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

December 22, 2021

Luke Anderson
Manager, Licensing
Brookfield Renewable
150 Main Street
Lewiston, ME 04240

RE: Comments on the Pre-Application Document and Requested Studies for the Lewiston Falls Hydroelectric Project (P-2302-099)

Dear Mr. Anderson,

On August 4, 2021, Brookfield White Pine Hydro (BWPH) submitted a Pre-Application Document and Notice of Intent to seek a new license for the Lewiston Falls project on the Androscoggin River, in Lewiston, Maine (Accession # 20210804-5115). On November 4, 2021 you held your Joint Agency Meeting.

We have reviewed the application and offer our comments and requested studies in our attachment.

If you have any questions, please contact me (978-281-9131 or christopher.boelke@noaa.gov).

Sincerely,

Christopher Boelke
Chief, New England Branch
Habitat and Ecosystem Services

cc: service list

National Marine Fisheries Service's Comments and Study Requests on Brookfield White Pine Hydro Power's Pre-Application Document for the Lewiston Falls Project (FERC No. 2302-099)

Based on our review of the Pre-Application Document (PAD) submitted by Brookfield White Pine Hydro Power Management (BWPH), we offer the following scoping comments, PAD comments, and study requests.

1 SCOPING COMMENTS

The National Environmental Policy Act (NEPA) review documents should include a cumulative effects analysis that analyzes the benefits of upstream and downstream safe, timely and effective passage at the project, as well as the costs of delaying restoration.

A cumulative effects analysis should be included in the NEPA analysis to evaluate the benefits of safe, timely and effective passage for American eel at the three downstream FERC licensed projects: Worumbo (P-3428) Pejebscot (P-4784) and Brunswick (P-2284).

As part of the balancing of non-power interests, the NEPA analysis should consider the benefits of safe, timely and effective passage for American eel and the costs associated with delaying the restoration of this species.

2 PAD COMMENTS

2.1 PAD SECTION 5.3.4 DIADROMOUS FISH SPECIES | ATLANTIC SALMON

The PAD discussed the 2016 Normandeau report that was conducted as a result of our 2013 Biological Opinion. The PAD does not mention the upstream hydropeaking operations that affect inflow to the project. As a run-of-river project, the projects passes the inflows it receives. The Androscoggin River near Auburn, Maine gage (USGS 01059000) provides an accurate depiction of the flows that are released from this project (Figure 1). The figure below shows the flow in the mainstem Androscoggin River downstream of the Lewiston Falls project that is also critical habitat for listed Atlantic salmon.

The figure shows that from approximately May 28th through June 20th 2020, a hydropeaking signal is apparent whereby flows are rapidly increasing and decreasing. All American shad, sea lamprey, American eel and Atlantic salmon that are in the mainstem Androscoggin River are subject to rapidly changing habitat conditions (e.g. velocity) as a result of rapidly changing flows that licensed projects upstream of Lewiston Falls are providing.

The final license application should state the nature of the inflows it receives from upstream projects, including the down ramping requirement that is in the Gulf Island license order (Accession # 20060823-3018) stating "the downramping of flows from the Deer Rips development from full generating flows to the required minimum flow shall be restricted to a rate no faster than linearly over 20 minutes".

