



United States Department of the Interior



U.S. FISH AND WILDLIFE SERVICE

Ecological Services
Maine Field Office
P.O. Box A
306 Hatchery Road
East Orland, Maine 04431
207/469-7300 Fax: 207/902-1588

June 20, 2024

ER 24/0151

Debbie-Anne A. Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: Comments on Pre-Application Document, Scoping Document 1, and Study Requests: Brunswick Hydroelectric Project P-2284-052

Dear Acting Secretary Reese:

This letter responds to the Federal Energy Regulatory Commission's (FERC) notice issued on April 16, 2024,¹ soliciting study requests and comments on Brookfield White Pine Hydro, LLC's (Brookfield or Applicant) Pre-Application Document (PAD)² and FERC's Scoping Document 1 (SD1)³ for the proposed relicensing of the Brunswick Hydroelectric Project (Project) (P-2284-052), located on the Androscoggin River in the towns of Brunswick and Topsham, Cumberland and Sagadahoc counties, Maine.

During the term of a new license, Brookfield proposes to operate the Project, as currently operated, in a run-of-river mode and proposes no new or upgraded facilities, structural changes, operational changes, or environmental measures.⁴ Upon review of the PAD and SD1, the U.S. Fish and Wildlife Service ('Service') finds that as proposed, the Project's operation and maintenance may impact aquatic and terrestrial resources within the Project's vicinity. These affected resources include, but are not limited to, water quality and quantity; aquatic, riparian, and wetland habitats; aquatic habitat connectivity; and associated aquatic and terrestrial fauna, including the federally endangered northern long-eared bat (*Myotis septentrionalis*) and the proposed endangered tri-colored bat (*Perimyotis subflavus*). Additionally, the PAD states on

¹ Accession Number 20240416-3025

² Accession Number 20240221-5163

³ Accession Number 20240416-3021

⁴ A detailed description of project facilities and operations may be found in the PAD and SD1.

page 132 that the wood turtle (*Glyptemys insculpta*) may utilize habitat within the Project area. The Service notes that we have received a petition to list the wood turtle as federally endangered, with a listing determination pending.

In section 6 of the PAD, Brookfield proposes three studies: 1) a computational fluid dynamics modelling study of upstream and downstream passage, 2) a visual survey of American eel movement, and 3) an upstream and downstream passage alternatives study. The PAD also notes longstanding and well-documented issues with fish passage at the Project, and the Service recognizes that Brookfield's proposed studies are intended to inform potential mitigation measures to improve upstream and downstream fish passage. However, upon the Service's review of the PAD, SD1, and existing information, we find there is insufficient information to fully assess the Project's effects on environmental resources or to inform the development of potential license requirements. Accordingly, pursuant to 18 CFR section 5.9 of FERC's regulations, we include an attachment with our requested studies that are necessary to assess the Project's effect on environmental resources, and to develop appropriate license conditions for the protection of those resources. Regarding upstream passage for American eel, we note Brookfield's proposed visual survey of American eel movement could be insufficient to inform potential protection, mitigation, and enhancement measures related to upstream American eel passage. The PAD does not provide enough detail regarding Brookfield's proposed study methods to determine whether modification is necessary. We will coordinate with the licensee during study plan development, implementation, and review to ensure study results appropriately inform needed measures for safe, timely, and effective fish passage.

We appreciate this opportunity to comment and look forward to working with FERC and Brookfield in the development of the license application. If you have any questions about this letter or our attached study requests, please contact Kyle Olcott by telephone at 207-902-1573 or via email at dudley_olcott@fws.gov.

Sincerely,

Amanda S. Cross, Ph.D.
Project Leader
Maine Field Office

Attachment: Study Requests

cc: Mike Scarzello, Brookfield Renewable U.S. (via email)
Matt Buhyoff and Don Dow; NOAA (via email)
Dan McCaw and Cody Dillingham; Penobscot Nation (via email)
Sean Ledwin, Casey Clark, and Lars Hammer; MDMR (via email)
Laura Paye, MDEP (via email)
John Perry and Nick Kalejs; MDIFW (via email)
FWS HQ Branch of Environmental Review (via email)

ES: DOIcort: 6-20-24: (207) 902-1573

Attachment – Study Requests

Study Request 1

DOWNSTREAM AMERICAN EEL PASSAGE ASSESSMENT

Goals and Objectives [Section 5.9(b)(1)]

The goal of this study is to assess behavior, approach and passage routes, passage success, survival (immediate and latent), and injury (external and internal) of American eel (*Anguilla rostrata*) as they encounter the Brunswick Hydroelectric Project (Project) during downstream migration. The objective of the study is to assess the need for improvements to downstream fish passage to facilitate effective and timely downstream passage and improve survival and injury rates.

Resource Management Goals [Section 5.9(b)(2)]

In hydroelectric project licensing, the Service seeks to:

- Protect and enhance aquatic and riparian habitats, and habitat connectivity for plants, animals, food webs, and communities in the watershed.
- Protect the genetic diversity and integrity of migratory and native fishes.
- Protect, rehabilitate, and restore migratory and native fishes and their populations.
- Protect and enhance populations of rare, endangered, at-risk, and Federal trust fish species.
- Minimize current and potential negative effects of hydroelectric project operation such as migration delays, turbine entrainment, survival of project passage routes, and trashrack impingement.

In 2020, the National Marine Fisheries Service (NMFS) released an *Androscoggin River Watershed Comprehensive Plan for Diadromous Fish*. This comprehensive plan is currently on file with FERC. The plan outlines numerous resource management goals and objectives for the Androscoggin River watershed, such as:

- Improving diadromous fish passage on the lower mainstem Androscoggin, Little Androscoggin, and Sabattus Rivers.
- Installing and maintaining upstream American eel passage at hydroelectric facilities within the Androscoggin River Watershed.
- Focusing efforts on hydroelectric projects within the restoration focus area to implement necessary downstream protection measures and bypasses for American eel, as turbine mortality is a significant threat to pre-spawn silver eels.

This study request is intended to facilitate the collection of information necessary to conduct an informed effects analysis and support the development of protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and any fishway prescriptions developed pursuant to Section 18 of the Federal Power Act (16 U.S.C. §791a, et seq.).

Public Interest [Section 5.9(b)(3)]

The requester is a resource agency.

