DRAFT ENVIRONMENTAL ASSESSMENT
FOR
HYDROPOWER LICENSE

Bear Swamp Project

Docket No. P-2669-089

Massachusetts

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

October 2019

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

APE	area of potential effect
BSPC	Bear Swamp Power Company, LLC
Bear Swamp PSD	Bear Swamp Pumped Storage Development
°C	degrees Celsius
certification	water quality certification
C.F.R.	Code of Federal Regulations
cfs	cubic feet per second or cubic foot per second
Commission or FERC	Federal Energy Regulatory Commission
CMR	Code of Massachusetts Regulations
CRC	Connecticut River Conservancy
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
Deerfield Project	Deerfield River Project No. 2323
Deerfield Station No. 2	Deerfield Project Station No. 2 Development
Deerfield Station No. 3	Deerfield Project Station No. 3 Development
Deerfield Station No. 4	Deerfield Project Station No. 4 Development
Deerfield Station No. 5	Deerfield Project Station No. 5 Development
DO	dissolved oxygen
EA	environmental assessment
ESA	Endangered Species Act
°F	degrees Fahrenheit
FPA	Federal Power Act
fps	feet per second or foot per second
Franklin Regional Government	Franklin Regional Council of Governments
FWS	U.S. Fish and Wildlife Service
g	gram
Great River Hydro	Great River Hydro, LLC
HPMP	Historic Properties Management Plan
IPaC	U.S. Fish and Wildlife Service Information for Planning and Consultation
Interior	U.S. Department of the Interior
IFIM	Instream Flow Incremental Methodology
kV	kilovolt
Massachusetts DEP	Massachusetts Department of Environmental Protection
Massachusetts DFW	Massachusetts Division of Fisheries and Wildlife
Massachusetts SHPO	Massachusetts State Historic Preservation Officer
MEOEEA	Massachusetts Executive Office of Energy and Environmental Affairs
µS/cm	microSiemens/centimeter
mg/L	milligrams per liter

mm	millimeter
mgd	million gallons per day
msl	mean sea level
MW	megawatt
MWh	megawatt-hours
National Register	National Register of Historic Places
NERC	North American Electric Reliability Corporation
NGVD	National Geodetic Vertical Dam of 1929
NHPA	National Historic Preservation Act
NLEB	northern long-eared bat
NPCC-New England	Northeast Power Coordinating Council's New England Region
NPDES	National Permit Discharge Elimination System
RM	river mile
SCORP	Statewide Comprehensive Outdoor Recreation Plan
Trout Unlimited	Deerfield River Watershed Chapter of Trout Unlimited
USGS	U.S. Geological Survey
Whitewater Interest Group	Informal group comprised of American Whitewater, Appalachian Mountain Club, New England FLOW, Zoar Outdoor, Crab Apple Whitewater, and Berkshire Whitewater
Wr	relative weight
YOY	young-of-year

EXECUTIVE SUMMARY

Proposed Action

On March 30, 2018, Bear Swamp Power Company, LLC (BSPC) filed an application for a new hydropower license with the Federal Energy Regulatory Commission (Commission or FERC) to continue to operate and maintain the Bear Swamp Project No. 2669 (Bear Swamp Project, or project). The original license for the project was issued on April 28, 1970, for a term of 50 years.

The 676-megawatt (MW) project consists of two developments, the 666-megawatt (MW) Bear Swamp Pumped Storage Development (Bear Swamp PSD) and the 10-MW Fife Brook Development. The project is located on the Deerfield River, in Berkshire and Franklin Counties, Massachusetts, and does not occupy federal land.

BSPC is proposing no major modifications to the project or its operation.

Project Description

Bear Swamp Pumped Storage Development

The 118-surface acre upper reservoir for the Bear Swamp PSD is contained by existing topography and four project dikes and has a gross storage capacity of 8,300 acre-feet at a crest elevation of 1,606 feet National Geodetic Vertical Dam of 1929 (NGVD). A concrete intake structure is located on the floor of the upper reservoir. The intake structure conveys water to two penstocks via an approximately 1,430.5-foot long tunnel system. The penstocks convey water to an underground powerhouse that contains two reversible, Francis pump-turbine-generator units. Water is conveyed from the powerhouse to the lower reservoir (the Fife Brook impoundment) through two underground draft tube tunnels. Each draft tube tunnel connects to two discharge bays that also serve as intake channels when pumping.

In addition to the structures listed above, the Bear Swamp Development includes: (1) a submerged weir in the upper reservoir that includes three gates that are used to maintain a pool of water during de-watering and re-watering of the upper reservoir; (2) two step-up transformers; (3) a 4,075-foot-long 230-kV transmission line and a 3,960-foot-long 230-kV transmission line; and (4) appurtenant facilities.

Fife Brook Development

The Fife Brook Development includes an 890-foot-long, 130-foot-high earthen rock-fill dam with a crest elevation of 880 feet NGVD. The Fife Brook dam impounds a 2.5-mile-long reservoir with a surface area of 152 acres and a gross storage capacity of 6,900 acre-feet at a surface elevation of 870 feet NGVD. From the impoundment, water is conveyed through the intake structure and a penstock to the powerhouse containing a 10-MW Francis turbine-generator unit. From the powerhouse, water is conveyed to the downstream reach of the Deerfield River via a 21-foot-long draft tube.

In addition to the structures listed above, the Fife Brook Development includes: (1) a minimum flow release pipe that extends from the Fife Brook dam; (2) a partially buried (860-foot-long section) and partially above-ground (7,060-foot-long section) 13.8-kV transmission line; and (3) appurtenant facilities.

Project recreation facilities include the Bear Swamp Visitor Center, the Fife Brook Fishing and Boating Access Area, the Zoar Whitewater Access Area, the Zoar Picnic Area, the Bear Swamp Public Hunting Area, and the Bear Swamp and Hoosac Tunnel Trail.

Project Operation

Inflow to the Fife Brook development comes from Great River Hydro's Deerfield River Project No. 2323 (Deerfield Project). The Bear Swamp Project is located downstream of five of the Deerfield Project's developments. The Station No. 5 Development of the Deerfield Project (Deerfield Station No. 5) is located immediately upstream and adjacent to the Bear Swamp Project. The Deerfield Station No. 5 powerhouse discharges directly into the Fife Brook impoundment, approximately 0.5 mile upstream of the intake for the Bear Swamp PSD. The dam for Deerfield Station No. 5 is located about 3.6 miles upstream of the intake for the Bear Swamp PSD. Approximately 1.2 miles of the bypassed reach of Deerfield Station No. 5 overlaps with the upper extent of the Fife Brook impoundment.

The Bear Swamp PSD typically pumps water at night and generates off that water during the day. The upper reservoir for the Bear Swamp PSD has an allowable daily fluctuation of 50 feet, while the Fife Brook impoundment has an allowable daily fluctuation of 40 feet, as specified in Ordering Paragraph C of the April 28, 1970 license order.

Inflows to the Fife Brook impoundment come primarily from the discharge of the Deerfield Station No. 5, which operates in a peaking mode. BSPC releases the majority of the inflow from Deerfield Station No. 5 to the Deerfield River downstream of the Fife Brook dam on a daily basis. Flows downstream of Fife Book dam therefore vary on a regular basis according to the generation release at Deerfield Station No. 5 and attenuate with distance downstream.

Pursuant to Article 401 of the current license, a minimum flow of 125 cfs is released from the Fife Brook dam to protect aquatic habitat in the Deerfield River. The license also requires (Article 404) whitewater releases from the Fife Brook dam at a minimum flow of 700 cfs for a duration of at least three continuous hours for 56 weekdays and 50 weekend days from April 1 through October 31. These flows provide class II and III whitewater boating opportunities in the Deerfield River below Fife Brook dam.

The current project boundary encompasses approximately 1,474 acres of land, including: (1) the upper and lower reservoirs (approximately 270 acres); (2) land associated with project structures (approximately 130 acres); and (3) land around the reservoirs and downstream of Fife Brook dam that is used for recreation and environmental protection (1,074 acres). The license also requires (Article 405) the protection of scenic, forestry, and natural resources on 1,257 acres of land in the project boundary around the reservoirs and downstream of Fife Brook dam.

Proposed Facility Modifications

BSPC does not propose to add any new project facilities. However, on August 13, 2008, the Commission authorized BSPC to increase the total generating capacity of the Bear Swamp PSD from 600 MW to 666 MW. Since authorization, BSPC has been completing the upgrades in a phased approach. On December 9, 2016, the Commission granted BSPC an extension of time to August 13, 2022 to complete the rehabilitation of the turbine-generators.

Proposed Project Boundary

BSPC proposes a project boundary that encompasses approximately 1,305.3 acres of land and water, which is approximately 168.7 acres less than the existing project boundary. The proposed boundary modifications would remove 161.8 acres of land that is currently part of a conservation easement, and 6.9 additional acres of land not required for project purposes.

Proposed Environmental Measures

The licensee proposes the following measure to protect or enhance environmental resources at the project:

<u>General Measures</u>

- Develop an Operation Compliance Monitoring Plan that describes: (1) the mechanisms and structures that will be used to provide minimum flow releases and whitewater flow releases; (2) periodic maintenance and calibration for any installed measuring devices; and (3) procedures for recording and reporting data to FERC and resource agencies.

Aquatic Resources

- Continue to provide a 125-cfs continuous minimum flow release from the Fife Brook dam to protect fish and aquatic resources in the Deerfield River.

- Develop an Invasive Mussel Species Monitoring and Management Plan that includes the following measures to minimize the spread of invasive mussel species at the project, including dreissenid mussels (e.g., zebra mussels and quagga mussels): (1) educational training for project maintenance staff; (2) educational signage; (3) best management practices for minimizing the spread of invasive mussel species during project-related construction and maintenance activities; and (4) rapid notification, coordination, and response with appropriate federal and state resource agencies in the event invasive dreissenid mussel species are detected at the project.

Terrestrial Resources

- Develop a State-Listed Rare Plants Management Plan that includes measures to minimize adverse project effects on state-listed rare plants.

- Develop an Invasive Plant Species Monitoring and Management Plan that includes measures to reduce the spread of invasive plant species, including: (1) educating recreational users on ways to reduce the spread of invasive plant species; (2) implementing best management practices, such as identifying invasive plant species that may be introduced by a given project-related activity, identifying critical control points (locations and times), and implementing measures to prevent the spread of invasive plant species during routine project operation and maintenance activities; (3) recording incidental observations of invasive plant species; and (4) using only native seed and plant materials outside of lawn areas.

- Develop a Bald Eagle Protection Plan that includes provisions to: (1) avoid killing, injuring, or harassing bald eagles during tree cutting or thinning operations at the project; and (2) minimize project effects on nesting bald eagles at the project.

Threatened and Endangered Species

- Develop a Bat Management Plan that includes measures to avoid/minimize adverse project effects on the federally threatened northern long eared bat (NLEB) and little brown bat.

Recreation Resources

- Develop a Recreation Facilities Management Plan that includes provisions to: (1) continue operating and maintaining the existing project recreation facilities; (2) design and construct a new boater egress trail that begins downstream from the Showtime rapid and extends upstream to the existing vehicle turnaround at Great River Hydro's Dunbar Brook Picnic Area, which is part of Deerfield Station No. 5; (3) enhance overflow parking at the Fife Brook Fishing and Boating Access Area; (4) widen the access trail at the Zoar Whitewater Access Area; (5) install additional seasonal restroom facilities, a stall-type changing facility, and an additional staircase at the Zoar Picnic Area; (6) install handrails on staircases at project recreation areas; and (7) install additional signage to educate recreationists on safety and the Deerfield River flow regime.

- Continue to provide 106 annual whitewater flow releases from the Fife Brook dam for a minimum duration of 3 hours on 50 weekend days and 56 weekdays from April 1 through October 31.

- Increase whitewater flow releases from 700 cfs to 800 cfs.

Cultural Resources

- Develop an HPMP to protect historic properties that are eligible for or listed on the National Register.

Public Involvement

Before filing its license application, the licensee conducted pre-filing consultation under the Commission's Integrated Licensing Process for hydropower licensing. The intent of the Commission's pre-filing process is to initiate public involvement early in the project planning process and to encourage citizens, governmental entities, tribes, and other interested parties to identify and resolve issues prior to an application being formally filed with the Commission. As part of the pre-filing process, staff conducted scoping to identify issues and alternatives. Staff distributed a scoping document to stakeholders and other interested entities on February 18, 2015 and held two scoping meetings in North Adams, Massachusetts on March 18, 2015. A revised scoping document addressing these comments was issued on June 1, 2015. On March 30, 2018, BSPC filed its final license application. On January 30, 2019, the Commission issued a public notice accepting the application and soliciting motions to intervene and protests, stating that the application is ready for environmental analysis, and requesting comments, recommendations, terms and conditions, and prescriptions.

Action Alternatives Considered

This draft environmental assessment (EA) analyzes the effects of continued project operation and recommends conditions for any license that may be issued for the project. In addition to the license applicant's proposal, we consider two alternatives: (1) the license applicant's proposal with additional staff modifications (staff alternative); and (2) no action, meaning that the license applicant would continue to operate the project with no changes to project facilities or operation.

<u>Staff Alternative</u>

Under the staff alternative, the project would include most of BSPC's proposed measures, except for the development of a Bat Management Plan. In place of a Bat Management Plan, Commission staff recommends implementing a seasonal clearing restriction for trees greater than 3 inches in width at breast height, between June 1 and July 31, to avoid the time period when the federally threatened northern long-eared bat (NLEB) may be occupying nearby roosting trees.

The staff alternative for the project includes modifications of and additions to BSPC's proposed measures as follows:

- When decreasing outflow from the Fife Brook dam, ramp down the generation/whitewater flow release to the 125-cfs minimum flow release over a one-hour period from March 15 through June 30 to protect emerging trout fry.

- Incorporate the following measures for nesting bald eagles from the FWS's 2007 *National Bald Eagle Management Guidelines* in BSPC's proposed Bald Eagle Protection Plan: (1) keep a distance of at least 330 feet between the activity and the nest (distance buffers); (2) maintain forested (or natural) areas between the activity and around nest trees (landscape buffers); and (3) avoid construction and maintenance activities during the breeding season.

- Avoid cutting trees greater than 3 inches in width at breast height, between June 1 and July 31, to protect NLEB.

- Modify BSPC's proposed Recreation Facilities Management Plan by adding the following measures to improve boating in the upper reaches of the Fife Brook impoundment: (1) construct and maintain a boater take-out site downstream of the Showtime rapid, along with the new boater egress trail proposed by BSPC; and (2) install signs along the river to guide boaters to the take-out.