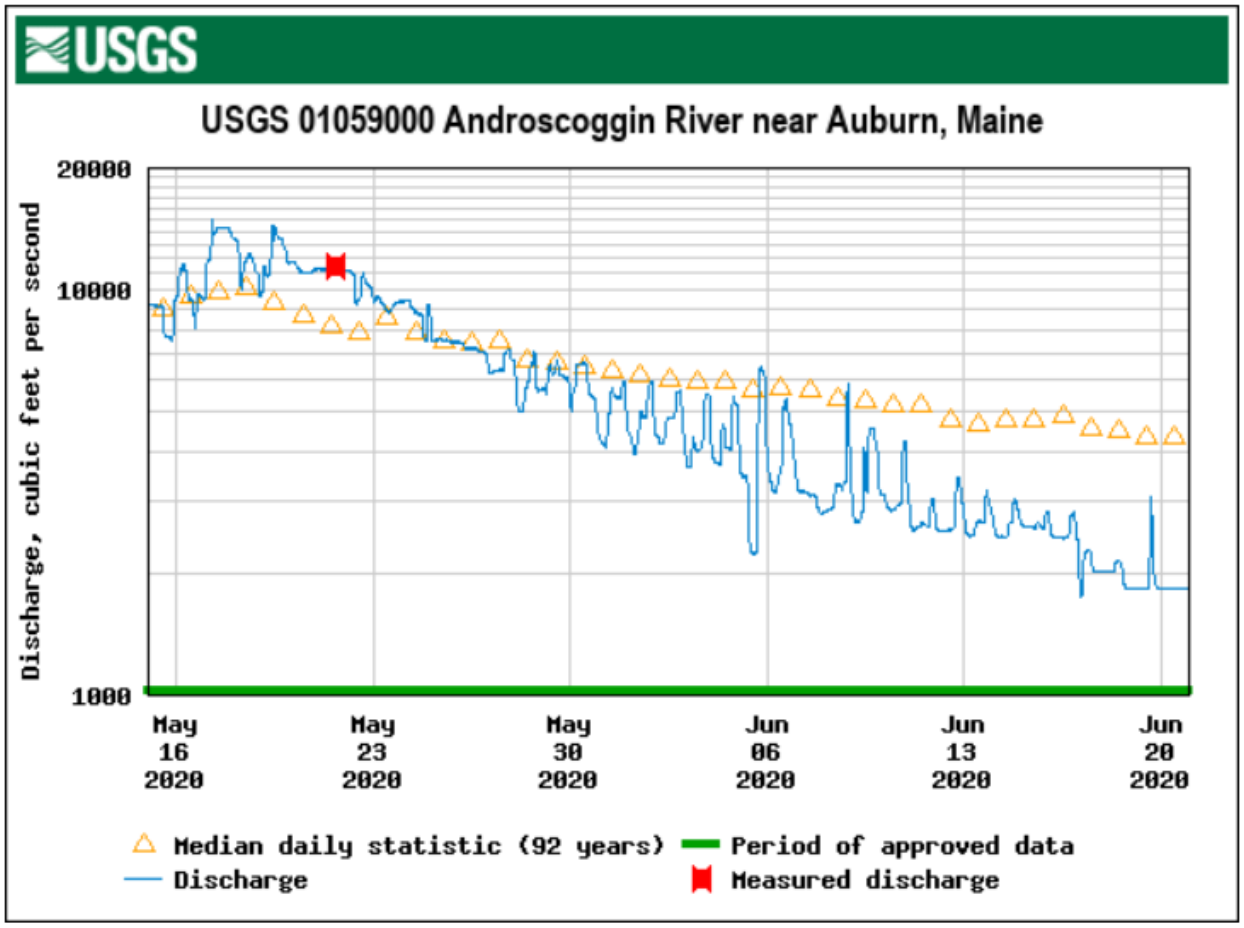

Figure 1. USGS 15-minute flow data for the Androscoggin River near Auburn Maine from May 16, 2020 to June 20, 2020. By May 30, inflows to the project were within the hydraulic capacity range of the Monty Station. Several flow reversals are imposed on the river over a naturally receding limb of the hydrograph.

The PAD references Yoder et al 2006 indicating the presence of American eel. We recommend that the Final License Application include Yoder et al. (2015), specifically the data that are included in this publication's Appendix that highlights the number of observed American Eel observed upstream of the project. We additionally recommend that the license applicant consult with the Maine Department of Inland Fisheries and Wildlife to obtain any geospatial data they have regarding the presence of this species upstream of the project.

Over the course of the new license for this project, we anticipate that American eel returns to the Lewiston Falls project will increase due to improvements made to the three federally licensed projects downstream of Lewiston Falls. The final license application should take into account resource agency involvement at these projects to improve upstream and downstream passage for American eel.

2.3 Section 5.3.2 Fish Resources and Habitats

The PAD provides eel count data in Tables 5-13 and 5-14 at the Brunswick Project (P-2284) and the Worumbo Project (P-3428). The PAD does not provide any of the data that Maine Department of Inland Fisheries and Wildlife has collected with respect to the presence of eels upstream of Lewiston Falls (MDIF&W personal communication)

2.4 General Comments

We recommend that the final license application include the following information:

- Clear width spacing of the existing trashrack
- Minimum hydraulic capacity of the Project's generating units
- The minimum flow of 1,430 cfs or inflow, whichever is less, applies to the flow through the powerhouse, not spill over the dam
- A record of when "refreshment" flows of 300 cfs in the canal system are expected to occur
- The length of free flowing river below the project, i.e. distance to the upstream extent of the Worumbo headpond.

3 Requested Studies

3.1 Three-dimensional computational fluid dynamics (CFD) modeling upstream and downstream of the discharge and in the vicinity of powerhouse Forebays.

1. Goals and Objectives

The goal of this study is to determine the flow field conditions that exist upstream of the project powerhouse and dams under existing condition and potential future conditions. The information from this study can be coupled with data from our other requested studies of downstream passage (Requested Study 3.3) to develop a comprehensive understanding of migratory fish behavior. The objective of this study is to develop a series of layered drawings that show velocity magnitudes at discharges that have been agreed upon by the resource agencies and the licensee. We request that the following three flow conditions be studied, at a minimum: a) river flow at powerhouse capacity, no spill; b) river flow at 50% powerhouse hydraulic capacity, no spill; and c) river flow at 20% exceedance on the May through October flow duration curve with the powerhouse operating at capacity and excess flow being spilled either through gates or over the spillway. The CFD modeling should also be conducted for at least these three aforementioned conditions for each alternative studied in the Downstream Fish Passage Alternatives Study. We expect the results demonstrate velocities and flow orientations upstream of the powerhouse and along the racks.