Existing Information and the Need for Additional Information [Section 5.9(b)(4)]

The Pre-Application Document (PAD) describes current information pertaining to the project, including summarizing a variety of studies related to Atlantic salmon (*Salmo salar*) and alosines.¹ However, none of the information in the PAD provides a comprehensive evaluation of downstream passage route selection and safe, timely, and effective passage for outmigrating adult American eel (*Anguilla rostrata*), or report on the total project survival.

Outmigrating adult American eel may egress the Project through multiple downstream passage routes, including the Project's downstream fish bypass, turbines, and spillway. Information on passage route selection, passage delay, passage survival, and passage injury is needed to inform an environmental analysis of total Project effects to downstream migrants and determine whether the Project provides safe, timely, and effective downstream passage for American eel.

Nexus to Project Operations and Effects [Section 5.9(b)(5)]

Adult American eel pass through the Project on their downstream migration to spawning habitats in the Sargasso Sea. Hydroelectric project facilities are known to impede downstream migration through behavioral delay and can cause physical harm or mortality through impingement, entrainment, and other passage hazards (e.g., spill passage without sufficient receiving waters).

Data from this study would provide information necessary to conduct an analysis of the Project's effects on the target species and their downstream migration and would be used to develop any appropriate protection, mitigation, and enhancement measures needed to limit project induced migration delay and improve downstream passage survival at the Project.

Methodology Consistent with Accepted Practice [Section 5.9(b)(6)]

To assess American eel behavior, delay, and passage success the Project, the study should utilize appropriate telemetry technologies to assess passage route selection and delay for adult American eel. These technologies have been widely used and are readily accepted methods to assess behavior and passage route selection.

¹ Alosine refers to members of the subfamily Alosinae, which includes alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), and American shad (*Alosa sapidissima*).

The proposed study plan should specify sufficient sample sizes and tag and telemetry receiver configurations to ensure an appropriate level of resolution and precision to assess migratory delay, passage route selection, and overall efficiency of downstream passage at the Project for various river and turbine flow conditions.

To assess the safety (e.g., survival, injury) and effectiveness of downstream passage, the study should assess each available passage route (e.g., downstream fishway, spillway, and turbines). The assessment should evaluate impingement, injury, and immediate and latent mortality of downstream migrating target species and life stages through each downstream passage route.

To assess American eel injury and mortality, study methods should incorporate balloon tags and necropsy, consistent with those outlined in the August 22, 2023 Downstream American Eel Evaluation Plan prepared by HDR and Normandeau Associates and developed for the Mattaceunk Hydroelectric Project (FERC No. 2520).²

With the proper methodology and implementation, and when coupled with Project operation and river flow data, and results of the Applicant’s proposed computational fluid dynamics modelling study, this study will provide information on a variety of structural and operational aspects of fish migration relative to route selection and attraction, timing and delay, and passage survival and injury at the Project and inform any potential downstream fish passage enhancements at the Project. Therefore, this study is necessary to inform the Applicant’s proposed upstream and downstream passage alternatives study, as discussed below in *Study Request 6*.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice [Section 5.9(b)(7)]

The requested study will require a moderate level of effort and cost associated with (1) the telemetry and balloon tags sufficient to tag a large enough sample of target fish and life stages with which to evaluate study results; and (2) placement of monitoring equipment and receivers to provide the resolution needed to satisfy the study’s goals and objectives. We are not aware of any other study technique that would provide cost effective, project-specific fish behavior and migration information to inform an assessment of Project effects or provide adequate information to analyze alternative operations or infrastructure modifications needed to address observed effects. Cost for the study and data analysis is anticipated to be between \$250,000 to \$350,000.

The Applicant did not propose an alternate study.

References

Androscoggin River Watershed Comprehensive Plan for Diadromous Fish. Greater Atlantic Region Policy Series 20-01. NOAA Fisheries Greater Atlantic Regional Fisheries Office, Gloucester, MA. 2020.

²Accession Number: 20231002-5331.

Study Request 2

DOWNSTREAM ALOSINE PASSAGE ASSESSMENT

Goals and Objectives [Section 5.9(b)(1)]

The goal of this study is to determine the effectiveness of the existing downstream fish passage facility for adult and juvenile alosines during their migration season (July 1 to August 31 for summer, low flow conditions for adult and early juvenile alosines and September 1 to October 30 for fall moderate flow and freshet conditions for larger juvenile alosines) under a range of flow conditions. The specific objectives of the study for each species and life stage are to:

- Estimate injury and mortality through all routes of passage at the facility.
- Document the proportion of migrants that utilize the routes of passage during the range of environmental and operational conditions present during the migration season.
- Estimate forebay residence time.
- Determine temporal rate of arrival at the dam.
- Estimate transit time through the headpond, past the project, and through defined reaches downstream.

Resource Management Goals [Section 5.9(b)(2)]

In hydroelectric project licensing, the Service seeks to:

- Protect and enhance aquatic and riparian habitats, and habitat connectivity for plants, animals, food webs, and communities in the watershed.
- Protect the genetic diversity and integrity of migratory and native fishes.
- Protect, rehabilitate, and restore migratory and native fishes and their populations.
- Protect and enhance populations of rare, endangered, at-risk, and Federal trust fish species.
- Minimize current and potential negative effects of hydroelectric project operation such as migration delays, turbine entrainment, survival of project passage routes, and trashrack impingement.

In 2020, NMFS released an *Androscoggin River Watershed Comprehensive Plan for Diadromous Fish*. This comprehensive plan is currently on file with FERC. The plan outlines numerous resource management goals and objectives for the Androscoggin River watershed, such as:

- Improving diadromous fish passage on the lower mainstem Androscoggin, Little Androscoggin, and Sabattus Rivers.
- Working to ensure annual recruitment of adult American shad and blueback herring reach the upper limits of suitable spawning habitat in the Little Androscoggin and Sabattus Rivers.

- Ensuring safe emigration for both adults and juvenile shad to the Gulf of Maine. Once the mainstem and tributary spawning habitat is opened up for American shad, the plan anticipates a minimum of 125,000 adult American shad will return each year to the Androscoggin River.

This study request is intended to facilitate the collection of information necessary to conduct an informed effects analysis and support the development of protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and any fishway prescriptions developed pursuant to Section 18 of the Federal Power Act (16 U.S.C. §791a, et seq.).

Public Interest [Section 5.9(b)(3)]

The requester is a resource agency.

