastal midden sites of this period have long been identifiable due to their highly visible nature. These shell midden sites contain not only discarded marine shells, but also a wealth of data concerning terrestrial and marine animals, utilized pottery technology and sequencing, and stone and bone tools. Preservation of artifacts that in most other environmental locations in Maine would not survive, is a notable feature of these midden sites (Bourque, 2001; Sanger, 1979). Sites in the interior are commonly found close to both moving and non-moving water bodies. Artifacts recovered from Ceramic period sites indicate trade and communication with peoples from different regions far outside of Maine (Bourque, 2001). By the end of this period, historical accounts and archeological evidence suggests horticulture was practiced in at least southern Maine.

The Ceramic period ends with European contact around 500 – 450 years ago, after which many of the artifacts attributable to the Pre-Contact inhabitants of Maine disappear from the archeological record, replaced with European trade goods. While the Native American artifacts disappeared, the historical descendants of these people remained.

<u>Contact and Post-Contact period (500 – Present B. P.)</u>

The coast of Maine was explored as early as 1524 by Giovanni da Verrazano, who made contact with local inhabitants. The same year, Estevan Gomez kidnapped and sold into slavery 58 Maine natives. After this, a long period of Native American and European contact occurred off the Maine coast between natives and Basque fishermen, initiating a trade system. European exploration continued into the early 17th century including early attempts by the French in 1604 and the English in 1607 to establish settlements in the region of Maine (Maine History Online, 2017). However, the European introduction of epidemic diseases to the native people, who had no natural immunity to them, began to take a sudden and terrible toll on the Native American population of Maine and New England. This dramatic decrease in the native population of the region lead the way for European colonization of Maine and New England. European and native groups forged trading partnerships allowing Europeans to acquire furs and natives to gain European goods which often replaced many of their traditional tools.

Relationships between the native inhabitants and the European explorers alternated between civil partnership and open hostility. By the late 17th century, open hostilities between the predominantly English settlers of the New England region and the remaining native groups took a toll on both populations, resulting in the near abandonment of the Maine region by the English. Hostilities continued off and on until the conclusion of the Seven Years War in 1763. Many of the native groups in Maine had allied themselves with the French, so with their defeat the native people were forced to sign treaties with the English settlers that were unfavorable to them. After this period, Native groups in Maine and New England became increasingly marginalized by the European settlers, and were either forced onto reservations or to emigrate out of the region. The groups that remained in the Maine region persisted, gaining more political recognition in the latter 20th century (Bourque, 2001). Federally recognized tribes within the State of Maine include the Aroostook band of Micmac, the Houlton Band of

Maliseets, the Passamaquoddy (Pleasant Point and Princeton), and the Penobscot Indian Nation.

European settlement of the Auburn area first occurred in the late 1700s (around 1786) and these early settlers focused on subsistence farming. Large areas of land were cleared of old growth vegetation to set up new agricultural undertakings. In the years after this initial settlement period and into the early 19^{th} century, many natural and cultural hardships stagnated the growth of the town so that it was not until the mid-19^{th} century that the town began to prosper and grow. During this early period, some mercantile, milling and manufacturing (shoes production) work occurred. However, it was not until the connection of the town with outside world via the Maine Central Rail Road in 1848 and the harnessing of water power Lewiston Falls on the Androscoggin River, that large scale production began that would help grow Auburn from a town to a city (Merrill, 1891).

In 1871, the Little Androscoggin Water-Power company completed what was likely the first dam ever built on the Little Androscoggin River. In 1872, the company built its first dam at the lower falls on the Little Androscoggin River (the project dam site) and by 1874, the Barker Mill had been built with the dam providing the power for this large textile mill. By this time, some urbanization had occurred on the east bank of the river. However, much of the land that included the project area was still fairly undeveloped. In 1888, the company built a stone dam on the upper falls (the present day site of the Upper Barker Dam) and leased it to the Lewiston and Auburn Electric Light Company for the next 40 years (Merrill, 1891). A new concrete dam was built in 1907 to replace the wooden Lower Barker Dam. The dam was most recently rehabilitated in 1979.

Between 1873 and 1874, the 5.4-mile-long Lewiston and Auburn Rail road, connecting the two towns with the Grand Trunk Railroad, was constructed (Hodgkin, 2010). At this time, the vicinity of the project area was becoming increasingly industrial, with a brickyard to the northeast and several mills further upstream. Between 1908 and 1942, there was a gradual increase in urbanization in the uplands east of the project area.

Archeological, Traditional Ethnographic, and Historic Resources Investigations

Gray and Pape, Inc., the applicant's contractor, conducted a literature search and a reconnaissance survey within the project's APE between September 28, 2015 and February 6, 2016, which was followed up by a Phase I Pre-Contact Archeological survey conducted between September 27 and October 6, 2016 (Gray and Pape, 2016a). The literature search revealed locations of Pre-Contact archeological sites close to the project. Some of these sites were discovered within the past 30 years as a result of two surveys – one conducted for a dam repair at the Littlefield Hydroelectric Project in 1986 and 1987 and another conducted by the Maine Department of Transportation of the Michaud site, a Paleoindian site located in the Royal River drainage about four miles away from the Barker's Mill Project. The applicant then conducted a reconnaissance survey of the APE which identified five areas that had high potential for archeological resources and needed further study. A Phase I Pre-Contact Period archeological survey was then conducted within 5-meter-wide areas (measured back from the top edge of the Little Androscoggin River bank) at each site. The entire survey involved a total of 98 shovel tests and 12 excavated units (Gray and Pape, 2016b).

Pre-Contact Archaeological Resources and Historic Resources Located within the APE

The literature search revealed ten Pre-Contact Period archeological sites in the project vicinity but only two that are close to the project site. These two sites (Site 23-41 and 24-6) are located less than 450 meters downstream from the Barker's Mill Dam at the confluence of the Little Androscoggin River with the Androscoggin River. Site 23-41 is recorded as the Fort Hill site, which was part of a Native American village site that existed up to the Post-Contact Period. Records indicate that the site contained artifacts that are possibly from the Late Archaic or Ceramic Period. No information is recorded for Site 24–6, other than it is a Native American site and could be associated with Site 23-41. Both sites' eligibility for the National Register are undetermined. Two of the five areas tested as part of the Phase I Pre-Contact Period survey found two previously-unidentified sites – Site 23.43 on the west bank of the project impoundment and Site 23.44 on the east bank. Site 23.43 is an isolated find, consisting of three quartz flakes recovered from Holocene alluvium. Site 23.44 is an isolated find of a quartz core recovered from Holocene alluvium. No Pre-Contact materials were found in the other three areas surveyed. Because findings at both sites appear to provide little to no information on Native American use of the area and would contribute little to the archeological record, the applicant did not recommend either site as eligible for the National Register. We concur.

Historic Architectural Resources located within the APE

The applicant's contractor conducted a survey of historic architectural resources within and adjacent to the APE between July 27, 2015 and August 5, 2015 (Gray and Pape, 2015). The area surveyed included the Barker Mill, which was listed on the National Register in 1980 and is in sight of the project dam and powerhouse. Structures surveyed within the APE included the project dam, gatehouse, penstock, and powerhouse. Because the gatehouse, penstock, and powerhouse are less than 45 years old, these structures were determined not eligible for listing on the National Register.

Although the dam was initially determined not eligible for listing on the National Register, subsequent communication between the Maine SHPO and the applicant's contractor[79] led KEI Power to revise its architectural report to find that the dam is eligible under Criteria A and C[80] because it has a historical association with the Barker Mill (Criterion A) and is a representative example of an Ambursen-type of dam construction which is not common in Maine (Criterion C). KEI Power determined that relicensing the project would have no effect on the historical attributes of the dam. The Maine SHPO concurred with this finding in a July 31, 2018, email filed with the Commission on August 2, 2018.[81]

3.3.5.2 Environmental Effects

The future construction of upstream fish passage facilities could involve some modification of Barker's Mill Dam which could adversely affect the properties that make the dam eligible for listing on the National Register. KEI Power proposes to manage historic properties within the APE, including National Register-eligible properties, on a "case by case basis;" but does not specifically address the possible effects of constructing a fish passage facility on the historic properties of the dam.

Our Analysis

We concur with the applicant's determination that Barker's Mill Dam is eligible for listing on the National Register because it meets criteria A and C. We also agree that relicensing the project, as proposed by KEI Power or under the Staff Alternative would have no effect on the dam because there would be no changes in the current operation of the project and no proposed modifications to the dam. Constructing the upstream eel

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[79] *See* email correspondence between Robin Reed, Maine Commission on Historic Preservation and Don Burden, Gray and Pape, Inc., January 22, 2016 and February 3, 2016; and between Patrick O'Bannon, Gray and Pape, Inc. and Andy Qua, Kleinschmidt, May 23, 2016, filed with the Commission along with the 2015 Architectural Survey on July 6, 2018.

[80] In evaluating the eligibility of historic properties for listing on the National Register, National Register criteria A through D (36 CFR 60.4) are applied. To meet Criterion A, the property must retain integrity and be associated with a significant event or broad pattern in history. To meet Criterion C, it must either: (1) be characteristic of the type or period of a certain type of architecture or engineering, (2) be the work of a master, (3) have high artistic values, or (4) have distinguishing characteristics.

[81] *See* email correspondence between Patrick O'Bannon, Gray and Pape, Inc., and Andy Qua, Kleinschmidt, May 23, 2016, filed with the Commission along with the 2015 Architectural Survey on July 6, 2018.

passage facility, under the Staff Alternative, is not expected to adversely affect the dam because eel passage facilities are typically simple, light-weight structures that are removable and require minimal construction, primarily bolting it to the dam in places which would not adversely affect the integrity of the dam.

However, constructing the upstream fish passage facilities for alosines and Atlantic salmon, under the Staff Alternative with Mandatory Conditions, has the potential to adversely affect the historical properties of the dam because construction of either a pool and weir design ladder or a fish lift,[82] would require more significant construction and would likely require some modification of the dam. The degree of adverse effect would depend on the final design of the fishway, which would occur after license issuance. Evaluating such effects upon the completion of a conceptual design of the fish passage facility and developing and implementing an HPMP to address any adverse effects would ensure that any impacts to the dam are minimized or adequately mitigated.

It is possible that proposed land-disturbing activities over the license term could uncover previously unknown cultural resources in the project area. In the event of any such discovery, Commission licenses typically include a requirement to discontinue any ground-clearing, ground-disturbing, or spoil-producing activities and consult with the SHPO to resolve any potential adverse effect to such properties though the development and implementation of a HPMP.

3.4 NO-ACTION ALTERNATIVE

Under the no-action alternative, the project would continue to operate under the terms of the existing license. There would be no changes to the physical, biological, or cultural resources of the area. None of the proposed or recommended measures would be implemented and there would be no further enhancement of environmental resources.

4.0 DEVELOPMENTAL ANALYSIS

In this section, we look at the project's use of the Little Androscoggin River for hydropower purposes to see what effects various environmental measures would have on the project's costs and power generation. Under the Commission's approach to evaluating the economics of a hydropower projects, as articulated in *Mead Corp.*,[83] the

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[82] *See* NMFS's December 19, 2018, and Interior's December 20, 2017 letters providing section 18 preliminary fish passage prescriptions filed on December 21, 2017 and December 20, 2017, respectively.

[83] *See Mead Corporation, Publishing Paper Division*, 72 FERC ¶ 61,027 (July 13, 1995). In most cases, electricity from hydropower would displace some form of fossil-

Commission compares the current project cost to an estimate of the cost of obtaining the same amount of energy and capacity using a likely alternative source of power for the region (cost of alternative power). In keeping with Commission policy as described in *Mead Corp*, our economic analysis is based on current electric power cost conditions and does not consider future escalation of fuel prices in valuing the hydropower project's power benefits.

For each of the licensing alternatives, our analysis includes an estimate of: (1) the cost of individual measures considered in the EA for the protection, mitigation, and enhancement of environmental resources affected by the project; (2) the cost of alternative power; (3) the total project cost (i.e., operation, maintenance, and environmental measures); and (4) the difference between the cost of alternative power and total project cost for the project. If the difference between the cost of alternative power and total project cost is positive, the project helps to produce power for less than the cost of alternative power. If the difference between the cost of alternative power and total project cost is negative, then the project helps to produce power for more than the cost of alternative power. This estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license. However, project economics is only one of many public interest factors the Commission considers in determining whether, and under what conditions, to issue a license.

4.1 POWER AND ECONOMIC BENEFITS OF THE PROJECT

Table 21 summarizes the assumptions and economic information we use in our analysis for the project. This information was provided by KEI Power in its license application or estimated by staff. We find that the values provided by KEI Power are reasonable for the purposes of our analysis. Cost items common to all alternatives include: taxes and insurance costs, net investment, estimated future capital investment required to maintain and extend the life of facilities, relicensing costs, normal operation and maintenance cost, and Commission fees.

Table 21. Parameters for economic analysis of the Barker's Mill Project.

Parameter	Values (2017$)	Source
Period of analysis	30 years	Staff
Term of financing	20 years	Staff
Escalation rate	0 percent	Staff
Alternative energy value	\$40.30/MWh[a]	KEI Power
Relicensing cost	\$400,000	KEI Power
Undepreciated net investment	\$914,584	KEI Power

fueled generation, in which fuel cost is the largest component of the cost of electricity production.

Annual operation and maintenance costs	$143,201	KEI Power
Annual administrative expenses	$42,074	KEI Power

[a] Calculated from KEI Power's average annual value of $205,000.

4.2 COMPARISON OF ALTERNATIVES

Table 22 summarizes the installed capacity, annual generation, annual cost of alternative power, annual project cost, and difference between the cost of alternative power and project cost for each of the alternatives considered in this EA: no-action, KEI Power's proposal, the Staff Alternative, and Staff Alternative with Mandatory Conditions.

Table 22. Summary of the annual cost of alternative power and annual project cost for the four alternatives for the Barker's Mill Project. (Source: Staff).

	No Action	**KEI Power'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	5,087 MWh	4,311 MWh	4,311 MWh	4,018 MWh
Annual cost of alternative power	$205,006 $40.30/MWh	$173,733 $40.30/MWh	$173,733 $40.30/MWh	$161,925 $40.30/MWh
Annual project cost	$249,630[a] $49.07/MWh	$337,252[a] $78.23/MWh	$328,976[a] $76.37/MWh	$1,054,437[a] $262.43/MWh
Difference between the cost of alternative power and project cost	($44,624)[b] ($8.77/MWh)	($163,519)[b] ($37.93/MWh)	($155,243)[b] ($36.01/MWh)	($892,512)[b] ($222.13/MWh)

[a] The loss of generation is reflected as a higher project cost, rather than a lower power value.
[b] Numbers in parenthesis are negative.

4.2.1 No-Action Alternative

Under the no-action alternative, the project would continue to operate as it does now. The project would have an installed capacity of 1.5 MW, and generate an average of 5,087 MWh of electricity annually. The average annual cost of alternative power would be $205,006, or about $40.30/MWh. The average annual project cost would be $294,630, or about $49.07/MWh. Overall, the project would produce power at a cost that is $44,624, or $8.77/MWh, more than the cost of alternative power.

4.2.2 Applicant's Proposal

Under KEI Power's proposal, the project would have an installed capacity of 1.5 MW, and generate an average of 4,311 MWh of electricity annually. The average annual cost of alternative power would be $173,733, or about $40.30/MWh. The average annual project cost would be $337,252, or about $78.23/MWh. Overall, the project would produce power at a cost that is $163,519, or $37.93/MWh, more than the cost of alternative power.

4.2.3 Staff Alternative

Under the Staff Alternative, the project would have an installed capacity of 1.5 MW, and generate an average of 4,311 MWh of electricity annually. The average annual cost of alternative power would be $173,733 or about $40.30/MWh. The average annual project cost would be $328,976, or about $76.31/MWh. Overall, the project would produce power at a cost that is $155,243, or $36.01/MWh, more than the cost of alternative power.

4.2.4 Staff Alternative with Mandatory Conditions

Under the Staff Alternative with Mandatory Conditions, the project would have an installed capacity of 1.5 MW, and generate an average of 4,018 MWh of electricity annually. The average annual cost of alternative power would be $161,925, or about $40.30/MWh. The average annual project cost would be $1,054,437, or about $262.43/MWh. Overall, the project would produce power at a cost that is $892,512, or $222.13/MWh, more than the cost of alternative power.

4.3 COST OF ENVIRONMENTAL MEASURES

Table 23 provides the cost of each of the environmental mitigation and enhancement measures considered in our analysis. All dollars in table 23 are year 2018. 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.

Table 23. Cost of environmental mitigation and enhancement measures considered in assessing the environmental effects of the Barker's Mill Project (Source: Staff).

Enhancement / Mitigation Measure	Entity	Capital Cost (2018$)	Annual Cost[a] (2018$)	Levelized Cost[b] (2018$)
AQUATIC RESOURCES				
Project Operation				
1. Continue to operate the project in run-of-river mode.	KEI Power, NMFS, Interior, Maine DMR, Maine DIFW, Staff	$0	$0	$0
2. Maintain impoundment levels within 1 foot or less from the full pond elevation or from the spillway crest when the flashboards are down.	NMFS, Maine DIFW, Staff	$0	$0	$0
3. Consult with Maine DIFW prior to any planned impoundment drawdowns that occur between May 1 and June 30.	Maine DIFW	$0	$0	$0
4. Restrict the timing of planned maintenance activities to July through September.	Staff	$0	$0	$0
5. Develop an operation compliance monitoring plan.	Staff	$5,000	$0	$390
Minimum Flows				
6. Release a continuous minimum flow of 113 cfs or inflow, whichever is less, to the project bypassed reach.	KEI Power, Maine DMR, Maine DIFW, Staff	$0	$31,266[c]	$31,266
7. Release a continuous minimum flow of 175 cfs or inflow, whichever is less, to the project bypassed reach and Interior recommends that the flows be prioritized as follows: (1) through the new upstream alosine fishway, (2) through the fish bypass, and (3) over the spillway.	NMFS, Interior	$0	$49,663[c]	$49,663

Enhancement / Mitigation Measure	Entity	Capital Cost (2018$)	Annual Cost[a] (2018$)	Levelized Cost[b] (2018$)
8. Provide a flow in the bypassed reach sufficient for safe, timely, and effective passage to the dam during the upstream anadromous fish passage season from May to November.[d]	NMFS[e]	$0	$25,364[f]	$25,364
Downstream Fish Passage				
9. Operate the existing downstream fish passage facility from June 1 through November 15 until the modifications to the downstream passage facility are completed.	KEI Power, Interior[e], Maine DMR	$0	$0	$0
10. Modify the existing downstream fish passage facility by: (1) providing a minimum conveyance flow of 25 cfs in the fish bypass, (2) installing a ramp beneath the fish bypass entrance, and (3) modifying the existing plunge pool beneath the fish bypass exit.	KEI Power, NMFS[e], Interior[e], Maine DMR, Staff	$175,800[c]	$5,000[c]	$18,730
11. As part of the modifications to the downstream fish passage facility, install a new 0.75-inch-spaced inclined or angled trash rack adjacent to the fish bypass entrance with a cleaning deck that spans the canal to facilitate manual cleaning of the trash rack. Once completed, operate the modified facility from June 1 to November 30.	NMFS[e], Interior[e], Maine DMR	$210,000[c]	$23,500[g]	$39,900
12. Same as item 10 above, except install a new 1-inch-spaced angled trash rack. Once completed, operate the modified facility from June 1 to November 15.	KEI Power	$175,000[c]	$19,500[g]	$33,170
13. Do not install a new trash rack but operate the existing and modified downstream fish passage facility as described in item 9 and item 10 from June 1 through November 30.	Staff	$0	$0	$0
14. Once construction of the anadromous upstream fishway is completed in 2024, expand the operation of the modified downstream fish passage facility to also include April, May, and December for Atlantic salmon.	NMFS[e]	$0	$15,500	$9,470[h]

Enhancement / Mitigation Measure	Entity	Capital Cost (2018$)	Annual Cost[a] (2018$)	Levelized Cost[b] (2018$)
15. Begin operation of the modified downstream passage facility by September 1, 2021.	NMFS[e], Interior[e], Maine DMR	$0	$0	$0
16. Begin operation of the modified downstream passage facility at least 30 days before the second migratory season after license issuance.	Interior[e]	$0	$0	$0
17. Begin operation of the modified downstream passage facility within two years of license issuance.	NMFS[e]	$0	$0	$0
18. When the project is spilling, prioritize the release of flows as follows: (1) through the fish bypass, (2) through the other stop log bays, and (3) over the spillway.	Interior[e]	$0	$21,000[i]	$21,000
19. When the project is spilling during the downstream fish passage season (June 1 to November 30), prioritize the release of flows as follows: (1) through the fish bypass, (2) through the other stop log bays, and (3) over the spillway.	Maine DMR, Staff	$0	$9,000[i]	$9,000
20. Construct a plunge pool beneath the overflow spillway to provide a safe downstream passage route for fish passing the spillway.	Interior[e], Maine DMR	$435,000[c]	$3,000[c]	$36,970
Upstream Fish Passage				
21. Construct a new upstream passage facility for anadromous fish consisting of a pool-type fishway.	NMFS[e], Interior[e], Maine DMR	$6,000,000[c]	$60,000[c]	$528,520
22. Construct a new upstream passage facility for anadromous fish consisting of a fish lift.	NMFS[e], Interior[e], Maine DMR	$5,250,000[c]	$175,000[c]	$584,960[j]
23. Operate the new upstream passage facility for anadromous fish from May 1 to July 31, and maintain a 50-cfs minimum conveyance flow in the facility during this period.	Interior[e], Maine DMR	$0	$0	$0
24. Operate the new upstream passage facility for anadromous fish from May 1 to November 10.	NMFS[e]	$0	$0	$0