The goal of this study is to determine the potential impacts of the Lewiston Falls Project on: (1) the zone of passage for migratory fish near turbine discharge; and (2) natural flow regimes in the Androscoggin River immediately upstream and downstream of each project.

Specific objectives of the study include:

1. Develop a CFD model of the full width of the Androscoggin River upstream and downstream of each projects discharge.

2. Model flow characteristics upstream and downstream of the project under existing project operations and at several representative river flow levels, as well as any other modifications under

consideration (including potential future impacts to operations as a result of climate change), to assess potential impacts to fish and wildlife resources.

3. Assess velocities and flow fields at, and in proximity to each project's intake/discharge structure when generating, and their potential to (1) interfere with fish migration; (2) create undesirable attraction flows; and (3) result in fish entrainment and/or impingement.

4. Assess the potential for velocity barriers to aquatic organism movement in the mainstem river resulting from generation flows at each project, alone and in combination with generation flows from the other projects on the Androscoggin River.

5. Model, and then evaluate, flow characteristics under alternative project operations with potential measures to avoid, minimize, or mitigate impacts to fish and wildlife resources.

6. Define flow velocities, fields/magnitudes, and direction in front of each project's powerhouse.

2. Resource Management Goals

Resource management goals and plans are codified in our regulatory statutes. We rely on the best available data to support conservation recommendations and management decisions. This study is an appropriate request for the pre-application period. Minimizing mortalities of adult downstream migrating American Eel is consistent with our resource management goals for this species.

3. Public Interest

The requestor, NMFS, is a federal resource agency.

4. Existing Information and the Need for Additional Information

To date, no CFD modeled data exists in the project forebay. No existing information is available to evaluate the project's effect on downstream migrating anadromous species.

No project-specific information exists that will allow for a comprehensive assessment of existing project operations on Androscoggin River flows and on fish and aquatic organisms in the project areas upstream and downstream the Project. The Pre-Application Document does not contain any information, or tool(s), that will allow for predictions of impacts of alternative project operations, or potential mitigation measures to protect or enhance aquatic fish and wildlife resources. Further, a comprehensive understanding of fish behavior at each powerhouse forebay is needed to create safe, timely, and effective upstream and downstream passage for American Eel on the Androscoggin River. CFD models are a relatively cost-effective way to analyze existing and future conditions. As such, changes in the amount of attraction water, changes in which turbines are operating, and which spillway gates and rubber dams are releasing water can all be examined.

Modeling this information now can help the resource agencies, as well as the Applicant, account for potential drought and/or flood related scenarios that might occur during the duration of any newly issued license, due to climate change and other factors.

This information is necessary to properly assess the scale, and feasibility, of potential upstream and downstream passage alternatives (see the *Downstream Passage Alternatives* study request). The requested information can be utilized to create a more productive, cost-effective, and efficient alternatives analysis process by helping to narrow the focus to a minimal number of feasible alternatives.

5. Nexus to Project Operations and Effects

The Lewiston Falls Project has direct impacts to instream flows, aquatic habitats, and upstream and downstream migrating American eel in the Androscoggin River. The development of the requested CFD models will aid in determining the potential impacts of the Lewiston Falls Project and Project Facilities. For downstream passage, the U.S. Fish and Wildlife Service (FWS) has velocity vector guidelines associated with intake racks and guidance screens; the output from these models will inform the resource agencies under what conditions appropriate velocities are being met and when they are being exceeded. Additionally, modeling of flow will aide in our interpretation of year one downstream passage telemetry results. Therefore, aspects of the CFD modeling effort could focus on the locations identified as important in the study results and the Applicant could assess changes to structures of operations and evaluate them in the model. Suitable alternatives would then be tested in year three studies.

Downstream migrating fish are susceptible to injury or death by becoming entrained or being impinged on project structures while migrating downstream – a direct nexus to project-related effects. Results of this study will be essential for a complete understanding of the project's effects to downstream migrating anadromous fish and will be used to determine the necessity and scope of potential protection, mitigation, and enhancement measures for downstream migrants under Section 18 of the Federal Power Act.