Existing Information and the Need for Additional Information [Section 5.9(b)(4)]

As described in the PAD, the effectiveness of the downstream passage facility has only been studied for Atlantic salmon smolts. No site-specific information (e.g. route of passage, injury, mortality, or delay) exists on downstream alosine passage at the Brunswick project.

Nexus to Project Operations and Effects [Section 5.9(b)(5)]

Hydropower project related mortality and delay has a direct effect on migratory fish populations. Although the Project has been in operation under the current license for 45 years, the effectiveness of the fish passage facilities has not been tested for all species and life stages that inhabit the project areas. Data from this study would provide information necessary to conduct an analysis of the Project's effects on alosines and their downstream migration and would be used to develop any appropriate protection, mitigation, and enhancement measures needed to limit project induced migration delay and improve downstream passage survival at the Project.

Methodology Consistent with Accepted Practice [Section 5.9(b)(6)]

We recommend that a suite of methods including acoustic and/or radio telemetry, hi-z tagging, and split beam hydroacoustics be used to evaluate downstream passage facilities for all species and life stages listed in the goals and objectives. Adult alosines can be tagged with radio tags either before upstream passage or tagged post-spawning, can be released downstream of the Pejepscot project, and be allowed to volitionally approach the Brunswick Project and attempt to pass downstream. Large juvenile alosines can be caught at the outlet of Sabattus Pond, fitted with nano radio tags, and released downstream of the Pejepscot Project to assess juvenile downstream fish passage at the Brunswick Project. Methods for this approach were developed explicitly for testing of hydropower facilities with funding support from PNNL (Deters et al. 2024). In addition, split beam hydroacoustics in the area upstream of the turbines and sections of the spillway would allow assessment of route of passage by large schools of untagged juvenile alosines.

If any lifestage is frequently entrained in the turbines, a second year of study would utilize hi-z tags or draft tube netting to directly assess mortality and injury through the turbine route of passage.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice [Section 5.9(b)(7)]

This study will require multiple years and an extended field season in order to assess the existing facilities for multiple species and life stages. We estimate that the study will be \$100,000 per season, species, and lifestage. However, there are cost efficiencies in testing multiple species and lifestages in a single season because the complementary studies would use the same receivers and layout. The existing facilities have never been tested for all species and life stages in part because of technology limitations in the 1990s and the difficulty in obtaining some species of test fish. The standard methods we have proposed will make the study efficient and cost effective. The results of these studies will inform downstream passage alternatives and avoid development or construction of downstream facilities that do not address resource impacts. There are no alternative methods that can be substituted for the proposed study because there is no project specific information available. The effectiveness of fish passage facilities is site specific and variable depending on the species being tested.

The Applicant did not propose an alternate study.

References

Androscoggin River Watershed Comprehensive Plan for Diadromous Fish. Greater Atlantic Region Policy Series 20-01. NOAA Fisheries Greater Atlantic Regional Fisheries Office, Gloucester, MA. 2020.

Deters et al. (2024). Development of optimal methods for collection, transport, holding, handling, and tagging of juvenile American Shad. *Rev Fish Biol Fisheries* (2024) 34:731-751. <https://doi.org/10.1007/s11160-024-09835-5>

Study Request 3

**DIADROMOUS FISH BEHAVIOR, MOVEMENT, AND PROJECT INTERACTION
STUDY**

Goals and Objectives [Section 5.9(b)(1)]

The goal of this study is to assess the Project-related effects on migratory fish, particularly alosine, behavior in and downstream of the Project tailrace. The objectives of the study are to:

- Assess alosine distribution and movement in the Project’s tailrace and the proximal downstream river reach.
- Assess alosine utilization of the existing Project fishway, the effectiveness of the existing fishway entrance, and alosine movement near potential alternative fishway entrance locations.
- Determine extent of alosine behavioral modification due to Project-induced passage delay.
- Assess passage outcomes following alosine behavioral modification as it relates to the presence of predators such as striped bass (*Morone saxatilis*).

Resource Management Goals [Section 5.9(b)(2)]

In hydroelectric project licensing, the Service seeks to:

- Protect and enhance aquatic and riparian habitats, and habitat connectivity for plants, animals, food webs, and communities in the watershed.
- Protect the genetic diversity and integrity of migratory and native fishes.
- Protect, rehabilitate, and restore migratory and native fishes and their populations.
- Protect and enhance populations of rare, endangered, at-risk, and Federal trust fish species.
- Minimize current and potential negative effects of hydroelectric project operation such as migration delays, turbine entrainment, survival of project passage routes, and trashrack impingement.

In 2020, NMFS released an *Androscoggin River Watershed Comprehensive Plan for Diadromous Fish*. This comprehensive plan is currently on file with FERC. The plan outlines numerous resource management goals and objectives for the Androscoggin River watershed, such as:

- Improving diadromous fish passage on the lower mainstem Androscoggin, Little Androscoggin, and Sabattus Rivers.
- Working to ensure annual recruitment of adult American shad and blueback herring reach the upper limits of suitable spawning habitat in the Little Androscoggin and Sabattus Rivers.

- Ensuring safe emigration for both adults and juvenile shad to the Gulf of Maine. Once the mainstem and tributary spawning habitat is opened up for American shad, the plan anticipates a minimum of 125,000 adult American shad will return each year to the Androscoggin River.

This study request is intended to facilitate the collection of information necessary to conduct an informed effects analysis and support the development of protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and any fishway prescriptions developed pursuant to Section 18 of the Federal Power Act (16 U.S.C. §791a, et seq.).

Public Interest [Section 5.9(b)(3)]

The requester is a resource agency.

Existing Information and the Need for Additional Information [Section 5.9(b)(4)]

There are documented issues with fish not locating the fishway entrance amidst competing attraction flow from turbine discharges and spillway and gate flow. Some species (most notably American shad) do not pass the fish ladder in a timely manner. The PAD cites recent upstream alosine telemetry studies that clearly demonstrate that alosines are not able to utilize the existing fishway, but these studies do not provide sufficient information to understand fish movement in the vicinity of the Project tailrace and fishway entrance or to inform potential protection, mitigation, and enhancement measures to address the lack of safe, timely, and effective passage. The licensee proposes to conduct a computational fluid dynamics study of upstream and downstream passage and an upstream and downstream passage alternatives study (discussed below in *Study Request 6*). This study will provide information necessary to inform these proposed studies, and, therefore, it would be premature to conduct either proposed study prior to gaining a greater understanding of fish movement.