Enhancement / Mitigation Measure	Entity	Capital Cost (2018$)	Annual Cost[a] (2018$)	Levelized Cost[b] (2018$)
25. As part of the new upstream passage facility for anadromous fish, construct and operate a holding/sorting facility during fish passage operations to remove non-native fish species.	Maine DIFW	$300,000[c]	$150,000[c]	$173,400
26. As part of the new upstream passage facility for anadromous fish, install and operate a fish counting facility to count upstream migrants.	NMFS[e], Maine DMR	$20,000[c]	$25,000[c]	$26,560
Fish Passage for American Eel				
27. Construct and operate an upstream passage facility for American eel.	NMFS[e], Interior[e], Maine DMR, Staff	$75,000[c]	$5,000[c]	$10,860
28. Begin operation of the upstream passage facility for American eel no later than June 1, 2021.	Interior, NMFS[e], Maine DMR	$0	$0	$0
29. Begin operation of the upstream passage facility for American eel by the start of the second migration season after license issuance.	Interior[e]	$0	$0	$0
General Fishway Measures				
30. Monitor passage success at the new upstream and downstream fish passage facilities for a minimum of 2 years after construction.	NMFS[e], Interior[e]	Depends on study design and parameters to be monitored	Depends on study design and parameters to be monitored	Depends on study design and parameter s to be monitored
31. Develop fishway effectiveness testing and evaluation plans for the downstream fish passage facility for alosines and the new upstream fish passage facility for American eel.	Interior[e]	Depends on study design and parameters to be monitored	Depends on study design and parameters to be monitored	Depends on study design and parameter s to be monitored
32. Provide as-built drawings to the agencies.	NMFS[e], Interior[e], Maine DMR,	$0	$0	$0

Enhancement / Mitigation Measure	Entity	Capital Cost (2018$)	Annual Cost[a] (2018$)	Levelized Cost[b] (2018$)
33. Provide copies of the fish passage facility operating procedures, and any revisions made during the term of the license to the resource agencies.	Maine DMR	$0	$0	$0
34. Operate each constructed or modified fish passage facility for a one-season "shakedown" period and make minor adjustments to facilities and operations.	Maine DMR	$0	$0	$0
35. Operate the new upstream eel fishway for a one-season "shakedown" period and make minor adjustments to the facility and operations.	Staff	$0	$0	$0
36. Develop a fishway operation and maintenance plan in consultation with the resource agencies.	Interior[e], Maine DMR, Staff	$5,000[c]	$0	$390
37. Meet with resource agencies annually to review fish passage operational data.	Interior[e], Maine DMR	$0	$300	$300
38. Collect data on daily river conditions and fish counts, and include in an annual fish passage report.	NMFS[e], Maine DMR	$1,000[c]	$3,000[c]	$3,080
39. Modify fish passage facility operating schedules during the term of the license based on new information	Interior[e], Maine DMR	Depends on nature of modification	Depends on nature of modification	Depends on nature of modificati on
40. Improve fish passage facilities that do not meet performance standards.	NMFS[e]	Depends on how improved	Depends on how improved	Depends on how improved
41. Consult with agencies on design of new and modified fish passage facilities and design the facilities according to the FWS's 2017 Design Criteria Manual.	Maine DMR, Interior[e], Staff	$20,000[c]	$0	$1,560

Enhancement / Mitigation Measure	Entity	Capital Cost (2018$)	Annual Cost[a] (2018$)	Levelized Cost[b] (2018$)
42. Develop a construction schedule for new and modified fish passage facilities and file within 6 months of license issuance.	Staff	$2,000	$0	$160
43. Obtain agency approval of fish passage facility design plans.	NMFS[e], Interior[e], Maine DMR	$0	$0	$0
44. Require documentation from a licensed engineer that each fish passage facility is constructed and operating as designed.	Maine DMR	$0	$0	$0
45. Provide resource agencies access to the fish passage facilities and records.	NMFS[e], Interior[e]	$0	$0	$0
TERRESTRIAL RESOURCES				
1. Restrict tree removal activities from April 1 to October 31 to protect the northern long-eared bat.	Staff[k]	$0	$0	$0
RECREATION RESOURCES				
1. Prepare and file a final recreation plan for the design and construction of the boat ramp, foot path, and signs; the maintenance of the parking lot and the Barkers Mill Trail; and the monitoring and reporting of recreational use.	Staff	$5,000	$0	$390
2. Monitor and report on recreational use of project facilities in year 6 then every 10 years thereafter.	Staff	$10,000[c]	$0	$780
3. Maintain the entire Barker Mill Trail (includes portage).	City of Auburn, Staff	$0	$2,000[c]	$2,000
4. Improve the recreation paths from the parking areas to the river bank; maintain the public parking areas; add directional and safety signage, and improve the hand-carry boat launch and portage.	KEI Power, Staff	$15,000[c]	$2,500[c]	$3,670
5. Construct an accessible walking path along the bypassed reach from the dam to the powerhouse.	American Whitewater, Park Service	$8,000[c]	$2,000[c]	$2,630
6. Provide up to 5 boating releases annually of an unspecified amount.	KEI Power	$0	$396[l]	$396

Enhancement / Mitigation Measure	Entity	Capital Cost (2018$)	Annual Cost[a] (2018$)	Levelized Cost[b] (2018$)
7. Provide annual release of 600 to 800 cfs for 5 hours each on 5 weekend days during the boating season (5 days total).	City of Auburn	$0	$467—$630[m]	$630
8. Release all available flows between 300 cfs to 1,000 cfs for 5 hours on Saturdays and holidays between April 15 and October 15 (average 11 days total).	American Whitewater	$0	$515—$871[n]	$871
9. Install a new stream gage in the bypassed reach and transmit the flow data to a publicly available website.	City of Auburn, American Whitewater	$20,000[c]	$20,000[c]	$21,560
10. Calculate bypassed reach flows based on data from the USGS's South Paris stream gage, and post the data to a publicly available website.	KEI Power, Staff	$5,000[c]	$0	$390
CULTURAL RESOURCES				
1. Continue to manage historic properties within the APE and address tribal resources, if discovered, on a case-by-case basis.	KEI Power, Staff	$0	$0	$0
2. Prepare and implement an HPMP to evaluate and address the effects of section 18 fish passage facilities on the dam.	Staff[k]	$30,000[c]	$0	$2,340

[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 all costs.

[c] Staff estimate.

[d] Staff estimate for the cost of minimum flows under the Staff Alternative with Mandatory Conditions would be a levelized annual cost of $48,687, and include costs to provide staff's recommended minimum flow of 113 cfs from December to April and NMFS's stipulated minimum flow of 175 cfs for upstream fish passage from May to November.

[e] Section 18 prescription.

[f] Staff estimate for a continuous minimum flow of 175 cfs to the project bypassed reach from May to November.

[g] Staff estimate for cost of trash rack cleaning and debris removal, and head loss from smaller bar spacing on new trash racks.

[h] Staff estimate for cost of trash rack cleaning and debris removal, and head loss from smaller bar spacing on new trash racks, over the three additional months (i.e., April, May, and December) of facility operation for Atlantic salmon beginning in year 2024 and continuing through the end of the 30-year period of analysis.

[i] Staff estimate for cost of weekly inspection and debris removal from stop logs bays and plunge pool.

[j] For the Staff Alternative with Mandatory Conditions, staff used the higher cost of the two upstream fish passage facility design alternatives.

[k] As a consequence of NMFS's and Interior's section 18 prescriptions, this is a staff-recommended measure only under the Staff Alternative with Mandatory Conditions.

[l] Cost is loss in annual generation as calculated by KEI Power for releases of 500 cfs for 5 hours and 5 weekend days.

[m] Cost is loss in annual generation as calculated by staff for releases of 600 and 800 cfs for 5 hours for 5 days total of whitewater boating flows.

[n] Cost is loss in annual generation as calculated by staff for releases of 300 and 1,000 cfs for 5 hours for an average of 11 days total of whitewater boating flows.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

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

Based on our independent review of 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 KEI Power to continue to operate its Barker's Mill 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 proposed and recommended measures would protect and enhance fish and wildlife resources and would improve public recreation opportunities at the project.

In the following section, we make recommendations as to which environmental measures proposed by KEI Power or recommended by agencies or other entities should be included in any license issued for the project.

5.1.1 Measures Proposed by KEI Power

Based on our environmental analysis of KEI Power's proposal in section 3, and the costs presented in section 4, we conclude that the following environmental measures proposed by KEI Power 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 to operate the project in run-of-river mode to protect aquatic resources.

- Continue to monitor impoundment levels to track compliance with run-of-river operation.

- Increase bypassed reach minimum flow releases at the dam from 20 cfs to 113 cfs or inflow, whichever is less, to protect fisheries and aquatic habitat in the bypassed reach.

- Continue to operate the downstream fish passage facility from June 1 through November 15 to provide downstream passage for diadromous fish species. Modify the existing downstream fish passage facility by constructing a ramp in the impoundment beneath the fish bypass entrance, maintaining a 25-cfs conveyance flow in the bypass, and modifying the existing plunge pool beneath the fish bypass and other stop log bays to ensure a minimum depth of 4 feet within the plunge pool.

- Improve the hand-carry boat launch upstream of the dam and the informal foot trail leading to the bypassed reach just downstream of the dam, add signage for the boat launch and trail, designate the parking area near the gatehouse, and maintain these facilities.

- Maintain portions of the Barker Mill Trail where it serves as a portage route around the project dam.

- Automate the calculation of stream flows in the bypassed reach using real-time flow data obtained from the USGS's existing upstream South Paris Gage, and publish the calculated flows to a public website, in coordination with the City of Auburn, to help inform recreation users of current conditions for boating and fishing in the bypassed reach.

- Continue to manage historic properties within the Area of Potential Effect, including any properties eligible for listing on the National Register of Historic Properties and address tribal resources, if discovered, on a case-by-case basis.

5.1.2 Additional Measures Recommended by Staff

In addition to the above measures, we recommend the following staff-recommended measures be included in any license issued for the project:

- Expand the operation of the existing and modified downstream fish passage facility by 15 days to November 30, to protect downstream migrating juvenile alewife.

- During the downstream fish passage season of June 1 through November 30, prioritize flow releases over the dam as follows to enhance downstream fish passage: (1) through the fish bypass, (2) through the remaining stop log bays, and (3) over the spillway.

- Maintain impoundment levels within 1 foot or less from the top of the flashboards or the spillway crest when the flashboards are down, to protect nearshore aquatic habitat in the impoundment and in the Little Androscoggin River downstream of the powerhouse during operation.

- To protect Atlantic salmon that may occur in the bypassed reach, conduct any planned maintenance activities requiring the impoundment to be drawn down below the normal operating limits between July and September.

- Develop an operation compliance monitoring plan that includes provisions for: monitoring and reporting compliance with the operating requirements of the license (e.g., run-of-river, minimum flows, impoundment levels, and regulating flow over the dam to enhance downstream fish passage), and reporting deviations from operating requirements to the Commission.

- Construct a new upstream eel fishway and annually operate it from June 1 to September 15.

- Design the new upstream eel fishway and staff-recommended modifications to the downstream fish passage facility consistent with the FWS's 2017 Fish Passage Engineering Design Criteria Manual, submit design plans and a construction schedule to the resource agencies for review, and file the plans and schedule for Commission approval prior to beginning construction.

- Operate the new upstream eel fishway for a one-season "shakedown" period following construction to ensure that the fishway is generally operating as designed, and if not, make minor adjustments to the facility and operation.

- Develop a fish passage operation and maintenance plan to ensure proper operation and maintenance of the modified downstream fish passage facility and the new upstream eel fishway. Include a maintenance schedule that ensures any maintenance and changes to fish passage facilities are completed 30 days prior to the start of the next migratory season.

- Provide NMFS and FWS access to the project site and to pertinent records in the performance of their official duties and with reasonable advance notification.

- File with the Commission, for approval, a recreation plan that includes the following: (1) conceptual design drawings and descriptions of the improvements to the hand-carry boat ramp, the foot path to the bypassed reach immediately downstream of the dam, parking, and signage; (2) a provision and schedule for maintaining the Barker Mill Trail where it parallels the project impoundment to below the dam, and including the trail within the project boundary; (3) a provision to monitor and report recreational use in the project area during year 6 of the license and every 10 years thereafter; and (4) include with the filing revised Exhibit G drawings identifying all of the above project recreation facilities.

Below, we discuss the basis for the staff-recommended modifications and measures.

Impoundment Levels

KEI Power states it tries to maintain impoundment levels as close as possible to the top of the flashboards without overtopping them while the project is operating even though there is no formal license requirement to do so. While KEI Power proposes to continue operating the project in run-of-river mode consistent with its current practice, it does not propose a specific range of impoundment elevations it would maintain under any subsequent license that is issued for the project.

NMFS and Maine DIFW recommend that fluctuations be kept to within 1 foot of the top of the flashboards on a regular basis or within 1 foot of the permanent crest when replacing flashboards. Our analysis in section 3.3.1.2, *Impoundment Levels*, indicates that minimizing fluctuations within this recommended range would maintain aquatic habitat in nearshore areas of the impoundment and in the Little Androscoggin River downstream of the powerhouse and would maintain stable passage routes for migratory fish under normal project operation. Because KEI Power already maintains impoundment levels within the recommended range under its current practice, the costs of formalizing this operating procedure would be negligible and would be included in routine operation of the project and, therefore, we recommend this measure.

Planned Maintenance Drawdowns

KEI Power indicates that it prefers to conduct planned maintenance activities that require the impoundment to be drawn down during the summer and early fall low-flow period although it does not indicate the specific time periods during which it would conduct these activities.

Although it does not indicate why it believes planned maintenance drawdowns would occur outside of the low-flow season or how it would use this information, Maine

DIFW recommends that KEI Power consult with Maine DIFW prior to any planned maintenance drawdowns that would occur during the May through June smallmouth bass spawning period.

Our analysis in section 3.3.1.2 shows July through September would likely be the most efficient and cost-effective time of the year to conduct planned maintenance work because: (1) flows would be at the seasonally lowest levels of the year and the project would already typically be shut down due to insufficient inflows, which would both minimize the costs of lost generation due to the maintenance outage as well as flow fluctuations in the bypassed reach if the powerhouse were operating at the time of the planned shutdown; and (2) the weather would typically be warmer and drier and debris levels lower than at other times of the year, which would make it easier to complete the maintenance work. In addition, conducting drawdowns during July through September would avoid intentional flow fluctuations in the bypassed reach when the most-sensitive life stages of Atlantic salmon can be present (i.e., fry in the spring and early summer, spawning adults later in the fall) and would also avoid intentional fluctuations in the impoundment during the May through June smallmouth bass spawning period. Because the powerhouse would typically already be shut down and the flow and weather conditions would be favorable to complete the work during July through September, we estimate there would be minimal additional costs to restrict planned maintenance activities to this period, and conclude that the benefits to the sensitive life stages of Atlantic salmon would justify the cost.

Also, because planned maintenance drawdowns would be restricted to the period of July through September under the Staff Alternative, there is no need for a separate license condition requiring KEI Power to consult with Maine DIFW on planned maintenance drawdowns during the smallmouth bass spawning period of May through June.

Operation Compliance Monitoring Plan

KEI Power proposes to continue operating the project in run-of-river mode and release a year-round minimum flow in the bypassed reach of 113 cfs or inflow, whichever is less.

KEI Power currently uses sensors to monitor impoundment levels and powerhouse operation to monitor compliance with run-of-river operation. KEI Power monitors compliance with the current 20-cfs minimum flow by verifying the flows released through a notched weir in the current plunge pool beneath the fish bypass, and filing annual flow monitoring reports with the Commission. However, KEI Power does not specify how it would monitor compliance with its proposed higher 113-cfs minimum flow release, or how it would report deviations from the operating requirements of the license to the Commission. In addition, we are recommending additional operating requirements to protect aquatic resources, including the regulation of flow releases at the dam during the June 1 to November 30 downstream fish passage season and maintaining impoundment levels within specified limits, which KEI Power would also need to monitor for compliance purposes.

Therefore, to enable the Commission to track and enforce the operating requirements of the license for the protection of fish and aquatic resources in the impoundment and downstream, we recommend that KEI Power develop an operation compliance monitoring plan that includes provisions for: (1) monitoring compliance with run-of-river operation, minimum flows, impoundment levels, and the regulation of flows passed over the dam to protect downstream migrating fish during the June 1 to November 30 downstream passage season; and (2) reporting operational data and deviations from operational requirements to the Commission.

We estimate that the annual levelized cost of developing an operation and compliance monitoring plan would be $390, and conclude that the compliance benefits outweigh the cost.

Modifications to Downstream Fish Passage Facility

The downstream passage season for migrating diadromous fish in the Little Androscoggin River primarily occurs from early summer through late fall. Under existing conditions, KEI Power operates the project's existing downstream passage facility from June 1 to November 15 to provide a safer downstream passage route over the dam than the other available passage routes such as the powerhouse, overflow spillway, or waste gates. Currently, downstream migrating diadromous fish species in the Little Androscoggin River include adult post-spawn alewife, young-of-year juvenile alewife, and adult American eel. In Maine rivers, adult alewife typically migrate downstream shortly after spawning in June and July, juvenile alewife typically migrate downstream later in the summer from mid-July through November, while adult American eel typically migrate downstream from August through October.

In section 3.3.1.2, we analyzed the effects of the various downstream passage routes on diadromous fish. Our analysis suggests that the existing downstream passage facility likely provides the safest downstream passage route at the project, but it's unlikely that all downstream migrants find the fish bypass entrance when the powerhouse is operating because the conveyance flow within the bypass is only 20 cfs, while the flows in the intake canal adjacent to the bypass entrance are significantly higher, ranging from 150 to 500 cfs.

For those fish that enter the intake canal and approach the intake 100 feet downstream, the existing trash rack on the intake which has 2-inch bar spacing, would not physically exclude any of the downstream migrating fish that approach it.

Additionally, because the trash rack is located downstream of the canal entrance at the gate house instead of at the fish bypass entrance, any fish that may be deterred by the trash rack would have to swim upstream a distance of 100 feet to safely exit the canal and enter the fish bypass. Of the species and life stages evaluated, juvenile alewife would not be able to swim back out of the canal because they lack the physical capability to overcome the canal velocities over such a long distance, while all adult alewife and some adult American eel would be able to do so if they elected to. There is no information on the percentage of each species and life stage that enter the intake canal versus the fish bypass, nor is there any information on the percentage of those fish that enter the intake canal and avoid entrainment by swimming back upstream out of the canal. For those fish that are entrained into the penstock intake, we estimate that survival through the project's semi-Kaplan turbine ranges from 78 to 97 percent for adult alewife, 80 to 98 percent for juvenile alewife, and about 50 percent for American eel. Thus, under existing conditions, it's likely that a portion of the downstream migrating fish are entrained into the powerhouse where they are injured or killed.

Although the fish bypass provides a safer downstream passage route than turbine passage, KEI Power's proposed and the agencies' stipulated or recommended modifications to the facility would likely make it more effective and safer at both attracting and passing fish downstream. Installing an entrance ramp and increasing conveyance flows to at least 25 cfs would improve attraction flows into the facility. Constructing a new wall with a cut-out on the downstream side of the plunge pool and increasing its depth to a minimum of 4 feet beneath all seven of the stop-log bays, would provide adequate depth to prevent fish from being injured or killed by striking bedrock when entering the plunge pool. Concentrating flow through the new cut-out section in the plunge pool wall would improve passage from the plunge pool and through the existing bedrock cascades located between the plunge pool and the bypassed reach. In section 4.3, we estimate the costs of the above modifications to the fish bypass and plunge pool would be $18,730, and conclude the benefits of providing safer and more effective fish passage throughout the entire the downstream fish passage season would justify the cost.

Downstream Fish Passage Facility Operating Schedule

KEI Power operates the existing downstream passage facility from June 1 to November 15 and proposes to continue to operate the existing and modified facility (once completed) according to the same schedule. Interiors and NMFS's fishway prescriptions and Maine DMR's 10(j) recommendations support KEI Power's proposed schedule for continuing to operate the existing downstream passage facility. However, once the modifications to the downstream fish passage facility are complete, Interior's fishway prescription stipulates and Maine DMR recommends that KEI Power operate the facility through November 30 to protect downstream migrating juvenile alewife. NMFS's fishway prescription stipulates that KEI Power operate the facility from April 1 to

December 31.

Our analysis in section 3.3.1.2 indicates that the downstream migration season for juvenile alewife, which are present due to stocking in habitats upstream of the project, can extend to the end of November. In section 4.3 we estimate that the costs to extend the operation of the facility by an additional 15 days each year would be minimal, and conclude that the benefits of operating the facility over the entire downstream migration period for alewife outweigh the cost. In addition, in order to ensure the protection of downstream migrating alewife in the interim period after license issuance and before completion of any modifications to the downstream fish passage facility, we also recommend that KEI Power extend the operation of the existing facility from November 15 to November 30.

However, we do not recommend extending operation of the downstream facilities to include April and May and December as stipulated by NMFS to protect downstream migrating Atlantic salmon. As discussed further below, Atlantic salmon do not occur upstream of the Barker's Mill Dam and we are not recommending an upstream passage facility for anadromous fish under the Staff Alternative; therefore, there would be no benefit to Atlantic salmon from operating the downstream facility for these additional months.

Prioritizing Spills for Downstream Fish Passage

Interior's fishway prescription specifies and Maine DMR recommends that KEI Power prioritize how the project spills water from the dam in the following order: (1) through the fish bypass, (2) through the additional stop log bays adjacent to the fish bypass that empty into the plunge pool, and (3) over the spillway. As discussed above, our analysis in section 3.3.1.2 indicates that, of these three alternative passage routes, the fish bypass would provide the safest downstream passage route as it is specifically designed to provide safe downstream passage for diadromous fish species at the project. The survival rate of fish passing through the other stop log bays and spillway are unknown; however, the stop log bays would likely be safer than the spillway because the drop height when fish pass through the stop log bays is lower than the drop height over the spillway. Additionally, the streambed beneath the spillway does not have an adequately sized plunge pool, while the plunge pool beneath the fish bypass and other stop log bays would be sufficient following proposed modifications to cushion fish from impacting the streambed. For these reasons, it would be safer for downstream migrating fish to pass via the stop log bays than the spillway.

Regulating spill flows over the dam according to these priorities would ensure that any inflows that are above the 25-cfs minimum conveyance flow for the fish bypass are first routed through the safer stop log bays before being routed through the spillway, thereby reducing the potential for injury or mortality of downstream migrating fish. We estimate that prioritizing spills would incur additional costs due to increased maintenance and debris removal within the stop logs bays, and the levelized annual costs of the additional maintenance during the June 1 to November 30 downstream passage season would be $9,000. We conclude that the benefits to downstream migrating alewife and eel are justified by the cost.