6. Methodology Consistent with Accepted Practice

A three-dimensional CFD model has become an increasingly common standard of analysis at hydroelectric projects across the nation. FERC's study determination at Worumbo (Accession # 20210928-3001) approved this same requested study. In addition, we have seen these types of models developed at the Holyoke (P-2004), Brunswick (P-2284), Shawmut (P-2322), Milford (P-2534), and Weston (P-2325). We would expect to engage with the licensee in terms of determining the appropriate areas and flows to be modeled. We expect the spatial extent of the model at each study site will vary. Given the large number of ways in which output from these models can be presented and the near infinite number of flows which could potentially be modeled, we would expect to consult with the applicant to reach agreed upon modeling efforts and scenarios to be examined.

7. Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The cost of developing, running, and testing a CFD model can vary tremendously; one large variable in determining the cost is based on the amount of existing bathymetric data to which the Applicant currently has access. We estimate the maximum cost of the CFD model to be $50,000, assuming no bathymetric data currently exists. Proactive communication with resource agencies will reduce the cost and iterative effort. Given the level of effort that has occurred at other projects where licensees have proposed to amend their license, we see the level of effort requested here as reasonable, given that the Applicant is seeking a renewal of its license.

Regarding alternatives, no project-specific instream flow analysis tool has been developed for the Androscoggin River that will allow for assessment of existing operations and alternative operational impacts on instream flow and aquatic habitat for fish and wildlife resources. Further, the model, once built, can be used to simulate flow conditions in the vicinity of each project during the migratory fish passage season and can be used together with behavior studies (i.e., telemetry studies and entrainment studies requested herein) to assess the impacts of varying project operations or potential mitigation operations and measures on fish migration and aquatic habitat.

We know of no other tool that will provide for these types of assessments. No alternatives were proposed in the Pre-Application Document.

3.2 Upstream Juvenile Eel Assessment

Several recent studies have documented the presence of American eel above the Lewiston Falls Project in the Androscoggin River watershed. Dams, such as the Lewiston Falls Project, are known to impair migration success for catadromous species such as American eel (ASMFC 2014). Presently, upstream passage facilities specific to the needs of migrating juvenile eels are not available at the Project (or any of the dams that comprise the Project Facilities). Installing upstream eel passage at the Project will address direct project related impacts and facilitate restoration of American eel within the Androscoggin River watershed. The study request below is intended to provide data necessary to develop reasonable and prudent conservation measures, specifically safe, timely and effective passage for American eel.

If aspects of the project design or project operations changes with any new license, this study may need to be repeated.

1. Goals and Objectives

The goal of this study is to assess the locations for dedicated upstream passage for American eel.

The study has two objectives:

1. Conduct systematic surveys of eel presence/abundance below the A) four stone masonry sections (Dams No. 1, 2, 3, and 4), B) concrete dam section (Dam No. 5), C) the Island Spillway, D) the Powerhouse, E) the two gatehouse buildings (Main Gatehouse and Little Gatehouse), F) the lower gatehouses on the canal or other identified obstructions to passage on the bypass canal, and any other locations within the Project Facilities to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures that would potentially establish the most effective location to place upstream eel passage facilities.

2. Collect eels with temporary trap/pass devices at areas identified from surveys as potential location of eel concentrations to assess whether eels can be collected/passed in substantial numbers, and whether locations are viable sites for permanent eel trap/pass structures.

2. Resource Management Goals

We developed the Androscoggin River Watershed Comprehensive Plan for Diadromous Fish in 2020 (Accession # 20200414-5171) which was the Commission accepted as a comprehensive plan (Accession # 20200618-3041). The comprehensive plan states:

> "The restoration goals for the Androscoggin River Watershed are to provide access to historical spawning, rearing, and migration habitats necessary for diadromous species to complete their life cycles and to make accessible seasonal habitats necessary to support the enhancement of the stocks." The comprehensive plan also notes that the "restoration approach for American eel includes installing and maintaining upstream eel ways at hydroelectric facilities within the Androscoggin River Watershed."

The Atlantic States Marine Fisheries Commission (ASMFC) has developed three documents related to the management of American eel and hydropower facilities:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.

2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

3. Addendum III to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved August 2014. 19 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance, but may now be absent, by providing access to inland waters for glass eel, elvers, and yellow eel, and adequate escapement to the ocean for pre-spawning adult eel. Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the Commission's relicensing process.

Based on these plans, we seek the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to upstream passage of American eel, our goals are:

1. Minimize current and potential negative project operational effects that could hinder management goals and objectives.
2. Minimize project-related sources of upstream passage delay, injury, and stress in order to facilitate access to historical rearing habitat.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

3. Public Interest

The requestor, NMFS, is a federal resource agency.

4. Existing Information and the Need for Additional Information

The PAD does not provide information relative to areas eels concentrate below the Lewiston Falls Projects or an assessment of the numbers and size of eels attempting to ascend each facility. Data from this study will provide information in support of the licensing process and in developing the administrative record for potential mitigation measures under Section 10(j) of the Federal Power Act.