Nexus to Project Operations and Effects [Section 5.9(b)(5)]

Diadromous species use natural waterways to migrate between ocean and freshwater habitats to complete their life history. Dams impede or block this migration. This study will provide critical information that will support the development of necessary fish passage enhancements at the Project, such as improvements to the existing fishway, channel modification(s), and/or design of new fish passage facilities.

The Project turbine configuration causes large differences in outflows during different operational scenarios. The resulting conditions in the tailrace and further downstream affect the ability of fish to utilize the existing fishway, and there is a large body of evidence suggesting that the existing fishway is ineffective. Additionally, the presence of the dam delays passage and in turn amplifies the effects of predators, such as striped bass. In order to inform potential measures to address the current lack of safe, timely, and effective fish passage, it is necessary to

understand how fish are moving in the vicinity of the fishway, in the tailrace, and just downstream.

Methodology Consistent with Accepted Practice [Section 5.9(b)(6)]

We recommend incorporating state-of-the-art telemetry methods for this study including both two-dimensional (2D) and three-dimensional (3D) tracking, utilizing passive receivers. Brookfield should tag a statistically significant number of adult river herring (blueback herring and alewife) and American shad during the migration run of each species at the Project.

Fish should be collected, tagged, and released downstream of the Project. River herring species should be tagged in the proportion they are encountered. Following tagging, all species should be released with an equal number of non-tagged fish to facilitate schooling behavior. Brookfield should record river flows and project operations throughout the study. During the study period, the Brookfield should document the Project's operational conditions to inform study results.

To determine a statistically significant sample size, Brookfield should first run power analyses to determine the number of fish they would need to tag to determine passage differences between all release cohorts through the project (i.e., attraction, within fishway, and overall passage for each cohort).

We note that during similar tagging studies for the Lowell Project on the Merrimack River in Massachusetts (FERC No. 2790), the number of fish tagged in studies paired with a substantial number of study fish leaving the study area, resulted in too few remaining detections to answer study questions and arrive at meaningful conclusions. Therefore, when developing the statistically significant sample size, attrition should be considered.

On May 10, 2024, FERC determined that a license applicant should conduct a similar study utilizing Juvenile Salmon Acoustic Telemetry System (JSATS) to monitor tagged alosines in the riverine environment downstream of the Lawrence Hydroelectric Project (FERC No. 2800) on the Merrimack River in Massachusetts.³ The JSATS technology was developed by the Pacific Northwest National Laboratory to monitor the behavior, movement, habitat use, and survival of juvenile salmonids migrating downstream in the Pacific Northwest. JSATS has been previously used to: (1) estimate route specific dam passage; (2) observe predator-prey interactions; and (3) evaluate fish behavior in dam tailraces using high-accuracy, high-efficiency three-dimensional (3D) tracking. JSATS technology would provide the detailed analysis necessary to understand alosine behavior in and near the Brunswick dam tailrace and to inform mitigation measures that would address well-documented concerns about poor alosine passage.

³ Accession Number: 20240510-3049

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice [Section 5.9(b)(7)]

The level of cost and effort for the diadromous fish behavior, movement, and project interaction study is moderate. This study will require one migratory season, provided sufficient numbers of fish can be collected and successfully tagged. We estimate the cost will be approximately \$500,000. The Applicant will be responsible for collecting and downloading tracking data, analysis, and reporting results. We are not aware of any alternate study that would provide adequate information to analyze the effects of the Project and develop effective protection, mitigation, and enhancement measures.

The Applicant did not propose an alternate study.

References

Androscoggin River Watershed Comprehensive Plan for Diadromous Fish. Greater Atlantic Region Policy Series 20-01. NOAA Fisheries Greater Atlantic Regional Fisheries Office, Gloucester, MA. 2020.

Study Request 4

UPSTREAM SEA LAMPREY PASSAGE ASSESSMENT

Goals and Objectives [Section 5.9(b)(1)]

The goal of this study is to evaluate the effectiveness of the existing upstream fish passage facility for adult sea lamprey (*Petromyzon marinus*) under a range of flow conditions during the migration season (May 1 – July 31) and identify the project facilities and downstream areas to which sea lamprey are attracted. The objectives of the study are to:

- Estimate the proportion of sea lamprey that approach and successfully use the existing vertical slot fishway or approach the spillway/bypass reach or other areas downstream of the project.
- Determine and quantify delay downstream of the Brunswick Project for this species.
- Document the hourly distribution of upstream migrating sea lamprey that attempt passage and those that successfully complete passage attempts.
- Determine and quantify injury associated with upstream migration at the Project.

Resource Management Goals [Section 5.9(b)(2)]

In hydroelectric project licensing, the Service seeks to:

- Protect and enhance aquatic and riparian habitats, and habitat connectivity for plants, animals, food webs, and communities in the watershed.
- Protect the genetic diversity and integrity of migratory and native fishes.
- Protect, rehabilitate, and restore migratory and native fishes and their populations.
- Protect and enhance populations of rare, endangered, at-risk, and Federal trust fish species.
- Minimize current and potential negative effects of hydroelectric project operation such as migration delays, turbine entrainment, survival of project passage routes, and trashrack impingement.

In 2020, NMFS released an *Androscoggin River Watershed Comprehensive Plan for Diadromous Fish*. This comprehensive plan is currently on file with FERC. The plan outlines numerous resource management goals and objectives for the Androscoggin River watershed, such as:

- Improving diadromous fish passage on the lower mainstem Androscoggin, Little Androscoggin, and Sabattus Rivers.
- The restoration approach for sea lamprey should follow the same approach as described for American eel, as their spawning habitat requirements span most of the watershed.

This study request is intended to facilitate the collection of information necessary to conduct an informed effects analysis and support the development of protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and any fishway prescriptions developed pursuant to Section 18 of the Federal Power Act (16 U.S.C. §791a, et seq.).

Public Interest [Section 5.9(b)(3)]

The requester is a resource agency.

Existing Information and the Need for Additional Information [Section 5.9(b)(4)]

As described in the PAD, the effectiveness of the upstream fish passage facility has only been studied for adult river herring and adult American shad. Apart from fishway counts and observations, no data exists on the passage efficiency or other impacts of upstream passage of the Brunswick facility for sea lamprey. Additionally, no information exists to determine how and where sea lamprey approach the project and if they interact with the turbines or the bypass reach.