Although we are recommending the prioritization of spill flows during the June 1 to November 30 downstream fish passage season, it is important to point out that Interior's fishway prescription also stipulates that KEI Power regulate flows spilled over the dam in the manner described above, at any point in time when the project is spilling (i.e., year-round). KEI Power indicates that it is feasible to spill flows through the fish bypass and other stop log bays prior to routing them over the spillway, but it prefers to pass spill flows over the spillway whenever possible because it is more efficient at passing logs and debris than the fish bypass and stop log bays. KEI Power also indicates that because of the spillway's location on the dam (i.e., on the other side of the stop log bays from the intake canal), passing flows over the spillway directs logs and debris away from the intake canal and trash rack, thereby minimizing maintenance costs to remove debris accumulating on the trash rack.

As we said, our analysis indicates that the downstream migration of alewife and American eel occurs from June 1 to November 30. Therefore, there would be no apparent benefit from requiring KEI Power to pass spill flows through the fish bypass and stop log bays to enhance downstream fish passage outside of this period. We estimate the additional debris removal efforts associated with prioritizing spill releases outside of this period would cost $21,000 annually and conclude that the lack of benefits to diadromous fish from requiring KEI Power to prioritize spill releases through the fish bypass and stop log bays year-round (including outside of the downstream migration period for alewife and American eel) would not justify the cost. For these reasons, we instead recommend that KEI Power prioritize spill flows as stipulated by Interior only during the June 1 to November 30 downstream migration period for alewife and eel.

Upstream Passage for American Eel

There are no existing upstream fishways for juvenile eels at the Barker's Mill Project and KEI Power is not proposing to install an upstream eel passage facility under its proposed action. Interior's and NMFS's preliminary fishway prescriptions would require, and Maine DMR recommends, that KEI Power construct and have operational by June 1, 2021, an upstream eel passage facility and operate and maintain the upstream eel passage facility from June 1 to September 15 annually thereafter. Maine DMR also specifically recommends that the facility consist of either an eel lift, eel ramp, or helical eel ladder; and that KEI Power operate the facility with a 50-gpm attraction flow.

In addition to a lack of dedicated upstream eel passage at the project, there are no dedicated upstream eel passage facilities at any of the other six mainstem dams on the Little Androscoggin River upstream of the project. Downstream of the project, only one of the three dams (Worumbo Dam) on the mainstem Androscoggin River has a dedicated upstream eel passage facility. Despite these impediments to upstream migration, eels have been documented in the Little Androscoggin River Basin upstream of the project in lakes and ponds above Biscoe Falls within the past 35 years (Maine DMR and Maine DIFW, 2017), indicating that some upstream movement of eels is occurring past the project as well as the other dams on the Little Androscoggin River. There is no estimate, however, of the number of individuals that successfully pass upstream on an annual basis.

KEI Power's eel passage study conducted between June 9 and August 5, 2015, documented 44 juvenile eel near the base of the dam, most of which were between 3 and 6 inches in length. Because there is no upstream eel passage facility at the project, eels must climb over or around the dam to access habitat in the Little Androscoggin River upstream. In section 3.3.1.2, our analysis indicates that juvenile eel are capable of climbing over or around dams, but the passage rate declines as they grow longer than 4 inches. Therefore, any existing upstream passage route over or around the dam may not be effective for all sizes of juvenile eels that reach the project.

Operating a dedicated upstream eel passage facility at the project during the juvenile eel upstream migration season (from June 1 to September 15) would likely increase upstream passage effectiveness and improve access to upstream habitat for eels. Designing the upstream passage facility consistent with FWS's Design Criteria Manual, which provides guidance on design, operation, and maintenance of fishways throughout the northeastern United States, would ensure that the upstream eel passage facility provides safe, timely, and effective movement of juvenile eels through the project, and would be consistent with Interior's preliminary fishway prescription. According to FWS's Design Criteria Manual, an upstream eel passage facility generally consists of a covered metal or plastic volitional ramp lined with a wetted substrate that is 100 feet long or less, and angled at a maximum slope of 45 degrees with 1-inch-deep resting pools sized to the width of the ramp every 10 feet. Because FWS's Design Criteria Manual specifies that the eel fishway consist of a ramp structure with a 50-gpm attraction flow, designing the fishway to be consistent with the manual would also be consistent with Maine DMR's design recommendations for upstream eel passage. We estimate that the annual levelized cost of constructing and operating an upstream eel fish passage facility that is designed in accordance with the FWS's Design Criteria Manual would be $10,860, and conclude that the benefits to American eel would outweigh the cost.

Fishway "Shakedown" Period

Maine DMR recommends operating each of the project's newly-constructed or modified fish passage facilities for a one-season "shakedown" period to ensure that the fish passage facilities are generally operating as designed, and if not, to make adjustments. KEI Power does not propose to test newly constructed or modified fish passage facilities for proper operation prior to putting them into permanent operation.

As discussed above, we are recommending that KEI Power modify its existing downstream fish passage facility by installing a guidance ramp and increasing attraction flows at the fish bypass entrance, and increasing the depth of the plunge pool beneath the fish bypass and other stop-log bays. These modifications would improve fish attraction into the facility and the safety of fish passing downstream, but would require little change to the overarching design of the facility. Thus, because these are relatively minor changes to the existing footprint of the downstream passage facility, there is no reason to believe that the modified facility would not continue to perform as designed and there would be little benefit to operating the downstream passage facility for a one-season "shakedown" period.

In contrast to the existing downstream fish passage facility, however, the upstream eel fishway that we recommend has not been constructed nor evaluated. While we fully expect that the facility designed to meet FWS's Design Criteria Manual should function properly, conducting a one-season "shakedown" period for new eel upstream fishway would allow KEI Power time to make minor modifications to the fishway to improve its performance prior to placing it into permanent operation. However, Maine DMR does not specify the timing of its recommendation, and the lack of specificity could result in a "shakedown" period interfering with the migration season. To prevent interference with the fish passage season, the "shakedown" period and any necessary adjustments should be timed so that they are completed prior to June 1. We estimate that the levelized annual cost of the "shakedown" period for the upstream eel fishway would be included in routine operation and maintenance, and thus the cost would be negligible. Therefore, the benefits of the measure outweigh the cost.

As discussed further below, staff is not recommending the construction of upstream fishways for other diadromous fish species. However, if required to be constructed as a mandatory condition of the license, conducting a similar evaluation of its operation would allow KEI Power to make minor modifications to the facility and its operation to improve its performance. The cost of such evaluations would be negligible for the reasons noted above for the upstream eel fishway.

Fish Passage Operation and Maintenance Plan

To provide safe, timely, and effective fish passage, fish passage facilities need to be properly operated and maintained. KEI Power does not propose to develop an operations and maintenance plan for its downstream fish passage facility. Interior's and NMFS's preliminary fishway prescriptions and Maine DMR's section 10(j) recommendation include specific provisions for operation and maintenance of new upstream fishways and the existing downstream fish passage facility.

Interior's prescription also requires the development of a fishway plan that includes measures for operating and maintaining the upstream and downstream fish passage facilities that are in operation at the time. Interior's prescription also requires KEI Power to complete maintenance 30 days prior to the beginning of a migration season, and to amend the fishway plan within 30 days of a request from the FWS. Interior also stipulates that KEI Power provide FWS personnel, and its designated representatives, access to the project site and to pertinent project records for the purpose of inspecting the fish passage facilities and to determine compliance with its fishway prescriptions.

Maine DMR recommends specific fish passage operation and maintenance measures, including: (1) maintaining fish passage facilities in proper working order and performing routine maintenance before a migratory season begins; (2) developing fish passage facility operating procedures, including maintenance schedules, procedures for routine operation, procedures for monitoring and reporting on facility operation, schedules for annual start-up and shutdown procedures, and procedures for emergencies and outages that could significantly affect fish passage facility operations; and (3) maintaining and operating fish passage facilities during defined upstream and downstream migration periods.

NMFS's preliminary fishway prescription would require KEI Power to maintain downstream passage facilities by clearing trash, logs, and other material that could hinder flow and passage, and performing anticipated maintenance before the migratory period. NMFS also prescribes that KEI Power allow resource agencies access to the fish passage facilities for inspection throughout the term of the license with reasonable notice.

A fishway operation and maintenance plan that incorporates Maine DMR's recommended and Interior's and NMFS's stipulated provisions for specific procedures and schedules for performing routine inspections and maintenance, the timing of facility operation, and monitoring and reporting on fish passage facility operational settings and conveyance flows to track compliance with the fish passage facility operating requirements of the license, would ensure that fish passage facilities operate as intended. Completing all maintenance 30 days prior to a migratory season, as stipulated by Interior would ensure that maintenance is completed in a timely fashion and that all fish passage facilities would operate as designed over the course of a migration season.

For the reasons discussed above, we recommend that KEI Power develop a fish passage operation and maintenance plan that includes measures for operating and maintaining the existing downstream fish passage facility and any newly-constructed fishways. We estimate that the levelized annual cost of the plan would be $390 and conclude that the benefits of the measure would outweigh the cost.

With regard to Interior's and NMFS's stipulations that KEI Power provide agency personnel and their designated representatives with site access for inspecting the fish passage facilities and determining compliance with the fishway prescriptions, the Commission's standard terms and conditions for a hydropower license require the licensee to provide federal employees access to project land and works in performance of their official duties. This standard article would apply to site access for FWS and NMFS employees and their designated representatives to inspect fish passage facilities. Therefore, staff does not recommend a separate license condition for providing FWS and NMFS personnel with site access for inspecting fish passage facilities.

Maintenance of Barker Mill Trail

The 0.6-mile-long Barker Mill Trail runs along the project impoundment, either within or immediately adjacent to the project boundary, and provides access to and views of the impoundment. The trail also briefly overlaps with an existing canoe portage around the dam before it terminates within the project boundary about 200 feet downstream of the dam. To ensure that the trail remains in good condition, the City of Auburn recommends that KEI Power make unspecified annual payments to the City of Auburn or the Androscoggin Land Trust for trail maintenance. KEI Power is agreeable to providing "reasonable" payments to either entity for trail maintenance, but only for the portion that is used for boat portage around the dam, since it does not believe the remainder of the trail serves project purposes. As we discuss in section 3.3.4.2, because the trail provides public access to the impoundment and users are likely drawn to the impoundment for viewing or fishing, it accommodates project-related recreation and therefore serves a project purpose.

To ensure that the Barker Mill Trail is adequately maintained and continues to provide recreation benefits throughout the term of any subsequent license issued for the project, we recommend that KEI Power maintain the entire 0.6-mile-long Barker Mill Trail and incorporate it into the project boundary as a licensed project facility. While the City of Auburn does not indicate funding amounts, we estimate that maintaining a natural trail of the same length as the Barker Mill Trail, including the minor cost of preparing and filing revised Exhibit G drawings, would have an annual levelized cost of $2,000. We believe it would be worth the extra cost to ensure that the entire trail is adequately maintained in a consistent manner that ensures it continues to accommodate project-related use throughout any new license issued to the project. Although KEI Power is free to provide funds to a third party, such as the City of Auburn or the Androscoggin Land Trust, to maintain the trail, KEI Power would ultimately be responsible for maintaining the trail.

Project Recreation Plan and Recreation Monitoring

KEI Power proposes to enhance recreation by: improving the hand-carry boat launch on the impoundment and the informal foot trail leading to the bypassed reach just downstream of the dam; adding signage for the launch and trail; designating the parking area near the gatehouse; and maintaining these facilities. It is not clear, however, how KEI Power intends to improve the foot path to the river, what it would include in the proposed signage, or how it would improve the boat launch. Additional detail describing the location of the trail, content of the directional and safety signage, and design of the trail and boat launch improvements are needed before installation can be authorized. For example, some special considerations may be needed along steep parts of the trail to ensure safe access to the bypassed reach. Filing conceptual drawings of the trail and boat launch improvements for Commission approval as part of a project recreation plan would ensure that the improvements are built appropriately. The Commission typically requires that all project recreation facilities be identified on Exhibit G drawings to aid in administering the license. Thus, revised Exhibit G drawings would need to be refiled.

As we discuss in section 3.3.4.2, anticipated population increases, improvements to recreation facilities, and increased minimum flows for fisheries may increase recreation use at the project over the course of a subsequent license. KEI Power does not propose any measures to monitor recreation use. Monitoring recreation use periodically would help determine whether existing facilities are accommodating recreation demands. We expect that monitoring in year 6 would be adequate to evaluate the immediate response to recreation enhancements, and that every 10 years thereafter would be adequate to evaluate changes in future recreation demands. Additionally, a report detailing recreational activity and any recommendations for facility improvements would help the Commission evaluate any necessary changes to meet recreation demands at the project. Therefore, we recommend that the project recreation plan include a provision to monitor recreational use in the project area in year 6 and every 10 years thereafter, and that this monitoring would be worth the estimated annualized cost of $780. The recreation plan should also describe the methods to be used to monitor recreational use and evaluate the conditions of project recreation facilities.

We estimate that preparing a project recreation plan that includes the above measures, as well as provisions for maintaining the Barker Mill Trail (discussed above) and for providing online data of flows in the bypassed reach for boating as proposed by KEI Power (discussed further below), would cost $390. The enhancements would be worth the cost.

5.1.3 Measures Not Recommended

Minimum Flows

Under existing conditions, KEI Power is required to release a minimum flow of 20 cfs or inflow, whichever is less, year-round to the bypassed reach. KEI Power also indicates that the minimum flow is augmented by about 5-8 cfs of leakage from the dam. To enhance aquatic habitat in the bypassed reach and aid fish migration, KEI Power proposes and Maine DMR and Maine DIFW recommend, a year-round higher minimum flow release of 113 cfs or inflow, whichever is less. NMFS and Interior recommend under section 10(j) that KEI Power release 175 cfs or inflow, whichever is less.[84] NMFS's fishway prescription stipulates that KEI Power release a minimum flow in the bypassed reach during the May 1 to November 10 upstream anadromous fish passage season that is sufficient to provide "safe, timely, and effective" fish passage through the bypassed reach to the dam. NMFS's fishway prescriptions indicate that 175 cfs would be sufficient to meet the safe, timely, and effective standard based on the best available information.

Both proposed minimum flow alternatives would increase habitat over existing conditions for all fish species and life stages evaluated by KEI Power's instream flow model. Increasing minimum flows to 113 cfs would provide about 62 percent of maximum salmon spawning habitat, 96 percent of maximum salmon parr habitat, and 66-73 percent of maximum brown and rainbow trout adult habitat. At a minimum flow of 175 cfs, salmon spawning and parr habitat would increase to 90 and 100 percent of maximum, respectively, and adult trout habitat would increase to 83-89 percent of maximum. Both minimum flow alternatives would provide the same habitat benefits (100 percent of maximum) for Atlantic salmon fry. Further, both minimum flows would provide adequate depths (i.e., two times the body depth of shad and Atlantic salmon) to support unimpeded upstream passage for migratory fish through the bypassed reach to the dam.

Providing a 113 cfs minimum flow year-round would have an annualized cost of $31,266. A year-round minimum flow of 175 cfs would have an annualized cost of $49,663. Given the incremental difference in maximum salmon spawning habitat (28 percentage points) and adult trout habitat (16-17 percentage points) and adequate zone of passage at 113 cfs, we conclude that a 113-cfs minimum flow strikes a better balance between the habitat benefits for trout and salmon in the bypassed reach and the costs to the project. The additional habitat benefits of a 175-cfs minimum flow are not worth the cost. Therefore, we recommend that KEI Power provide a year-round flow of 113 cfs in the bypassed reach.

New Trash Racks for Downstream Fish Passage Facility

As discussed above in our analysis and recommendations for the downstream fish

[84] NMFS also recommends its year-round minimum flow of 175 cfs as an EFH conservation measure.

passage facility, the existing 2-inch-spaced trash racks on the penstock intake are located in the intake canal about 100 feet downstream of the fish bypass entrance. Under this configuration, fish either must swim back upstream 100 feet to exit the canal through the fish bypass or pass through the turbines. To improve guidance away from the intake canal and toward the fish bypass to minimize turbine entrainment, KEI Power proposes to install a new set of 1-inch-spaced angled trash-racks adjacent to the fish bypass entrance (in addition to the other improvements already discussed above). NMFS's and Interior's fishway prescriptions stipulate and Maine DMR recommends that KEI Power install a new inclined trash rack adjacent to the fish bypass entrance with 0.75-inch bar spacing.

Constructing either a new 0.75-inch or 1-inch-spaced trash rack adjacent to the fish bypass entrance would physically exclude some but not all downstream migrating diadromous fish from turbine entrainment. Based on our analysis of fish body size, both the 0.75-inch and 1-inch spaced trash racks would not exclude any juvenile alewife because they are small enough to fit through either opening. The 0.75-inch trash rack would exclude most other downstream migrating adult diadromous fish, while the 1-inch spaced trash rack would exclude only adult alewife larger than 11.6 inches in length and adult American eel larger than 26.7 inches in lengths. In section 4.3, we estimated the costs of the two alternative trash racks would be $39,900 for the agencies' 0.75-inch alternative and $33,170 for KEI Power's proposed 1-inch alternative.

It is important to point out, however, that the benefits of constructing a new trash rack would only be realized when the powerhouse is operating. During periods when the powerhouse is shut down, there is no fish injury or mortality due to turbine passage because the turbine shut-off valve is closed and canal velocities approach zero; therefore, fish are not passing through the turbine. The likelihood that the powerhouse would be shut down during the June 1 to November 30 downstream fish passage season is analyzed in section 3.3.1.2. Under existing conditions, there is insufficient inflows for the powerhouse to operate and meet the 20-cfs minimum flow about 44 percent of the time during the 6-month-long downstream fish passage season. Under the proposed and recommended higher minimum flow alternatives of either 113 or 175 cfs, there would be insufficient inflows for the powerhouse to operate about 56 percent and 64 percent of the time, respectively, during the downstream passage season.

As noted above, we estimate that survival through the project's semi-Kaplan turbine ranges from 78 to 97 percent for adult alewife, 80 to 98 percent for juvenile alewife, and about 50 percent for American eel. Although installing a trash rack with either a 1-inch or 0.75-inch clear bar spacing with appropriate sweeping velocities that direct fish to the bypass would increase downstream survival of adult alewife and American eel, installing either trash rack substantially increases capital and operating costs through higher maintenance and head loss, with higher operating costs associated with the 0.75-inch trash rack. As discussed above, staff is recommending modifications to the downstream passage system (higher attraction flows, installing a ramp to guide fish to the bypass, and modifications to the plunge pool) and is also recommending that spill flows be prioritized to pass first through the fish bypass, then the other stop-log bays, and finally over the spillway . These measures are expected to increase attraction to the facility and survival past the dam. Because the benefits of installing either trash-rack alternative would typically be limited to less than half of the time during downstream fish migration period and there is no evidence of recurring fish kills due to turbine passage at the project, the benefits of either new trash-rack alternative do not justify the cost and we do not recommend either of them under the Staff Alternative.

Overflow Spillway Plunge Pool

The stream channel beneath the dam's overflow spillway consists of some areas of exposed bedrock or shallow water that may not provide adequate depths to cushion downstream migrating fish passing over the spillway from striking the stream bed. Although no entity specifically recommends that KEI Power modify the spillway plunge pool, Maine DMR recommends and Interior's fishway prescription stipulates that flows released over the spillway during the downstream passage season discharge into an "approved plunge pool".[85] Because the agencies did not specify how the existing plunge pool beneath the overflow spillway must be configured in order for it to be "approved", we compared the characteristics of the existing plunge pool with preferred design characteristics in the FWS's Design Criteria Manual.

The manual states that a plunge pool depth should be equal to 25 percent of the fall height or four feet, whichever is greater. The spillway section of the dam is about 30 feet tall; therefore, a plunge pool at the base of the dam would need to be at least 7.5 feet deep to be consistent with FWS's Design Criteria Manual and adequately protect downstream migrating fish from striking bedrock when passing over the spillway. There is little existing information on the water depths beneath the spillway, but based on our review of the project record, it appears unlikely that water depths are 7.5 feet deep. In order to provide a plunge pool that is at least 7.5 feet deep beneath the entire 125-foot-long spillway, KEI Power would likely need to either excavate a significant amount of bedrock beneath and downstream of the dam to deepen the channel, or construct a wall similar to that proposed below the stop-log bays, to impound water beneath the spillway. Because the plunge pool would be located at the base of the dam, it may create foundation issues. We estimate that the levelized annual cost of creating a plunge pool that is consistent with FWS's Design Criteria Manual would be $36,970.

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[85] Interior's fishway prescription specifies that FWS must approve the spillway plunge pool configuration. Maine DMR's recommendation does not specify which entity would be responsible for approving the plunge pool.

Although there are no data on survival rates for fish that pass over the spillway, the fall height of up to 30 feet coupled with the shallow water depths and bedrock substrate in some areas beneath the spillway suggest that at least some fish passing the spillway are injured or killed. However, as previously discussed, we are already recommending improvements to the project's downstream fish passage facility as well as a requirement that KEI Power release all spill flows through the fish bypass and other stop-log bays, before passing flows over the spillway. These measures would ensure that any flows and fish spilled at the dam would first be routed through the safest downstream passage route before being routed over the spillway, thereby minimizing fish injury or mortality that may occur via spillway passage.

For these reasons, we conclude that the staff-recommended modifications to the downstream fish passage facility, coupled with the prioritization of spills through the facility, strike a reasonable balance between protecting downstream migrating fish and the costs to the project. Therefore, the incremental passage benefits of modifying the plunge pool beneath the overflow spillway at the base of the dam do not justify the cost.

Upstream Passage for Anadromous Fish

Currently, there are no upstream passage facilities for anadromous fish at Barker's Mill Dam. Any anadromous fish that successfully pass upstream through the passage facilities at the three mainstem Androscoggin River dams and enter the Little Androscoggin River can only migrate about 0.7 RM upstream before encountering the Barker's Mill Dam. KEI Power does not propose installing any upstream fish passage facilities for anadromous fish. Rather, KEI Power states that it is open to developing upstream fish passage at the project at a pace and capacity that is in sync with the restoration of anadromous fish in the Little Androscoggin River. It believes that the fish run size estimates that Interior and NMFS base their prescriptions on are highly speculative and would only be possible if several other future events occur such as restoring habitat in Thompson Lake and other ponds upstream. KEI Power states that these activities likely won't be completed for several years and until they do, it believes that existing trap and truck methods currently employed in the river system are an adequate and more cost-effective way to provide upstream passage than constructing a new fishway at the project.