The documented presence of adult eels upstream of this project indicates that juveniles are able to find routes of passage past the project. However, the efficiency and delay of whatever routes of passage are taken is currently unknown. We do not have any information that relates to the total number of eels attempting to pass the Project and the proportion successfully passing the Project,

These information gaps need to be filled so resource agencies can determine the best locations to site upstream eel passage facilities.

5. Nexus to Project Operations and Effects

The project generates hydropower on the head created by the project's dam. This dam creates a barrier to upstream migrating eels. While some eels are able to pass dams, some are not, and the passability of a given dam depends on factors such as its height, hydraulics, presence of climbable surfaces, presence of predators, risk of exposure to heat or drying while climbing a dam, etc. The PAD refers to the project having five dams and the maximum height is 23 feet. The inflatable crest bladders lead to the dam face can be dry during the upstream eel passage season. Therefore, the design of the dam is not currently amenable to passage of eels by climbing and no passage criteria for American eel are currently met.

6. Methodology Consistent with Accepted Practice

This study request consists of two parts: (a) an initial survey for presence and identification of areas where juvenile eels congregate and (b) a site evaluation for permanent eel passage. The methodologies described here are consistent with commonly accepted practices.

1. Objective 1: Systematic Surveys

   Surveys of eel presence and relative abundance should be conducted at regular intervals (as described below) throughout the eel upstream migratory season (approximately April 1 to November 30). Surveys should consist of visual inspection and trapping in areas where eels may concentrate. Areas of quiescent water and leakage points along the downstream face of the dams should be targeted. Methods should include visual surveys (on foot, from a boat, or snorkeling) and trapping using small mesh (< 1/8" clear opening) baited eel pots. Visual surveys should be performed once per week, at night, preferentially during precipitation events. Trap sets should be performed once per week, with an overnight soak time. Recorded data should include location, observation of eels (presence, absence, relative numbers, relative sizes, behaviors, time/date of observation), and survey method.

2. Objective 2: Trap/Pass Collections

   Areas identified from the systematic surveys as having substantial number of eels present should be targeted as potential areas for permanent eel trap/passes and should be initially assessed using temporary/portable trap passes. Temporary trap/passes should be purpose-designed and built for each location and operated throughout the eel upstream migratory season in the year following the survey. Ramp-type traps with supplementary attraction flow are preferred temporary trap/pass designs (Solomon and Beach 2004). Traps should operate daily, with catches quantified every 2-3 days. Data recorded should include location, trapping interval, absolute numbers of eels trapped, relative eel sizes, and hydraulic and environmental conditions during the trapping period.

   All collected eels from surveys should be released at their point of capture; those eels collected from trap/pass collections should be transported to and released above each respective dam.

7. Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The level of cost and effort for the survey component of the study would be low; a minimal number of personnel may be able to conduct the weekly surveys. The trap/pass component would require

low to moderate cost and effort. We estimate the cost will be $50,000 for the study. No alternatives are proposed.

3.3 Downstream American Eel Passage Assessment

1. Goals and Objectives

The goal of this study is to determine the impact of the Lewiston Falls hydroelectric projects on the outmigration of silver American eels in the Androscoggin River. Entrainment into the turbines can result in mortality or injury. It is important to understand the passage routes at the project and the potential for delay, injury, and mortality to assess alternative management options to increase survival.

The objectives of this study are:

- Quantify the movement rates (including delays) and relative proportion of eels passing via various routes at the projects (i.e., through the turbines, through the downstream canal system and spill at the dam.
- Evaluate instantaneous and latent mortality and injury to eels passed via each potential route.

2. Resource Management Goals

We developed the Androscoggin River Watershed Comprehensive Plan for Diadromous Fish in 2020 (Accession # 20200414-5171) which was the Commission accepted as a comprehensive plan (Accession # 20200618-3041). The plan states:

> "The restoration goals for the Androscoggin River Watershed are to provide access to historical spawning, rearing, and migration habitats necessary for diadromous species to complete their life cycles and to make accessible seasonal habitats necessary to support the enhancement of the stocks."

The comprehensive plan also notes that "downstream protection measures and bypasses are necessary at hydroelectric facilities, as turbine mortality is a significant threat to pre-spawn silver eels (Shepard 2015, ASFMC 2013)."

The Atlantic States Marine Fisheries Commission (ASMFC) has developed three documents related to the management of American eel:

- Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
- Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.
- Addendum III to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved August 2013. 19 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance, but may now be absent, by providing access to inland waters for glass eel, elvers, and yellow eel, and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special

consideration for American eel in the Federal Energy Regulatory Commission relicensing process.