- Modify BSPC's proposed Recreation Facilities Management Plan by adding the following measures to improve parking at the Fife Brook Fishing and Boating

Access Area: (1) create up to 10 additional spaces at the unpaved, off-site overflow parking area by removing vegetation and placing gravel throughout the parking area; and (2) mark the parking spaces at the overflow parking area to enable the most efficient use of the space.

- Modify BSPC's proposed Recreation Facilities Management Plan by adding a measure to widen the access trail at the Zoar Whitewater Access Area to a width of 8 feet so that rafts can be carried flat from the road to the river.

- Modify BSPC's proposed Recreation Facilities Management Plan to include measures for installing and maintaining the following amenities at the Zoar Picnic Area: (1) at least two additional seasonal restrooms; (2) a changing facility with at least four changing stalls; and (3) at least six seasonal trash receptacles, with five of them located near picnic tables and one at the exit.

- Modify BSPC's proposed Recreation Facilities Management Plan to include measures that: (1) limit tree cutting at the Zoar Picnic Area to the selective cutting of only hazardous trees to maintain shade at this recreation site; and (2) replace any trees that are removed from the Zoar Picnic Area with new trees at the same site as the removed ones.

- Modify BSPC's proposed Recreation Facilities Management Plan to include measures for operating and maintaining two undeveloped access sites (*i.e.*, the "Carbis Bend" and the "Bridge to Nowhere" access sites), as project recreation sites to ensure safe river access for anglers in the Deerfield River downstream of the Fife Brook dam.

- Modify BSPC's proposed Recreation Facilities Management Plan to include the following measures for improving safety at project recreation sites: (1) install and maintain warning systems at project recreation facilities downstream of Fife Brook dam to provide warning of water releases from the dam, including auditory and visual warnings; (2) when increasing outflow from Fife Brook dam, hold the generator at 3 MW for 15 minutes before increasing outflow to higher levels; (3) install signage at project recreation sites describing the flow releases from Fife Brook dam and the safety warning systems at the sites, including the 15-minute pause at 3 MW; and (4) install either an emergency phone or dedicated Wi-Fi access for emergency communications with a limited range at each of the project recreation sites along the Deerfield River downstream of Fife Brook dam.

- Release the 106 scheduled whitewater flows from Fife Brook dam beginning at 10 a.m., instead of between 9:30 a.m. and 12:00 p.m. as proposed by BSPC.

- Maintain a public website that provides: (1) the annual schedule for the 106 whitewater flow release days; (2) a 24-hour schedule of the timing and size of flows from the Fife Brook Development to the Deerfield River, to be posted by 5 p.m. on the prior day; (3) current outflow from the Fife Brook dam; (4) updates to the current 24-hour schedule and the current outflow information on a 5-minute basis; and (5) a static map that displays the amount of time it takes for whitewater releases of 800 cfs to flow from Fife Brook dam to each project recreation site.

- Maintain the elevation of the Fife Brook impoundment at or below 835 feet NGVD until 12 p.m. on the 32 days of the year when the Deerfield Station No. 5 is scheduled to release whitewater flows to allow for whitewater recreation opportunities in the rapids located in the upper extent of the Fife Brook impoundment.

No-Action Alternative

Under the no-action alternative, the project would continue to operate under the terms and conditions of the existing license, and no new environmental protection, mitigation, or enhancement measures would be implemented. We use this alternative as the baseline environmental condition for comparison with other alternatives.

Environmental Effects of the Staff Alternative

The primary issues associated with relicensing the project are protecting aquatic habitat for fish and benthic macroinvertebrates in the Deerfield River downstream of the Fife Brook dam, and providing adequate, safe recreation along the Deerfield River. Below, we briefly discuss the anticipated environmental effects of issuing a new license for the project under the staff alternative.

Aquatic Resources

Under existing conditions, the large daily fluctuations associated with the Bear Swamp PSD operation create unstable conditions for fish and aquatic resources in the upper and lower reservoirs. Continuing to operate the Bear Swamp PSD in a store and release mode with the existing daily reservoir fluctuations would continue to limit the amount of stable, useable aquatic habitat in the Fife Brook impoundment and the upper reservoir. While current project operation is known to adversely affect fish by causing entrainment in the turbines at the Bear Swamp PSD and the Fife Brook Development, most adult and juvenile fish can avoid entrainment in the turbine at the Fife Brook dam because their burst swimming speeds exceed the measured approach velocities at the Fife Brook intakes. Entrainment is more likely to occur at the intake for the Bear Swamp PSD due to the high intake velocities associated with the pump-turbines.

Flow releases from the Fife Brook Development that are associated with current project operation, including hydropower generation and whitewater recreation, can result in rapid changes to the velocity and stage of the Deerfield River downstream of Fife Brook dam. The rapid changes in the velocity and stage of the Deerfield River can adversely affect fish spawning, fish distribution, benthic macroinvertebrate survival, and aquatic habitat. However, continuing to release a 125-cfs minimum flow and whitewater flows for 106 days per year would continue to provide adequate dissolved oxygen and water temperature conditions for fish and aquatic organisms in the Deerfield River downstream of Fife Brook dam. These flows would continue to maintain a diverse population of benthic macroinvertebrates, providing a stable food source for fish in the downstream reach of Fife Brook dam, as evidenced by a high fitness level of trout and reproducing numbers of trout species in the Deerfield River downstream of Fife Brook dam.

Under current project operation, flows downstream of Fife Brook dam return to 125 cfs approximately 1 hour after generation ceases. The current down-ramping rate provides some time for any fish that may have moved into shallow water at generation flows to return to deeper water as flows recede following generation. Based on the benefits to aquatic resources in the downstream reach that are provided by a 1-hour down-ramp, staff recommends implementing this measure from March 15 through June 30 to protect emerging trout fry.

Recreation at the project could potentially introduce invasive mussels to the project, which could outcompete benthic macroinvertebrates, a critical food resource for trout and other fish. Developing and implementing an Invasive Mussel Species Monitoring and Management Plan, as proposed by BSPC,, would reduce the potential introduction and spread of invasive mussel species in project waters.

Terrestrial Resources

The proposed improvements to project recreation facilities would cause some land disturbance. However, because these recreation improvements are located in areas that are already disturbed by ongoing project activities, wildlife habitat and wildlife populations at the project would not be significantly affected relative to current conditions.

Construction and maintenance activities that include soil disruption or material storage could affect state-listed plant species. However, BSPC's proposed plan to protect rare plants from construction-related activities and routine vegetation maintenance within the project boundary would minimize adverse effects on state-listed and special status plants within the project boundary.

Invasive plant species are widespread in the Deerfield River Basin, including at the project. Project-related recreation, as well as construction and maintenance activities, have the potential to introduce and spread invasive species at the project. A plan to monitor and manage invasive plant species, as proposed by BSPC, would help to protect native vegetation, wildlife habitat, and recreational resources by minimizing adverse effects associated with the spread of invasive plants within the project boundary.

Project maintenance activities have the potential to disturb resident eagles if tree cutting or thinning were to occur during nesting and other phases in their reproductive life cycle. Although there are no active bald eagle nests in the project boundary, eagles have been observed roosting and foraging at the project. Developing a Bald Eagle Protection Plan that includes measures from FWS's *National Bald Eagle Management Guidelines*, as recommended by staff, would ensure that bald eagles are protected from project-related activities.

Threatened and Endangered Species

Project maintenance activities and proposed recreation site improvements have the potential to disturb NLEB if tree cutting or thinning were to occur during roosting or other phases in their reproductive life cycle. Because the NLEB is likely present in the project area, staff recommends avoiding cutting trees greater than 3 inches in width at breast height, between June 1 and July, to avoid prohibited incidental take of NLEB. With the implementation of this measure, the project is not likely to adversely affect NLEB.

Recreation, Land Use, and Aesthetics

The project provides a variety of recreation opportunities. Existing project and non-project facilities are generally sufficient to meet demand in the project boundary, except during certain hours on summer weekends and holidays when demand for whitewater boating access causes congestion at put-in and take-out areas along the downstream reach of the Deerfield River. BSPC proposes to develop a Recreation Facilities Management Plan to formalize the operation and maintenance of project recreation sites and ensure that project facilities are properly operated and maintained for the term of any new license issued for the project. The plan also includes measures for improving site access, safety, and sanitation at recreation sites in the project boundary, which would improve conditions at recreation sites during periods of high demand.

Additional staff measures would modify BSPC's proposed Recreation Facilities Management Plan.

Egress from the Deerfield River following a series of rapids in the upper extent of the Fife Brook impoundment is difficult under existing conditions because there is no formal downstream take-out for boats and no trail back to the nearest parking area. Modifying the proposed Recreation Facilities Management Plan to include provisions for a boat take out site and egress trail would improve the recreation experience in the upper extent of the Fife Brook impoundment.

There is an inadequate number of parking spaces at the Fife Brook Fishing and Boating Access area during the summer whitewater boating season. Modifying the proposed Recreation Facilities Management Plan to include measures for increasing parking capacity at the Fife Brook Fishing and Boating Access Area would improve access to the recreation site.

The access trail at the Zoar Whitewater Access Area is too narrow for whitewater rafts to be carried to the river. Modifying the proposed Recreation Facilities Management Plan to include a measure to increase the trail width to 8 feet would improve recreation access at this site.

The Zoar Picnic Area has inadequate restroom, trash, and changing facilities to accommodate recreation users during the peak summer season. Modifying the Recreation Facilities Management Plan to include measures for at least two additional seasonal restrooms, a changing facility with at least four changing stalls, and at least six seasonal trash receptacles, would improve recreation at this site.

There are ten informal recreation sites within the project boundary. Two of them, Carbis Bend and the Bridge to Nowhere, provide important recreation access for anglers at the project. Modifying the Recreation Facilities Management Plan to include the operation and maintenance of these two sites as new project recreation sites would ensure river access for anglers in the Deerfield River downstream of the Fife Brook dam.

To improve recreation safety downstream of the Fife Brook dam, staff recommends several measures to warn recreation users of changing water levels, improve emergency communications, and to provide information about these measures to recreation users. Installing warning systems at the Fife Brook Fishing and Boating Access Area, the Zoar Whitewater Access Area, the Zoar Picnic Area, the Carbis Bend site, and the Bridge to Nowhere site would provide warning of water releases directly at the sites where anglers and other recreationists are located. Further, as an in-water safety measure to alert fishermen to rising water levels from a generation flow release, staff recommends continuing to ramp the Fife Brook Development generator to 3 MW, and then hold the generator at 3 MW for 15 minutes before increasing generation to higher output levels during the recreation season (April 1 through October 31).

Because of the rural nature of the project and the mountainous topography that blocks cellular phone service, staff recommends installing either an emergency phone or Wi-Fi access for emergency communications at each of the project recreation sites along the Deerfield River downstream of Fife Brook dam to provide a means of contacting emergency services. The intent of providing Wi-Fi access would be to provide a means for contacting emergency services for any incidents that occur at the project; therefore, the range of Wi-Fi access should be limited to the immediate area of each project recreation site.

Installing signs at the project recreation sites downstream of Fife Brook dam would ensure that river users would be informed of potential dangers, safety measures, and river conditions that they could expect to encounter at the project. Information describing flow releases from Fife Brook dam and the safety warning system would increase public safety at the project.

Cultural Resources

Project operation, recreation facility improvements, and recreation use have the potential to affect historic resources at the project. BSPC proposes to develop an HPMP in consultation with the Massachusetts SHPO and federally recognized tribes to address any potential adverse effects on historic properties.

Developing and implementing an HPMP would ensure that measures are in place to protect historic properties over the license term. To meet section 106 of the National Historic Preservation Act requirements, the Commission intends to execute a Programmatic Agreement with the Massachusetts SHPO and federally recognized tribes for the proposed project to protect historic properties that could be affected by the continued operation and maintenance of the project. The terms of the Programmatic Agreement would require BSPC to develop and implement an HPMP.

No Action Alternative

Under the no-action alternative, the project would continue to operate as it has in the past. None of the license applicant's proposed measures or the resource agencies' recommendations would be implemented. Further, none of the staff-recommended measures would be implemented, including measures to enhance environmental conditions for fish and wildlife, and measures to enhance recreation opportunities.

Draft License Articles

Staff recommendations for license articles for any new license for the project are based on the analysis presented in this draft EA. Draft license articles are attached in Appendix A.

Conclusions

Based on our analysis, we recommend licensing the project as proposed by BSPC with some staff modifications and additional measures.

In section 4.2 of the EA, we estimate the likely cost of alternative power for each of the alternatives identified above. Our analysis shows that under the no-action alternative, project power would cost $31,262,987, or about $58.60/MWh, less than the cost of alternative power. Under the proposed action alternative, project power would cost $33,713,213, or about $58.52/MWh, less than the cost of alternative power. Under the staff alternative, project power would cost $31,225,221, or about $58.53/MWh, less than the cost of alternative power.

We chose the staff alternative as the preferred alternative because: (1) issuing a new license for the project would allow BSPC to continue to operate its project as a dependable source of electrical energy; (2) the public benefits of the staff alternative would exceed those of the no-action alternative; and (3) the proposed and recommended measures would protect and enhance fish and wildlife resources. The overall benefits of the staff alternative would be worth the cost of the proposed and recommended environmental measures.

DRAFT ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
Washington, DC

BEAR SWAMP PROJECT
Docket No. P-2669-089 – Massachusetts

1.0 INTRODUCTION

1.1 APPLICATION

On March 30, 2018, Bear Swamp Power Company, LLC (BSPC) filed an application with the Federal Energy Regulatory Commission (Commission or FERC) for a new license to continue to operate and maintain the Bear Swamp Project No. 2669 (Bear Swamp Project, or project).[1] The project consists of two developments, the Bear Swamp Pumped Storage Development (Bear Swamp PSD) that has an authorized capacity of 666 megawatts (MW) and the Fife Brook Development that has an authorized capacity of 10 MW. The 676-megawatt (MW) project is located on the Deerfield River, in Berkshire and Franklin Counties, Massachusetts (see Figure 1). The project does not occupy federal land.