Interior's and NMFS's fishway prescription would require KEI Power to design and install either a fish lift or a pool-type fishway to provide upstream passage for anadromous fish; the fishway is to be operational by May 1, 2024. Maine DMR also recommends upstream passage for anadromous fish that is operational by May 1, 2025. In section 4.3, we estimate that the levelized annual costs of installing an upstream fishway for anadromous fish would be $584,960 for a fish lift and $528,520 for a pool-type fishway. Additional costs would be associated with constructing and operating a holding facility at the upstream fishway with a levelized annual cost of $173,400 and a counting facility at the fishway with a levelized annual cost of $26,560 bringing the total levelized annual cost of the upstream fishway to as high as $785,000.

At RM 0.7, the project is the first dam on the mainstem of the Little Androscoggin River; there are 14 other dams on the Little Androscoggin River or its tributaries above the project that block upstream fish passage. This includes the Upper Barker Project, which is located at the head of the project's 0.65-mile-long impoundment. Thus, the benefits of providing upstream fish passage at the project would currently be limited to a 0.65-mile-long reach of lacustrine habitat within the project's impoundment. Our analysis in section 3.3.1.2 suggests that the impoundment would provide no suitable spawning habitat for Atlantic salmon and about 11 acres of additional spawning habitat for alewife, blueback herring, and American shad. However, due to very-low run sizes of blueback herring (none were counted passing the Brunswick Project fishway from 2007 - 2016) and American shad (average of 122 adults per year at Brunswick Project fishway from 2007-2016) despite an abundance of currently accessible habitat in the Androscoggin River downstream, there would likely be few if any of these species utilizing habitat within the impoundment. For alewife, the relatively high run sizes of this species (average of 79,326 adults per year at Brunswick Project fishway from 2007-2016) and their documented presence in the bypassed reach suggest that they would likely ascend a fishway at the dam and utilize the impoundment for spawning. However, our analysis indicates that the 11 acres of alewife habitat within the impoundment would constitute only 0.2 percent of the available alewife habitat within the Little Androscoggin River Basin, as the vast majority of suitable habitat is located in currently inaccessible lakes and ponds on tributaries upstream (i.e., Taylor Pond, Lower Range Pond).

Interior's and NMFS's fishway prescriptions indicate that upstream and downstream fish passage will be required at the four lower-most FERC-licensed dams on the Little Androscoggin River by 2027 (i.e., Barker's Mill, Upper Barker, Hackett's Mill, and Marcal Projects). However, even if upstream passage is added to the Barker's Mills Project and the three additional FERC-licensed hydroelectric projects on the mainstem by 2027, there would still be three additional non-FERC licensed dams on the Little Androscoggin River mainstem and eight on the tributaries to the Little Androscoggin River that would continue to block upstream passage to spawning and rearing habitats for anadromous fish.

Overall, because of existing low run-sizes of blueback herring and American shad, in the Androscoggin River Basin; the lack of spawning habitat for Atlantic salmon and the low amount of spawning habitat for blueback herring and shad upstream of the project in the 0.65–mile-long impounded reach between the project's dam and the Upper Barker Dam; and the continued blockage of upstream passage throughout the Little Androscoggin River due to a lack of fish passage facilities at 14 additional dams throughout the basin, installing upstream fish passage facilities for anadromous fish at the Barker's Mill Project by 2025 would provide minimal benefits to these three species.

Furthermore, because of the limited amount of habitat in the impoundment and continued lack of alewife access to its most-productive natural lake and pond habitats in Taylor Pond and Lower Range Pond upstream, providing upstream passage for alewife would also provide minimal benefits. For these reasons, we conclude that the limited passage benefits to anadromous fish species do not justify the $785,000 levelized annual cost of an upstream anadromous fishway at the project, and we do not recommend an upstream fish passage facility under the Staff Alternative.

Although we are not recommending upstream fish passage at the project under the Staff Alternative because there is currently minimal available upstream habitat due to the current lack of passage at upstream dams, we are concerned about the extremely high annualized cost (as much as $785,000) of the prescribed upstream fishway relative to the size of and the energy production of the project. There may be other more cost effective solutions to providing upstream passage at the project, such as trap and haul, which while potentially not as effective as the prescribed fishway, would still move fish past the dam and could provide a better balance of the competing uses of the river for anadromous fish production and power generation.

Prioritizing Minimum Flows through the Upstream Fishway for Alosines

Once the upstream fishway is operational, Interior recommends under section 10(j) that KEI Power prioritize minimum flow releases at the project as follows: (1) through the upstream alosine fishway, (2) through the downstream fish bypass, and (3) spill over the dam. For the reasons previously discussed, we are not recommending any upstream fish passage facilities for anadromous fish; thus, there is no need to prioritize flows through an upstream alosine fishway as recommended by Interior. In addition, prioritizing flow releases in this manner would conflict with the flow release priorities stipulated by Interior's preliminary fishway prescription and recommended by staff, which instead would require the prioritization of flow releases as follows: (1) through the fish bypass, (2) through the six other stop-log bays, and (3) over the spillway. Because we are not recommending any upstream fishways for alosines and Interior's 10(j) recommendation would conflict with its preliminary fishway prescription, we do not recommend prioritizing flow releases as recommended by Interior's 10(j) recommendation.

Fish Passage Facility Design, Construction Timing, and Operation

KEI Power proposes to modify the existing downstream fish passage facility in consultation with resource agencies; however, it does not propose a specific process for completing the consultation. Interior's and NMFS's preliminary fishway prescriptions stipulate, and Maine DMR recommends, that KEI Power submit 30, 60, and 90 percent design plans for all new or modified fish passage facilities to the resource agencies and allow 30 days for the agencies to review and approve the plans, prior to submitting the plans to the Commission for final approval. Interior and NMFS go on to specify timeframes for submitting each design drawing and certain dates by which approval of the design drawings and construction of the downstream passage (within two years of license issuance and September 1, 2021) improvements and upstream eel fishway (by the second migration season following license issuance and June 1, 2021) must be completed. Maine DMR recommends similar approval and installation timeframes.

While we have no objection to KEI Power providing the design plans to the agencies for review and comment, we do not recommend a license requirement that the design plans be submitted to the agencies for approval. It is the Commission's sole responsibility to ensure that project facilities are designed and constructed according to the terms of the license. Therefore, we recommend a license requirement that KEI Power provide the fish passage facility design plans to the agencies and allow 30 days for the agencies to review and provide comments on the plans before filing them with the Commission for final approval.

The fishway design schedule stipulated by Interior and NMFS and recommended by Maine DMR, would require KEI Power to provide 90 percent design plans for the downstream fish passage facility and upstream eel fishway for their approval within 18 months of license issuance. While this may be feasible, specifying an exact date of fishway operation (June 1, 2021 or September 1, 2021) may not be feasible because the issuance date of any subsequent license is uncertain and dependent on variables beyond the control of the Commission or the licensee. Further, such a schedule would likely leave little time to complete construction and have the new fish passage facilities operational prior to the migration season and construction timing may not align with necessary site conditions needed to permit construction or align with the downstream fish migration season. Instead, we recommend that KEI Power file a construction schedule for the modified downstream fish passage facility and new eel upstream fishway within six months of license issuance. Doing so would provide some flexibility and greater certainty in achieving the desired objectives based on better defined parameters (timing of license issuance, suitable site construction characteristics, etc.). In section 4.3, we estimate the levelized annual cost of developing a construction schedule would be $160.

Similarly, Interior's and NMFS's preliminary fishway prescriptions would require KEI Power to provide as-built drawings to the resource agencies for any new fishways; and Maine DMR recommends that KEI Power provide as-built drawings for modified fish passage facilities, along with a licensed engineer's letter of certification. Although as-built drawings are an important component of the fishway design process because they provide documentation that fishways are designed properly, it is the responsibility of the Commission to approve and ensure proper design of fishways; therefore, there is no justification for a license condition requiring that certified as-built drawings be provided to the resource agencies. Nevertheless, as-built drawings would be filed with the

Commission and would be accessible to the resource agencies from the Commission under the normal protocol for drawings of such nature.

Maine DMR recommends that KEI Power file copies of the fish passage facility operating procedures to resource agencies. However, copies of these plans would already be filed with the Commission and would be accessible to the public, so there is no justification for a license condition requiring KEI Power to provide copies to the agencies.

Maine DMR also recommends modifying the fish passage facility operating schedules during the term of the license based on migration data, new information, and in consultation with the resource agencies. In addition, Maine DMR's recommendation states that, upon request of licensee and approval of resource agencies, the actual dates of fish passage facility operation could vary in any given year in response to river conditions, maintenance requirements, or annual variability in fish migration patterns. However, Maine DMR's recommendation does not include limits regarding the number of days (earlier or later) that the fish passage facilities should be able to operate beyond the proposed schedules. In the absence of recommended limits on operating schedule modifications, we have no information to analyze, and therefore no information to determine whether a particular schedule modification would or would not provide benefits to diadromous fish species at the project. More directly, we are unable to determine whether the schedule modifications would be in the public interest. Therefore, we are unable to identify any benefits to implementing unspecified modifications to the upstream fishway operating schedule. Thus, we do not recommend a license requirement that allows the operating schedules of the fish passage facilities to be modified without limits.

Fish Counting Facility

NMFS's fishway prescription would require KEI Power to install and operate a fish counting facility at the anadromous fish upstream passage facility. In section 3.3.1.2, our analysis suggests that such a facility could be used to collect data to estimate the abundance of anadromous fish passing upstream of the fishway once it is operational. Nevertheless, there is no benefit to counting fish as it relates to project effects on fish populations. More specifically, counting anadromous fish that pass the fishway does not protect fish from project effects, mitigate a project effect on fish, or enhance anadromous fish populations. Although NMFS's fishway prescription would require KEI Power to count fish at the required upstream fish passage facility, for the reasons stated above, we do not recommend installing and operating a fish counting facility be a necessary requirement in a subsequent license.

Fish Holding and Sorting Facility

Maine DIFW recommends that KEI Power construct and operate a holding/sorting facility in conjunction with any upstream fishway for anadromous fish at the project. Maine DIFW indicates that the purpose of the facility is to capture and remove invasive fish (e.g., Northern pike, rock bass, white catfish, European carp, and bluegill, etc.) from attempting to use the fishway to gain access to the impoundment and potentially preying on or outcompeting resident and/or migratory fish. Our analysis in section 3.3.1.2, *Upstream Passage for Anadromous Fish*, indicates that excluding non-indigenous fish from entering the project impoundment may provide a small benefit to resident and migratory fish by decreasing predation potential in the area of the impoundment and reducing competition for habitat and food resources; however, the benefits would be limited because Northern pike are known to occur upstream of the project and would still be able to recruit to the project's impoundment from habitats upstream. We estimate that the levelized cost of installing and operating such a facility would be $173,400, and conclude that the limited benefits would not outweigh the costs. In addition, as discussed in our analysis and recommendations for *Upstream Passage for Anadromous Fish*, we are not recommending that KEI Power construct an upstream fishway for anadromous fish at the project; therefore, there is no justification for requiring a fish holding and sorting facility as part of any such fishway.

Annual Meeting on Fish Passage Facilities

Interior's preliminary fishway prescription would require KEI Power to meet with FWS and other resource agencies in the late fall to report on fish passage maintenance and operation, report on monitoring results, and review a fish passage operation and maintenance plan. Likewise, Maine DMR recommends that KEI Power meet annually with resource agencies in March to review fish passage operation data, draft an annual report, and develop operational plans for the upcoming year.

Interior and Maine DMR do not explain the need or benefit of making these measures a requirement of the license. Under the Staff Alternative, we are recommending that KEI Power operate and maintain all fish passage facilities by following specific operation and maintenance plans that are developed in consultation with the resource agencies, and approved by the Commission. Therefore, there is no justification for a license condition requiring KEI Power to meet annually with the resource agencies.

Access to the Project Site and Records

Interior's and NMFS' fishway prescription would require KEI Power to provide Interior and NMFS personnel, and their designated representatives, access to the project site and to pertinent project records for the purpose of inspecting the fish passage facilities and to determine compliance with its prescription.

These measures are unnecessary because the Commission's standard terms and conditions for a hydropower license already require the licensee to provide employees of the U.S. Government access to project land and works in performance of their official duties. This standard article would apply to site access for FWS employees and its designated representatives to inspect fish passage facilities. In addition, ensuring compliance with the terms of the license is the Commission's responsibility, and certain project records could be proprietary.

Effectiveness of New Passage Facilities

Interior's and NMFS's fishway prescriptions stipulate that KEI Power conduct studies to test the effectiveness of any new or modified fish passage facilities at the project. Interior's and NMFS's preliminary fishway prescriptions would require KEI Power to conduct effectiveness testing for a minimum of two years after a fishway is operational. If the facility does not meet performance measures for safe, timely, and effective passage, then NMFS would require conducting studies on a biennial basis until achievement of performance standards.

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 the FWS 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 NMFS have not included any specific performance standards that would be used to test the effectiveness of the new downstream fish passage facility. Instead, they would require the development of plans and performance standards post-licensing, in consultation with resource agencies. Without specific performance standards to evaluate, there is no information to analyze and no information to determine whether effectiveness testing would or would not provide benefits to the diadromous fish species that utilize any fish passage facilities at the project. Therefore, there is no justification for recommending the effectiveness studies.

Interior states in its fishway prescription that effectiveness testing is critical to evaluating passage success, diagnosing problems, and determining when fish passage modifications are needed and what modifications are most likely to be effective. Interior also states that effectiveness testing is essential to ensuring the effectiveness of fishways over the term of the license, particularly in cases where the changing size of fish populations may also change fish passage efficiency or limit effectiveness. However, Interior's fishway prescription would require that the new fish passage facilities be designed in accordance with proven, species-specific design criteria from the FWS's 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 accordance with proven fish passage standards and operating procedures, there is no evidence that the facilities would be ineffective. Accordingly, there is no basis for recommending license conditions that would require effectiveness testing and potential modification of the passage facilities within two years of construction and operation.[86]

New Trail in the Bypassed Reach

Currently, there is no formal access to the project bypassed reach. To enhance recreational opportunities in this area, the Park Service and American Whitewater recommend that KEI Power construct and maintain a trail along the shoreline in the bypassed reach that would be designed to accommodate wheelchairs so that all populations, including a nearby community of senior citizens, can use it. KEI Power does not propose to provide the recommended trail as part of its access improvements at the project. Providing such a facility might create a new recreational opportunity in the bypassed reach for those normally unable to access this area. However, as we discuss in section 3.3.4.2, given the relatively light use of this area, there is no guarantee that the facility would be used to a significant extent. Further, constructing an approximate 0.34-mile-long trail along the shoreline of the bypassed reach would result in additional impacts to environmental resources from vegetation clearing and grading to meet standards to accommodate wheelchairs. Given the light recreation use at the project, the need to clear and disturb vegetation to construct the new trail, and in light of the other improvements recommended by staff, we do not recommend this measure. If results from the recreation monitoring plan recommended by staff (see sections 3.3.4.2 and

[86] *See Yakima Indian Nation v. FERC*, 746 F.2d 1451 (9th Cir. 1984) (noting that FERC must consider fishery issues before, not after, issuance of a license.)

5.1.2) show an increase in demand in the future for additional access in this area, KEI Power could pursue the possibility of such a trail at that time, in consultation with stakeholders.

Whitewater Boating Flows

The Little Androscoggin River, below the project dam, provides opportunities for whitewater boating; however, project operations currently limit those opportunities in the bypassed reach. To increase the number of days that whitewater boating flows are available, the City of Auburn recommends that KEI Power provide five scheduled whitewater boating flow releases of 600 cfs to 800 cfs for up to 5 hours each on weekend days, and that KEI Power coordinate the scheduling of these flow releases with the City so that they coincide with river recreation events in the City.

KEI Power believes that flow releases in this range would be difficult to schedule in advance because such releases would be dependent on available flow. Therefore, KEI Power proposes to provide up to five releases annually, when available, in coordination with the City. KEI Power does not propose a specific flow or duration, but suggests that a flow of 500 cfs annually for a 5-hour duration may be possible, but cannot be guaranteed.

Rather than schedule a specific number of releases as the City recommends, American Whitewater recommends that all flows between 300 to 1,000 cfs be released on Saturdays and holidays during the boating season (defined as April 15 through October 15) for a 5-hour duration. American Whitewater estimates that flows between 300 cfs and 1,000 cfs on Saturdays and holidays would likely be available during the boating season and would allow boaters to take advantage of a range of flows to accommodate various whitewater boating skill levels. KEI Power does not agree to this recommended measure, indicating that such flows would have a significant impact on power production.

As we discuss in section 3.3.4.2, optimal whitewater boating flows occur between 600 and 1,000 cfs, with the minimum preferable flow being 300 cfs. As shown in table 19, inflows to the project between 300 and 1,000 cfs do occur on the Little Androscoggin River over much of the year, though much less frequently in the summer months which encompass much of the whitewater boating season. In July, August, and September, median inflows are below 150 cfs. Inflows above 300 cfs occur from 14 to 28 percent of the time from July through September, less often above 500 cfs (7 to 16 percent of the time) and 600 cfs (6 to 13 percent of the time), and rarely above 1,000 cfs (3 to 7 percent of the time). Therefore, scheduling specified flows of 600 to 800 cfs as recommended by the City would be difficult and impractical. Curtailing generation when flows are between 300 cfs and 1,000 cfs on all Saturdays and holidays, as recommended by American Whitewater, would provide greater assurance of reliable boating flows, and would on average provide the desired flows on about one-third of the available Saturdays and holidays during the boating season. Although, as with the City's recommendation, there would be no guarantee that the flows would be available for the recommended duration of 5 hours.

Staff estimates that providing boating flows as recommended by KEI Power would cause the project to shut down even more frequently and have an estimated annual levelized cost of $396. Providing boating flows as recommended by the City and American Whitewater would have an annual levelized cost of $630 and $871, respectively.

While KEI Power's, the City of Auburn's, and American Whitewater's proposed flow scenarios would potentially add on average between 5 and 11 days of boatable flows in the bypassed reach, for the reasons discussed below, we conclude that the recreation benefits of the flows are relatively minor and are not justified in light of their unpredictability, adverse effects on other environmental resources, and to a lesser degree lost generation.

First, due to low summer inflows and the flashy nature of the Little Androscoggin River, it would be difficult to schedule and provide reasonable advanced notice to boaters of a planned optimal flow release (i.e., at least 600 cfs), and then guarantee that the flow would be available for at least 5 consecutive hours during the preferred time of day for boating. Second, the project reach is not likely to attract a significant amount of whitewater boaters due to its relatively short 3,000-foot-length (of which only about two-thirds consists of whitewater),[87] and the fact that better paddling opportunities are available during the summer within a 2-hour drive of the project area. Third, the project cannot provide incremental ramping rates to slow the rate of water rise and fall in the bypassed reach during powerhouse startup and shutdown, and therefore the flow releases would cause rapid flow fluctuations that could adversely affect sensitive life stages (i.e., fry and juvenile rearing, adult spawning) of endangered Atlantic salmon and other migratory and resident fish. Finally, the boating releases would exceed desirable angler wading flows (350 cfs or less) in the bypassed reach and cause some reduction in powerhouse generation ($396 - $871 levelized annual cost). Therefore, we do not recommend any whitewater boating flow releases at the project.

New Stream Gage to Provide Real-Time Flow Information

Currently there is no mechanism in place to notify whitewater boaters or other recreationists of flow levels in the project's bypassed reach. To allow recreationists to have access to real-time flow data in the bypassed reach, the City of Auburn and

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[87] The lower third of the bypassed reach predominately consists of low-gradient pool habitat.

American Whitewater recommend that KEI Power install a stream gage in the bypassed reach to monitor and record flows and transmit the flow data in real-time to a publicly available website. In section 4.3, we estimate that the levelized annual cost of installing and operating a new stream gage that is capable of providing real-time flow data and the transmission of that data to a publicly available website would be $21,560.

KEI Power disagrees with American Whitewater and the City of Auburn's stream gaging measure, and instead proposes a less expensive measure for making flow data available to the public. KEI Power proposes to develop an automated calculation of bypassed reach flows based on real-time flow data obtained from the upstream USGS South Paris Gage, and then post the calculated flow estimates to a public website in coordination with the City of Auburn. In section 4.3, we estimate the annual levelized cost of KEI Power's proposal for providing bypassed reach flow data to the public would be $390.

While installing and operating a real-time stream gage in the bypassed reach would provide accurate, real time flow data to recreationists, the benefits do not justify the high cost, particularly given we are not recommending any boating releases for the reasons discussed above. KEI Power's proposed measure would be less expensive and adequately serve the same purpose. Therefore, we do not recommend a license requirement that KEI Power install and operate a new stream gage in the bypassed reach. Instead, we recommend KEI Power's proposal to calculate real-time stream flow estimates based on an automated calculation derived from the USGS's South Paris Gage and post it to a publicly available website. However, KEI Power needs to explain how it would provide this data as part of the project recreation plan recommended by staff.

5.1.4 Additional Measures Recommended under the Staff Alternative with Mandatory Conditions

Northern Long-eared Bat Protection Measure

The project boundary falls within the range of the northern long-eared bat and contains upland, riparian, and open-water areas that provide suitable foraging and summer roosting habitat for the northern long-eared bat. As discussed in section 3.3.2, *Terrestrial Resources,* upstream fishway construction would likely necessitate some land-disturbing activities, and possibly vegetation clearing, although the location and extent of disturbance will depend on future plans and designs. If construction of upstream fishways are ultimately required by Interior and NMFS, the construction work may require removal of vegetation, including trees that provide roosting habitat for the northern long-eared bat. Tree removal in the summer months may disturb northern long-eared bats during roosting periods. Implementing a seasonal clearing restriction for trees greater than three inches diameter-at-breast height, between April 1 and October 31, would avoid the months when northern long-eared bats are active and may be occupying nearby roosting trees. Implementing this measure would minimize the potential for northern long-eared bats to be directly affected by tree cutting in the project area, and would come at no additional cost to KEI Power.