Nexus to Project Operations and Effects [Section 5.9(b)(5)]

Hydropower project related mortality and delay has a direct effect on migratory fish populations. Although the Brunswick Project has been in operation under the current license for 45 years, the effectiveness of the fish passage facilities has not been tested for all species and life stages that inhabit the project areas. Data derived from this study will facilitate evaluation of various upstream passage alternatives, inform FERC’s licensing process, and contribute to the development of an administrative record documenting protection and enhancement opportunities.

Methodology Consistent with Accepted Practice [Section 5.9(b)(6)]

We recommend that radio telemetry be used to evaluate the upstream passage facilities for adult sea lamprey, which is similar to methods used by Peterson et al. (2023). Similar to previous telemetry studies at the site, sea lamprey can be captured using the current facilities at the Brunswick fishway.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice [Section 5.9(b)(7)]

This study could require multiple years to adequately assess the existing facilities across the range of environmental conditions and operational measures for sea lamprey passage. We estimate the study will cost approximately \$100,000 per season. The existing facilities have never been rigorously tested for sea lamprey. The standard methods we have proposed will make the study efficient and cost effective. The results of this study will inform upstream passage alternatives at the site and will avoid the development or construction of upstream passage facilities that do not address avoidable project impacts on sea lamprey. There are no alternative methods that can be substituted for the proposed study that would provide the required level of information while maintaining cost effectiveness. The effectiveness of fish passage facilities is site specific and variable depending on the species being tested.

The Applicant did not propose an alternate study.

References

Androscoggin River Watershed Comprehensive Plan for Diadromous Fish. Greater Atlantic Region Policy Series 20-01. NOAA Fisheries Greater Atlantic Regional Fisheries Office, Gloucester, MA. 2020.

Peterson E, R Thors, D Frechette, and JD Zydlewski. 2023. Adult sea lamprey approach and passage at the milford dam fishway, Penobscot River, Maine, United States. North American Journal of Fisheries Management, DOI: 10.1002/nafm.10919

Study Request 5

EVALUATION OF STRANDING RISK/BATHYMETRY STUDY

Goals and Objectives [Section 5.9(b)(1)]

The area below the approximately 322-foot-long spillway section of the project includes a substantial ledge area that could pose a risk for stranding certain species and life stages of up- and downstream migrating fish. The Applicant has previously acknowledged this potential risk. On page 119 of the PAD, Brookfield notes that its Final Species Protection Plan for Atlantic salmon (Final SPP), filed on December 31, 2019 included a proposal to “conduct a bathymetry study of the below [sic] the Project spillway to investigate potential for and possible solutions to, fish stranding.” To our knowledge, this study has not yet been performed. As such, we are requesting a study consistent with that which was proposed by the Applicant in its SPP and thus, is currently required in Brookfield’s existing license. However, whereas that proposed/required study was specific to the species considered in the Endangered Species Act (ESA) consultation, we request that this study be expanded to include alosines.

The goal of the study is to evaluate: 1) the effect of project operations and the physical configuration of the project spillway(s) on stranding risk of up- and downstream migratory fish, specifically: Atlantic salmon, Atlantic sturgeon, shortnose sturgeon, alewife, American shad, and blueback herring; and 2) identify alternatives, as necessary, to mitigate for stranding risk.

Resource Management Goals [Section 5.9(b)(2)]

In hydroelectric project licensing, the Service seeks to:

- Protect and enhance aquatic and riparian habitats, and habitat connectivity for plants, animals, food webs, and communities in the watershed.
- Protect the genetic diversity and integrity of migratory and native fishes.
- Protect, rehabilitate, and restore migratory and native fishes and their populations.
- Protect and enhance populations of rare, endangered, at-risk, and Federal trust fish species.
- Minimize current and potential negative effects of hydroelectric project operation such as migration delays, turbine entrainment, survival of project passage routes, and trashrack impingement.

In 2020, NMFS released an *Androscoggin River Watershed Comprehensive Plan for Diadromous Fish*. This comprehensive plan is currently on file with FERC. The plan outlines numerous resource management goals and objectives for the Androscoggin River watershed, such as:

- Improving diadromous fish passage on the lower mainstem Androscoggin, Little Androscoggin, and Sabattus Rivers.

- Working to ensure annual recruitment of adult American shad and blueback herring reach the upper limits of suitable spawning habitat in the Little Androscoggin and Sabattus Rivers.
- Ensuring safe emigration for both adults and juvenile shad to the Gulf of Maine. Once the mainstem and tributary spawning habitat is opened up for American shad, the plan anticipates a minimum of 125,000 adult American shad will return each year to the Androscoggin River.

This study request is intended to facilitate the collection of information necessary to conduct an informed effects analysis and support the development of protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and any fishway prescriptions developed pursuant to Section 18 of the Federal Power Act (16 U.S.C. §791a, et seq.).

Public Interest [Section 5.9(b)(3)]

The requester is a resource agency.

Existing Information and the Need for Additional Information [Section 5.9(b)(4)]

Information in the PAD is not sufficient to evaluate the potential for Project-related stranding effects, nor to identify suitable alternatives to mitigate such effects. The Applicant's 2019 SPP proposes a study to investigate the potential for and possible solutions to fish stranding at the projects, but to our knowledge, that study has not yet been performed. There is no information regarding the potential risk for stranding of up- and downstream migrating alewife, blueback herring, or American shad.

Nexus to Project Operations and Effects [Section 5.9(b)(5)]

As described above, the project is configured such that the spillway section is directly upstream of perched ledge (formerly a natural falls). Project operations dictate the timing and magnitude of flows downstream of the spillway. Under certain hydraulic conditions, areas of the perched ledge may be passable to certain species and lifestages of upstream migrating species and is accessible to downstream migrating fish when/if project operations allow for spill. When the project restricts flow to the spillway, stranding of fish in pools downstream of the spillway could occur. This study will assist FERC in identifying the risk of stranding by species and lifestage and provide information relevant to the development of mitigation measures to reduce or eliminate stranding risk.