1.2 PURPOSE OF ACTION AND NEED FOR POWER

1.2.1 Purpose of Action

The purpose of the Bear Swamp Project is to provide a source of hydroelectric power and provide ancillary services to the electrical grid. Under the provisions of the Federal Power Act (FPA), the Commission must decide whether to issue a new license to

[1] The current, original license for the project was issued on April 28, 1970 for a term of 50 years. *See New England Power Company*, 43 FPC ¶ 568 (1970). A license order clarifying the effective date of the license term as April 1, 1970 was issued on May 25, 1970. *See New England Power Company*, 43 FPC ¶ 785 (1970) (original license); The license was transferred to BSPC on March 11, 2005. *See New England Power Company and USGen New England, Inc.*, 82 FERC ¶ 62,138 (1998); *USGen New England, Inc., Bear Swamp Generating Trust No. 1, Bear Swamp Generating Trust No.* 2, 85 FERC ¶ 62,079 (1998); *USGen New England, Inc., Bear Swamp Generating Trust No. 1, Bear Swamp Generating Trust No.* 2, *Bear Swamp Power Company LLC*, 110 FERC ¶ 62,245 (2005). The current license expires March 31, 2020.

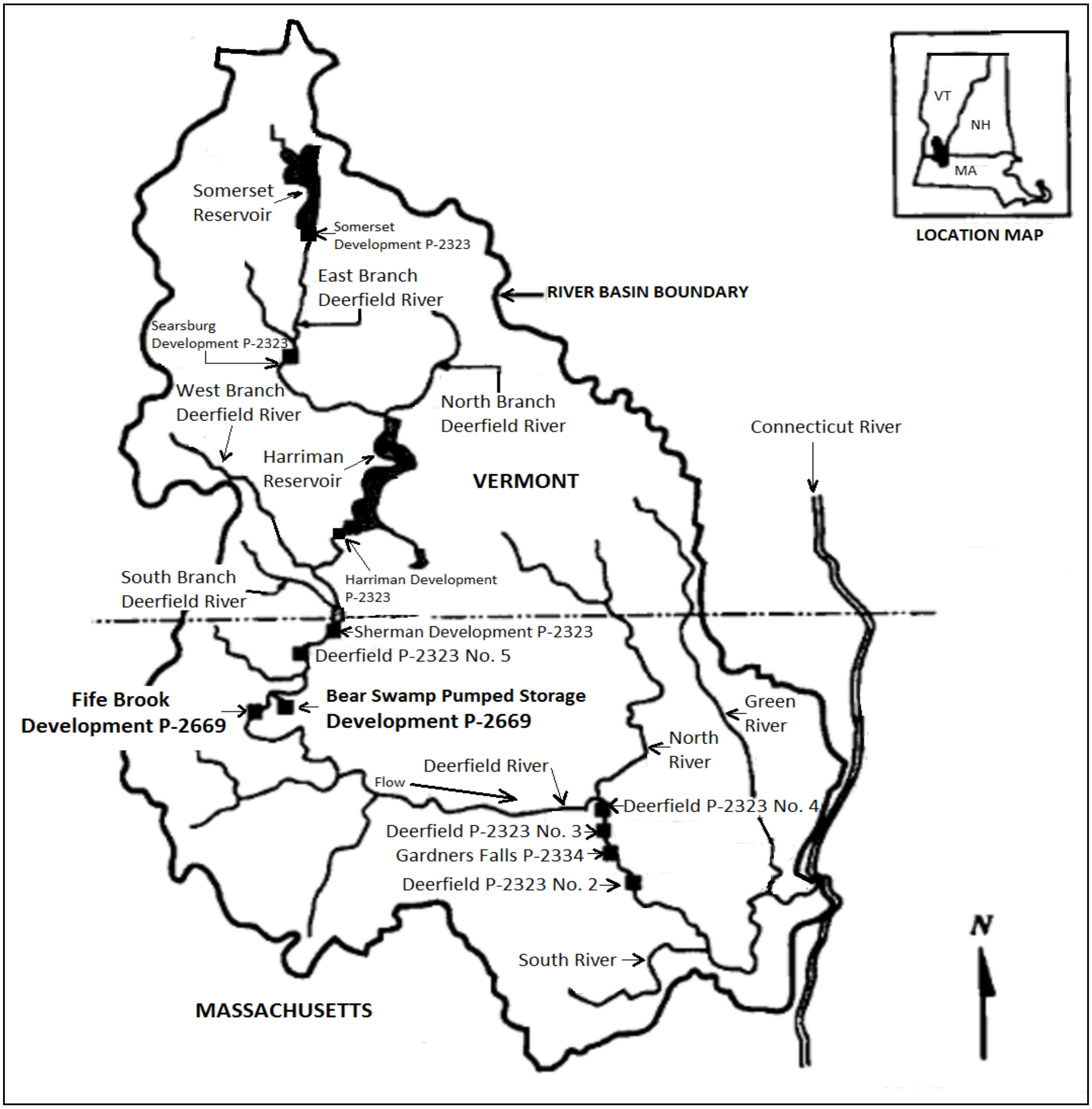


Figure 1. Location of the Bear Swamp Project and other hydroelectric projects in the Deerfield River Basin (Source: staff).

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

Issuing a new license for the Bear Swamp Project would allow BSPC to generate electricity at the project for the term of the new license, making electric power from a renewable resource available to the regional grid.

This draft environmental assessment (EA) analyzes the environmental and economic effects associated with operation of the project and alternatives to the project, and makes recommendations to the Commission on whether to issue a license, and under what terms and conditions to issue a license.

The draft EA assesses the environmental and economic effects of: (1) operating and maintaining the project as proposed by BSPC; and (2) operating and maintaining the project as proposed, with additional staff-recommended measures (staff alternative). We also consider the effects of the no-action alternative. Under the no-action alternative, the project would continue to operate as it does under the existing license, and no new environmental protection, mitigation, or enhancement measures would be implemented. The primary issues associated with relicensing the project are protecting aquatic habitat for fish and benthic macroinvertebrates, and providing adequate, safe recreation along the Deerfield River.

1.2.2 Need for Power

The Bear Swamp Project would provide hydroelectric generation to meet part of the New England region's power requirements and capacity needs during periods of peak energy demand. The project has an authorized capacity of 676-MW and average annual energy production of 483,863 megawatt hours (MWh).

The Bear Swamp Project consists of two developments, the 10-MW Fife Brook Development and the 666-MW Bear Swamp PSD. The Fife Brook Development is a traditional hydroelectric facility. From 2006 through 2015, the Fife Brook Development had an average annual energy production of 32,793 MWh.

The Bear Swamp PSD is a pumped storage facility that provides the region with power at times of high energy demand, and is available in a reserve mode to respond to an unanticipated loss of generation within the electric system. From 2006 through 2015, the Bear Swamp PSD had an average annual energy production of approximately

451,070 MWh and an average annual energy consumption from pumping of 618,293 MWh.[2]

To assess the need for power, staff looked at the needs in the operating region in which the project is located. The Bear Swamp Project is located within the Northeast Power Coordinating Council's New England region (NPCC-New England) of the North American Electric Reliability Corporation (NERC). NERC annually forecasts electrical supply and demand nationally and regionally for a 10-year period. According to NERC's 2018 Long-Term Reliability Assessment, the summer internal demand for this region is projected to decrease by 0.25 percent from 2019 to 2028. The anticipated reserve margin[3] is forecasted to range from 29.43 percent in 2019 to 29.24 percent in 2028. The NPCC-New England assessment area is forecasted to meet NPCC-New England's target reserve margin of 16.91 percent in 2019, 17.20 percent in 2020, and 16.36 percent in 2021 through 2028 (NERC, 2018).

Although demand is projected to decrease somewhat in the region, the project currently provides power and other grid services that help meet the region's power requirements and capacity needs during peak energy demand periods. Should a new license for the Bear Swamp Project not be granted, the services that the project provides to the grid, including peaking generation and black start capability would need to be provided by other existing projects or in some other fashion by the system operator. We conclude that power from the Bear Swamp Project would help meet a need for power in the NPCC-New England region in both the short and long-term.

---

[2] Pumped storage facilities are net energy consumers. The amount of energy produced as water passes from the upper reservoir to the lower reservoir through the turbines is less than the amount of energy required to operate the plant and to pump water back up to the upper reservoir. The benefits of pumped storage facilities are realized when the price for pumping is less than the value of generation. Specifically, pumped storage facilities pump water during periods of low energy demand when energy prices are relatively low (such as during the night), and then produce electricity during peak demand periods when energy prices are relatively high (such as during mid-day).

[3] The "anticipated reserve margin" considers the amount of anticipated generation resources relative to net electricity demand. For example, an anticipated reserve margin of 15 percent means that 15 percent of a region's electric generating capacity would be available as a buffer to supply the summer's peak hourly load.

1.3 STATUTORY AND REGULATORY REQUIREMENTS

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

1.3.1 Federal Power Act

1.3.1.1 Section 18 Fishway Prescriptions

Section 18 of the FPA, 16 U.S.C. § 811, states that the Commission is to require the construction, operation, and maintenance by a licensee of such fishways as may be prescribed by the Secretaries of the U.S. Department of Commerce or the U.S. Department of the Interior (Interior). On March 27, 2019, Interior requested that the Commission include a reservation of authority to prescribe fishways under section 18 in any license issued for the project.

1.3.1.2 Section 10(j) Recommendations

Under section 10(j) of the FPA, 16 U.S.C. § 803(j)(1), each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

On March 27, 2019, Interior filed timely recommendations under section 10(j). Massachusetts Division of Fisheries and Wildlife (Massachusetts DFW) filed its timely recommendations on April 1, 2019. These recommendations are summarized in Table 24 and discussed in section 5.3, *Fish and Wildlife Agency Recommendations*.

1.3.2 Clean Water Act

Under section 401(a)(1) of the Clean Water Act (CWA), 33 U.S.C. § 1341(a)(1), a license applicant must obtain either a water quality certification (certification) from the appropriate state pollution control agency verifying that any discharge from a project would comply with applicable provisions of the CWA, or a waiver of such certification. A waiver occurs if the state agency does not act on a request for certification within a reasonable period of time, not to exceed one year after receipt of such request.

On March 25, 2019, BSPC applied to the Massachusetts Department of Environmental Protection (Massachusetts DEP) for section 401 certification for the Bear Swamp Project. Massachusetts DEP received this request on March 27, 2019. Massachusetts DEP has not yet acted on the application.

1.3.3 Endangered Species Act

Section 7 of the Endangered Species Act (ESA), 16 U.S.C. § 1536, requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. On August 20, 2019, we accessed the U.S. Fish and Wildlife Service's (FWS) Information for Planning and Consultation (IPaC) database to determine federally listed species that could occur in the project vicinity. According to the IPaC database, the federally threatened northern long-eared bat (NLEB) (*Myotis septentrionalis*) could occur in the project vicinity.[4] No critical habitat has been designated for the NLEB.

Our analysis of project impacts on the NLEB is presented in section 3.3.3.2, *Threatened and Endangered Species, Environmental Effects*. Based on available information, we conclude that licensing the project is not likely to adversely affect the NLEB.

1.3.4 Coastal Zone Management Act

The Coastal Zone Management Act of 1972 (CZMA), as amended, requires review of the project's consistency with a state's Coastal Management Program for projects within or affecting the coastal zone. Under section 307(c)(3)(A) of the CZMA, 16 U.S.C. §1456(c)(3)(A), the Commission cannot issue a license for a project within or affecting a state's coastal zone unless the state's CZMA agency concurs with the license applicant's certification of consistency with the state's CZMA Program, or the agency's concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant's certification.

The project is not located within the state-designated Coastal Management Zone, which extends from the lands and waters within the seaward limit of the state's territorial sea to generally 100 feet beyond (landward of) the first major land transportation route encountered (a road, highway, rail line, *etc.*), and the project would not affect Massachusetts's coastal resources (Massachusetts Office of Coastal Zone Management, 2011). Therefore, the project is not subject to Massachusetts coastal zone program

---

[4] *See* Interior's official list of threatened and endangered species, accessed by staff using the IPaC database (https://ecos.fws.gov/ipac/) on August 20, 2019, and placed in the record for Docket No. P-2669-089 on August 20, 2019.

review and no consistency certification is needed for the action. By letter dated September 30, 2014, the Massachusetts Office of Coastal Zone Management confirmed that certification is not required, because "[t]he activities associated with this project fall outside the geographical boundaries of the Massachusetts Coastal Zone as delineated in *Chapter 5: Massachusetts Coastal Regions and An Atlas of Resources, 1 June 1977* and further described in the Massachusetts Coastal Zone Management Plan, and therefore are not subject to federal consistency review by this office."

1.3.5 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) requires that the Commission take into account the effects of its actions on historic properties and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the undertaking.[5] Historic properties are those that are listed or eligible for listing on the National Register. In this document, we also use the term "cultural resources" for properties that have not been evaluated for eligibility for listing on the National Register. Cultural Resources represent things, structures, places, or archaeological sites that can be either prehistoric or historic in origin. In most cases, cultural resources less than 50 years old are not considered historic. Section 106 also requires that the Commission seek concurrence with the state historic preservation office on any finding involving effects or no effects on historic properties, and consult with interested Indian tribes or Native Hawaiian organizations that attach religious or cultural significance to historic properties that may be affected by an undertaking.

In response to BSPC's December 19, 2014 request, Commission staff designated BSPC as its non-federal representative for the purposes of conducting section 106 consultation under the NHPA on February 18, 2015. Pursuant to section 106, and as the Commission's designated non-federal representative, BSPC initiated consultation with the Massachusetts Historical Commission (*i.e.*, the State Historic Preservation Officer (SHPO)) and federally recognized tribes to identify historic properties, determine the eligibility of cultural resources for listing on the National Register, and assess potential adverse effects on historic properties within the project's area of potential effect (APE).

To meet the requirements of section 106 of the NHPA, we intend to execute a Programmatic Agreement with the Massachusetts SHPO and federally recognized tribes for the protection of historic properties from the effects of continued operation and

---

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

maintenance of the Bear Swamp Project. The terms of the Programmatic Agreement would ensure that BSPC protects all historic properties identified within the project's APE from the adverse effects of the project through the implementation of a Historic Properties Management Plan (HPMP).