Development of a Historic Properties Management Plan

As discussed in Section 3.3.5.2, under the Staff Alternative there would be no effect on historic properties because there would be no change to the dam which is eligible for listing on the Federal Register. Consequently, there would be no need for a HPMP. However, if construction of the upstream fish passage facility for anadromous fish under the Staff Alternative with Mandatory Conditions continues to be required, the modification to the dam may result in an adverse modification under section 106.

To ensure that any impacts to the dam from construction of the upstream fish passage facility are adequately addressed, KEI Power would need to evaluate these impacts and develop and file for Commission approval, a HPMP that defines protocols and appropriate measures to avoid or minimize any adverse effects. We estimate that evaluating these impacts and developing and implementing the HPMP in accordance with a PA, including any data recovery and recordation that may be necessary, would have an annual levelized cost of $2,340. These measures would be needed to comply with section 106 and would be worth the cost.

5.2 UNAVOIDABLE ADVERSE IMPACTS

Continued operation of the project would cause some turbine entrainment injury and mortality of downstream migrating juvenile and adult alewife and adult eels. Additional injury and mortality of these species and life stages would continue to occur at times when they pass over the spillway during periods of high flow.

There would be infrequent drawdowns of the reservoir and corresponding temporary increases and decreases in bypassed reach flows during planned maintenance activities requiring the reservoir to be drawn down below normal operating limits. These maintenance activities would cause temporary dewatering of shoreline habitat in the reservoir and flow ramping in the bypassed reach. Staff's recommended limits on the timing of these activities would minimize effects on aquatic habitat and sensitive life stages of Atlantic salmon that may occur in the bypassed reach.

5.3 SUMMARY OF SECTION 10(j) RECOMMENDATIONS

Under the provisions of section 10(j) of the FPA, each hydroelectric license issued by the Commission shall include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project.

Section 10(j) of the FPA states that whenever the Commission finds that any fish and wildlife agency recommendation is inconsistent with the purposes and the requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of the agency.

In response to our Ready for Environmental Analysis notice, Interior filed section 10(j) recommendations for the project on December 20, 2017, and NMFS and Maine DMR filed section 10(j) recommendations on December 21, 2017, resulting in a total of 27 recommendations submitted pursuant to section 10(j). In the draft EA, we made a preliminary determination that 16 of the 27 recommendations were within the scope of section 10(j). Of the 16 recommendations that we considered to be within the scope of section 10(j), we determined that three of the recommendations in whole and three in part may be inconsistent with the purpose and requirements of the FPA or other applicable law.

We sent letters to NMFS, Interior, and Maine DMR on October 4, 2018, informing them of the inconsistencies. On October 26, 2018, Maine DMR filed comments and additional information in support of its recommendations, but did not request a 10(j) meeting. On October 29, 2018, NMFS filed a letter requesting a 10(j) meeting. Interior did not file comments or request a 10(j) meeting.

On November 26, 2018, Commission staff conducted a 10(j) meeting with NMFS via teleconference[88] to attempt to resolve the inconsistency between NMFS's recommended 175-cfs minimum flow and the FPA. No resolution was reached on this issue at the meeting.

Table 24 lists each of the 27 recommendations submitted pursuant to section 10(j) and whether they are included under the staff alternative. 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 and in section 5.1, *Comprehensive Development and Recommended Alternative*.

The specifics of each of the recommendation's inconsistency and our determinations are discussed below.

Minimum Flows

[88] Interior, the City of Auburn, and KEI Power and its representatives also participated in the teleconference.

In the draft EA, we did not adopt NMFS's and Interior's recommendation that KEI Power release a continuous minimum flow of 175 cfs or inflow, whichever is less, to maximize aquatic habitat and provide adequate depths and attraction flows in the bypassed reach to aid in fish migration. Our analysis in the draft EA found that both KEI Power's proposed 113-cfs minimum flow and NMFS's recommended 175-cfs minimum flow would likely provide adequate depths to support unimpeded upstream passage for migratory fish through the bypassed reach to the dam and would enhance aquatic habitat for trout and Atlantic salmon over existing conditions. While NMFS's recommended 175-cfs minimum flow would also result in an additional 28 percentage points of Atlantic salmon spawning habitat, 4 percentage points of salmon parr habitat, and 16-17 percentage points of adult trout habitat in the bypassed reach compared to KEI Power's proposed 113-cfs minimum flow, we found that a minimum flow of 113 cfs would strike a better balance between the habitat benefits for trout and salmon in the bypassed reach and the lost generation costs to the project. Therefore, staff concluded that the additional habitat gains from providing a flow of 175 cfs would not justify the additional annualized cost of $18,397, and made a preliminary determination that the recommendation was inconsistent with the comprehensive planning standard of section 10(a) of the FPA and the equal consideration provision of section 4(e) of the FPA.

At the 10(j) meeting, NMFS stated that a 113-cfs minimum flow would not likely provide "sufficient enhancements" to aquatic habitat and maintain adequate depths for fish migration and questioned whether staff thoroughly considered the benefits to listed Atlantic salmon in its balancing call. NMFS pointed out that on-site data is sparse, and that the four transects used in KEI Power's instream flow study did not provide an adequate characterization of the bypassed reach. NMFS suggested that a higher minimum flow is warranted given the difficulty in determining whether adequate depths are maintained throughout the bypassed reach to pass migratory fish and because of future plans for restoration activities in the Androscoggin watershed. NMFS also stated that its recommended 175-cfs minimum flow is supported using the Tennant method and is consistent with FWS's aquatic base flow policy for the region.

We explained at the meeting that we based our analysis on the site-specific information that was available and emphasized that it was reasonable for staff to have done so in this case where such site-specific information is available rather than rely on more general methods, such as the Tennant method, for analyzing the minimum flow alternatives. In the draft EA, we compared the site-specific depth measurements that KEI Power collected across four representative transects with the estimated body depths of the largest fish that may migrate through the bypassed reach and used a conservative approach that assumed that flows providing depths of at least two times the body depth of the largest fish (i.e., adult shad and Atlantic salmon) would support adequate passage through the bypassed reach for all target migratory fish species. We found that flows of at least 108 cfs would provide adequate depths across each of the four representative transects, including at least one of the braided channels where depths tend to be shallower. We also explained that KEI Power's proposed 113-cfs minimum flow represents an over five-fold increase from the current minimum flow, which substantially improves available habitat for Atlantic salmon. We considered the costs to the project of providing the higher flows, and in our judgment, the 113-cfs flow represents a better balance of the developmental and non-developmental resources of the project.

No resolution was reached on this issue at the 10(j) meeting.

After taking into consideration NMFS's comments at the 10(j) meeting, we continue to conclude that the incremental habitat gains of a 175-cfs minimum flow would not be worth the additional annualized cost. Therefore, there is no resolution of this issue.

New Trash Racks for Downstream Fish Passage Facility

In the draft EA, we did not adopt Maine DMR's recommendation that KEI Power install a new inclined trash rack adjacent to the fish bypass entrance with 0.75-inch bar spacing to minimize turbine entrainment. We determined in the EA that the new trash rack would likely exclude most adults and some juvenile fish from turbine entrainment; however, the benefits of the trash rack would only be realized during periods when the powerhouse is operating, which only occurs about half the time during the June 1 to November 30 downstream fish passage season and would occur even less under the higher minimum flows recommended by staff. Additionally, a new trash rack with 0.75-inch spacing would substantially increase capital and operating costs through higher maintenance and head loss, resulting in an additional annualized cost of $39,900. For these reasons, we concluded that the benefits of the new trash rack do not justify the cost, and made a preliminary determination that the recommendation was inconsistent with the comprehensive planning standard of section 10(a) of the FPA and the equal consideration provision of section 4(e) of the FPA.

In its October 26, 2018 filing, Maine DMR states that because the downstream migration of juvenile river herring occurs in waves that have been attributed in large part to precipitation and discharge, downstream passage of large numbers of juvenile fish would occur when the powerhouse is operating. Thus, Maine DMR disagrees with staff's analysis that the benefits of installing the trash rack would be limited and continues to recommend that KEI Power install a 0.75-inch trash rack to minimize turbine entrainment.

We agree that precipitation and the resulting increase in discharge are likely some of the factors that prompt downstream migration of juvenile alewives. Nevertheless, the powerhouse is only one of the available downstream passage routes at the dam, and even when the powerhouse is operating and turbine entrainment could occur, the modified downstream passage facility as recommended by staff would still be operating to provide a safe passage route for some downstream migrants. Further, our analysis indicates that staff's recommendation to prioritize spill during the fish passage season such that they are first released through the fish bypass, then through the additional stop log bays adjacent to the fish bypass that empty into the plunge pool, and, lastly, over the spillway would ensure that additional safe downstream passage routes are provided during high flow events, when juvenile river herring are more likely to pass through the project. Finally, only one fish kill incident has been documented in the project record; thus, there is no evidence at this time to suggest that fish are routinely being killed as a result of turbine entrainment at the project.

After reviewing the comments and additional information filed by Maine DMR, we continue to conclude in section 5.1.3 that the benefits of installing, operating, and maintaining a new trash rack at the project would not justify the annualized cost of $39,900. Therefore, there is no resolution of this issue.

Prioritizing Spills for Downstream Fish Passage

In the draft EA, we adopted Maine DMR's recommendation that KEI Power prioritize how the project spills water from the dam to increase the survival of downstream migrants; however, we only recommended prioritizing spills during the June 1 to November 30 downstream passage season because there would be no apparent fish passage benefit from requiring this measure outside of the passage season.[89] We determined that the annualized costs of prioritizing spills outside of the fish passage season would be $21,000, and concluded that the lack of benefits to downstream migrating fish was not worth the additional cost. We therefore made a preliminary determination that the recommendation was inconsistent with the comprehensive planning standard of section 10(a) of the FPA and the equal consideration provision of section 4(e) of the FPA.

In its October 26, 2018 filing, Maine DMR states that it agrees with the analysis of spill prioritization in the draft EA. Therefore, the inconsistency between Maine DMR's recommendation and the FPA has been resolved.

Upstream Fishway for Anadromous Fish

In the draft EA, we did not adopt Maine DMR's recommendation that KEI Power construct a new upstream anadromous fishway (i.e., fish lift or pool-type fishway) designed in accordance with FWS's Design Criteria Manual. We determined that there

[89] Maine DMR did not specify a timeframe for when KEI Power should prioritize spill over the dam, thus we assumed the recommendation was intended to apply year-round.

would be little benefit to providing upstream fish passage because of the low amount of additional habitat upstream in the project's 0.65–mile-long impoundment, and because of the continued blockage of upstream passage throughout the Little Androscoggin River due to a lack of fish passage facilities at 14 additional dams throughout the basin. We concluded that the limited passage benefits to anadromous fish species do not justify the $785,000 levelized annual cost of a new upstream fishway at the project. We also did not adopt Interior's recommendation that KEI Power prioritize flow releases through any new upstream anadromous fishway required by the license, and Interior's and Maine DMR's recommendation that KEI Power provide a 50-cfs conveyance flow through any such fishway. We concluded that there would be no benefit to these fishway operation measures because we did not recommend an upstream anadromous fishway under the staff alternative. We therefore made a preliminary determination that the recommendations were inconsistent with the comprehensive planning standard of section 10(a) of the FPA and the equal consideration provision of section 4(e) of the FPA.

In its October 26, 2018 filing, Maine DMR states that it disagrees with staff's recommendation to not require an upstream anadromous fishway at the project. Maine DMR states that unlike Interior and NMFS, it cannot reserve authority to require fish passage at the project at some later date, and the licensee has not proposed an acceptable schedule for providing future upstream passage at the project. Therefore, Maine DMR continues to support a license requirement for upstream fish passage as specified in NMFS's and Interior's section 18 fishway prescriptions, and that it would not agree to any alternative measures.

After reviewing the additional information filed by Maine DMR and taking its comments into consideration, we continue to conclude in section 5.1.3 that the limited passage benefits to anadromous fish species do not justify the $785,000 levelized annual cost of an upstream fishway and thus would not be in the public interest. In regard to Maine DMR's comment that it cannot reserve authority to require fish passage at a later date, we note that any subsequent license issued for the project would include a standard fish and wildlife reopener article that could be used to require changes to project facilities or operation as recommended by Maine DMR after notice and opportunity for hearing. There is no resolution of this issue.

Fishway "Shakedown" Period for Downstream and Upstream Anadromous Fishways

In the draft EA, we did not adopt Maine DMR's recommendation to require a one season "shakedown" period to ensure that the modified downstream fish passage facility and the new upstream anadromous fishway at the project are operating as designed. Because staff only recommended minor modifications to the downstream fish passage facility that were based on the design guidelines of the FWS's Design Criteria Manual, there was no reason to believe that the modified facility would not perform as designed and there would be little benefit to conducting an evaluation of the facility. Additionally, because staff did not recommend a new upstream anadromous fishway, there was no need for a "shakedown" period for such a facility. We therefore made a preliminary determination that the recommendation was inconsistent with the comprehensive planning standard of section 10(a) of the FPA and the equal consideration provision of section 4(e) of the FPA.

In its October 26, 2018 filing, Maine DMR states that it disagrees with staff's conclusions in the EA regarding the need for a "shakedown" period and to test the operation of a fish passage facility if it is designed in accordance with the FWS's Design Criteria Manual. Maine DMR asserts that the FWS manual is a dynamic document that is modified as new information becomes available from recent studies, and because so many variables can affect fish passage, it is imperative that each facility be tested. Maine DMR states that it would only be willing to remove its recommendation for a "shakedown" period if staff adopted the fishway effectiveness testing studies specified by NMFS's and Interior's fishway prescriptions.

After reviewing the additional information filed by Maine DMR and taking into consideration the comments, we continue to conclude that there would be little benefit to operating the downstream passage facility for a one-season "shakedown" period for the reason already explained in section 5.1.3. Further, because we are not recommending an upstream anadromous fishway, there is no need for a shakedown period for such a fishway. Therefore, there is no resolution of this issue.

Table 24. Analysis of fish and wildlife agency recommendations for the Barker's Mill Project.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Adopted?
1. Operate in an instantaneous run-of-river mode with minimal impoundment fluctuations.	Interior, NMFS, Maine DMR	Yes	$0	Adopted.
2. Maintain impoundment levels to within 1 foot or less from the full pond elevation or from the spillway crest when the flashboards are down.	NMFS	Yes	$0	Adopted.
3. Release a continuous minimum flow of 113 cfs or inflow, whichever is less, to the bypassed reach.	Maine DMR	Yes	$31,266	Adopted.
4. Release a continuous minimum flow of 175 cfs or inflow, whichever is less, to the bypassed reach.	Interior, NMFS	Yes	$49,663	Not adopted.[a] Staff's recommendation for KEI Power to release a minimum flow of 113 cfs would provide sufficient enhancements to aquatic habitat and maintain adequate depths for fish migration at a lower cost; therefore, benefits do not justify the cost.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Adopted?
5. Modify the existing downstream passage facility by installing a new angled or inclined trash rack with 0.75-inch clear bar spacing and an adequately sized plunge pool that is designed in accordance with FWS's Design Criteria Manual. Operate the new trash rack from June 1 to November 30.	Maine DMR	Yes	$58,630	Adopted in part.[a] We recommend modifying the plunge pool beneath the fish bypass and other stop log bays to be consistent with FWS's Design Criteria Manual; however, we do not recommend a new trash rack because the benefits of the trash rack are not justified by the cost.
6. Complete modifications and begin operation of the downstream fish passage facility by September 1, 2021.	Maine DMR	No, construction deadlines are not specific fish and wildlife measures	$0	Not adopted. Instead, we recommend that KEI Power file a construction schedule for the staff-recommended modifications to the downstream fish passage facility with the conceptual design of the facility within six months of license issuance.
7. Continue to operate the existing downstream fish passage facility until the modifications to the facility are completed.	Maine DMR	Yes	$0	Adopted.
8. Maintain a 25-cfs conveyance flow in the fish bypass from June 1 to November 30.	Interior, Maine DMR	Yes	$0	Adopted.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Adopted?
9. Prioritize the release of spill flows during the downstream passage season as follows: (1) through the fish bypass, (2) through the other stop-log bays, and (3) over the spillway.	Maine DMR	Yes	$9,000	Adopted.
10. Construct an upstream eel fishway (i.e. eel lift, eel ramp, or helical eel ladder), and operate it with an attraction flow of 50 gallons per minute.	Maine DMR	Yes	$10,860	Adopted, this is consistent with the staff recommendation that KEI Power construct an upstream eel fishway that is designed in accordance with FWS's Design Criteria Manual.
11. Complete construction and begin operation of the eel upstream fishway by June 1, 2021.	Maine DMR	No, construction deadlines are not specific fish and wildlife measure	$0	Not adopted. Instead, we recommend that KEI Power file a construction schedule for the eel fishway with the conceptual design of the facility within six months of license issuance.
12. Construct a new upstream anadromous fishway (i.e., fish lift or pool and weir fishway) designed in accordance with FWS's Design Criteria Manual and operate it with a 50-cfs conveyance flow.	Maine DMR	Yes	$528,520 to $584,960	Not adopted.[a] The benefits of the measure do not justify the cost.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Adopted?
13. Complete construction and begin operation of new upstream anadromous fishway by May 1, 2025.	Maine DMR	No, construction deadlines are not specific fish and wildlife measures	$0	Not adopted.
14. Maintain a 50-cfs conveyance flow in the upstream anadromous fishway from May 1 to July 31, and prioritize minimum flow releases during this period as follows: (1) through the new upstream anadromous fishway, (2) through the downstream fish bypass, and (3) over the spillway.	Interior	Yes	$0	Not adopted.[a] We are not recommending any upstream passage facilities for anadromous fish; therefore, there is no need for a minimum conveyance flow or prioritization of flow releases through such a fishway.
15. Provide sufficient flow from May 1 to July 31 to maintain an adequate zone of passage in the bypassed reach. The amount of flow will be determined after the fishway becomes operational.	Maine DMR	No, modifying the bypassed reach minimum flow during the upstream passage season without specific limits would represent an uncertain future action. There is no reserved authority under	Unknown – recommendation lacks specificity needed to estimate a cost.	Not adopted. We have sufficient information to conclude that the staff-recommended minimum flow is sufficient to provide unimpeded passage for diadromous fish through the bypass reach. Therefore, there is no justification for requiring an as-yet unspecified bypassed reach minimum flow during the upstream passage season.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Adopted?
		section 10(j) for future, uncertain actions.		
16. Adhere to the following design milestone schedules for modifying to the downstream fish passage facility and installing the new upstream eel fishway: (1) conceptual design within 6 months of license issuance, (2) 30 percent design within nine months of license issuance, (3) 60 percent design within 12 months of license issuance and a basis of design report (if requested), and (4) 90 percent design within 18 months of license issuance.	Maine DMR	No, deadlines for completing design plans are not specific fish and wildlife measures	$0	Adopted.
17. Adhere to the following design milestone schedules for the new upstream anadromous fishway: (1) conceptual design within 36 months of license issuance, (2) 30 percent design within 39 months of license issuance, (3) 60 percent design within 42 months of license issuance and a basis of design	Maine DMR	No, deadlines for completing design plans are not specific fish and wildlife measures	$0	Not adopted. We are not recommending an upstream anadromous fishway; therefore, there is no need for a design review process for such a facility.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Adopted?
report (if requested), and (4) 90 percent design within 48 months of license issuance. For each design stage, a minimum of 30 days should be incorporated into the schedule for agency review.				
18. Operate each newly constructed or modified fish passage facility for a one-season "shakedown" period to ensure that it is generally operating as designed and to make minor adjustments to facilities and operations as needed.	Maine DMR	Yes	$0	Adopted in part.[a] We recommend a "shakedown" period for the new upstream eel fishway only.
19. At the end of each shakedown period, have a licensed engineer certify that the fishway is constructed and operating as designed in all material aspects.	Maine DMR	No, not a specific measure to protect, mitigate, or enhance fish and wildlife	$0	Not adopted.
20. Provide resource agencies with a copy of the as-built fishway drawings as submitted to FERC, along with a licensed engineer's letter of certification.	Maine DMR	No, not a specific measure to protect, mitigate, or enhance fish and wildlife	$0	Not adopted.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Adopted?
21. Maintain fish passage facilities in proper working order and remove trash, logs, and material that would hinder passage. Perform routine maintenance before a migratory period such that fish passage facilities can be tested and inspected, and will be operational during the migratory periods.	Maine DMR	Yes	$0	Adopted. This measure is consistent with our recommendation to develop and implement a fishway operation and maintenance plan for the project.
22. Develop fish passage facility operating procedures in consultation with stakeholders, including general schedules of routine maintenance, procedures for routine operation, procedures for monitoring and reporting on the operation of each fish passage facility or measure, and schedules for procedures for annual start-up and shutdown, and procedures for emergencies and project outages significantly affecting fish passage facility operations.	Maine DMR	Yes	$390	Adopted. This measure is consistent with our recommendation to develop and implement a fishway operation and maintenance plan for the project.
23. Send copies of the fish passage facility operating procedures, and any revisions made during the	Maine DMR	No, not a specific measure to protect, mitigate, or	Unknown	Not adopted. Copies of the operation and maintenance plan, and modifications thereto would be filed with the

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Adopted?
term of the license to resource agencies.		enhance fish and wildlife		Commission and made available to the public through normal filing procedures.
24. Collect data on daily river conditions, air and water temperatures, fishway counts, and fishway operational settings; and prepare annual reports on monitoring results	Maine DMR	Yes, for monitoring data on fishway operational settings as this could be used to document compliance with fishway operating requirements No, for general data collection on fish counts, river and temperature conditions, or annual reports; these are not specific measures to protect, mitigate, or	$0 – Cost of monitoring fishway operational settings is already included in the fishway operation and maintenance plan. $3,080	Adopted, for monitoring and reporting on fishway operational setttings, which we are already recommending as part of a fishway operation and maintenance plan for the project. Not adopted, for general data collection on fish counts, river conditions, and air and water temperatures.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Adopted?
		enhance fish and wildlife.		
25. Meet annually with resource agencies to review monitoring data, fish passage facility operational data, and to develop an operational plan for the upcoming year.	Maine DMR	No, not a specific measure to protect, mitigate, or enhance fish and wildlife	$300	Not adopted.
26. Maintain and operate permanent fish passage facilities as follows: Upstream May 1 – July 31 (alewife, blueback herring, American shad); June 1 – September 15 (American eel). Downstream June 1 – November 30 (alewife, blueback herring, American shad); August 15 – November 15 (American eel)	Maine DMR	Yes	$0 – Cost of operating and maintaining the facility during a pre-defined migration period is included separately above for each facility	Adopted, to the extent that we are recommending that KEI Power operate the downstream fish passage facility and new upstream eel fishway according to the recommended migration dates.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Adopted?
27. Modify the fish passage facility operating schedules during the term of the license based on migration data, new information, and in consultation with the resource agencies. Upon request of licensee and approval of resource agencies, the actual dates of operation may vary in any given year in response to river conditions, maintenance requirements, or annual variability in fish migration patterns.	Maine DMR	No, modifying the operating schedules without specific limits would represent an uncertain future action. There is no reserved authority under section 10(j) for future, uncertain actions.	Unknown – recommendation lacks specificity needed to estimate a cost.	Not adopted.
[a] Preliminary findings that recommendations found to be within the scope of section 10(j) are inconsistent with the comprehensive planning standard of section 10(a) of the FPA, including the equal consideration provision of section 4(e) of the FPA, are based on staff's determination that the costs of the measures outweigh the expected benefits.				