We seek the accomplishment of several resource goals and objectives through the relicensing process for the project. General goals include the following:

- Ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
- Conserve, protect, and enhance the habitats for fish, wildlife, and plants that the projects continue to affect.

Specific to downstream passage of American eel, our goals are:

- Minimize current and potential negative project operation effects that could hinder management goals and objectives.
- Minimize project-related sources of downstream passage delay, injury, stress, and mortality to maximize the number of silver eels migrating to the spawning grounds.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

3. Public Interest

The requestor, NMFS, is a federal resource agency.

4. Existing Information and the Need for Additional Information

To date, no directed studies of eel entrainment or mortality have been conducted with complete results at the Lewiston Falls project. Significant information gaps regarding project impacts to downstream migrating eels exist. This information is needed for natural resource agencies to assess the relative and cumulative impacts of project operations on outmigrating eels and develop adequate passage and protection measures to meet management goals and objectives.

5. Nexus to Project Operations and Effects

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes are deep and the trashrack have 3-inch spacing which are unlikely to prevent entrainment of eels given that eels tend to move much deeper in the water column than other surface oriented downstream migrants. Eels are known to occur upstream of the dam; therefore, it is necessary to understand how eels move through the project and the level of injury and/or mortality caused by entrainment through the projects' turbines.

6. Methodology Consistent with Accepted Practice

In order to understand the movements of outmigrating silver eels as they relate to operations at the Project, radio telemetry technology should be utilized. Radio telemetry is an accepted technology that has been used for several studies associated with hydropower projects, including the 2018 downstream eel passage study at West Enfield (P-2600) (Accession # 20180213-5378) and others (Bellows Falls (FERC No. 1855), Wilder (FERC No. 1892), and Vernon (P-1904) Projects).

Studies should be designed to investigate route selection (i.e., entrainment vs. spill vs. fishway vs. downstream bypass) independently from estimation of mortality/injury, because these metrics require different telemetric methodologies. Studies will also likely benefit from data collected over two study years (especially route selection studies, which may be more significantly affected by environmental conditions during a given season than mortality/injury studies). It is also envisioned that results from route selection studies can guide design of turbine mortality studies. Therefore, it is proposed, at a minimum, route selection studies be conducted in multiple years, but mortality/injury studies may be conducted after the first year of route selection studies have been completed.

Objective 1: Route Selection

This study will involve systematic releases of radio-tagged silver phase eels above the Project, to assess general routes of passage (i.e., via spill, canal, or turbines). Active downstream migrants should be collected within-basin, if possible, but fish sourced from out of basin may be acceptable to meet sample size demands. Experimental fish must meet morphometric (e.g., eye diameter relative to body size) criteria to ensure they are migrant silver phase. Collections should be made within the migratory season (late August to mid-October), and eels should be tagged and released within 21 days after capture, but preferably within seven days (particularly if the test eels are from out-of-basin).

A minimum number of 150 telemetered eels (e.g., five separate groups of approximately 30 eels each) will be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Project. Groups of eels should be released during spill (if any) and non-spill and during periods of low, moderate, and high generation conditions. All operational measures during these releases must be documented included releases from the gatehouse into the canal system. Additionally, since fish can drift a considerable distance downstream after they have died (Havn et al. 2017); a minimum of 25 dead eels should also be released as a control group in this study.

Telemetry receivers and antennas should be located upstream and downstream of the each section of the dam, upstream and downstream of the Main Gatehouse, above and below the decommissioned generation facilities in the canal system at turbine intakes, the station tailrace, downstream of the confluence of the Androscoggin River and the canal system, and downstream of the Brunswick Project (FERC No. 2284). These locations will permit assessment of passage via the following potential routes: A) four stone masonry sections (Dams No. 1, 2, 3, and 4), B) concrete dam section (Dam No. 5), C) the Island Spillway, D) the Powerhouse, E) the Main Gatehouse, and F) the lower gatehouses on the canal or other identified obstructions to passage in the bypass canal. While the canal system is no longer part of the Project facilities, water is released through the Main Gatehouse and creates the potential for adult eels to migrate via this route. The final placement of receivers and antennas should be developed in consultation with the fisheries agencies.

Mobile tracking (i.e., via boat or streambank) in the river and canal between release sites and several kilometers downstream will be performed at regular intervals during and after releases to confirm routes and fates of passed fish or lost fish.

Movement rates (time between release and detection at radio antenna locations, and between additional radio antenna locations) of eels passing the projects by various routes will also be quantified.

The route selection portion of this study should occur in both study years to capture variation in flow and spill conditions at the Project facilities.