Methodology Consistent with Accepted Practice [Section 5.9(b)(6)]

We anticipate that the study would entail two phases. The first phase of the study would require a desktop analysis of stranding risk potential for up- and downstream migrating fish (e.g. Atlantic salmon, Atlantic sturgeon, shortnose sturgeon, alewife, American shad, and blueback herring) throughout the fish passage season (early April to mid-November). Risk potential could be

defined using known project operations for each month under varying hydraulic conditions (to be established in consultation with state and federal natural resource agencies), combined with an expert analysis of risk of stranding based upon species- and lifestage specific characteristics (e.g., migratory timing, swimming ability, etc.). The second phase of the study would require a bathymetric survey of the spillway paired with flow-modelling information (i.e., HEC-RAS or similar model) and/or visual surveys of the spillway during “high risk” periods identified in the first phase.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice [Section 5.9(b)(7)]

Both a desktop analysis and field work would be required over the course of a year to complete our requested study. We estimate that this study would cost roughly \$30,000. The level of effort and cost of the recommended study is commensurate with a project the size of the Brunswick Project and the likely license term. Both stranding evaluations and bathymetric surveys are common studies that are widely accepted in the scientific community.

The Applicant did not propose an alternate study.

References

Androscoggin River Watershed Comprehensive Plan for Diadromous Fish. Greater Atlantic Region Policy Series 20-01. NOAA Fisheries Greater Atlantic Regional Fisheries Office, Gloucester, MA. 2020.

Study Request 6

**UPSTREAM AND DOWNSTREAM PASSAGE ALTERNATIVES STUDY
(MODIFICATION OF PROPOSED STUDY)**

Goals and Objectives [Section 5.9(b)(1)]

Page 227 the PAD indicates that the Applicant it is proposing the following study:

Upstream and Downstream Passage Alternatives Study

[Brookfield] is proposing to conduct an Upstream and Downstream Passage Alternatives Study that will include evaluations of previously conducted telemetry studies at the Project, an evaluation of the existing upstream and downstream fish passage facilities at the Project as compared to agency design criteria, a desktop evaluation of entrainment potential, as well as an evaluation of potential upstream and downstream passage alternatives. The study results will be used to identify potential measures and/or modifications, as necessary, for improving upstream and downstream fish passage at the Project.

We agree with Brookfield that existing information regarding the project’s effects on fish passage unequivocally demonstrates a need to develop a wide range of alternatives to significantly improve the safety, timeliness, and effectiveness of fish passage at the Brunswick Project. However, the study as currently proposed is insufficient to adequately inform the development of alternatives. As such, we are requesting several additional studies related to fish passage. As we describe in these study requests, the information derived from our other requested studies will be necessary to adequately inform the development of up- and downstream passage alternatives. Additionally, the study as proposed by the Applicant does not contain enough detail to adequately define its goals and objectives, nor whether the methodology would be suitable to achieve the stated goals and objectives.

We request the following modifications to the proposed upstream and downstream passage alternatives study:

- As indicated above, we are requesting several additional studies related to fish passage, therefore we request the following modification to the proposed study [modification in bold italics]:

“BWPH is proposing to conduct an Upstream and Downstream Passage Alternatives Study that will include evaluations of previously conducted telemetry studies at the Project, ***including the results of the Downstream American Eel Passage Assessment; Downstream Alosine Passage Assessment; Diadromous Fish Behavior, Movement, and Project Interaction Study; Upstream Sea Lamprey Passage Assessment; Evaluation of Stranding Risk/Bathymetry Study; and any upstream American eel study.***”

- The Applicant’s proposed study includes very little detail regarding the goals and objectives or proposed methodology. The Service is an active participant in the relicensing of the Worumbo Hydroelectric Project (FERC No. 3428), the third dam upstream on the Androscoggin River. On September 28, 2021, FERC issued a Study Plan Determination for that project, which included an approval for Brown Bear II Hydro, Inc’s (BB2H) proposed downstream passage alternative study⁴. It is important to ensure consistency within the watershed, and, consequently, we recommend that Brookfield modify its proposed *Upstream and Downstream Passage Alternatives Study* to incorporate elements of BB2H’s *Downstream Passage Alternatives Study*⁵. At a minimum, we recommend the following inclusions:
 - A more clearly defined goal that specifies that the study will determine conceptual options and expected performance for improved up- and downstream passage that will reduce delay, increase passage efficiency, and increase survival for American eels, blueback herring, alewives, American shad, Atlantic salmon, and sea lamprey.
 - A more clearly defined methodology that includes specifications of resource agency consultation during each stage/task of the study. The adequate development of alternatives will require expert analysis and interpretation of data and consultation regarding engineering designs suitable to achieve objectives for multiple fish species, including endangered Atlantic salmon.

Resource Management Goals [Section 5.9(b)(2)]

In hydroelectric project licensing, the Service seeks to:

- Protect and enhance aquatic and riparian habitats, and habitat connectivity for plants, animals, food webs, and communities in the watershed.
- Protect the genetic diversity and integrity of migratory and native fishes.
- Protect, rehabilitate, and restore migratory and native fishes and their populations.
- Protect and enhance populations of rare and endangered fishes.
- Minimize current and potential negative effects of hydroelectric project operation such as migration delays, turbine entrainment, survival of project passage routes, and trashrack impingement.

In 2020, the National Marine Fisheries Service (NMFS) released an *Androscoggin River Watershed Comprehensive Plan for Diadromous Fish*. This comprehensive plan is currently on file with FERC. The plan outlines numerous resource management goals and objectives for the Androscoggin River watershed, such as:

- Improving diadromous fish passage on the lower mainstem Androscoggin, Little Androscoggin, and Sabattus Rivers.

⁴ FERC Accession #: 20210928-3001

⁵ FERC Accession #: 20210903-5115; pages 63-66

- Installing and maintaining upstream American eel passage at hydroelectric facilities within the Androscoggin River Watershed.
- Focusing efforts on hydroelectric projects within the restoration focus area to implement necessary downstream protection measures and bypasses for American eel, as turbine mortality is a significant threat to pre-spawn silver eels.
- Working to ensure annual recruitment of adult American shad and blueback herring reach the upper limits of suitable spawning habitat in the Little Androscoggin and Sabattus Rivers.
- Ensuring safe emigration for both adults and juvenile shad to the Gulf of Maine. Once the mainstem and tributary spawning habitat is opened up for American shad, the plan anticipates a minimum of 125,000 adult American shad will return each year to the Androscoggin River.
- The restoration approach for sea lamprey should follow the same approach as described for American eel, as their spawning habitat requirements span most of the watershed.