5.4 CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2) of the FPA, 16 U.S.C., § 803(a)(2)(A), requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. We reviewed 22 qualifying comprehensive plans that are applicable to the Barker's Mill Project, located in Maine. No inconsistencies were found.

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6.0 FINDING OF NO SIGNIFICANT IMPACT

If the Barker's Mill Project is issued a subsequent license as proposed with the additional staff-recommended measures, the project would continue to operate while providing enhancements to aquatic resources, improvements to recreation facilities, and protection of cultural and historic resources in the project area.

Based on our independent analysis, we find that the issuance of a license for the Barker's Mill 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

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APPENDIX A

Staff Response to Comments on the Draft Environmental Assessment

Commission staff issued its draft environmental assessment (EA) for the relicensing of the Barker's Mill Hydroelectric Project (Barker's Mill Project) on September 27, 2018. Staff requested comments on the draft EA be filed within 30 days of the issuance date. The following entities filed comments pertaining to the draft EA.

Commenting Entity	Date Filed
Maine Department of Inland Fisheries and Wildlife (Maine DIFW)	October 24, 2018
National Marine Fisheries Service (NMFS)	October 25, 2018
American Whitewater (AW)	October 26, 2018
Maine Department of Marine Resources (Maine DMR)	October 26, 2018
KEI (Maine) Power Management (III) LLC (KEI Power)	October 29, 2018
Atlantic Salmon Federation, Maine Rivers, Natural Resources Council of Maine, and Maine Council of Trout Unlimited (Environmental Groups)	October 29, 2018

On January 2, 2019, KEI Power filed supplemental comments in response to agencies' comments on the draft EA. The Maine Council of Trout Unlimited filed responses to KEI Power's supplemental comments on January 24, 2019.

Below, we summarize the comments received on the draft EA that pertain to our analysis; respond to those comments; and indicate, where appropriate, how we modified the final EA. The comments are grouped by topic for convenience. We do not summarize and respond to comments that request legal determinations, only express opinions (e.g., either for or against the proposed project or the staff alternative), or simply reiterate a stakeholder's position or recommendation. For example, KEI Power's letters did not provide substantive comments on the EA or staff's analysis, but rather supports its proposed action and the Staff Alternative and did not provide any new substantive information that we incorporated into the analysis.

General Comments

Comment: Maine DMR states that it is concerned that the Staff Alternative inappropriately omits the federal agencies' section 18 fishway prescriptions and Maine DMR's section 10(j) recommendations.

Response: Pursuant to section 18 of the Federal Power Act (FPA), the Commission must include section 18 fishway prescriptions in any license issued for a project; however, staff develops its preferred alternative pursuant to section 10(a) of the FPA. Neither section 18 nor section 10(a) of the FPA obligate Commission staff to include the fishway prescriptions or section 10(j) recommendations under the Staff Alternative. Accordingly, in conducting our analysis, we believe that some of the measures recommended by Maine DMR as well as some of the federal agency fishway prescriptions do not provide benefits that justify their costs; therefore, we did not include them in the Staff Alternative.

Comment: NMFS comments that, as the federal resource agency for the management of diadromous fish and habitat, its comments, recommendations and prescriptive terms and conditions should have been given more deference in the Commission's decisions and recommendations affecting aquatic resources.

Response: We base our recommendations on the record of information before the Commission, which includes considering an agency's expertise in a particular resource area, as applicable. While we recognize NMFS's role and expertise in fisheries resource issues and oversight, we have the responsibility to conduct an independent analysis and weigh the benefits of the measures to the resource and cost to the project under section 10(a) and 4(e) of the FPA.

Alternatives to Project Licensing and Decommissioning

Comment: NMFS comments that the draft EA should include consideration of alternatives to project licensing (i.e., decommissioning), which it says is necessary to support a decision-making process and to inform the public.

Response: Under section 2.5, *Alternatives Considered But Eliminated From Detailed Analysis*, we briefly discuss project decommissioning with and without dam removal, and state our reasons why these alternatives do not warrant further analysis.

Comment: NMFS comments that section 2.5.1, *Decommissioning*, in the draft EA does not adequately assess the beneficial or adverse effects of the Barker's Mill Project on a variety of trust resources or public interests. It recommends that the final EA evaluate the eleven criteria listed in its comment letter for justifying decommissioning as a reasonable alternative.

Environmental Groups comment that the draft EA is inadequate in its analysis of project decommissioning with dam removal. They state that the Commission addresses the potential negative impacts of dam removal while ignoring most of the associated benefits.

Response: Under section 2.5.1, *Decommissioning*, we summarize the potential effects to aquatic, terrestrial, and cultural resources as well as recreation and aesthetics that may result from decommissioning the project and removing the dam and have revised that section to include some additional potential benefits to aquatic, recreation, and cultural resources from decommissioning as cited in NMFS's and the Environmental Group's respective letters. However, as the Commission has previously held in its policy statement on the matter, decommissioning is not a reasonable alternative to relicensing a project in most cases, when appropriate protection, mitigation, and enhancement measures are available, as is the case here. Therefore, no further analysis of decommissioning in the EA is warranted.

Cumulative Effects

Comment: NMFS comments that the draft EA does not include a cumulative effects analysis as required under NEPA. Environmental Groups also state that the environmental analysis must consider the cumulative environmental impact of the proposed action.

Response: Scoping document 2 identified diadromous fishes as a resource that could be cumulatively affected by the proposed project. Accordingly, section 3.3.1.3 of the EA provides our analysis of cumulative effects on diadromous fish populations.

Comment: NMFS acknowledges that the EA can only assess the Barker's Mill Project impacts; however, a cumulative effects analysis should take into account the negative effects FERC licensed projects upstream and downstream have on the eel and alewife populations. It states, "as example, with turbine survival of 78% for adult alewife and 80% for juvenile alewife, the predicted level of mortality at the Barker's Mill Project will not allow for a sustainable restoration of this species. When viewed from a cumulative effects analysis, these mortality rates will significantly limit the number of returning adults and, more importantly, a limited number of repeat spawners. Repeat spawners are essential for a sustainable population because their fecundity is approximately 50% higher than first year spawners up to the year seven age group (Mullen et al. 1986). For alewife stocked in Marshall Pond, Lower Range Pond and Taylor Pond (via trap and truck), the cumulative effects of mortality at each FERC licensed project downstream of these ponds diminishes our restoration efforts." NMFS goes on to say "the omission of the cumulative negative effects of blade strike mortality at the Upper Barker, Barker's Mill, Worumbo, Pejepscot and Brunswick Projects results in an inadequate analysis."

Response: The cumulative effects analysis in section 3.3.1.3 of the draft EA acknowledges that the Barker's Mill Project, in combination with other dams and hydroelectric projects on the Androscoggin River and its tributaries, adversely affects diadromous fish populations, in part, by causing mortality of downstream migrants due to unsafe passage through turbines and other flow regulating equipment. While there is insufficient information on the mortality rates for alewife at each of these projects to determine a cumulative mortality rate, based on the number of adult alewife that passed the fishway at the Brunswick Project from 2007 to 2016 (ranging from about 40,000 to over 170,000 individuals per year) it appears that enough juvenile alewife are surviving downstream passage to sustain the population. For American eel, because their abundance in the Lower Androscoggin River Basin upstream of each of the existing projects is undocumented coupled with the lack of estimated mortality rates for eel at each of these projects, we are unable to determine a cumulative mortality rate.

In regard to NMFS's example of the turbine survival of 78 percent for adult alewife and 80 percent for juvenile alewife being insufficient to sustain restoration of alewife, our analysis in the draft EA estimated that project turbine survival could be as high as 97 and 98 percent for adult and juvenile alewife, respectively. It is also important to point out that these turbine survival estimates only apply to downstream migrants that pass through the powerhouse. There are other safer passage routes than turbine passage at the project (e.g., downstream fish passage facility) that downstream migrants can utilize when the powerhouse is both operating and shut down, and we expect that downstream passage survival through the project would further increase with the measures included in the staff alternative (e.g., higher conveyance flows, improvements to the plunge pool, more-frequent powerhouse shutdowns due to higher minimum flows, etc.). Additionally, according to the draft fisheries management plan, the three lower mainstem Androscoggin River dams as well as the three other FERC-licensed projects in the Little Androscoggin River operate dedicated downstream fish passage facilities. This information suggests that there are other safer passage alternatives besides turbine passage for downstream migrants, and cumulative downstream passage mortality at the five projects specified by NMFS is not impairing alewife restoration efforts in the basin.

Comment: NMFS comments that the final EA should acknowledge the adverse cumulative effect on anadromous fish species as a result of deferring the construction of an upstream fish passage facility at Barker's Mill to an unspecified future date as it did in 1996, when FERC acknowledged that deferring installation of fish passage at the Gulf Island-Deer Rips Projects would continue to contribute to cumulative effects relative to fish passage.

Response: Our cumulative effects analysis in section 3.3.1.3 already acknowledges that the Barker's Mill Project, in combination with other dams and hydroelectric projects on the Androscoggin River and its tributaries, adversely affect diadromous fish populations by blocking access to historical spawning habitat within the geographic scope of analysis. However, providing an upstream passage facility at the project would provide access to an additional 11 acres of lacustrine habitat within the project's impoundment. Any further passage benefits would continue to be limited by upstream passage obstructions at three FERC-licensed dams as well as 11 non-FERC-licensed dams on the mainstem and tributaries to the Little Androscoggin River. Predicting whether and when fish passage would be installed, particularly at the 11 non-FERC-licensed dams in the basin, is uncertain and speculative. Thus, we expect that these existing passage barriers would remain over the next 30 to 50 years.

Need for Power

Comment: NMFS states that the Barker's Mill Project produces an insignificant amount of power contributing: 2.66% of hydropower capacity in the Draft EA cumulative effects analysis area, 0.58% of hydropower capacity in the Androscoggin River watershed, 0.21% of the hydropower capacity in Maine, and 0.017% of the hydropower capacity in the New England region. NMFS comments that, since the demand for power over the long-term is expected to decrease in the New England region and the project's power contribution on a local, state, and regional scale is small, there is limited need for the power produced by the project. NMFS also comments that the power generated by the project could be replaced by other sources of renewable energy with less environmental and recreational effects to the public resource.

Response: Although demand is projected to decrease somewhat in the region, the project currently provides clean, renewable electric power that helps meet part of the region's power requirements and capacity needs while displacing non-renewable, fossil-fired generation. If the project was not generating power, the Commission cannot assume that the power produced by the project would be replaced by other renewable energy sources such as solar or wind generation. Currently, the generation portfolios for Maine and the New England region contain a diversified mix of energy sources, of which a substantial amount of electricity generated comes from hydroelectric plants and from natural-gas-fired plants.

Comment: NMFS contends that the project should not be considered a dependable source of electricity because the ageing infrastructure has caused numerous outages during the existing license, and the project operates with poor efficiency relative to contemporary hydroelectric standards.

Response: While KEI Power has had to make necessary repairs to project facilities and equipment that has resulted in outages (i.e., 22 outages between 2011 and 2017), KEI Power continues to make electric power from a renewable resource available to the state and regional grid. Additionally, KEI Power proposes to repair and replace components of the existing turbine/generator unit that have contributed to nearly half of the outages in recent years.

Economic Viability

Comment: NMFS comments that since the cost of alternative energy is less than the cost of power produced by the project, the project may not be economically viable and the alternative of decommissioning with dam removal warrants further evaluation.

Response: As we've stated in section 4.0, project economics is only one of many public interest factors the Commission considers in determining whether, and under what conditions, to issue a license. It is the applicant who must decide whether to accept a license and any financial risk that doing so entails.

Aquatic Resources

Comment: NMFS comments that the staff recommendation to monitor minimum flow compliance using prorated real-time flow data from the U.S. Geological Survey's (USGS) South Paris gage is not appropriate for the Barker's Mill Project because it does not accurately or consistently reflect flow conditions on the Little Androscoggin River in the vicinity of Auburn, Maine. Instead, NMFS suggests monitoring flows in the bypassed reach using headpond levels, rating curves, and project generation, or establishing a new gauge in the bypassed reach.

Response: Staff's recommendation for KEI Power to publish prorated flow data derived from the USGS South Paris gage to a public website was not intended to be used for minimum flow compliance monitoring purposes. Instead, the recommendation was intended to benefit recreational users by providing an estimate of flow conditions for boating and fishing in the bypassed reach. Because KEI Power did not specify in its license application how it would monitor or report compliance with its proposed higher minimum flows, we recommend that KEI Power develop an operation compliance monitoring plan for Commission approval after license issuance that describes how it would monitor compliance with minimum flows. While we agree with NMFS that methods such as calibrated flow releases based on headpond levels and rating curves are acceptable methods for minimum flow compliance monitoring, the Commission would make a final determination on the approved methods for compliance monitoring after reviewing KEI Power's proposed operation compliance monitoring plan.

Comment: NMFS disagrees with staff's analysis that a minimum flow of 113 cfs would maintain sufficient depths in the bypassed reach to support fish migration. NMFS comments that the flow data collected at three transects in the bypassed reach are insufficient to assess whether a fish can swim to the base of the dam at a given minimum flow. NMFS states that continuous bathymetric coverage and a hydraulic model (i.e., a 2-dimensional hydraulic model) would be needed to demonstrate that a contiguous migratory path with sufficient depth is maintained under each of the minimum flow alternatives being considered.

Response: Our analysis in section 3.3.1.2 of the draft EA is based on the best available information in the project record, and utilizes site-specific water depth data measured at different flow levels across four representative transects in the bypassed reach.[90] In conducting our analysis, we compared the site-specific depth measurements at each of the four transects with the estimated body depths of the largest fish that could migrate through the bypassed reach. We then used a conservative approach that assumed that flows providing depths of at least two times the body depth of the largest fish (i.e., adult shad and Atlantic salmon) would support adequate passage through the bypassed reach for all target migratory fish species. Given that the majority of the reach consists of low gradient riffle and pool habitat with little change in gradient throughout, we continue to conclude that the data collected at each of the four transects provides an adequate and reasonable representation of the reach on which to base our conclusions for minimum flows and fish migration conditions.

Comment: NMFS asserts that KEI Power's statements included in the footnote on page 52 of the draft EA that question NMFS's observations of alewife in the bypassed reach are inappropriate and should be removed from the EA. NMFS states that because it is the federal agency charged with protection of alewife, it is fully qualified to identify observed fish species and their location.

Response: While we acknowledge NMFS's expertise, KEI Power offers a different opinion, which the EA discloses. Therefore, we have not deleted the footnote.

Comment: NMFS disagrees with staff's conclusion in the EA that the anadromous fish production estimates in the draft fisheries management plan "may not be realistically achievable in the foreseeable future based on a comparison of the estimated production potential versus the recent returns of these fish species to accessible habitats within the mainstem Androscoggin River downstream of Lewiston Falls." NMFS asserts that the statement "lacks deference to their fisheries management expertise, ignores their Congressional mandate, and minimizes the balancing of energy production and environmental protection that the Commission is charged with." NMFS adds that the draft EA does not take into account ongoing restoration efforts and additional efforts likely to occur in the foreseeable future. NMFS further states that it fully anticipates a robust restoration of Atlantic salmon, blueback herring, alewife, and American shad in the Androscoggin River in the foreseeable future after fish passage is addressed during

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[90] As part of its instream flow study, KEI Power identified three river transects that were representative of the reach as a whole. KEI Power also established a fourth transect just upstream of the powerhouse to gage river flows released from the dam. Depth measurements were collected across each of these four transects during the study at each of the different test flows released from the dam.

upcoming relicensing of FERC-licensed projects upstream and downstream of the Barker's Mill Project.

NMFS states that the licensing schedule for other hydroelectric projects in the Androscoggin River Basin including the Brunswick, Pejepscot, Worumbo, Upper Barker, Hackett Mills, and Mechanic Falls Projects will provide an opportunity to significantly improve upstream and downstream passage of public trust species and to facilitate the restoration of trust species to meet management goals of the Androscoggin River within the term of any new license issued for the Barker's Mill Project. NMFS also states that it is actively pursuing restoration projects at non-hydropower dams in partnership with other federal and state agencies, municipalities, non-government organizations, and private owners to eliminate some, if not all, of these barriers, such that it is entirely reasonable, that within the time period of the forthcoming Barker's Mill Project license, other barriers on the Little Androscoggin River such as the Littlefield Dam and the Welchville Dam will implement fish passage improvements.

Response: The FPA requires the Commission to independently analyze a licensing proposal. The Commission can't abrogate its FPA responsibilities to other agencies. In this particular instance, NMFS provides no new information that would lead us to change our independent analysis. Our analysis in section 3.3.1.2 of this final EA continues to show that actual returns to the Androscoggin River are substantially lower than the estimated production levels specified in the draft fisheries management plan, and the estimated production levels for the Little Androscoggin River upstream of the project are not realistically achievable in the foreseeable future. Furthermore, the EA already acknowledges that several hydroelectric projects in the Androscoggin River Basin will be undergoing relicensing in the foreseeable future, and that the State of Maine's draft fisheries management plan for the lower Androscoggin River and Little Androscoggin River (Maine DMR and MDIFW, 2017) provides goals for the restoration of anadromous fish species which includes providing fish passage at these facilities.

Comment: Maine DMR states that page 39 of the draft EA incorrectly reports that returns of American shad to the Androscoggin River are low because the number of American shad returning is unknown. Instead, Maine DMR requests that the final EA be revised to state that the Brunswick Project fishway is ineffective at passing American shad, but those that pass are able to reach the Barker's Mill Project. Maine DMR also points out that: American shad have been observed or tracked swimming past the fishway entrance repeatedly but rarely enter it, the few shad that enter the fishway rarely ascend the halfway point, and those shad that reach the exit often have significant scale loss.

Response: After taking into consideration Maine DMR's comments and reviewing additional information contained in the *2007 American Shad Stock Assessment Report* (Atlantic SMFC, 2007), we revised the discussion in section 3.3.1.1 to describe the issues with shad passage at the Brunswick Project fishway, and to state that the number of American shad that pass the Brunswick fishway is low.

Comment: NMFS comments that the staff alternative does not protect fisheries and habitat resources because the Staff Alternative lacks turbine entrainment prevention and, the small, high-speed Kaplan turbine would likely kill 50 percent (based on the Commission staff's analysis in the draft EA) of the downstream migrating silver eels that pass through the turbine. NMFS further states that it does not consider the lack of turbine entrainment prevention to be a balancing of energy production and environmental protection.

Response: The FPA does not require a fish survival standard or limit on turbine entrainment that must be met in order to appropriately balance energy production with environmental resource protection. Rather, it requires that any license issued be in the Commission's judgement, an appropriate balance of all public interest considerations. For the reasons discussed in the EA, the EA concludes that staff's recommended environmental measures (e.g., higher minimum flows, downstream passage facility improvements, eel upstream fishway) would provide an adequate level of protection and enhancement for fisheries resources of the project area.

Comment: Maine DMR comments that staff's analysis showing that implementing higher minimum flows would reduce fish entrainment mortality at the project by causing the project to shut down more frequently during the fish passage season is flawed because the analysis does not account for the downstream migration behavior of juvenile river herring. Maine DMR comments that juvenile river herring typically migrate downstream in waves triggered in large part to environmental cues such as periods of increasing precipitation and discharge; thus, Maine DMR expects that downstream passage of large numbers of juvenile river herring would be more likely to overlap periods when the powerhouse would be operating. Maine DMR also states that the analysis in the EA clearly indicates the 0.75-inch trash rack would physically exclude most adult alewife and American eel, and either the 1.0-inch or 0.75-inch trash rack would act as a behavioral deterrent to guide juvenile and adult fish away from the track rack and toward the fish bypass. Thus, Maine DMR disagrees with staff's analysis that the benefits of installing the trash rack would be limited and continues to recommend that KEI Power install a 0.75-inch trash rack to minimize turbine entrainment.

Response: We agree that a 0.75-inch spaced trashrack would physically exclude most adult alewife and American eel, and either a 1-inch or 0.75-inch spaced trashrack would act as a behavioral deterrent. However, for the reasons that follow, we find that the benefits of installing either a 0.75-inch or 1-inch space trashrack do not justify the annual cost.

Precipitation and the resulting increase in discharge are likely some of the factors that prompt downstream migration of juvenile river herring, and we have edited our analysis in section 3.3.1.2 to reflect these factors. However, not all juvenile alewives move downstream during such pulse events and some migration occurs throughout the passage season which may be driven by food availability, water visibility, decreasing rainfall, or water temperature.

While it is also true that the project would likely be operating during high flow events that could trigger outmigration, the project would operate less often under staff's recommended minimum flows than it currently does, which would reduce the potential for entraining juvenile river herring relative to existing conditions. Nevertheless, as discussed in the EA, the powerhouse is only one of the available downstream passage routes at the dam. Even during periods of higher flow when the powerhouse is operating and turbine entrainment could occur, the downstream passage facility would still be operating to provide a safe downstream passage route for some downstream migrants. Staff is also recommending modifications to the downstream passage system (higher attraction flows, installing a ramp to guide fish to the bypass, and modifications to the plunge pool) and that spill flows be prioritized to pass first through the fish bypass, then the other stop-log bays, and finally over the spillway which would increase attraction to the facility and survival past the dam. These measures would ensure that additional safe downstream passage routes are provided during high flow events, when juvenile river herring are more likely to pass through the project. Together, all of these factors minimize the benefits of installing a trashrack.