1.4 PUBLIC REVIEW AND COMMENT

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

1.4.1 Scoping

Before preparing this draft EA, we conducted scoping to determine what issues and alternatives should be addressed. Scoping Document 1 (SD1) was distributed to interested agencies and others on February 18, 2015. It was noticed in *the Federal Register* on February 26, 2015. Two scoping meetings were held to request oral comments on the project on March 18, 2015 in North Adams, Massachusetts. A court reporter recorded all comments and statements made at the scoping meetings, and these are part of the Commission's public record for the project. In addition to comments provided at the scoping meetings, the following entities provided written comments pertaining to SD1, the Pre-Application Document, and additional study needs:

Commenting Entity	Date Filed
American Whitewater	March 19, 2015
New England FLOW	March 27, 2015
Massachusetts Historical Commission	March 30, 2015
Crab Apple Whitewater	April 14, 2015
Deerfield River Watershed Chapter of Trout Unlimited (Trout Unlimited)	April 16, 2015
Appalachian Mountain Club	April 16, 2015
Appalachian Mountain Club, American Whitewater, New England FLOW, Crab Apple Whitewater, and Zoar Outdoor	April 16, 2015
FERC staff	April 16, 2015
Connecticut River Watershed Council	April 17, 2015
Massachusetts DEP	April 17, 2015
Massachusetts DFW	April 17, 2015
FWS	April 17, 2015
Robert May	April 20, 2015

TransCanada Hydro Northeast Inc.	April 20, 2015
National Park Service	April 20, 2015

A revised scoping document (SD2), addressing these comments was issued on June 1, 2015.

1.4.2 Interventions

On January 30, 2019, the Commission issued a notice accepting the application and setting April 1, 2019 as the deadline for filing motions to intervene and protests. The notice was published in the *Federal Register* on February 6, 2019. In response to the notice, the following entities filed motions/notices to intervene (none opposed issuance of a license):

Intervenors	**Date Filed**
Massachusetts DFW	December 22, 2014
American Whitewater	March 14, 2019
Appalachian Mountain Club	March 14, 2019
New England FLOW	March 14, 2019
Zoar Outdoor	March 14, 2019
Crab Apple Whitewater	March 14, 2019
Berkshire Whitewater	March 14, 2019
Franklin Regional Council of Governments	March 28, 2019
Trout Unlimited	March 29, 2019
Great River Hydro, LLC (Great River Hydro)	March 29, 2019
Connecticut River Conservancy	April 1, 2019
Deerfield River Watershed Association	April 1, 2019

1.4.3 Comments on the Application

On January 30, 2019, the Commission issued a notice setting April 1, 2019 as the deadline for filing comments, recommendations, terms and conditions, and prescriptions; and May 15, 2019 as the deadline for filing reply comments. Timely responses were filed by the following entities:[6]

[6] The following comments were received after the April 1, 2019 deadline: the town of Charlemont, Massachusetts on April 29, 2019, Rich Holschuh on May 1, 2019, the Whitewater Interest Group on April 22, 2019, and Massachusetts Historical Commission on May 15, 2019.

Commenting Entity	Date Filed
Massachusetts Historical Commission	February 21, 2019
American Whitewater, Appalachian Mountain Club, New England FLOW, Zoar Outdoor, Crab Apple Whitewater, and Berkshire Whitewater (Whitewater Interest Group)	March 14, 2019
Deerfield River Watershed Association	March 21, 2019
Interior[7]	March 27, 2019
Franklin Regional Council of Governments	March 28, 2019
Appalachian Mountain Club, American Whitewater, and New England FLOW	March 28, 2019
Trout Unlimited	March 29, 2019
Great River Hydro	March 29, 2019
Connecticut River Conservancy	April 1, 2019
Massachusetts DFW[8]	April 1, 2019

Reply comments were filed by BSPC on May 15, 2019.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 NO ACTION ALTERNATIVE

Under the no-action alternative, the project would continue to operate under the terms and conditions of the existing license, and no new environmental protection, mitigation, or enhancement measures would be implemented. We use this alternative as the baseline environmental condition for comparison with other alternatives.

2.1.1 Existing Project Facilities

The Bear Swamp Project is located on the Deerfield River in Berkshire and Franklin Counties, Massachusetts. The project consists of two developments, the Bear Swamp PSD and the Fife Brook Development. The project facilities are shown in Figure 2.

---

[7] Interior's March 27, 2019 filing includes its section 10(j) recommendations.

[8] Massachusetts DFW's April 1, 2019 filing includes its section 10(j) recommendations.

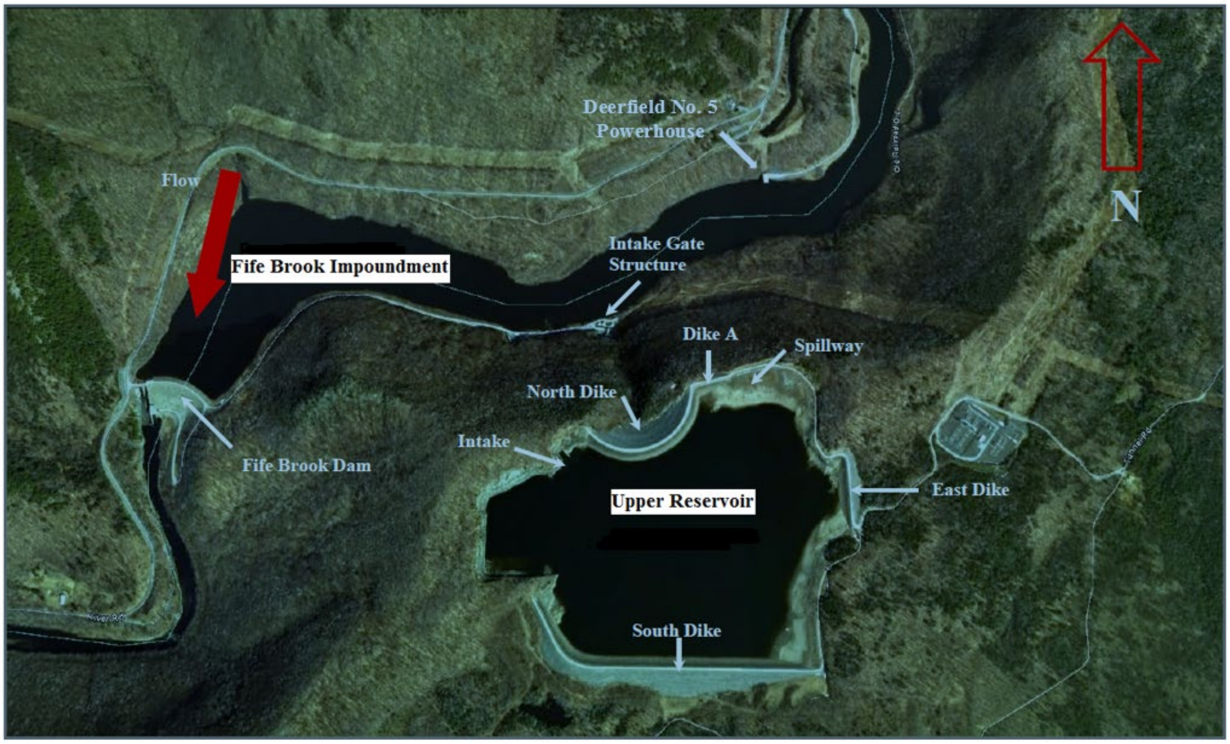


Figure 2. Aerial view of the Bear Swamp Project (Source: staff).

Bear Swamp Pumped Storage Development

The Bear Swamp PSD consists of an upper reservoir, upper reservoir intake structure and penstocks, powerhouse and transmission lines, tailrace and lower reservoir outlet and intake structure, lower reservoir, and appurtenant facilities.

The 118-acre upper reservoir for the Bear Swamp PSD has a gross storage capacity of 8,300 acre-feet at the normal maximum water level elevation of 1,600 feet National Geodetic Vertical Dam of 1929 (NGVD). The upper reservoir is contained by existing topography and four project dikes with a crest elevation of 1,606 feet NGVD, including: (1) an approximately 1,300-foot-long, 155-foot-high curved, earth and rockfill dike (North Dike); (2) an approximately 350-foot-long, 23-foot-high earth and rockfill dike extending from the east side of the North Dike (Dike A); (3) an approximately 2,880-foot-long, 140-foot-high earth and rockfill dike (South Dike); and (4) an approximately 750-foot-long, 50-foot-high earth and rockfill dike (East Dike). An approximately 420-foot-long emergency spillway with a crest elevation of 1,602-feet NGVD is excavated into the bedrock to the east of Dike A.

A 40-foot-diameter, concrete intake structure is located on the floor of the upper reservoir. The intake structure conveys water from the upper reservoir to two 11-foot-diameter, steel-lined penstocks via an approximately 1,430.5-foot long tunnel system. The penstocks convey water to a 227-foot-long, 79-foot-wide, 182-foot-high underground powerhouse that contains two reversible, Francis pump-turbine-generator units with a total authorized capacity of 666 MW.[9]

Water is conveyed from the powerhouse to the lower reservoir (*i.e.,* Fife Brook impoundment) through two 504-foot-long, 22-foot-wide, 29.5-foot-high concrete-lined underground draft tube tunnels. Each draft tube tunnel connects to two 20-foot-high, 15-foot-wide discharge bays that also serve as intake channels when pumping. The four discharge bays/intake channels are equipped with 16-foot-wide, 20.6-foot-high slide gates and 15-foot-wide, 26.7-foot-tall trashracks with 6-inch clear bar spacing. A 150-foot-long concrete apron extends from the trashracks into the Fife Brook impoundment. In addition to the structures listed above, the Bear Swamp Development includes: (1) an approximately 88-foot-long, 4-foot-high submerged weir in the upper reservoir that includes three 5-foot-wide, 3-foot-high stoplog gates that are used to maintain a pool of water during de-watering and re-watering of the upper reservoir; (2) two 13.8/230-kilovolt (kV) step-up transformers; (3) an approximately 4,075-foot-long 230-kV transmission line and an approximately 3,960-foot-long 230-kV transmission line; and (4) appurtenant facilities.

Fife Brook Development

The Fife Brook Development includes an 890-foot-long, 130-foot-high earthen rock-fill dam with a crest elevation of 880 feet NGVD. The dam consists of the following structures: (1) an approximately 72-foot wide spillway section that includes two 36-foot-wide, 40-foot-high steel Tainter spillway gates; (2) an approximately 15-foot-wide concrete intake structure that includes an 11.2-foot-wide, 24-foot-tall trashrack with 3-inch bar spacing and a 15-foot-wide, 18-foot-high headgate; and (3) an approximately 803-foot-wide non-overflow earthen embankment section. A roadway crosses the dam with a bed elevation of 880 feet NGVD and includes an approximately 72-foot-long bridge over the Tainter spillway gate section.

The Fife Brook dam impounds a 152-acre, 2.5-mile-long reservoir with a gross storage capacity of 6,900 acre-feet at a surface elevation of 870 feet NGVD. From the impoundment, water is conveyed through the intake structure and a 10-foot-diameter,

[9] The April 28, 1970 license authorized an installed generating capacity of 600 MW for the Bear Swamp PSD. *See New England Power Company*, 43 FPC ¶ 568 (1970). On August 13, 2008, the Commission authorized the rehabilitation of the existing turbine units to create an additional 66 MW of installed capacity, thereby increasing the total authorized capacity for the Bear Swamp PSD to 666-MW. *See Bear Swamp Power Company, LLC*, 124 FERC ¶ 62,127 (2008). On December 9, 2016, the Commission granted an extension of time until August 13, 2022 for BSPC to complete the rehabilitation of the turbine units.

200-foot-long steel penstock to an approximately 79.25-foot-long, 44-foot-wide, 94-foot-tall concrete powerhouse containing a 10-MW Francis turbine-generator unit. From the powerhouse, water is conveyed to the downstream reach of the Deerfield River via a 21-foot-long steel-lined draft tube.

In addition to the structures listed above, the Fife Brook Development includes: (1) a 30-inch-diameter minimum flow release pipe that extends from the Fife Brook dam for approximately 325 feet before bifurcating into an approximately 55-foot-long, 20-inch-diameter pipe and an approximately 55-foot-long, 24-inch-diameter pipe; (2) a partially buried (860-foot-long section) and partially above-ground (7,060-foot-long section) 13.8-kV transmission line that connects the turbine-generator unit to the regional grid at a non-project substation owned by Great River Hydro; and (3) appurtenant facilities.

Project recreation facilities include the Bear Swamp Visitor Center, the Fife Brook Fishing and Boating Access Area, the Zoar Whitewater Access Area, the Zoar Picnic Area, the Bear Swamp Public Hunting Area, and the Bear Swamp and Hoosac Tunnel Trail.

2.1.2 Existing Project Boundary

The existing project boundary, as established in the Commission's April 28, 1970 license order and amended in the Commission's April 4, 1997[10] and November 17, 2006[11] orders, encompasses approximately 1,474 acres of land, including: (1) the upper and lower reservoirs (approximately 270 acres); (2) land associated with project structures (approximately 130 acres); and (3) land around the reservoirs and downstream of Fife Brook dam that is used for recreation and environmental protection (1,074 acres). The current project boundary does not include any federal land.

A total of 1,407 acres of land within the project boundary is protected by conservation easements that were granted to the Massachusetts Department of Conservation and Recreation in July 2001. Approximately 1,206 acres of the protected land occurs near the project's upper and lower reservoirs, and 201 acres of the protected land occurs along the river corridor for approximately 7.5 miles downstream of the Fife Brook dam.[12] The 201 acres of river corridor are subject to in-perpetuity conservation

---

[10] *New England Power Company*, 79 FERC ¶ 61,009 (1997).

[11] *Bear Swamp Power Company,* 117 FERC ¶62,164 (2006).

[12] Article 405 of the current license requires the licensee to protect 1,257 acres of land. The licensee chose to establish a conservation easement for an additional 200 acres,

easements, while the 1,206 acres near the project's upper and lower reservoirs are subject to conservation easements that expire with the current license on April 1, 2020. The conservation easements restrict use of the property to agricultural, forestry, educational, non-commercial recreation, open space, and electric transmission and hydroelectric generation purposes.

2.1.3 Project Safety

The Bear Swamp Project has been operating for about 45 years under its existing license. During this time, Commission staff has conducted operational inspections focusing on the continued safety of the structures, identification of unauthorized modifications, efficiency and safety of operations, compliance with the terms of the license, and proper maintenance. In addition, the project has been inspected and evaluated every 5 years by an independent consultant and a consultant's safety report has been submitted for Commission review.