This study request is intended to facilitate the collection of information necessary to conduct an informed effects analysis and support the development of protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and any fishway prescriptions developed pursuant to Section 18 of the Federal Power Act (16 U.S.C. §791a, et seq.).

Public Interest [Section 5.9(b)(3)]

The requester is a resource agency.

Existing Information and the Need for Additional Information [Section 5.9(b)(4)]

As described above, information provided in the applicant-proposed study does not sufficiently define explicit goals and objectives, nor does it provide sufficiently detailed methodology to determine whether the study could reasonably achieve its stated goals and objectives. More detail is needed to ensure that any approved Passage Alternatives study is adequate to inform the Commission and stakeholders of feasible and effective alternatives for the protection, mitigation, and enhancement of migratory fish.

Nexus to Project Operations and Effects [Section 5.9(b)(5)]

The operation of the Brunswick Project directly affects the up- and downstream passage of migrating fish. Existing information demonstrates a need to develop a wide range of alternatives to significantly improve the safety, timeliness, and effectiveness of fish passage at the project.

Methodology Consistent with Accepted Practice [Section 5.9(b)(6)]

As described above, the study proposal does not adequately specify goals or objectives, nor does it include methodology with sufficient specificity. At a minimum, we request a modification of the study proposal to incorporate the elements described above. Additionally, we request that the proposed Upstream and Downstream Passage Alternatives Study be modified to more closely resemble the goals and methodology presented in the Worumbo Project’s Downstream Passage Alternatives Study, a relicensing study approved by the Commission in 2021. As such, this modification is consistent with accepted study protocols elsewhere in the watershed.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice [Section 5.9(b)(7)]

On page 66 of the PAD, the Applicant estimates that the study would be conducted over the course of a year and would cost between \$45,000 and \$90,000. We do not anticipate that our requested modifications would result in any substantial changes to this cost estimate.

References

Androscoggin River Watershed Comprehensive Plan for Diadromous Fish. Greater Atlantic Region Policy Series 20-01. NOAA Fisheries Greater Atlantic Regional Fisheries Office, Gloucester, MA. 2020.

Study Request 7

MUSSEL SURVEY

Goals and Objectives [Section 5.9(b)(1)]

The goal of this study is to determine presence, location, and species of freshwater mussels that inhabit Project-affected aquatic habitats. The objectives of this study are to:

- Conduct surveys to characterize the distribution, composition, and relative abundance of freshwater mussels in the Project’s impoundment and reaches downstream of the Brunswick Dam that are influenced by Project’s operation and maintenance.
- Assess potential host-fish for documented freshwater mussel species through review of relevant publications and concurrent fish data collected upstream, downstream, and passing through the Brunswick Dam.

Resource Management Goals [Section 5.9(b)(2)]

In hydroelectric project licensing, the Service seeks to:

- Protect and enhance aquatic and riparian habitats, and habitat connectivity for plants, animals, food webs, and communities in the watershed.
- Protect the genetic diversity and integrity of migratory and native fishes.
- Protect, rehabilitate, and restore migratory and native fishes and their populations.
- Protect and enhance populations of rare and endangered fishes.
- Minimize current and potential negative effects of hydroelectric project operation such as migration delays, turbine entrainment, survival of project passage routes, and trashrack impingement.

This study request is intended to facilitate the collection of information necessary to conduct an informed effects analysis and support the development of protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and any fishway prescriptions developed pursuant to Section 18 of the Federal Power Act (16 U.S.C. §791a, et seq.).

Public Interest [Section 5.9(b)(3)]

The requester is a resource agency.

Existing Information and the Need for Additional Information [Section 5.9(b)(4)]

On page 143 and 144, the PAD notes that previous mussel surveys downstream of the Project area in the Lower Androscoggin found eight native freshwater mussel species, including the tidewater mucket (*Leptodea ochracea*).⁶ The Service is not aware of any previous systematic mussel/bivalve surveys conducted within the Project area. Therefore, the Applicant should conduct field surveys to establish the status of freshwater mussel assemblage in Project-affected waters. Given the potential effects of current and future operation and maintenance activities on mussel species, the requested information is needed to inform any protection, mitigation, and enhancement measures.

Nexus to Project Operations and Effects [Section 5.9(b)(5)]

Hydroelectric projects alter natural flow and sediment regimes within river systems like the Androscoggin River. These alterations potentially affect aquatic habitats for bivalves. Within riverine impoundments, water level fluctuations can stabilize and accumulate fine sediments, driving changes in mussel assemblage composition and leading to potential species loss (Haag 2012). Additionally, rapid and routine impoundment drawdowns associated with maintenance activity may strand mussels, leaving them vulnerable to mortality from desiccation or predation. Likewise, any rapid change in the location of flow discharge may influence aquatic habitats downstream of the Project. Finally, hydroelectric projects impede fish passage and limit or prevent the upstream movements of host-fish, negatively impacting upstream mussel populations by restricting dispersal. The study will provide information to protect and enhance mussel communities throughout the Project area.

Methodology Consistent with Accepted Practice [Section 5.9(b)(6)]

Information on the abundance and distribution of mussel species within the influence of the Project operations and maintenance activities will be collected for this study. This information is necessary to evaluate the potential Project operation and maintenance activities that may affect the mussel species and beds, and their establishment and dispersal.

Field identification of freshwater mussels can be quite difficult. A freshwater mussel expert should perform the assessment. The methodology should be similar to the recent FERC-approved mussel study at the Lawrence Hydroelectric Project (P-2800) on the Merrimack River in Massachusetts.⁷ In brief, unconstrained surveys, transects or quadrat-based surveys are conducted in all suitable habitats, including the Project's reservoir and downstream reach, or a predefined subsample thereof, using a combination of snorkel and SCUBA (in depths > 3ft.). Sub-surface excavation by hand may be necessary to improve detection probability and abundance estimates. The extent of all habitats surveyed is geographically recorded.

⁶ The State of Maine listed the tidewater mucket as threatened in 1997.

⁷ See FERC's May 10, 2024 Study Plan Determination for the Lawrence Hydroelectric Project, Accession Number: 20240510-3049

Information collected should include the location and biometrics of each mussel found and identification with photograph of each specimen. The bivalve survey should follow standard protocols and published methods (e.g., Strayer and Smith 2003).