Furthermore, only one fish kill incident has been documented in the project record, suggesting that substantial numbers of fish are not routinely being killed as a result of turbine entrainment through the existing 2-inch spaced trash rack at the project. For all of these reasons and in accordance with sections 4(e) and 10(a) of the FPA, our comprehensive development analysis in section 5.1.3 continues to conclude that the costs to install, operate, and maintain a new trash rack are not justified by the benefits to downstream migrating alewife.

Comment: NMFS states that the Staff Alternative, which does not recommend a new trash rack at the project to protect downstream migrating fish from turbine entrainment, is inconsistent with other environmental assessments for hydropower projects. As an example, NMFS cites the EA for the Upper Collinsville Project (FERC No. 10822), where Commission staff recommended the U.S. Fish and Wildlife Service's (FWS) preliminary prescriptions, which included full-depth trash racks angled at approximately 45 degrees to the current and using 3/4 –inch clear bar spacing, because it would be necessary to ensure protection of juvenile fish and eels, However, in the Barker's Mills draft EA, the Staff Alternative focuses on cost and the amount of time the rack would be protective, as justification for not providing safe, timely, and effective passage for downstream migrants.

Response: Commission staff evaluate each project and associated environmental measures on their own merits as directed by sections 4(e) and 10(a) of the FPA. Our case-specific analysis for the proposed relicensing of the Barker's Mill Project is documented in this EA.

Comment: While NMFS agrees that providing upstream passage for alewife would have limited benefits because alewife would only have access to an additional 11 acres of spawning habitat provided by the project's impoundment, additional habitat would become available starting in 2025 when passage would be required at the Upper Barker Project. Therefore, alewife habitat would only be limited to the Barker's Mill Project impoundment for the one year that coincides with the "shakedown" period for the new upstream fish passage facility at the Barker's Mill Project.

Response: NMFS' assertions are consistent with our analysis in the EA. However, our analysis also shows that the vast majority of productive alewife habitat is located in lakes and ponds on tributaries upstream (i.e., Taylor Pond, Lower Range Pond, Thompson Lake) that are currently inaccessible because they are blocked by private dams and diversion structures. Thus, even if upstream fish passage facilities were constructed and operated at the Barker's Mill and Upper Barker Projects in 2025, alewife would still lack access to the majority of their most-productive spawning areas and it is uncertain if or when such access would be provided. Therefore, we continue to conclude that the cost of a new upstream fishway at the Barker's Mill Project would not be justified by the benefits.

Comment: NMFS disagrees with staff's determination in the draft EA that trap and haul operations currently employed in the Androscoggin River system are an adequate and cost effective way to provide upstream fish passage compared to constructing and operating a new upstream fishway for anadromous fish. NMFS states that although trap and haul operations can support interim restoration efforts, they primarily benefit a single species, such as alewife or Atlantic salmon, and therefore do not facilitate a multi-species restoration effort. Instead, NMFS contends that only safe, timely, and effective volitional fish passage on the Androscoggin and Little Androscoggin Rivers will support multiple species restoration.

Response: To be clear, we are not recommending any upstream anadromous fish passage facilities at the project under the Staff Alternative because there is minimal available upstream habitat due to the current lack of passage at upstream dams. In the draft EA, we stated our concern about the extremely high cost (i.e., $785,000) of NMFS's prescribed upstream fishway relative to the benefits and only suggested that there may be other more cost effective solutions to providing upstream passage (such as a trap and haul program) that although may be of lesser benefit would also come at a lesser cost.

Moreover, there are numerous examples of FERC-licensed hydroelectric projects where trap and haul has been utilized and intended as a potential long-term solution for passing multiple fish species upstream of dams and diversions with the intent of restoring anadromous fish populations to historical habitat. Specific examples of these include: Cowlitz River Hydroelectric Project No. 2016 (*see* 98 FERC ¶ 61, 274), Baker River Hydroelectric Project No. 2150 (*see* 125 FERC ¶ 62,064), and Pelton Round Butte Hydroelectric Project No. 2030 (*see* 111 FERC ¶ 61,450).

In the case of the Barker's Mill Project, our analysis indicates that existing run sizes of blueback herring, American shad, and Atlantic salmon in the Androscoggin River are very low and most of the historic habitat for these species occurs downstream of the project. Therefore, there is no guarantee that a volitional upstream fishway that meets agency design criteria and is capable of passing the large numbers of fish specified in the fishway prescriptions would ever be fully utilized or needed. Furthermore, Maine DMR currently traps alewife at the Brunswick Project on the mainstem Androscoggin River and stocks them in several lakes and ponds upstream of the Barker's Mill Project which currently aids in restoration efforts. Nevertheless, we recognize that NMFS's and Interior's section 18 fishway prescriptions are mandatory and would be made part of any license issued, unless modified by the conditioning agency.

Comment: To support installing upstream passage facilities now, NMFS notes that unlike staff's analysis in the Lower Androscoggin FEIS where staff recognized that the installation of fish passage at Gulf Island-Deer Rips and Lewiston Falls would "provide significant cumulative benefits to the Androscoggin River Basin's anadromous fish restoration program", the Barkers Mill Draft EA does not take into account the ecological and economic benefits that a multi-species restoration of the Lower Androscoggin and Little Androscoggin watersheds would provide. NMFS recommends that the "EA quantify the benefits that upstream passage at the project would provide along with the reasonably anticipated fish passage installation at the Upper Barker and Hackett Mills projects and fish passage improvements at lower mainstem Androscoggin River projects."

Response: As we have said, the EA acknowledges that many of the hydropower projects within the Androscoggin River Basin will be undergoing relicensing over the next 20 years, and that it is the goal of state and federal agencies to restore diadromous species to the basin. It also acknowledges that such restoration efforts have been underway for many years and reports on the current status and future plans for those efforts. Based on currently available information, even if fish passage improvements are required at the FERC-licensed projects upstream and downstream, there are several other dams and diversions within the Little Androscoggin River Basin that would continue to block fish passage for anadromous fish throughout the basin. Further, there are numerous other factors in addition to fish passage that would affect anadromous fish restoration success. Examples of these include: freshwater habitat quality, fish harvest, predation, competition with invasive fish species, droughts, floods, disease, and marine survival rates. Attempting to assess how all of these factors would manifest in a specific number of returning adult fish, which would be needed to quantify an ecological and economic benefit, would be uncertain and speculative.

Comment: Maine DMR disagrees with staff's conclusion that there would be no benefit of conducting an effectiveness evaluation of installed fish passage facilities designed in accordance with proven fish passage standards and operating procedures in FWS's Fish Passage Engineering Design Criteria Manual (FWS, 2017). Maine DMR states that FWS's Fish Passage Engineering Design Criteria Manual is a dynamic document that is modified as new information becomes available from recent studies, and because so many variables can affect fish passage, it is imperative that each facility be tested. Maine DMR also asserts that staff's conclusions contradicts the recommendations in the Commission's technical report entitled, *Evaluation of Mitigation Effectiveness at Hydroelectric Projects: Fish Passage* (FERC, 2004), which recommends monitoring fish passage facilities to determine site-specific effectiveness of the facility and evaluate its potential use at other sites, and providing more information on fish passage effectiveness, especially of new technologies.

Response: Although there could be benefits from conducting effectiveness studies when the passage facilities are using new technologies or are experimental in nature, when the facilities are constructed using proven technologies that are designed in accordance with agency fishway design manuals, as is the case here, there is sufficient existing information to conclude that the facilities would effectively pass the target fish species. For these reasons, there is no basis for recommending the effectiveness studies and we do not recommend them in the staff alternative.

Comment: Maine DIFW states that it would like to clarify its consultation recommendation for planned maintenance drawdowns of the impoundment. Specifically, it recommends that the licensee consult with Maine DIFW prior to conducting planned maintenance drawdowns of the impoundment during the smallmouth bass spawning period of May 1 through June 30.

Response: We have revised the description of Maine DIFW's recommended measure in section 3.3.1.2. Although we understand that Maine DIFW would prefer to be consulted prior to a maintenance drawdown that occurs during the May through June smallmouth bass spawning period, it does not indicate why it believes KEI Power would conduct planned drawdowns during these months. KEI Power has stated it typically conducts planned maintenance outside of this period during the low-flow summer and early fall months and we have no reason to believe that it wouldn't continue to do so under any subsequent license issued. Nevertheless, in section 5.1.2, we recommend restricting planned maintenance drawdowns to the period of July through September to avoid intentional flow fluctuations in the bypassed reach when the most sensitive life stages of Atlantic salmon are present. Thus, because planned maintenance drawdowns would be restricted to the period of July through September under the Staff Alternative, there is no need for a separate license condition requiring KEI Power to consult with Maine DIFW on planned maintenance drawdowns during the smallmouth bass spawning period of May through June.

Comment: In response to staff's analysis showing that the benefits of operating a fish holding and sorting facility as part of any upstream fishway constructed at the project would be limited due to the existing presence of non-native Northern pike upstream of the project, Maine DIFW states that, in addition to Northern pike, it is also concerned with invasive rock bass, white catfish, European carp, and bluegill in the Androscoggin River and that it will explore additional sorting facilities upstream of the Barker's Mill Project to address Northern pike as those projects come up for relicensing.

Response: We have revised sections 3.3.1.2 and 5.1.3 to include the additional invasive species identified by Maine DIFW in its comment letter. Although we understand that it is Maine DIFW's desire to require a fish holding and sorting facility at the project to limit the spread and proliferation of invasive fish species attempting to pass upstream of the project in the Little Androscoggin River Basin, in section 5.1.3 we continue to conclude that the costs of requiring such a facility as part of any upstream fishway constructed at the project are not justified by the benefits.

Essential Fish Habitat

Comment: NMFS states that its section 10(j) recommendations for run-of-river operation, impoundment levels, and minimum flows also serve as its Essential Fish Habitat (EFH) conservation recommendations pursuant to Section 305(b)(4)(A) of the Magnuson-Stevens Fishery Conservation and Management Act and recommends that FERC adopt these EFH conservation measures to support the protection of Atlantic salmon EFH.

Response: We have revised sections 1.3.6, 3.3.3., and 5.1 to address NMFS's EFH conservation recommendations. As we state in section 5.1, we recommend adopting NMFS's recommendations for KEI Power to operate the project in run-of-river mode and maintain impoundment levels within 1 foot or less from the full pond elevation or from the spillway crest when the flashboards are down. However, in section 5.1.3, we continue to conclude that the incremental habitat gains to Atlantic salmon from a minimum flow of 175 cfs would not be worth the additional annualized cost compared to staff's recommended flow of 113 cfs.

Recreation Resources

Comment: AW disagrees with staff's finding that whitewater boating flows could exceed flows desired by anglers in the bypassed reach because staff's conclusion was not based on an angler wading study in which anglers were asked to evaluate controlled flow releases to determine flow preferences, as was done in the whitewater boating study. AW contends that increasing natural flows in the bypassed reach will improve fish habitat and therefore increase angling opportunities. AW further states that even if boating releases would impact anglers, it would be a minor effect because the flows proposed by the applicant would be for only 5 days.

Response: Our recreation resources analysis in section 3.3.4.2 shows that proposed increases in minimum flows would improve fish habitat, thereby increasing angling opportunities. However, proposed whitewater boating flow releases (particularly higher flows above 600 cfs) could have the opposite effect by preventing anglers from safely wading in the stream. There is no need to conduct an angler flow preference study because the information provided by KEI Power's "wadeability" study was based on a proven method ("Rule of Ten" Index)[91] to determine how flows might influence wade fishing, taking into account water depth and velocity at a transect that was considered sufficiently representative of areas that would be desireable for wading anglers.[92] Although the effects of such high flows on angling would be limited given the few days that such flows we be available and released, we did not recommend whitewater boating flows solely on impacts to anglers. As discussed in section 5.1 of the draft EA, we also took into account the adverse effects of whitewater boating flows on fish and project economics.

Comment: AW states that staff did not provide an adequate basis for its finding that whitewater flows in the bypassed reach would cause fish strandings because no studies or analyses were done to determine an appropriate rate of change in flows when water is released. AW points out that sudden drops in flow from 170 cfs to 20 cfs presently occur in the bypassed reach under normal project operation without limitations on ramping, and that such fluctuations in flow would continue under staff's recommended minimum flow which would result in sudden drops from 263 cfs to 113 cfs. AW believes that staff's reliance on old fish stranding studies does not provide a sufficient basis for rejecting whitewater boating flows and that any conclusion about flow release impacts on a particular species must be based on a site-specific study of impact on the target species.

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[91] The Rule of Ten Index was developed by Abt *et al.* (1989) and states that the product of water depth (in feet) and velocity (in feet per second) should not exceed 10 square feet per second.

[92] The transect used for the angling wadeability study was located about 300 feet downstream of the dam and is considered an attractive area for angling.

Response: Our analysis of project effects on aquatic resources in section 3.3.1.2 examined the potential effects of sudden flow fluctuations from whitewater boating releases on sensitive fish species. As explained in that section, endangered Atlantic salmon are known to occur in the bypassed reach and would be more likely to spawn and rear in the bypassed reach with staff's recommended higher minimum flows. Although sudden flow changes do occur under existing conditions during powerhouse startup and shutdown, the magnitude of these events is typically limited to a flow increase or decrease of about 150 cfs when the powerhouse initially starts up and subsequently shuts down in response to a natural rise and fall in inflow due to a rain event during the low-flow season. These operational flow fluctuations would continue to occur periodically under the proposed and staff-recommended higher minimum flows. As explained below, however, the magnitude of the flow change would typically differ between normal project operation and the recommended whitewater boating releases.

Under existing operating conditions, the powerhouse starts up when inflows reach 170 cfs, resulting in an abrupt drop in bypassed reach flows down to 20 cfs (change of 150 cfs). Under the proposed and staff-recommended minimum flows, the powerhouse would start up when inflows reach 263 cfs, resulting in an abrupt drop in bypassed reach flows down to 113 cfs (again a change of 150 cfs). However, releasing whitewater boating flows in the range of 300 to 1,000 cfs would increase both the frequency of abrupt flow changes as well as the magnitude of the change, especially under the more desirable higher flows of 600 cfs or above that are likely to draw more interest from recreationists. For instance, if there is sufficient inflow to provide a 600-cfs boating release, then the powerhouse would be operating near its maximum 500-cfs hydraulic capacity just prior to shutdown, causing a bypassed reach flow increase from 113 cfs to 600 cfs (change of 487 cfs) during the start of the release and a subsequent decrease of the same magnitude after the five-hour long boating event. The magnitude of the change due to the boating release would, therefore, be as much as three times higher than what typically occurs under normal project operating conditions.

Although there are no site-specific studies of the effects of these abrupt flow changes on fish and aquatic resources of the bypassed reach, we disagree with AW that such studies are needed to conclude that the additional and greater-magnitude flow changes that would occur during boating releases could adversely affect sensitive fry rearing and spawning life stages of Atlantic salmon. There is a large body of existing scientific information that documents the effects of unrestricted flow ramping on these life stages of anadromous salmonids (Casas-Mulet et al., 2014; Hass et al., 2016; Scruton et al., 2008; Vollset et al., 2016; Young et al., 2011), and we are expecting that Atlantic salmon would utilize the bypassed reach for spawning and rearing under the staff-recommended minimum flows. For these reasons, our analysis in sections 3.3.1.2 and 3.3.4.2 continues to show that AW's recommended boating flow releases would pose an additional risk to Atlantic salmon as they would increase the frequency and magnitude of abrupt flow changes beyond what are already occurring under normal project operating conditions.

Comment: AW contends that staff's recommendation against providing whitewater boating flows is "arbitrary and capricious" because it is unsupported by the studies conducted for the relicensing of the project and does not give equal consideration to recreational values as required by the FPA. AW states that staff disregarded current project impacts on whitewater boating and possible mitigation measures in making its recommendation.

Response: Contrary to AW's assertion, staff's analysis is based on the best information available, including a whitewater boating study. In our recreation resources analysis in section 3.3.4.2, and comprehensive development analysis in section 5.1.3, we evaluated the availability of whitewater resources and other recreation needs in the project region. We also thoroughly considered the public interest benefits associated with providing whitewater boating flows specifically in the bypassed reach as well as other recreation enhancements. At the same time, we also considered the adverse effects they could have on listed fish species (see section 3.3.1.2, *Effects of Whitewater Boating Flow Releases*), fishing opportunities, and project generation. Pursuant to sections 4(e) and 10(a) of the FPA, we recommended against requiring the release of whitewater flows because the benefit of such releases would not outweigh their potential for adverse effects on fishery resources (e.g., potential take of an endangered species) and project generation.

APPENDIX B

U.S. DEPARTMENT OF INTERIOR'S SECTION 18 MODIFIED FISHWAY PRESCRIPTONS

10 RESERVATION OF AUTHORITY TO PRESCRIBE FISHWAYS

In order to allow for the timely implementation of fishways, including effectiveness measures, the Department proposes to reserve its authority by requesting that the Commission include the following condition in any license it may issue for the Project:

> *Pursuant to Section 18 of the Federal Power Act, the Secretary of the Interior herein exercises his authority under said Act by reserving that authority to prescribe fishways during the term of this license and by prescribing the fishways described in section 11 of the Department of Interior's Prescription for Fishways at the Barker's Mill Hydroelectric Project.*

11 MODIFIED PRESCRIPTION FOR FISHWAYS

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

The Department's Modified Prescription for Fishways reflects a number of issues and concerns related to fish restoration and passage that have been raised by KEI (Maine) Power Management (Applicant or Licensee), Commission staff, and state and federal resource agencies. 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 will construct, operate, maintain, and periodically test the effectiveness of fishways for sea-run alewife, American shad, blueback herring, and American eel (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 through the zone of passage. Anadromous species will be timely passed at the peak hour of the peak day of their migratory run without material delay or change of fish migratory behavior.

11.2 Design Populations

Determination of the American eel population in the Little Androscoggin River is not possible at this time. However, current eel passage technologies should allow for sufficient passage. As noted in the "Upstream Passage (Alosines)" section of the Service memo (FWS 2017, pages 6-7), capacity is a key component of a fishway to ensure that the biological goals for the target species can be achieved. The capacity for technical fishways that pass species other than American eel (e.g., Alosines, Atlantic salmon) are derived based on an estimated rate of ascent as well as their body size. Typically, only a small number of fish can pass over a weir or through a section of fishway. For example, the annual biological capacity of a Model A Steeppass for river herring is estimated to be 50,000 (FWS, 2017, page 6-15, Table 5). This number is small compared to a larger fishway like the Denil, with an estimated capacity of 250,000 river herring. The higher value of the Denil is due to the fact that multiple river herring can pass through the fishway at one time. A comparable estimate of capacity associated with the American eel does not exist. This is due to the fact that upstream migrating eel can vary in size, some being less than 6 inches. This allows them to congregate in very large numbers, making it feasible for their rate of ascent to be much higher than that of Alosines. Also, the timing of American eel migration is more spread out in time than for alosines. It is for this reason that, if placed in the correct location and designed and operated correctly, one (or is some cases two) fishway for American eel can have the capacity to pass 10's, even 100's of thousands of eels. In 2017, an estimated 11,500 American eel were observed passing the eel ladder at the Stillwater project on the Stillwater Branch of the Penobscot River (HDR, 2017, page 8). Therefore, even though the Service has not determined a design population for eels, the Service believes that a properly located, designed, operated, and installed upstream eelway will provide enough capacity for the eel population in the Little Androscoggin River.

Based on the DMR Draft FMP (2017) the design population for the Little Androscoggin River for blueback herring is 327,188; for American shad is 37,694; and for alewife is 1,728,895. The total design population is therefore 2,093,777 alosines. Historically, within the entire Androscoggin watershed, the Little Androscoggin River represents 77 percent of the alewife spawning habitat (lakes and ponds), and 30% of American shad and blueback herring spawning habitat. The Little Androscoggin River is a major component to restoring alosines in the Androscoggin watershed.

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; ASMFC 2000, page 8; Saunders et al. 2006, page 539; ASMFC 2009, page 9). The season depends on geographic location, water temperature, river flow and other habitat cues. These dates may change based on new information, improved access at the lower dams, evaluation of new literature, and agency consultation. Based on state-wide and Androscoggin River watershed specific data, approved fish passage protective measures shall be operational during the following migration windows (See Table 1):

Table 1. Summary of migration periods for which fish passage will be provided.*

Species	**Upstream Migration Period**	**Downstream Migration Period**
Alosines: American shad, blueback herring, Alewife	May 1–July 31	June 1 – November 30
American eel	June 1–September 15	August 15 – November 15

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

11.4 Fishway Operation and Maintenance Plan

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

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

The FOMP shall be submitted to the U.S. Fish and Wildlife 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 U.S. Fish and Wildlife 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 U.S. Fish and Wildlife Service. Any modifications to the FOMP by the Licensee will require the approval of the U.S. Fish and Wildlife 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 U.S. Fish and Wildlife 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 Inspections

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

Fishway Design Review

The Licensee shall submit design plans to the U.S. Fish and Wildlife Service and other resource agencies for review and approval during the conceptual, 30, 60, and 90 percent design stages. Designs shall be consistent with the 2017 Fish Passage Engineering Design Criteria Manual (USFWS 2017, entire) or updated version.

The Licensee shall adhere to the following dates for the following fishways:

1. The upstream eel passage system is to be installed and operational by June 1, 2021.
2. The downstream alosine and eel passage system is to be installed and operational by September 1, 2021.

For both fishways the Licensee shall adhere to the following design milestone schedule:

a) Conceptual design within 6 months of license issuance,
b) 30% design within 9 months of license issuance,
c) 60% design within 12 months of license issuance and a basis of design report (if requested),
d) 90% design within 18 months of license issuance.

The Licensee shall adhere to the following design milestone schedule for the upstream alosine passage system, which is to be installed and operational by May 1, 2024:

a) Conceptual design within 36 months of license issuance (January 2022),
b) 30% design within 39 months of license issuance (April 2022),
c) 60% design within 42 months of license issuance (August 2022),
d) 90% design within 48 months of license issuance (March 2023).