Objective 2: Spill, Bypass, and Turbine Mortality/Injury Studies

Spill, gatehouse/canal, and turbine mortality will be assessed using a radio-telemetric balloon tag method. A minimum number of 70 tagged eels will be required to assess impact of relevant project facilities: one group of 30 eels to assess passage via spill at each section of the dam, a separate group of 20 eels to assess the Main Gatehouse and canal system, and a final group of 20 eels to assess turbine passage at the project.

For non-turbine mortality sites (spill, canal), tagged eels will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec to minimize the possibility of eels swimming upstream into the headpond or canal. Passed balloon-tagged eels will be recovered below areas of spill and held for 96 hours in isolated tanks for observation of injury and latent mortality; any injuries or unusual behavior should be noted, unrecovered balloon-tagged eels will be censored from the data.

For turbine mortality, tagged eels will be injected into intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec to minimize the possibility of eels swimming back upstream through the intakes. Passed balloon-tagged eels will be recovered in the tailrace and held for 96 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

X-ray imaging should be used to assess internal injuries of recovered balloon-tagged eels. Mueller et al. (2020) demonstrated that 29 percent of individuals with vertebral fractures did not present externally visible signs of severe injury and x-ray imaging showed that skeletal fractures were most pronounced for eel. Therefore, this method will ensure accurate documentation of injuries sustained during passage.

If the balloon-tag mortality component of the study occurs in study year one, all route selection sites would need to be evaluated. If the balloon-tag mortality component of the study occurs in study year two, results from the route selection study could be used to inform which sites need to be evaluated for mortality. Eels recovered from balloon tag studies should not be used for route selection studies.

Data analyses of route selection and turbine mortality (instantaneous and latent) will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

7. Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The level of cost and effort for the downstream eel passage study would be moderate to high; silver eels would need to be collected, tagged, and released in several locations over the course of the migration season. Antennas and receivers would need to be installed at various locations at the Project and monitored regularly. Data would need to be retrieved periodically, then analyzed. A multi-site route selection study conducted by the USGS Conte Lab on the Shetucket River in

Connecticut cost approximately $75,000 for the first year of study. Costs are estimated at $100,000 per year for the route selection studies and $75,000 per year for the spill, bypass, canal, and turbine mortality/injury studies although it may be less since this is a single-site study.

3.4 FEASIBILITY OF CONVERTING THE PROJECT TO A FLOW REREGULATION PROJECT

1. Goals and Objectives

The goal of this study is to determine if it is feasible to manage the headpond and project operations to reduce the influence of peaking received inflows on outflows of the project. The outcome of this study would be one or several operational plans that will reduce the artificial flow regime characterized by sudden increases and decreases in flow.

The objectives are the following

- When project inflows are within the range of minimum and maximum hydraulic capacity of the project, determine if 1,600-acre feet of headpond storage and four feet of allowed headpond fluctuation can reregulate received inflows
- Evaluate whether battery storage could aid in the reregulation of flows to offset generation losses from reregulating flows

2. Resource Management Goals

Dams disrupt the natural characteristics and ecological integrity of rivers (Juracek, 2016). Figure 1 in the comments above indicate a departure from the natural flow regime which is essential for providing the diversity of habitat conditions required to maintain the ecological integrity of rivers. (Poff et al. 1997).

NMFS is a federal resource agency with a mandate to protect and conserve fisheries resources and associated habitat. Resource management goals and plans are codified in our regulatory statutes. We rely on the best available data to support conservation recommendations and management decisions. This study is an appropriate request for the pre-application period.

The Androscoggin River downstream of Lewiston Falls is listed as critical habitat for Atlantic salmon. American shad, river herring, sea lamprey and American eel are all present in the Androscoggin River downstream of Lewiston Falls and use this section of the river as migratory habitat.

The goal of this study is to determine if operational changes to the Project can improve the overall aquatic habitat of the Androscoggin River by dampening the effects of upstream hydropeaking projects, reducing the flashiness and number of flow reversals.

3. Public Interest

The requestor, NMFS, is a federal resource agency.

4. Existing Information and the Need for Additional Information

The PAD states that the Lewiston Falls impoundment is approximately 2.5 miles long, covers an area of 200-acres and has a gross storage volume of 1,600-acre-feet at the full pond elevation. In addition, the Project is licensed to operate with up to four feet of impoundment fluctuation. The PAD does not state the downramping restriction for the Gulf Island-Deer Rips Project (P-2283), which directly relates to the inflow rate to the Lewiston Falls headpond.

The 2016 Flow Demonstration study showed that all four transects downstream of the project fluctuated by approximately 2.5 feet as flows in the mainstem Androscoggin River went from allowed project minimum flow to maximum hydraulic capacity of the Monty Station at 6,600 cfs. We reviewed the station, depth and velocity measurements made at Transects 1-4 and calculated discharge at each of these transects under the minimum flow and maximum generation conditions. We acknowledge the limitations of the equipment to measure velocity in the deep pool at Transect 3 and do not include it our summary below.