The study should document and map the precise location of all mussel beds and species. Relative abundance (catch per unit effort) by species, the location and condition of each mussel, and a habitat description where it was found should be documented.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice [Section 5.9(b)(7)]

We estimate the cost of this study to be \$30,000.

The Applicant did not propose an alternate study

References

Haag, W.R. (2012). North American freshwater mussels: natural history, ecology, and conservation. Cambridge University Press.

Strayer, D.L., & Smith, D.R. (2003) A guide to sampling freshwater mussel populations. Bethesda, MD: American Fisheries Society.

Study Request 8

INVASIVE PLANT SURVEY

Goals and Objectives [Section 5.9(b)(1)]

The goal of the study is to: (a) characterize and describe the terrestrial, riparian, shallow littoral, and aquatic invasive plant species associated with the Project and its area of effect; and (b) determine if and how the Project may be affecting and or contributing to the establishment and spread of new or existing invasive plant species. The objectives of the study are to:

- Identify, map, and determine the abundance of all invasive species occurring in the Project's area of influence, and assess the risk of these species present to native fish and wildlife habitats.
- Identify vectors for invasive species dispersal within the Project's area of influence.
- Provide information about the need and methods of long-term invasive species control.
- Develop a report to determine the potential Project operation and maintenance, vegetation management, or recreational activities, that may directly or indirectly impact the establishment and dispersal of invasive species.

Resource Management Goals [Section 5.9(b)(2)]

In hydroelectric project licensing, the Service seeks to:

- Protect and enhance aquatic and riparian habitats, and habitat connectivity for plants, animals, food webs, and communities in the watershed.
- Protect the genetic diversity and integrity of migratory and native fishes.
- Protect, rehabilitate, and restore migratory and native fishes and their populations.
- Protect and enhance populations of rare and endangered fishes.
- Minimize current and potential negative effects of hydroelectric project operation such as migration delays, turbine entrainment, survival of project passage routes, and trashrack impingement.

This study request is intended to facilitate the collection of information necessary to conduct an informed effects analysis and support the development of protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and any fishway prescriptions developed pursuant to Section 18 of the Federal Power Act (16 U.S.C. §791a, et seq.).

Public Interest [Section 5.9(b)(3)]

The requester is a resource agency.

Existing Information and the Need for Additional Information [Section 5.9(b)(4)]

Invasive species have the potential to adversely affect the quality of native plant, fish and wildlife habitat within the Project's area of effect by replacing native species, reducing biodiversity and degrading ecosystem function (Powell et al. 2022, Castro-Diaz et al. 2014, Vilà et al. 2011). On page 154, the PAD describes existing information regarding confirmed observations of invasive species within the Project area. The PAD does not provide any specific, detailed baseline information on known occurrences of these species. As such, additional information on invasive species occurrence, and relative abundance throughout the Project's area of effect is needed.

Nexus to Project Operations and Effects [Section 5.9(b)(5)]

Artificial impoundments and areas of altered natural flows are more vulnerable to invasion and establishment of invasive species than natural systems. Continued Project operations may affect the existence, prevalence and or spread of invasive plant species located within the Project's area of effect. For example, water level fluctuations may disturb littoral zones such that invasive plant species are provided a competitive advantage over native plant species. Similarly, land disturbances following Project maintenance activities may favor establishment of invasive plants over native plants. Recreational activities at the Project can also act as vectors for introduction and spread of invasive plant seeds and parts. For example, boats may contain vegetation parts and fragments from other water bodies that create a vector for invasive species infestation of the Androscoggin River.

The requested study will evaluate the presence and distribution of invasive plant species within the Project's area of effect. Results from the study will inform the need for invasive species management and any measures necessary to minimize existing and future occurrences of invasive plant species during the term of the license.

Methodology Consistent with Accepted Practice [Section 5.9(b)(6)]

The Study Area is the Project's area of effect and includes all areas within the Project Boundary and the downstream reach of the Androscoggin River extending to the vicinity 250th Anniversary Park.

The requested study should utilize any existing information (e.g., existing maps or aerial photos that depict the area; remote detection methods) in conjunction with field surveys designed to (a) maximize detection of invasive species and (b) ensure they can be conclusively identified to species. Surveys should be conducted by a qualified botanist at the lowest water level under low-flow conditions for terrestrial, riparian, and shallow littoral species; aquatic plant surveys may benefit from surveys during more moderate water elevations. Field methods will need to include several approaches to ensure plants can be detected (e.g., visual while walking or boating, rake-toss, snorkel/scuba, etc.). Surveys should also include all public boat landings, ramps, or other access points.

In addition to standard botanical information to confirm taxonomic identification, the study should also collect:

- Phenology of the majority of the local infestation (e.g., vegetative, bud, flower, immature fruit, mature fruit, seed-dispersing);
- Woody growth (e.g., seedling, sapling, mature);
- The location and mapping (points and polygons, as appropriate) of all invasive plants;
- Estimated area of local infestation;
- Estimated abundance (stem count/percent cover);
- Description of habitat and mapping of vegetation class in which the plants are observed;
- Predominant land use(s) and description of any potential vectors of spread (e.g., recreational use, cutting and leaving in place, etc.) associated with each occurrence;
- Hydrology (e.g., upland, riparian, perennial stream/river, intermittent stream/river, wetland, streambed);
- Recommendations for control, management, and monitoring; and
- All invasive occurrences shall be georeferenced as points or polygons, as appropriate, and overlain on an orthophoto at suitable scale.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice [Section 5.9(b)(7)]

The level of effort and cost of this study are expected to be similar to equally sized FERC projects. More intensive efforts, including mapping of all vegetation classes and wetlands, may require six to eight months of work and cost \$40,000 to \$50,000.

Brookfield did not propose an alternate study.

References

- Castro-Díez P, Godoy O, Alonso A, Gallardo A, Saldaña A (2014) What explains variation in the impacts of exotic plant invasions on the nitrogen cycle? A meta-analysis. *Ecol Lett* 17(1): 1–12.
- Powell KI, Chase JM, Knight TM (2011) A synthesis of plant invasion effects on biodiversity across spatial scales. *Am J Bot* 98(3): 539–548.
- Vilà M, Espinar JL, Hejda M, Hulme PE, Jarošík V, Maron JL, Pergl J, Schafner U, Sun Y, Pyšek P (2011) Ecological impacts of invasive alien plants: a meta-analysis of their effects on species, communities, and ecosystems. *Ecol Lett* 14(7): 702–708.