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

2.1.4 Existing Project Operation

Project inflow is controlled by flow releases from Great River Hydro's Deerfield River Project No. 2323 (Deerfield Project). The Bear Swamp Project is located downstream of five of the Deerfield Project's developments. The uppermost hydropower development in the Deerfield River Basin is the Deerfield Project's Somerset Development, which operates as a storage reservoir to regulate water in the river basin for the downstream Deerfield Project developments. The Station No. 5 Development of the Deerfield Project (Deerfield Station No. 5) is located immediately upstream and adjacent to the Bear Swamp Project. The Deerfield Station No. 5 powerhouse discharges directly into the Fife Brook impoundment, approximately 0.5 mile upstream of the intake for the Bear Swamp PSD (see Figure 2). The dam for Deerfield Station No. 5 is located about 3.6 miles upstream of the intake for the Bear Swamp PSD. Approximately 1.2 miles of the bypassed reach of Deerfield Station No. 5 overlaps with the upper extent of

---

including 50 acres outside of the project boundary. *See New England Power Company*, 79 FERC ¶ 61,009 (1997).

the Fife Brook impoundment, from the Deerfield Station No. 5 powerhouse to the upstream extent of the project boundary near the Dunbar Brook Picnic Area.

The Fife Brook impoundment serves as the lower reservoir of the Bear Swamp PSD. The Bear Swamp PSD operates as a peaking facility, typically pumping at night when power prices are low and generating during peak power demand periods during the day. The Fife Brook impoundment has an allowable daily fluctuation of 40 feet from a maximum water surface elevation of 870 feet NGVD, which provides a useable storage capacity of 4,900 acre-feet.[13] The upper reservoir for the Bear Swamp PSD has an allowable daily fluctuation of 50 feet from a maximum water surface elevation of 1,600 feet NGVD,[14] which provides a useable storage capacity of 5,260 acre-feet. However, BSPC holds a portion of its useable storage capacity between elevations 1,555.5 and 1,550 feet NGVD in reserve for emergency conditions (*i.e.*, to provide ancillary services[15] to the regional grid), thereby reducing the storage capacity of the upper reservoir to 4,600 acre-feet for daily energy production.

The specific timing of the pumping/generation process at the Bear Swamp PSD varies on a daily basis depending on the on-peak and off-peak power conditions, and the need to provide ancillary services to the regional grid. Within a 24-hour period, the Bear Swamp PSD typically uses the 4,600 acre-feet of storage capacity to produce approximately 3,028 MWh of generation over approximately 5.3 hours, and then uses approximately 4,286 MWh of pumping energy to refill the reservoir over approximately 7.2 hours. The combined hydraulic capacity of the two pump-turbines at the Bear

---

[13] The original 1970 license order (*see* Ordering Paragraph C), as well as the 2008 amendment order indicate the useable storage within the Fife Brook impoundment is 4,900 acre-feet. *See New England Power Company*, 43 FPC ¶ 568 (1970); and *Bear Swamp Power Company, LLC*, 124 FERC ¶ 62,127 (2008). In the March 30, 2018 license application, BSPC indicates the useable storage within the Fife Brook impoundment and the upper reservoir is 4,600 acre-feet. However, staff cannot verify this change to the project description with the information provided by BSPC.

[14] See *New England Power Company*, 43 FPC ¶ 568 (1970), Ordering Paragraph C.

[15] Ancillary services help balance the transmission system as electricity is moved from generating sources to ultimate consumers, and are necessary for proper grid operation. Ancillary services include: load following, reactive power-voltage regulation, system protective services, loss compensation service, system control, load dispatch services, and energy imbalance services.

Swamp PSD is 10,860 cubic feet per second (cfs) in generation mode[16] and 9,040 cfs in pump mode.

As part of a March 2005 off-license agreement between BSPC and the licensee of the Deerfield Project,[17] BSPC has committed to: (1) "operate the upper and lower reservoirs of the Bear Swamp Project in balance as though the project was a closed-cycle system;" and (2) "each day operate the Fife Brook development in a run-of-river mode of operation that maintains the flow balance, provided such operation is in compliance with [BSPC's] FERC license."

The 10-MW turbine-generator unit at the Fife Brook Development has a minimum hydraulic capacity of approximately 270 cfs[18] and a maximum hydraulic capacity of 1,540 cfs. BSPC does not run the turbine-generator at the Fife Brook Development below an output of approximately 3 MW due to rough operating conditions that are encountered when output reaches this level.[19] To avoid sudden increases in flow downstream of Fife Brook dam, BSPC ramps the generator up to the 3-MW output level, and holds the generator at 3 MW for 15 minutes before increasing generation to higher output levels. A generator output of 3 MW is equivalent to a discharge of between 270 cfs and 650 cfs from the Fife Brook dam, depending on the elevation of the impoundment. When the Fife Brook impoundment is full and inflow exceeds the maximum hydraulic capacity of the turbine, the turbine-generator unit is operated at its maximum capacity and excess flow is released through the tainter gates.

---

[16] On August 13, 2008, the Commission authorized the rehabilitation of the existing turbine units to increase the hydraulic capacity of each of the turbines from 5,430 cfs to 6,200 cfs, for a combined hydraulic capacity of 12,400 cfs. The proposed changes will result in an additional 770 cfs going through the project turbines. *See Bear Swamp Power Company, LLC*, 124 FERC ¶ 62,127 (2008). On December 9, 2016, the Commission granted an extension of time until August 13, 2022 for BSPC to complete the rehabilitation of the turbine units.

[17] *See* TransCanada Hydro Northeast, Inc., Motion to Intervene and Comments, Docket No. P-2669-061, at Attachment A (filed June 9, 2008).

[18] The minimum hydraulic capacity of 270 cfs is based on an impoundment elevation of 870 feet NGVD.

[19] BSPC references cavitation conditions that occur at lower operating ranges. Cavitation occurs when the local fluid pressure falls below the vapor pressure of water and has the potential to cause vibration, damage to the blade surface, and performance loss.

On April 4, 1997, the Commission amended the license to include additional operating conditions related to minimum flows, whitewater flow releases, and the protection of environmental resources, pursuant to a settlement agreement between the licensee, federal and state resource agencies, and several non-governmental organizations.[20] Article 401 of the license requires a minimum flow of 125 cfs to be released from the Fife Brook dam to protect aquatic habitat in the Deerfield River. The license requires water to be released from "reservoir storage," if necessary, to ensure that the minimum flow of 125 cfs is met.[21] BSPC states that it reserves an additional 150 acre-feet of stored water in the Fife Brook impoundment to supplement inflow when needed.

Article 402 of the license requires whitewater releases from the Fife Brook dam at a minimum flow of 700 cfs for a duration of at least three continuous hours for 56 weekdays and 50 weekend days from April 1 through October 31. The whitewater flows must occur between 9:30 a.m. and 12:00 p.m. These flows are generally released through the Fife Brook turbine-generator unit. In addition, Article 405 of the license requires the protection of scenic, forestry, and natural resources on 1,257 acres of land around the reservoirs and downstream of Fife Brook dam.

2.2 APPLICANT'S PROPOSAL

2.2.1 Proposed Project Facilities

BSPC does not propose to add any new project facilities. However, on August 13, 2008, the Commission authorized BSPC to increase the total generating capacity of the Bear Swamp PSD from 600 MW to 666 MW and the hydraulic capacity from 5,430 cfs to 6,200 cfs by replacing the pump-turbine runners and rewinding the motor-generators.[22] Since authorization, BSPC has been completing the upgrades in a phased approach. On

[20] *See New England Power Company,* 79 FERC ¶ 61,009 (1997). The settlement agreement was filed with the Commission on October 6, 1994 (1994 Settlement Agreement). The settlement agreement covered a wide range of issues involving the relicensing of the Deerfield Project, but also included measures that the former licensee, New England Power Company, agreed to implement at the Bear Swamp Project.

[21] The minimum flow requirement for Deerfield Station No. 5 into the Fife Brook impoundment is 73 cfs, which is less than the minimum flow requirement of 125 cfs for the Bear Swamp Project. *New England Hydropower Company*, 79 FERC ¶ 61,006 (1997).

[22] *Bear Swamp Power Company, LLC*, 124 FERC ¶ 62,127 (2008).

December 9, 2016, the Commission granted BSPC an extension of time to August 13, 2022 to complete the rehabilitation of the turbine-generators.

Based on the Exhibit G filed on April 30, 2018, BSPC proposes a project boundary that encompasses approximately 1,305.3 acres of land and water, which is approximately 168.7 acres[23] less than the existing project boundary. BSPC states that the majority of the land it is proposing to remove is associated with a conservation easement that was granted to the Massachusetts Department of Conservation and Recreation in July 2001 and that expires on April 1, 2020, concurrent with the expiration date of the existing license. BSPC proposes modifying the current project boundary by:

- Removing 109.74 acres of land northeast of the upper reservoir that is currently part of a conservation easement;
- Removing 20.04 acres of land west of the Fife Brook dam that is currently part of a conservation easement;
- Removing 31.99 acres of land associated with River Road and land north of Fife Brook impoundment that is currently part of a conservation agreement;
- Removing 5.9 acres of land associated with River Road downstream of the Fife Brook dam; and
- Removing approximately 1.0 acre of land due to minor adjustments to the project boundary line.

BSPC states that the land that is currently held under a conservation easement and that it is proposing to remove, consists of mixed-use property that includes rugged upland areas not typically used by the public for recreation or any other purposes. BSPC states that the removal of the land will not affect any exiting or proposed shoreline access, recreation uses, or riverine habitat, nor will it affect BSPC's ability to operate or maintain the project.

[23] BSPC's Exhibit G filed on April 30, 2018 states the proposed project boundary includes the removal of 165 acres of land and water and measures 1,309 acres. However, BSPC appears to have incorrectly summed the proposed acreage changes. Based on Commission staff's review of the Exhibit G maps and georeferenced shape files, BSPC is proposing to remove approximately 168.7 acres of land and water from the current project boundary which results in a proposed project boundary measuring 1,305.3 acres.

2.2.2 Proposed Operation and Environmental Measures

BSPC proposes to:

- Continue to operate the Bear Swamp PSD in a store and release mode by pumping water from the Fife Brook impoundment (*i.e*., the lower reservoir) during periods of low electricity demand, storing the water until periods of high electricity demand, and then generating electricity by discharging water back into the Fife Brook impoundment during periods of high electricity demand.

- Continue to operate the Bear Swamp PSD upper reservoir with a normal maximum water level elevation of 1,600 feet NGVD and a 50.0-foot maximum allowable drawdown (*i.e.,* 1,550 to 1,600 feet NGVD);

- Continue to operate the Fife Brook impoundment with a normal maximum water level elevation of 870 feet NGVD and a 40.0-foot maximum allowable drawdown (*i.e.,* 830 to 870 feet NGVD);

- Continue to provide a 125-cfs continuous minimum flow release from the Fife Brook dam to protect fish and aquatic resources in the Deerfield River;

- Develop an Operation Compliance Monitoring Plan that describes: (1) the mechanisms and structures that will be used to provide minimum flow releases and whitewater flow releases; (2) periodic maintenance and calibration for any installed measuring devices; and (3) procedures for recording and reporting data to FERC and resource agencies;

- Develop an Invasive Mussel Species Monitoring and Management Plan that includes the following measures to minimize the spread of invasive mussel species at the project, including dreissenid mussels (e.g., zebra mussels and quagga mussels): (1) educational training for project maintenance staff; (2) educational signage; (3) best management practices for minimizing the spread of invasive mussel species during project-related construction and maintenance activities; and (4) rapid notification, coordination, and response with appropriate federal and state resource agencies in the event invasive dreissenid mussel species are detected at the project.

- Develop a State-Listed Rare Plants Management Plan that includes measures to minimize adverse project effects on state-listed rare plants;

- Develop an Invasive Plant Species Monitoring and Management Plan that includes measures to reduce the spread of invasive plant species, including: (1) educating recreational users on ways to reduce the spread of invasive plant species; (2) implementing best management practices, such as identifying invasive plant species that may be introduced by a given project-related activity, identifying critical control points (locations and times), and implementing measures to prevent the spread of invasive plant species during routine project operation and maintenance activities; (3) recording incidental observations of invasive plant species; and (4) using only native seed and plant materials outside of lawn areas;

- Develop a Bald Eagle Protection Plan that includes provisions to: (1) avoid killing, injuring, or harassing bald eagles during tree cutting or thinning operations at the project; and (2) minimize project effects on nesting bald eagles at the project;

- Develop a Bat Management Plan that includes measures to avoid/minimize adverse project effects on the NLEB and little brown bat;

- Develop a Recreation Facilities Management Plan that includes provisions to: (1) continue operating and maintaining the existing project recreation facilities; (2) design and construct a new boater egress trail that begins downstream from the Showtime rapid and extends upstream to the existing vehicle turnaround at Great River Hydro's Dunbar Brook Picnic Area, which is part of Deerfield Station No. 5; (3) enhance overflow parking at the Fife Brook Fishing and Boating Access Area; (4) widen the access trail at the Zoar Whitewater Access Area; (5) install additional seasonal restroom facilities, a stall-type changing facility, and an additional staircase at the Zoar Picnic Area; (6) install handrails on staircases at project recreation areas; and (7) install additional signage to educate recreationists on safety and the Deerfield River flow regime;

- Continue to provide 106 annual whitewater flow releases from the Fife Brook dam for a minimum duration of 3 hours on 50 weekend days and 56 weekdays from April 1 through October 31;

- Increase whitewater flow releases from 700 cfs to 800 cfs;

- Remove approximately 168.7 acres of land from the existing project boundary; and

- Develop an HPMP to protect historic properties that are eligible for or listed on the National Register.

2.3 STAFF ALTERNATIVE

Under the staff alternative, the project would be operated as proposed by BSPC except for the proposed measure to develop a Bat Management Plan. In place of a Bat

Management Plan, Commission staff recommends implementing a seasonal clearing restriction for trees greater than 3 inches in width at breast height, between June 1 and July 31, to avoid the time period when the federally threatened NLEB may be occupying nearby roosting trees.