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

11.6 Fish Passage Effectiveness Measures

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

The downstream bypass for alosines and the upstream and downstream passage for eels are to be operational no later than two years after license issuance. Effectiveness testing and evaluation plans shall be developed by the Licensee, in consultation with the Service. The Licensee must submit effectiveness testing and evaluation plans to the Service for approval within 6 months of license issuance. The effectiveness testing and evaluation plans must be reviewed, accepted, and approved by the U.S. Fish and Wildlife Service prior to implementation. The Licensee shall begin implementing effectiveness testing measures at the start of the first migratory season after a fishway is operational and shall conduct quantitative fish passage effectiveness testing and evaluation for a minimum of two years.

The upstream fishway for alosines is to be constructed and operational by the start of the migration season in 2024. This will allow for a year shakedown period before expected passage at Barker Upper Project (P-3562, current license expires in 2023) by 2025. The Licensee must submit effectiveness testing and evaluation plans to the Service for Approval at the same time conceptual designs are provided.

The Licensee shall meet annually, in the late fall, with the U.S. Fish and Wildlife 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.

11.7 Downstream Alosine and Eel Passage

1. The Licensee shall construct a downstream alosine and eel passage system within years of the issuance of a new license.
2. The Licensee shall construct a downstream alosine and eel passage system with: (1) a full depth inclined (minimum 45 degrees) bar rack with ¾- inch spacing, (2) a minimum flow of 5 percent of the station capacity (currently 500 cfs, so 25 cfs),

(3) a receiving bypass flow plunge pool with a depth that is equal to 25 percent of the fall height or 4 feet, whichever is greater, (4) designs, operations, and maintenance shall be consistent with the U.S. Fish and Wildlife Service's 2017 Fish Passage Engineering Design Criteria Manual (USFWS 2017, entire).

3. The 3/4-inch bar rack shall be present from June 1 through November 30 of each year to prevent adult American eel and juvenile and post-spawn alosines from entering the penstock intake.
4. Spill pathway shall be prioritized as such: (1) through the newly constructed bypass, (2) through the stop log system that empties into the plunge pool, (3) over the spillway, and if necessary, into a Service approved plunge pool.
5. The new downstream passage facility shall be operational at least 30 days before the second migratory season after the issuance of a new license. In the interim, the Licensee shall maintain existing downstream measures at the Project. The Licensee shall keep the new downstream passage facilities and the existing stop log system in proper order and clear of trash, logs, and material that would hinder flow and passage.
6. The new downstream facility shall be designed in consultation with the U.S. Fish and Wildlife Service and the other resource agencies, and they will have 30 days to review and comment on the 30%, 60%, and 90% drawings that will be consistent with the Service's 2017 Fish Passage Engineering Design Criteria Manual (USFWS 2017, entire).

Justification

Dedicated downstream fish passage facilities are necessary to protect migrating diadromous species and may also be used by American eel. This position is based on the fact that alewife and blueback herring are presently stocked upstream of the Barker Lower Project (KEI 2017, page 4-27 to 4-30). Downstream migrating adult and juvenile alosines, and adult American eel are exposed to project related impacts (Larinier 2001, page 47-53 and 74). Downstream migrating adults and juvenile fish can be protected from project operations that result in injury and mortality (NMFS 2012, page 21).

11.8 Upstream Alosine Passage

1. The Licensee shall construct and have in operation an upstream alosine passage system by 2024. The facility shall be designed to pass a maximum of approximately 2 million river herring.
2. The Licensee shall construct either a pool and weir fishway or a fish lift.
3. The upstream facility shall be designed in consultation with the U.S. Fish and Wildlife Service and the resource agencies. All groups shall review the conceptual, 30%, 60%, and 90% drawings and is to be consistent with the Service's 2017 Fish Passage Engineering Design Criteria Manual (USFWS 2017, entire).

Justification

The Little Androscoggin River once supported runs of diadromous species including alosines (KEI 2017a, page 4-26). The MDMR's policy is to restore Maine's native diadromous fishes to their historic habitat. The MDMR has been stocking Taylor, Lower Range, and Marshall Ponds with adult river herring since 1983 (KEI 2017a, page 4-30). The MDMR has estimated that the lakes and ponds in the Little Androscoggin River watershed could produce approximately 2 million river herring (MDMR 2017, pages 35-36). The design alternatives are outlined and justified in the Service's Regional Fish Passage Engineer's Report (FWS 2017, pages 6-10).

11.9 Upstream American Eel Passage

1. The Licensee shall construct, operate and maintain an upstream passage facility for American eel that provides safe, timely and effective upstream passage. This facility shall provide passage from the downstream side of the dam to the Barker Lower headpond.
2. This facility shall be operational before the second migration season after the issuance of a new license.
3. The upstream facility shall be designed in consultation with the resource agencies, and the resource agencies shall review the conceptual, 30%, 60%, and 90% drawings and is to be consistent with the Service's 2017 Fish Passage Engineering Design Criteria Manual (USFWS 2017, entire).

Justification

Dedicated upstream eel passage is necessary to provide migration to rearing habitat upstream of the Project throughout the migratory season. We base this position on the factual background that eels are currently present above the project. Upstream migrating juvenile eels can be effectively passed at hydroelectric projects (Solomon and Beach 2004, entire). Upstream eel passage facilities are briefly described in the Service's Regional Fish Passage Engineer's Report (FWS 2017, page 10).

APPENDIX C

U.S. DEPARTMENT OF COMMERCE'S SECTION 18 MODIFIED FISHWAY PRESCRIPTONS

8.3. Section 18 Preliminary Fishway Prescription

We hereby submit the following modified prescription for fishways pursuant to Section 18 of the FPA, 16 USC §811. Section 18 of the FPA states in relevant part that, "the Commission must require the construction, maintenance, and operation by a Licensee of...such fishways as may be prescribed by the Secretary of Commerce or the Secretary of the Interior." Congress provided guidance on the term "fishway" in 1992 when it stated as follows:

> "The items which may constitute a 'fishway' under Section 18 for the safe and timely upstream and downstream passage of fish must be limited to physical structures, facilities, or devices necessary to maintain all life stages of such fish, and Project operations and measures related to such structures, facilities, or devices which are necessary to ensure the effectiveness of such structures, facilities, or devices for such fish." Pub.L. 102-486, Title XVII, § 1701(b), Oct. 24, 1992.

We base the following mandatory fishway prescription on the best biological and engineering information available at this time, as described in the explanatory statements that accompany each prescription. We developed this prescription over a period of several years by our biological and engineering staff, in close consultation with the Licensee, the USFWS and other entities that participated in this relicensing proceeding. We received no substantive comments on the preliminary prescription; therefore, no changed were made to modify this prescription.

We support each prescription measure by substantial evidence contained in the record of pre-filing consultation, and subsequent updates, compiled and submitted in accordance with the Commission's procedural regulations. The explanatory statements included with each prescription summarizes the supporting information and analysis upon supplying the basis for the prescription. We include an index to the administrative record for this filing herein, and reserve the right to file updated and supplemental supporting information as needed.

8.3.1. Upstream Fish Passage – Anadromous Species

The Licensee shall construct, operate and maintain upstream fish passage facilities that pass anadromous fish species in a safe, timely and effective manner consistent with the performance standards described in Section 8.3.6. Based on the best scientific information available at this time, one of the following types of fishways could satisfy the standard of safe, timely and effective: a fish lift, vertical slot fishway, or an ice harbor fishway. We have confidence based on experience that each of these designs will function for the full suite of anadromous species. The size of the fishway shall accommodate the anticipated production potential of the Little Androscoggin River: 1.7 million river herring, 37,000 American shad, approximately 370 Atlantic salmon, and other resident or target species. The design elements (e.g. slope, pool/slot size, attraction water) of the fishway shall ensure successful passage of river herring, American shad, Atlantic salmon, and sea lamprey. The fishway shall operate for the full range of design flows based on the migratory season for each species in accordance with provisions of Section 8.3.5. The fishway shall be constructed and operational before the 2024 fish migration season, at which time the existing license for the Upper Barker Project (FERC No. P-3562) expires. This deadline for operation of new upstream fishways is to ensure sufficient time for a shakedown year and at least one year of evaluation before implementing potential fish passage requirements contained within any new license for the Upper Barker Project. The operation date may change in consultation with the agencies. Design review will proceed guided by the provisions in Section 8.3.7.

The Licensee shall keep the fishways in proper order and shall keep fishway areas clear of trash, logs, and material that would hinder passage. Anticipated maintenance shall be performed in sufficient time before a migratory period such that fishways can be tested and inspected and will properly operate prior to the migratory periods. In addition, the fishway shall include a counting facility to enumerate successful passage of target species.

The Licensee did not propose upstream fish passage facilities for anadromous fish.

Rationale

Restoration of anadromous fish is a long-standing resource goal for the Little Androscoggin River watershed. The original order issuing a license for the Barkers Mill Project contemplated fishways in 1979.[93] The requirement for dedicated fish passage facilities issued during this licensing proceeding, as well as the Upper Barker's Mill (FERC No. P-3562) relicensing starting 2018, is necessary to support our broader restoration goal for the watershed. Upstream fish passage at Lower Barker, and eventually Upper Barker's Mill, will open approximately 3.7 miles of mainstem migratory, spawning and rearing habitat for diadromous fish. Fish passage at Lower Barkers Mill, along with relicensing of other hydroelectric facilities on the river and the state of Maine's fishery management plan for the Little Androscoggin River (MDMR and

[93] Maine Hydroelectric Development Corporation, Project No. 2808, Order Issuing License (Minor), February 23, 1979.

MDIFW, 2017), will stimulate increased fish passage at dams along the mainstem and tributaries. The timing of passage implementation, within five years of license issuance, reflects the timing of relicensing for the Upper Barker's Mill Project. The Upper Barker's Mill Project license expires in 2023. The five years post licensing allows time to consult with the resource agencies on design and construct the new fishway facility before starting the same process at the Upper Barker's Mill Project. Any delay in fishway completion does not allow sufficient time to ensure the fishway is operational and effective commensurate with the fishway that will likely be required at Upper Barkers Mill.

As the first fishway on the Little Androscoggin River, the counting facility is necessary to monitor the success of restoration in the watershed.

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

a) Anadromous fish historical habitat has been identified in many reaches of the Little Androscoggin River watershed (MDMR 2016).
b) Alewife, blueback herring, American shad, sea lamprey, and Atlantic salmon have access to the Little Androscoggin River. Alewife and blueback herring[94] and Atlantic salmon[95] have been within the project bypassed reach.
c) The state of Maine has stocked alewife in lake habitat above the Lower Barker Project since the early 1980's (MDMR 2016, KEI (Maine) 2017), resulting in juveniles imprinted to spawning habitat within the Little Androscoggin River (Mullen et al. 1986).
d) Dams such as the Lower Barker dam are an impediment to upstream migration of anadromous fish (74 FR 29300, June 19, 2009; 74 FR 29344, June 19, 2009; 78 FR 48944, August 12, 2013).
e) Properly designed and located fishways, with suitable near-field and far-field attraction are capable of passing Atlantic salmon, sea lamprey, American shad, and river herring upstream of dams (Larinier 2002a, b, Larinier and Marmulla 2004, Bunt et al. 2012, NMFS 2012, USFWS 2017).

8.3.2. Upstream Fish Passage – Catadromous Species

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[94] MDMR comments of January 23, 2017, on the KEI (Maine) draft license application. Accession #20170123-5057; observations of NOAA staff (B. Lake, May 22, 2016); observations of Eric Cousens, City of Auburn (June 10, 2014).

[95] KEI (Maine) Power Management (III), LLC. 2017. Final License Application, Lower Barker Hydroelectric Project (FERC No. 2808) Accession # 20170130-5361.

The Licensee shall construct, operate and maintain an upstream passage facility for American eel that provides safe, timely and effective upstream passage consistent with the performance standards described in Section 8.3.6. This facility shall provide passage from the downstream side of the dam to the Lower Barker impoundment. This facility shall be operational by June 1, 2021. The Licensee shall keep the upstream eel passage facility in proper order and clear of trash, logs, and material that would hinder flow and passage. Anticipated maintenance shall be performed in sufficient time before a migratory season such that fishways can be tested and inspected and will operate effectively prior to migration. The Licensee conducted nighttime surveys of migratory American eel and identified the appropriate area to site the fishway, but did not propose to construct the fishway. Design review of the new fishway shall follow the process outlined in Section 8.3.7. Fishway Design Review.

Rationale
Dedicated upstream eel passage is necessary to provide migration to rearing habitat upstream of the Project throughout the migratory season. We base this position on the factual background herein and the following:

a) Upstream migrating juvenile eel were observed at the Lower Barker Project (KEI (Maine) 2017).
b) Dams similar to the Lower Barker Project inhibit the passage of American eel juveniles, including elver and yellow eel (Shepard 2015).
c) Upstream migrating juvenile eels can be effectively passed at hydroelectric projects (Solomon and Beach 2004).
d) The proposed upstream fishway design can function to support passage and prevent injury and mortality of adult eel (Solomon and Beach 2004).

8.3.3. Downstream Fish Passage

The Licensee shall construct, operate and maintain downstream fish passage facilities for diadromous species that provide safe, timely and effective downstream passage consistent with the performance standards described in Section 8.3.6. The downstream passage facility shall be operational by September 1, 2021. The downstream passage facility shall prevent entrainment into the penstock without causing injury or mortality due to impingement and provide a safe route of passage to the bypassed reach. The downstream fish passage facility shall consist of:

1. entrainment prevention using a minimum of ¾-inch spaced bar racks (or equivalent);
2. impingement prevention by minimizing approach velocity and maximizing sweeping velocity components near the bar racks;
3. sufficient flow to attract emigrating fish to the bypass entrance;
4. gradually accelerating flow near the bypass entrance;

5. safe hydraulic conditions through the bypass; and
6. safe discharge conditions at the bypass outfall.

These design parameters are consistent with criteria used nationally (NMFS 2011, USFWS 2017). Downstream passage facilities shall be operational within two years after the issuance of a new license. The Licensee shall keep the downstream passage facilities in proper order and clear of trash, logs, and material that would hinder flow and passage. Anticipated maintenance shall be performed in sufficient time before a migratory period such that fishways can be tested and inspected and will operate effectively prior to the migratory periods.

KEI (Maine) proposes to make improvements to the existing downstream fishway to prevent turbine entrainment in their final license application. On June 5, 2017, we provided potential downstream passage measures to the Licensee, but no specifics were included in the final license application or subsequently agreed to in writing or on the record. Design review of any new downstream fish passage facility shall follow the process outlined in Section 8.3.7. Fishway Design Review such that modifications can be implemented and operational within 2 years of license issuance.

Rationale
Dedicated fish passage facilities are necessary to protect diadromous species emigrating past the Project. We base this position on the factual background herein and the following:

1. Approximately 6,100 alewife are presently stocked upstream of the Lower Barker Project (KEI (Maine) 2017, MDMR and MDIFW 2017).
2. Downstream migrating adult and juvenile alosines are exposed to project related impacts (Franke et al. 1997).
3. Adult American eel are present upstream of the Lower Barker Project (KEI (Maine)2017).[96]
4. Downstream migrating adults and juvenile diadromous fish through hydropower projects such as Lower Barker can be effectively protected from project operations that result in injury and mortality (NMFS 2011, 2012, USFWS 2017). 74 FR 29344, June 19, 2009, 78 FR 48944, August 12, 2013.

8.3.4. Zone of Passage

The Licensee shall provide a flow in the bypassed reach sufficient for safe, timely, and effective passage to the dam during the upstream anadromous fish passage season

[96] Lakes of Maine provides species distribution maps. Website accessed December 8, 2017. http://www.lakesofmaine.org/lake-maps.html

(See Section 8.3.5.). The zone of passage refers to the contiguous area of sufficient lateral, longitudinal, and vertical extent in which adequate hydraulic and environmental conditions are maintained to provide a route of passage through a stream reach influenced by a dam (USFWS 2017). We propose a flow of 175 cfs will be adequate based on the best available information. The current and proposed minimum bypass flow have depths less than 1 foot in sections of the bypassed reach that may limit or preclude upstream passage of the full suite of targeted diadromous species to be passed by the Project.

Rationale
Unless the Licensee is willing to build two upstream fishways, one at the powerhouse and another at the dam, adequate flow is necessary in the bypassed reach to attract fish upstream from the powerhouse discharge and deep enough to provide a zone-of-passage to the upstream fishway entrance at the dam. We base this position on the factual background herein and the following:

a) Observations on June 10, 2014 show that alewife have difficulty migrating through the bypassed reach during low flow conditions (Attachment C, personal observation, Eric Cousens, June 10, 2014).
b) Migrating diadromous fish require a zone-of-passage with suitable depth to swim upstream. Typically, this is 2 to 3 times the body depth of the target species (Turek et al. 2016, USFWS 2017).
c) Migrating fish are subject to predation in low flow conditions (Attachment C).

8.3.5. Seasonal Migration Windows

Based on state-wide and Androscoggin River watershed specific data, approved fish passage protective measures, including the zone of passage, shall be operational during the migration windows for each life stage of Atlantic salmon (adults, kelts and smolts), and adults and juveniles of American shad, blueback herring, American eel, and alewife (Table 3). These dates may change based on new information and agency consultation.

Table 3. Summary of migration periods for which fish passage is required. The migration period for Atlantic salmon is depended on presence and may be refined in consultation with the resource agencies.

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

Alewife and Blueback herring	May 1–July 1	July 15 – November 30 (juveniles) June 1 – July 31 (adults)
American eel	June 1–September 15	August 15 – November 15 (adults; night)

Rationale

a) Adult alosine in Maine rivers commonly migrate upstream between May and June, and as late as August and emigrate soon after spawning from June to early August (Loesch 1987, ASMFC 2009).
b) Juvenile alosine in Maine rivers typically emigrate in September and October but may emigrate as early as August and as late as December (Mullen et al. 1986, Weiss-Glanz et al. 1986, Loesch 1987).
c) Juvenile American eel in Maine rivers start immigration in early June and continue as late as September 15th in Maine (Shepard 2015).
d) Adult Atlantic salmon typically pass in April (Baum 1997). Trap operations at the former Veazie Dam typically captured adult salmon from May to November (Dubé et al. 2011, Dubé *et al.* 2012).
e) Following spawning in the fall, Atlantic salmon kelts in Maine rivers typically return to the sea immediately, or over-winter in freshwater habitat and migrate in the spring, typically April or May (Baum 1997).
f) Based on NMFS Penobscot River smolt trapping studies in 2000 - 2005, smolts migrate in Maine rivers between late April and early June with a peak in early May (Fay et al. 2006).

8.3.6. Passage Performance Standards and Monitoring

Fishways need to be tested to ensure they are constructed, operating and functioning as intended, and whether improvements are needed to ensure safe, timely and effective passage is provided. Therefore, the Licensee shall conduct the following monitoring studies:

1. Alosine – A minimum of two years of quantitative monitoring for the new upstream and downstream measures. Monitoring shall begin after a one-year operational shakedown period for each fishway facility with another year of monitoring during the Project license in consultation with resource agencies.
2. Atlantic salmon – Upstream and downstream monitoring of all life stages is contingent on agency consultation and presence of testable individuals.
3. The Licensee shall develop study design plans in consultation with state and federal resource agencies. The resource agencies shall approve the study design prior to the Licensee filing with the Commission for final approval.

4. All monitoring will adhere to scientifically accepted practices.
5. The Licensee shall prepare reports of the monitoring studies to the resource agencies for a minimum 30-day review and consultation prior to submittal to the Commission for final approval.
6. The Licensee shall include resource agencies' comments in the monitoring study reports submitted to the Commission for final review.
7. The Licensee shall prepare annual fish passage reports that consist of data from the fish passage season including passage counts for each species, daily river flow conditions, fishway operational settings, and Project operations.
8. The Licensee shall allow resource agencies access to the fishway for inspection throughout the length of the license provided reasonable notice.

If the facility does not meet performance standards for safe, timely and effective passage, then studies will continue biennially until achievement of performance standards. We will derive performance standards in consultation with other resource agencies and the Licensee during the development of monitoring plans. If the facility does meet performance standards, a second year of monitoring will occur during the license timeframe through consultation with the resource agencies. If the fishway facility does not meet performance standards, additional improvements to the fishways will be required in consultation with resource agencies.

The same monitoring process will occur for any new upstream or downstream fish passage measure implemented at the Project through our reservation of Section 18 authority.

8.3.7. Fishway Design Review

The Licensee shall submit design plans to NMFS for review and approval during the conceptual, 30, 60 and 90 percent design stages. The Licensee shall incorporate into their schedule a minimum of 30 days of review time by resource agencies for each stage.

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

1. Conceptual design within 6 months of license issuance,
2. 30% design within 9 months of license issuance,
3. 60% design within 12 months of license issuance and a basis of design report (if requested), and
4. 90% design within 18 months of license issuance.

The Licensee shall adhere to the following design milestone schedule for upstream anadromous passage facilities:

1. Conceptual design within 36 months of license issuance (January 2022),
2. 30% design within 39 months of license issuance (April 2022),
3. 60% design within 42 months of license issuance (August 2022) and
4. 90% design within 48 months of license issuance (March 2023).

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

8.4. Reservation of Authority

This prescription for fishways was developed in response to the proposals being considered by the Commission in this proceeding, our current policies and mandates, and our understanding of current environmental conditions at the Project. If any of these factors change over the term of the license, then we may need to alter or add to the measures prescribed in this licensing process. Therefore, we hereby reserve authority under Section 18 of the FPA to prescribe such additional or modified fishways at those locations and at such times as we may subsequently determine are necessary to provide for effective upstream and downstream passage of anadromous fish through the Project facilities. This reservation of authority includes, without limitation, our authority to amend this fishway prescriptions upon approval by us of such plans, designs, and completion schedules pertaining to fishway construction, operation, maintenance, and monitoring as may be submitted by the Licensee in accordance with the terms of the license articles containing such fishway prescriptions. We propose to reserve authority by requesting that the Commission include the following condition in any license it may issue for the Project:

Pursuant to Section 18 of the Federal Power Act, the licensee shall build the fishways described in the National Marine Fisheries Service' Prescription for Fishways at the Lower Barker Hydroelectric Project (FERC No.2808). The Secretary of Commerce reserves his authority to prescribe additional or amended fishways as he may decide are required in the future.