Scenario	**T1**	**T2**	**T4**
Minimum Flow (cfs)	1,652	2,545	3,849
Maximum Generation (cfs)	9,088	8,306	6,178
Delta in scenario	7,436	5,761	2,329

These data indicate that at Transect 1, the difference in flows conditions was in excess of 7,400 cfs whereas at Transect 4, the difference was less than 2,400 cfs. Based on these differences, the depth and velocity comparisons that were presented should be reconsidered. We do not know the depth and velocity fluctuations that fish in the river experience between the required minimum flow and maximum generation capacity in the mainstem Androscoggin River below the project. We do know, however, that depth and velocity can rapidly change in the mainstem Androscoggin River which in turn is rapidly changing the habitat characteristics for our trust species that are using the river as a migration corridor to get to spawning habitat.

The modeling effort in (Olivares et al. 2021) suggests that re-regulation reservoirs can significantly reduce the flashiness of a river. The information derived from this study request is necessary to determine if the Lewiston Falls headpond can be operated in such a way as to reduce the flashiness and overall habitat of the Androscoggin River downstream of the project.

An understanding of ways the project can feasibly change to a reregulation project so that rapid changes in outflow are not imposed on Atlantic Salmon Critical Habitat downstream of the project is important. Changes in depth and velocity can limit the amount of persistent habitat that remains intact between two flow conditions. These results were evident in the persistent habitat analyses that were conducted at the Turners Falls Project (P-1889) (Accession # 20161017-5012).

5. Nexus to Project Operations and Effects

A clear nexus exists between project operations, downstream releases, and aquatic habitat (e.g., depth and velocity) in the mainstem Androscoggin River. The project's headpond has a volume of 1,600-acre feet and the project is allowed to fluctuate the headpond by up to four feet. Trust species are using the Androscoggin River as migratory habitat to swim to spawning habitat. The literature review in Olivares et al. (2021) points out several hydropeaking impacts including stranding of juvenile fish.

Improved flow releases from the project have the potential to improve upstream migration conditions for Atlantic salmon, river herring, American shad and sea lamprey that use the fishways at Brunswick, Pejebscot and Worombo.

6. Methodology Consistent with Accepted Practice

McManamay et al. (2016) would classify the Lewiston Falls project as a run-of-river/upstream peaking project. The methods in this study request will determine the ways in which the project

can feasibly be converted to a reregulating project whereby the received inflows are reregulated to diminish the upstream peaking signal.

The licensee should use the U.S. Army Corps of Engineers Hydrologic Engineering Center's HEC-ResSim to develop an existing condition model[1]. After that model is developed, the licensee should develop models that evaluate reregulation scenarios that the Lewiston Falls project is operationally capable of executing. The 2016 Flow Demonstration Study indicated that water surface elevations below Lewiston Falls rose approximately 2.4 feet as the project went from the minimum flow condition to maximum hydraulic capacity. The HEC-ResSim model should develop scenarios whereby the change in downstream water surface elevations from minimum to maximum hydraulic capacity is reduced on a sub-daily basis. The input and output should use hourly data. The developed metrics should be based on those developed in Zimmerman et al. (2010) for existing conditions and reregulated conditions:

- Richards-Baker Flashiness Index
- Number of Reversals
- Percent of Total Flow
- Coefficient of Diel Variation

The licensee should review the costs and benefits of installing battery storage. Installation of a battery, such as what was proposed at the Bonny Eagle project (P-2529), could yield an increase in revenue from the ISO real time energy market as well as from the capacity market. The study should review the potential revenue gains and how the installation of a battery could allow the headpond to serve as a means to reregulate the received inflows.

7. Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The level of effort of a study of this type is commensurate with a project that has an installed capacity of 28.44 MW. HEC-ResSim is a standard piece of software for dam owners to evaluate different operational release regimes. Brookfield Renewable Energy Group filed a non-capacity license amendment for the Bonny Eagle Project indicating that it is fully capable of conducting a cost benefit analysis for this type of technology (Accession # 20210323-5253).

Federally licensed hydropower projects upstream of Lewiston Falls are allowed to operate as hydropeaking facilities. The mainstem Androscoggin River downstream of Lewiston Falls is listed Critical Habitat for Atlantic salmon. This study is necessary in order to determine if Lewiston Falls can reregulate its received inflows for the term of the new license. Other alternative studies will not determine if the observed two and half feet of observed water surface elevation fluctuation downstream of the project can be diminished (Accession # 20160329-5151).

4 REFERENCES

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[1] Software is available for download from the U.S. Army Corps of Engineers Hydrologic Engineering Center here: https://www.hec.usace.army.mil/software/hec-ressim/downloads.aspx

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