The staff alternative for the project includes modifications of and additions to BSPC's proposed measures as follows:

- When decreasing outflow from the Fife Brook dam, ramp down the generation/whitewater flow release to the 125-cfs minimum flow release over a one-hour period from March 15 through June 30 to protect emerging trout fry;

- Incorporate the following measures for nesting bald eagles from the FWS's 2007 *National Bald Eagle Management Guidelines* in BSPC's proposed Bald Eagle Protection Plan: (1) keep a distance of at least 330 feet between the activity and the nest (distance buffers); (2) maintain forested (or natural) areas between the activity and around nest trees (landscape buffers); and (3) avoid construction and maintenance activities during the breeding season;

- Avoid cutting trees greater than 3 inches in width at breast height, between June 1 and July 31, to protect NLEB;

- Modify BSPC's proposed Recreation Facilities Management Plan by adding the following measures to improve boating in the upper reaches of the Fife Brook impoundment: (1) construct and maintain a boater take-out site downstream of the Showtime rapid, along with the new boater egress trail proposed by BSPC; and (2) install signs along the river to guide boaters to the take-out;

- Modify BSPC's proposed Recreation Facilities Management Plan by adding the following measures to improve parking at the Fife Brook Fishing and Boating Access Area: (1) create up to 10 additional spaces at the unpaved, off-site overflow parking area by removing vegetation and placing gravel throughout the parking area; and (2) mark the parking spaces at the overflow parking area to enable the most efficient use of the space;

- Modify BSPC's proposed Recreation Facilities Management Plan by adding a measure to widen the access trail at the Zoar Whitewater Access Area to a width of 8 feet so that rafts can be carried flat from the road to the river;

- Modify BSPC's proposed Recreation Facilities Management Plan to include measures for installing and maintaining the following amenities at the Zoar Picnic Area: (1) at least two additional seasonal restrooms; (2) a changing facility with at least four changing stalls; and (3) at least six seasonal trash receptacles, with five of them located near picnic tables and one at the exit;

- Modify BSPC's proposed Recreation Facilities Management Plan to include measures that: (1) limit tree cutting at the Zoar Picnic Area to the selective cutting of only hazardous trees to maintain shade at this recreation site; and (2) replace any trees that are removed from the Zoar Picnic Area with new trees at the same site as the removed ones;

- Modify BSPC's proposed Recreation Facilities Management Plan to include measures for operating and maintaining two undeveloped access sites (*i.e.*, the "Carbis Bend" and the "Bridge to Nowhere" access sites), as project recreation sites to ensure safe river access for anglers in the Deerfield River downstream of the Fife Brook dam;

- Modify BSPC's proposed Recreation Facilities Management Plan to include the following measures for improving safety at project recreation sites: (1) install and maintain warning systems at project recreation facilities downstream of Fife Brook dam to provide warning of water releases from the dam, including auditory and visual warnings; (2) when increasing outflow from Fife Brook dam, hold the generator at 3 MW for 15 minutes before increasing outflow to higher levels; (3) install signage at project recreation sites describing the flow releases from Fife Brook dam and the safety warning systems at the sites, including the 15-minute pause at 3 MW; and (4) install either an emergency phone or dedicated Wi-Fi access for emergency communications with a limited range at each of the project recreation sites along the Deerfield River downstream of Fife Brook dam;

- Release the 106 scheduled whitewater flows from Fife Brook dam beginning at 10 a.m., instead of between 9:30 a.m. and 12:00 p.m. as proposed by BSPC;

- Maintain a public website that provides: (1) the annual schedule for the 106 whitewater flow release days; (2) a 24-hour schedule of the timing and size of flows from the Fife Brook Development to the Deerfield River, to be posted by 5 p.m. on the prior day; (3) current outflow from the Fife Brook dam; (4) updates to the current 24-hour schedule and the current outflow information on a 5-minute basis; and (5) a static map that displays the amount of time it takes for whitewater releases of 800 cfs to flow from Fife Brook dam to each project recreation site; and

- Maintain the elevation of the Fife Brook impoundment at or below 835 feet NGVD until 12 p.m. on the 32 days of the year when the Deerfield Station No. 5 is scheduled to release whitewater flows to allow for whitewater recreation opportunities in the rapids located in the upper extent of the Fife Brook impoundment.

Section 10(j) Measures Not Recommended[24]

The staff alternative does not include the following section 10(j) recommendations submitted by Interior:

- Operate the Fife Brook Development in a run-of-release mode passing inflow received from the Deerfield Station No. 5 on a near instantaneous basis;
- Provide a continuous minimum flow of 350 cfs downstream of the Fife Brook Development from November 1 through April 15 to protect trout incubating trout eggs;
- During the dragonfly emergence period of May 1 through August 31, adhere to the up-ramping protocol developed by the Massachusetts Natural Heritage and Endangered Species Program to protect the state-listed riffle snaketail and ocellated darner; and
- Develop a Bat Management Plan to identify and implement measures to avoid or minimize adverse effects to the NLEB.

The staff alternative does not include the following section 10(j) recommendations submitted by Massachusetts DFW:

- Operate the Fife Brook Development in a run-of-release mode;
- Provide a continuous minimum flow of 350 cfs downstream of the Fife Brook Development from November 1 through April 15;
- Ramp at 0.060 foot per hour or 130 cfs per hour (not to exceed 32 cfs per 15-minute period) between 7 a.m. and 4 p.m. from May 15 through June 30;
- Ramp at 0.334 foot per hour or 158 cfs per hour (not to exceed 40 cfs per 15-minute period) between 7 a.m. and 4 p.m. from July 1 through August 31;
- Develop a Dragonfly Flight and Emergence Survey Plan to be implemented every three years to assess state-listed dragonfly populations and ensure that

[24] *See* section 5.3, *Fish and Wildlife Agency Recommendations*, for additional details on the recommendations.

state-listed dragonfly habitat utilization along the river remains stable or increases;

- Develop a plan to increase the population of state-listed dragonflies on project lands and lands over which conservation easements are established or re-established;

- Establish a 200-foot, natively vegetated buffer zone on all riverfront lands within and downstream of the project boundary;

- Create a Rare Dragonfly Species Mitigation Fund to fund survey, conservation, and enhancement actions for dragonflies in the Deerfield Watershed;

- Develop a Special Status Bat Management Plan to identify and implement measures to avoid or minimize adverse effects to special status bats;

- Conduct a comprehensive survey of invasive plants every 5 years to develop site-specific control/management actions to reduce the spread of invasive species at the project;

- Implement a permanent conservation restriction on 1,264 acres of land, or transfer lands to qualified conservation entity for perpetual conservation; and

- Allow Massachusetts DFW and FWS to inspect the project and request pertinent operation records for the purpose of monitoring compliance with the terms and conditions of a new license.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

The following alternatives were considered but have been eliminated from further analysis because they are not reasonable in the circumstances of this case: (1) issuing a non-power license, (2) federal government takeover of the project, and (3) retiring the project.

2.4.1 Issuing a Non-Power License

A non-power license is a temporary license that the Commission would terminate when it determines that another governmental agency will assume regulatory authority and supervision over the land and facilities covered by the non-power license. At this point, no agency has suggested a willingness or ability to do so. No party has sought a non-power license for the project and we have no basis for concluding that the project should no longer be used to produce power. Thus, we do not consider issuing a non-power license a realistic alternative to relicensing in this circumstance.

2.4.2 Federal Government Takeover of the Project

We do not consider federal takeover to be a reasonable alternative. Federal takeover and operation of the project would require Congressional approval. While that fact alone would not preclude further consideration of this alternative, there is currently no evidence to indicate that federal takeover should be recommended to Congress. No party has suggested federal takeover would be appropriate, and no federal agency has expressed an interest in operating the project.

2.4.3 Project Decommissioning

As the Commission has previously held, decommissioning is not a reasonable alternative to relicensing a project in most cases, when appropriate protection, mitigation, and enhancement measures are available.[25] The Commission does not speculate about possible decommissioning measures at the time of relicensing, but rather waits until an applicant actually proposes to decommission a project, or there are serious resource concerns that cannot be addressed with appropriate license measures, making decommissioning a reasonable alternative to relicensing.[26] This is consistent with NEPA and the Commission's obligation under section 10(a) of the FPA to issue licenses that balance developmental and environmental interests.

Project retirement could be accomplished with or without dam removal.[27] Either alternative would involve denial of the license application and surrender or termination of the existing license with appropriate conditions.

---

[25] *See, e.g.*, *Eagle Crest Energy Co.*, 153 FERC ¶ 61,058, at P 67 (2015); *Public Utility District No. 1 of Pend Oreille County*, 112 FERC ¶ 61,055, at P 82 (2005); *Midwest Hydro, Inc.*, 111 FERC ¶ 61,327, at PP 35-38 (2005).

[26] *See generally Project Decommissioning at Relicensing; Policy Statement*, FERC Stats. & Regs., Regulations Preambles (1991-1996), ¶ 31,011 (1994); *see also City of Tacoma, Washington*, 110 FERC ¶ 61,140 (2005) (finding that unless and until the Commission has a specific decommissioning proposal, any further environmental analysis of the effects of project decommissioning would be both premature and speculative).

[27] In the unlikely event that the Commission denies relicensing of a project or a licensee decides to surrender an existing project, the Commission must approve a surrender "upon such conditions with respect to the disposition of such works as may be determined by the Commission." 18 C.F.R. § 6.2 (2019). This can include simply shutting down the power operations, removing all or parts of the project (including the dam), or restoring the site to its pre-project condition.

No participant recommended project retirement in response to the Commission's January 30, 2019 notice accepting the application and soliciting protests, comments, recommendations, terms and conditions, and prescriptions, and we have no basis for recommending project retirement. The power and ancillary services provided by the Bear Swamp Project would be lost if the project were retired, and replacement power and services would need to be found. There also could be significant costs associated with retiring the project's powerhouses and appurtenant facilities.

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

3.0 ENVIRONMENTAL ANALYSIS

This section includes: (1) a general description of the project vicinity, (2) an explanation of the scope of our cumulative effects analysis, and (3) our analysis of the proposed action and other recommended environmental measures. Sections are organized by resource area (aquatic, recreation, *etc.*). Historic and current conditions are described under each resource area. The existing conditions are the baseline against which the environmental effects of the proposed action and alternatives are compared, including an assessment of the effects of the proposed protection, mitigation, and enhancement measures, and any cumulative effects of the proposed action and alternatives. Staff conclusions and recommended measures are discussed in section 5.1, *Comprehensive Development and Recommended Alternative*.[28]

3.1 GENERAL DESCRIPTION OF THE RIVER BASIN

The Bear Swamp PSD is located at river mile (RM) 37.6 and the Fife Brook Development is located at RM 37.0 on the Deerfield River in Franklin and Berkshire Counties, Massachusetts. The Deerfield River begins near the towns of Glastenbury and Stratton in Vermont and flows approximately 70 miles mostly south and east to its confluence with the Connecticut River in Greenfield, Massachusetts. The Deerfield River has a total drainage area of 665 square miles with about half the area in southern Vermont (318 square miles) and half in western Massachusetts (347 square miles). The gradient of the Deerfield River is quite steep, averaging 46.8 feet/mile from its headwaters downstream to the U.S. Geological Survey (USGS) streamflow gage near

[28] Unless otherwise indicated, our information is taken from the license application filed by BSPC on March 30, 2018 and additional information filed by BSPC on June 29, 2018, July 9, 2018, August 27, 2018, April 30, 2019, and May 15, 2019.

West Deerfield, Massachusetts, a distance of about 69.5 river miles (Deerfield River Watershed Association, 2019). The Deerfield River Basin includes 149 rivers, streams, brooks, and creeks; and 27 lakes, ponds, and impoundments in the Massachusetts portion of the watershed. Major tributaries in the vicinity of the project include the Cold River and Chickely River, which flow into the Deerfield River approximately 7.7 and 9.5 miles downstream of the Fife Brook dam, respectively.

The Deerfield River Basin is informally divided into an upper and lower basin. The upper Deerfield River Basin, where the project is located, extends from the river's headwaters in the Green Mountains of Vermont and the Berkshire Hills of Massachusetts to the town of Charlemont, Massachusetts. The lower Deerfield River Basin extends from the town of Charlemont to the confluence of the Deerfield and Connecticut Rivers in Greenfield, Massachusetts.

The topography of the upper Deerfield River Basin is generally characterized by forested uplands, low mountains, steep slopes, and narrow valleys. Climate varies by season, with moderately cool summers and cold winters. Temperatures range from summer highs near 72 degrees Fahrenheit (°F) to winter lows around 24°F. Precipitation occurs year-round, with spring months being the wettest. The mean annual precipitation in the project vicinity is about 42.23 inches. Land in the project vicinity is predominately forested and agricultural, with some residential development.

The lower Deerfield River Basin is a region of low, open hills with some cropland and pastureland centralized around the mainstem of the Deerfield River and its tributaries. Land use in the lower Deerfield River Basin includes forestry, pasture, and cropland. The Deerfield River in this area has a moderate gradient that flattens further as the Deerfield River reaches the confluence with the Connecticut River.

The Deerfield River has been used for hydroelectric generation for more than 100 years. There are three FERC-licensed hydropower projects on the Deerfield River, which consist of a water storage reservoir, nine conventional hydroelectric dam facilities, and a pumped storage development (see Table 1). The Somerset Development of the Deerfield Project operates as a storage reservoir to regulate water in the river basin for the downstream Deerfield Project developments.

Table 1. FERC-licensed dams on the Deerfield River.

FERC Project Name	FERC Project Number	Dam/ Development Name	Type	Capacity (MW)	Approximate River Mile
Deerfield Project	P-2323	Somerset	Storage	0	66.0
Deerfield Project	P-2323	Searsburg	Conventional Hydroelectric	4.16	60.3
Deerfield Project	P-2323	Harriman	Conventional Hydroelectric	33.6	48.5
Deerfield Project	P-2323	Sherman	Conventional Hydroelectric	7.20	42.0
Deerfield Project	P-2323	Station No. 5	Conventional Hydroelectric	17.55	41.2
Bear Swamp Project	P-2669	Bear Swamp PSD	Pumped-Storage	666	37.6
Bear Swamp Project	P-2669	Fife Brook	Conventional Hydroelectric	10	37.0
Deerfield Project	P-2323	Station No 4	Conventional Hydroelectric	4.80	20.0
Deerfield Project	P-2323	Station No. 3	Conventional Hydroelectric	4.80	17.0
Central Rivers Power	P-2334	Gardners Falls	Conventional Hydroelectric	3.58	15.7
Deerfield Project	P-2323	Station No. 2	Conventional Hydroelectric	4.80	13.2

(Source: BSPC, 2018; modified by staff)

3.2 SCOPE OF CUMULATIVE EFFECTS ANALYSIS

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (40 C.F.R. § 1508.7), a cumulative effect is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor, but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

Based on our review of the license application and agency and public comments, we have identified water quality, water quantity, aquatic resources (fish, benthic macroinvertebrates, and mussels), and recreation in the Deerfield River Basin as resources that could be cumulatively affected by the proposed continued operation and maintenance of the project in combination with other hydroelectric projects and activities in the Deerfield River Basin. Water quality, water quantity, and aquatic resources were selected because hydroelectric developments along the waterway have altered the flow regime, and have the potential to block or delay fish movement, and entrain fish into diversion canals or penstocks. Recreation was selected because a series of dams on the Deerfield River affect boating opportunities by altering the flow regime and limiting recreational access to project waters.

Although Commission staff's June 1, 2015 scoping document included hydroelectric development in the Deerfield River as a cumulatively affected resource, this EA only analyzes the specific effects of the Bear Swamp Project and the recommended environmental measures on other hydroelectric developments in section 3.3.6, *Socioeconomic Resources*. Commission staff did not identify other past, present, and reasonably foreseeable future actions that could affect other hydroelectric developments in the Deerfield River.

3.2.1 Geographic Scope

The geographic scope of the cumulative effects analysis defines the physical limits or boundaries of the proposed action's effects on the resource, and contributing effects from other hydropower and non-hydropower activities within the Deerfield River Basin. We have identified the geographic scope for water quality, water quantity, and aquatic resources to include the Deerfield River Basin from the headwaters of the Deerfield River in southern Vermont to the confluence of the Deerfield and Connecticut Rivers, based on the extent and potential effects of the hydropower projects on the Deerfield River. For aquatic and recreation resources, we define the geographic scope to include the upper extent of the Fife Brook impoundment, downstream to the confluence of the Deerfield and Connecticut Rivers because project operation begins affecting aquatic and recreation resources at the upstream extent of Fife Brook impoundment and the effects of project operation in conjunction with the operation of four other dams downstream can be seen all the way to the confluence of the Deerfield and Connecticut Rivers in Greenfield, Massachusetts.

3.2.2 Temporal Scope

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

3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

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

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

3.3.1 Aquatic Resources

3.3.1.1 Affected Environment

Water Quantity

Flow Regime

The Deerfield River from its headwaters to the Fife Brook dam has a drainage area of 254 miles. The Deerfield River Basin is characterized by steep valley slopes and a relatively shallow soil depth to bedrock. These conditions contribute to the natural "flashiness" of the flow regime in the Deerfield River and its tributaries, defined by relatively high peak flows and low base flows. Flashy rivers respond quickly to rainfall, with flows rising rapidly to a high peak before receding. Historically, the Deerfield River experiences its highest flows in the winter months (December through February) and its lowest flows during the summer (BSPC, 2018).

The flashiness of the Deerfield River is moderated by numerous hydroelectric developments, the largest of which is Great River Hydro's Deerfield Project, which spans more than 50 miles of the Deerfield River in Vermont and Massachusetts. The Somerset and Harriman Developments of the Deerfield Project regulate flows on the Deerfield River. These reservoirs retain flow during spring runoff, enhance hydropower peaking operations, and augment summer flows to enhance recreational boating and fisheries resources downstream.

Seasonal flow regulation by the Somerset and Harriman Developments results in generally lower spring flows in the Deerfield River than those experienced in nearby unregulated river systems. During the spring months (March through May), much of the flow is retained in the reservoirs. Conversely, Deerfield River flows during the summer, fall, and winter months (July through February) are typically higher than those in nearby unregulated river systems. These higher flows are the result of augmented flow releases from the Somerset and Harriman reservoirs.

Water resources at the project include the upper reservoir of the Bear Swamp PSD, the Fife Brook impoundment, the Deerfield River upstream and downstream of the Fife Brook impoundment, and Smith Brook, a tributary that feeds the Fife Brook impoundment.[29]

The Fife Brook dam is located at RM 37, and impounds the mainstem Deerfield River to create the Fife Brook impoundment. Water flows directly into Fife Brook impoundment from the bypassed reach of Deerfield Station No. 5 and the Deerfield Station No. 5 powerhouse. The Fife Brook impoundment serves as the lower reservoir of the Bear Swamp PSD. The Bear Swamp PSD operates as a peaking facility, typically pumping at night and generating during the day.

The current license requires BSPC to provide a continuous minimum flow of 125 cfs into the tailrace of the Fife Brook dam. The minimum flow release from Deerfield Station No. 5 into the Fife Brook impoundment is 73 cfs, which is less than the required minimum flow of 125 cfs into the Fife Brook dam tailrace. Article 401 of the current license, as amended by the Commission's April 4, 1997 order, requires water to be released from "reservoir storage, if necessary, to ensure that the minimum flow of 125 cfs is met." The minimum flow is released from the Fife Brook impoundment through a system of gated pipes, sized to pass the required minimum 125 cfs.

To provide flows for whitewater recreation, Article 404 of the current license requires 106 periodic, scheduled releases of 700 cfs from April 1 through October 31. These flows are generally released through the Fife Brook Development's turbine-generator unit.[30]

---

[29] Smith Brook contributes negligible flow to the Fife Brook impoundment. Flows are estimated to be less than 5 cfs approximately 95 percent of the time and less than 2 cfs approximately 75 percent of the time.

[30] BSPC states that it voluntarily provides a recreational release of 800 cfs instead of 700 cfs. *See* March 30, 2018 final license application at E-67.

As part of a March 2005 off-license agreement between BSPC and the licensee of the Deerfield Project,[31] BSPC committed to: (1) "operate the upper and lower reservoirs of the Bear Swamp Project in balance as though the project was a closed-cycle system;" and "each day operate the Fife Brook development in a run-of-river mode of operation that maintains the flow balance, provided such operation is in compliance with [BSPC's] FERC license." BSPC states that, because the project is "located in the middle of the [Deerfield Project's] peaking flow regime," the Fife Brook Development is "generally limited to operating in a run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5."

Table 2 shows the monthly and annual flow data from the Fife Brook dam for the period of 2006 through 2015 (excluding 2010, due to approximately 6 months of missing/inaccurate data) and reflects periods before and after Hurricane Irene in 2011. The mean annual flow is 744 cfs, with mean monthly flows lowest in September and highest in April. The maximum peak flow recorded during the period of record was 28,439 cfs, which occurred in August 2011 during Hurricane Irene.

Table 2. Minimum, mean, and maximum flow from Fife Brook dam (January 2006 to December 2015).

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	125	1,015	3,801
February	125	879	2,057
March	125	883	4,137
April	125	1,107	5,732
May	125	649	3,918
June	125	639	7,319
July	125	570	9,107
August	125	638	28,439
September	125	451	8,644
October	125	562	10,220
November	125	653	3,486
December	125	890	6,219
Annual	125	744	28,439

(Source: BSPC 2018, as modified by staff)

Downstream of Fife Brook dam, water levels in the Deerfield River fluctuate on a daily basis as BSPC adjusts outflow from the Fife Brook Development to match peaking inflows received from Deerfield Station No. 5. Figure 3 presents August 2017 gage height data from the USGS gage no. 01168500 on the Deerfield River at Charlemont,

[31] *See* TransCanada Hydro Northeast, Inc., Motion to Intervene and Comments, Docket No. P-2669-061, at Attachment A (filed June 9, 2008).

which is approximately 12 miles downstream of Fife Brook dam. As seen in Figure 3, fluctuating flow releases from Fife Brook dam can vary water levels in the Deerfield River and do not significantly attenuate before reaching this location. Fluctuating flow releases from Fife Brook dam would not be expected to attenuate before reaching the next downstream development, the Deerfield Project's Station No. 4 Development (Deerfield Station No. 4), based on a similar slope and streamwidth between the stretch of the Deerfield River above Charlemont and the stretch of the Deerfield River below Charlemont to Deerfield Station No. 4.

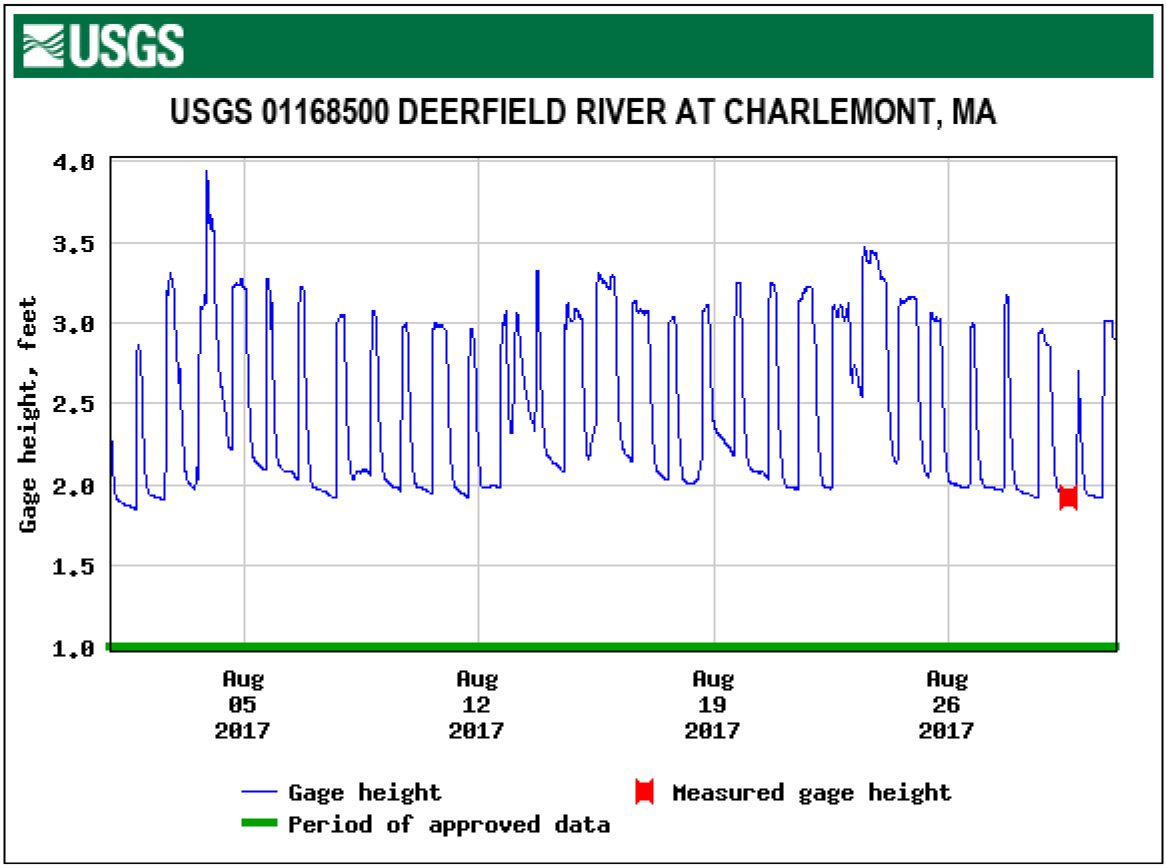


Figure 3. August 2017 gage height data for USGS Gage No. 01168500 in Charlemont, MA (Source: https://waterdata.usgs.gov/ma/nwis/uv?site_no=01168500).

Water levels in the in the Fife Brook impoundment upstream of Fife Brook dam are not stable and are influenced by peaking operations associated with Deerfield Station No. 5 and the Bear Swamp PSD. BSPC manages the volume of water in the Fife Brook impoundment such that there is sufficient volume to fill the upper reservoir to the maximum allowable water surface elevation of 1,600 feet NGVD under the current license. The Fife Brook impoundment has an allowable daily fluctuation of 40 feet between elevations 830 and 870 feet NGVD. During the evening, BSPC typically pumps water from Fife Brook impoundment to the upper reservoir, which reduces water levels in

Fife Brook impoundment. During periods of peak electricity demand (typically daylight hours), BSPC generates hydroelectric power using water stored in the upper reservoir, lowering the upper reservoir to an elevation of 1,555.5 feet NGVD, which in turn raises water levels in Fife Brook impoundment.

Existing Instream Flow Uses

Existing instream flow uses of waters of the Deerfield River within the project boundary include various recreation activities (*e.g.*, fishing, tubing, and recreational boating) and hydroelectric generation. No other instream flow uses of project waters have been identified. Outside of the project boundary, the Deerfield River is used for industrial and municipal water assimilation, irrigation, and snowmaking.

Water Quality

State Water Quality Classifications

The Bear Swamp Project is located on a reach of the Deerfield River that is classified as a Class B waterway with a cold water qualifier by the State of Massachusetts (Massachusetts DEP, 2014) (Table 3). Class B waters must be of such quality that they are suitable as a habitat for fish, other aquatic life, and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. Class B waters also must be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters must have consistently good aesthetic value. The cold water qualifier is applied to streams capable of supporting a year-round population of cold water-adapted aquatic life, such as trout.

Table 3. Established water quality standards for applicable parameters.

Parameter	Class B Cold Water Standard
Dissolved Oxygen (DO)[1]	Shall not be less than 6.0 milligrams per liter (mg/L) in cold water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
Temperature[1]	Shall not exceed 68°F (20°C) based on the mean of the daily maximum temperature over a seven-day period in cold water fisheries, unless naturally occurring.

Parameter	Class B Cold Water Standard
	Where a reproducing cold water aquatic community exists at a naturally occurring higher temperature, the temperature necessary to protect the community shall not be exceeded and the natural daily and seasonal temperature fluctuations necessary to protect the community shall be maintained. The rise in temperature due to a discharge shall not exceed 3°F (1.7°C) in rivers and streams designated as cold water fisheries (based on the minimum expected flow for the month); in lakes and ponds the rise shall not exceed 3°F (1.7°C) in the epilimnion[2] (based on the monthly average of maximum daily temperature).
pH[1]	Shall be in the range of 6.5 through 8.3 standard units and not more than 0.5 units outside of the natural background range. There shall be no change from natural background conditions that would impair any use assigned to this Class.
Solids[1]	These waters shall be free from floating, suspended, and settleable solids in concentrations and combinations that would impair any use assigned to this Class that would cause aesthetically objectionable conditions or that would impair the benthic biota or degrade the chemical composition of the bottom.
Color and Turbidity[1]	These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this Class.

(Source: Massachusetts DEP, 2017)

[1] Title 314 of the Code of Massachusetts Regulations (CMR), section 4.00.

[2] The epilimnion is the warm, oxygen-rich upper water layer of a thermally-stratified lake.

Water Quality Monitoring

BSPC conducted a water quality monitoring study from May 1 to October 27, 2016 that included: (1) vertical profile measurements of water temperature and dissolved oxygen every five feet at a deep location in the Fife Brook impoundment; (2) continuous monitoring of dissolved oxygen and water temperature at two locations in Fife Brook impoundment and four locations in a 15-mile reach of the Deerfield River downstream of Fife Brook dam to a point just upstream of the Deerfield Station No. 4 reservoir (Figure

4, locations in red); [32] and (3) in situ water quality measurements of temperature, dissolved oxygen, pH, and specific conductance at the same six locations as the continuous monitoring, on a monthly basis during the spring and fall (May 1 to June 30 and September 1 to November 1) and biweekly during the critical warm, dry periods of summer (July 1 to August 31).

Fife Brook Impoundment Dissolved Oxygen and Temperature Profiles

Results of the dissolved oxygen and temperature vertical profile monitoring at the deep location in the Fife Brook impoundment showed that the impoundment was well-mixed and did not thermally stratify during the study period. On average, water temperature varied less than 4°F between the surface and maximum depth. Vertical distribution of oxygen concentrations and percent saturation were nearly unaffected by depth, except at the deepest point in the reservoir. Within 5 feet of the bottom, dissolved oxygen dropped to 0 mg/L during most sampling events (Figure 5).

Continuous Water Quality Monitoring in Fife Brook Impoundment and Downstream of Fife Brook Dam

Water temperatures between locations had consistent daily and seasonal patterns, and ranged from a minimum of 40.3°F at the downstream-most location (Purinton Road) on October 27, 2016 to a maximum of 85.5°F at the Purinton Road location on May 27, 2016 (Table 4). The upper extent of the Fife Brook impoundment and the deep water sampling locations[33] within the impoundment generally had lower water temperatures than the downstream sampling locations. Downstream from Fife Brook dam, average water temperatures increased with distance downstream.

[32] Deerfield Station No. 4 is the next hydropower development downstream of Fife Brook dam.

[33] The dissolved oxygen probe was 6 feet off of the bottom of the impoundment, at approximately 806 feet NGVD. Accordingly, the depth of the deep water sampling location varied from 24 feet to as deep as 64 feet, depending on the elevation of the Fife Brook impoundment.

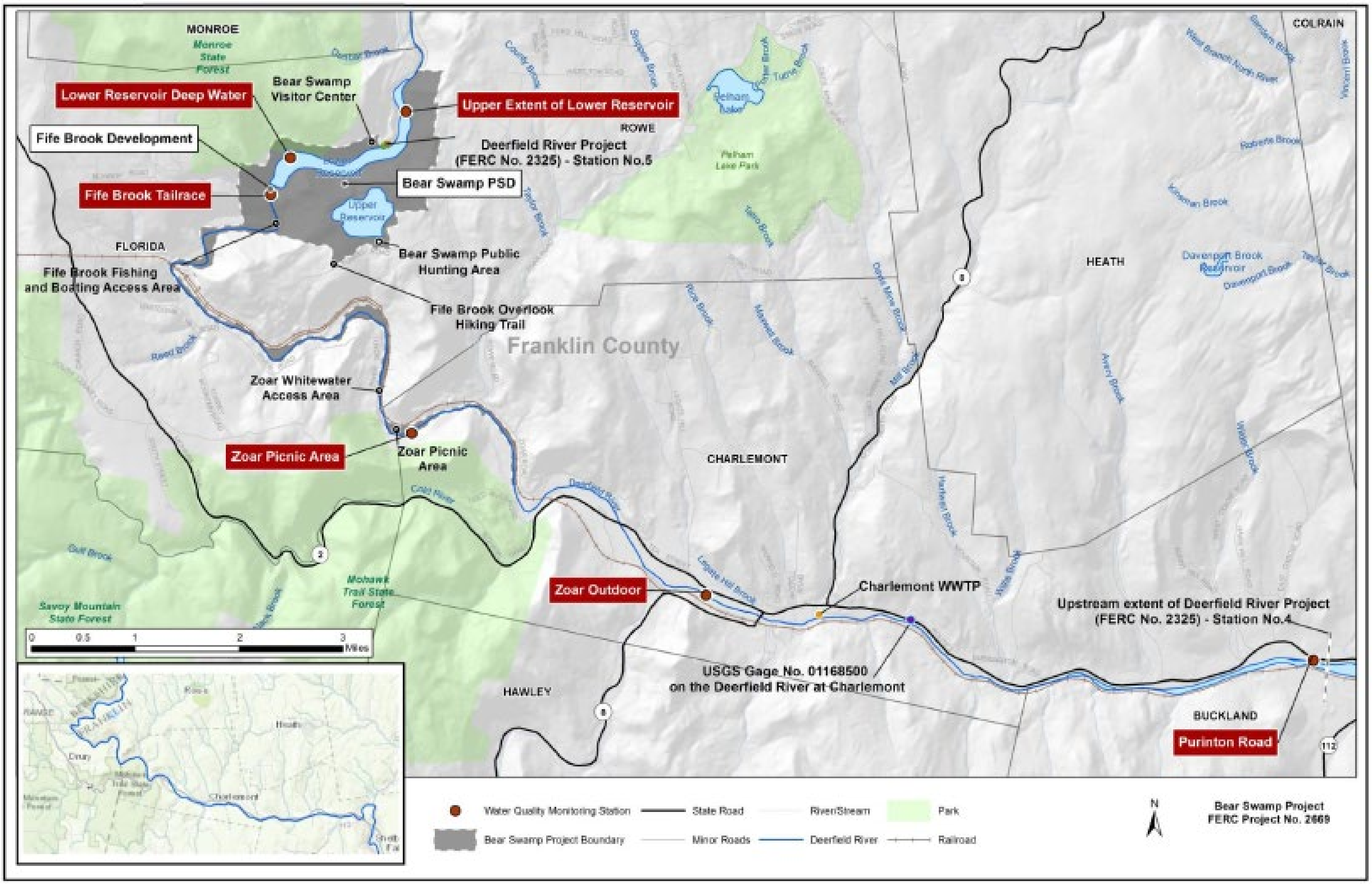


Figure 4. Monitoring locations for the 2016 water quality monitoring study (Source BSPC, 2017a).

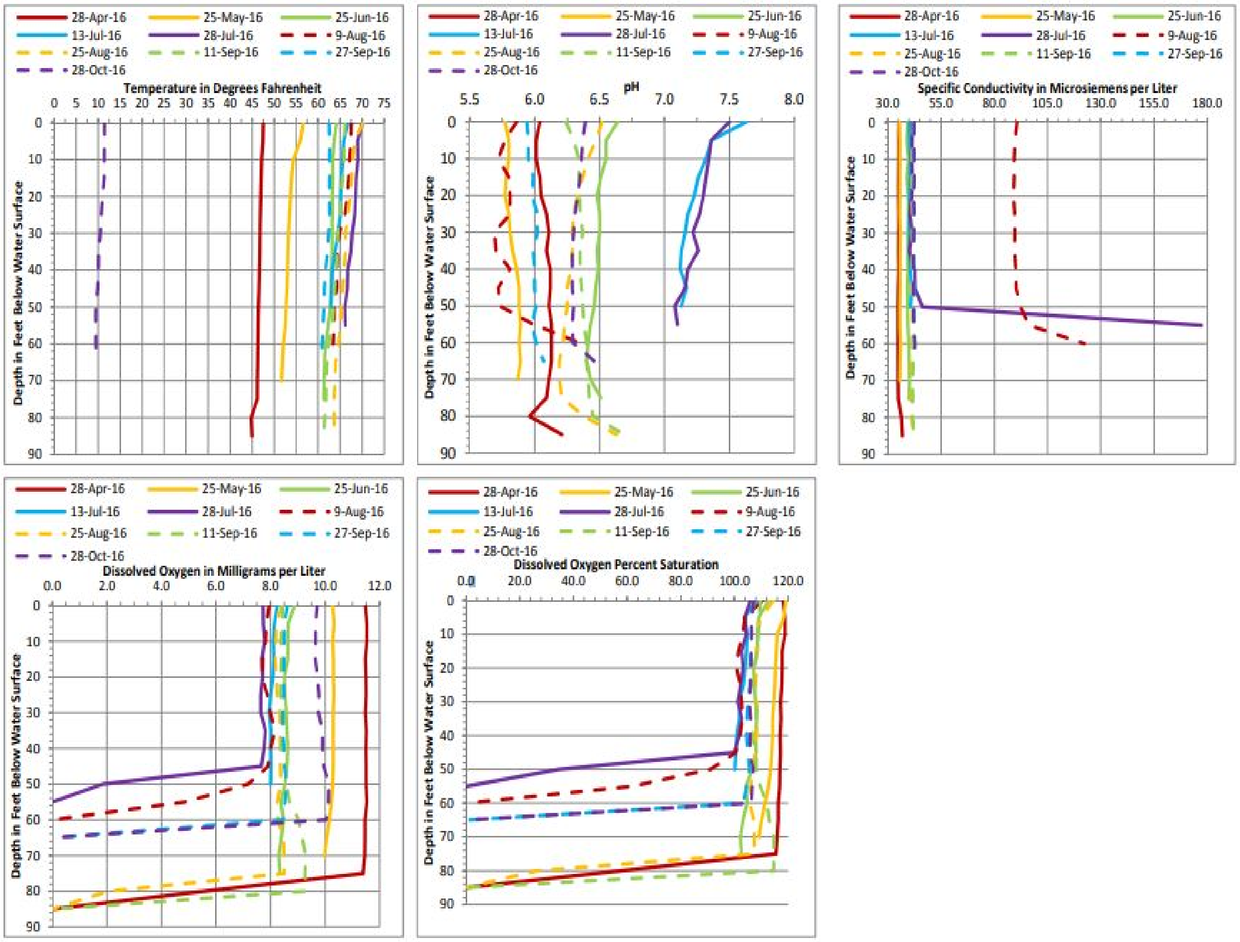


Figure 5. Fife Brook impoundment water quality data from the 2016 water quality monitoring study (Source: BSPC, 2018).

Table 4. Range of temperature and dissolved oxygen measurements from the 2016 water quality monitoring study.

Monitoring Location	River Mile	Temperature (°F)				Dissolved Oxygen (mg/L)			
		Min.	Max.	Mean	Median	Min.	Max.	Median	Mean
Upper Extent of Fife Brook Impoundment	39	42.1[1]	71.6	58.0	58.6	6.6	12.1	9.5	9.6
Fife Brook Impoundment Deep Water	37.8	45.0	78.9	58.7	60.2	0[2]	11.1	6.4	7.6
Fife Brook Tailrace	37.4	47.8	69.9	61.9	63.4	7.7	11.8	9.4	9.2
Zoar Picnic Area	32	43.9	77.8	62.3	63.6	7.2	12.4	9.6	9.4
Zoar Outdoor	27.0	43.7	81.4	64.0	65.4	7.7	12.3	9.4	9.2
Purinton Road	22.0	40.3	85.5[3]	64.6	66.3	3.4	12.5	8.9	8.8

(Source: BSPC, 2018, as modified by staff)

[1] Recorded on October 27, 2016.

[2] BSPC states that the data logger was resting on the bottom, which resulted in DO readings of 0 mg/L for periods during the study.

[3] Recorded on May 27, 2016.

Each monitoring location with the exception of the Fife Brook impoundment deep water location experienced water temperatures that exceeded the state regulatory threshold of 68°F (the state regulatory maximum threshold is based on the mean of the daily maximum temperature over a seven-day period in cold water fisheries). Both the Zoar Outdoor and Purinton Road locations experienced a total of 115 days of exceedances, which represented the highest number of exceedances for the monitoring stations. While daily exceedances at these stations occurred from May 28 through September 24, 2016 (except for five days in June), water temperatures at these stations dropped below 68°F on most days during the evening and morning.

Dissolved oxygen followed daily and seasonal patterns with higher concentrations generally measured in May and September and lower concentrations during June, July, and August. Excluding the measurements take in the deep water of Fife Brook impoundment, dissolved oxygen ranged from a minimum of 3.4 mg/L at Purinton Road on October 4, 2016 to a maximum of 12.5 mg/L on October 27, 2016 at Purinton Road.

The continuous logger in the deep sections of the Fife Brook impoundment recorded a mean dissolved oxygen of 7.63 mg/L; however, there were periods lasting several days where dissolved oxygen fell below the state regulatory threshold of 6.0 mg/L (*i.e.*, during the periods when the daily maximum mean temperature over a seven-day period exceeded 68°F). Low dissolved oxygen measurements in the Fife Brook impoundment were recorded primarily (although not always) when pond elevations fell below approximately 855 feet NGVD.

Besides the low dissolved oxygen concentrations recorded in the Fife Brook impoundment, Purinton Road was the only other location where dissolved oxygen fell below the state regulatory standard of 6.0 mg/L. Dissolved oxygen readings below 6.0 mg/L at Purinton Road occurred on nine days in July, August, September, and October. Each of the low dissolved oxygen readings occurred overnight during low flow periods. The low dissolved oxygen concentration could be due to the combination of low flow, photosynthetic activity, and/or warm water temperatures.

In Situ Water Quality Measurements

Water temperatures between monitoring locations followed a seasonal pattern similar to the continuous monitoring data. Water temperature at all locations warmed over the spring through the summer and subsequently cooled in the fall and ranged from 43.2°F to 80.7°F (Table 5). Water temperature generally increased with distance downstream, and temperatures exceeded 68°F during certain June, July, August, and September sampling events at the Fife Brook impoundment deep water, Fife Brook tailrace, Zoar Picnic Area, Zoar Outdoor, and Purinton Road locations. Water temperature at these locations was generally warmest from late June through early September. The upper extent of the Fife Brook impoundment was the only location that consistently had water temperatures below 68°F during all sampling events.

Dissolved oxygen concentrations were consistently above the state minimum water quality standard of 6.0 mg/L at all monitoring stations during each of the discrete sampling events (Table 6). Dissolved oxygen concentrations ranged from 7.72 mg/L to 12.57 mg/L. The highest dissolved oxygen concentrations were recorded in the upper extent of the Fife Brook impoundment. In contrast to the continuous dataset, dissolved oxygen concentrations recorded at Purinton Road were generally higher than other upstream stations in Deerfield River.

Measured pH during the *in situ* monitoring study ranged from 5.77 to 8.7 (Table 7). The lowest mean pH values were measured at the Fife Brook impoundment deep water location and the highest mean pH values were measured at Purinton Road location. Several pH values fell below the state standard range at multiple monitoring stations in April, May, August, September, and October, and exceeded the standard range in July. All stations were within the state standard pH range during the June 2016 sampling event.

Table 5. Results of *in situ* water temperature measurements for the 2016 water quality monitoring study.

Temperature (ºF)											
Monitoring Station	**4/28**	**5/25**	**6/24**	**7/13**	**7/28**	**8/09**	**8/25**	**9/06**	**9/26**	**10/27**	**Mean**
Upper Extent of Fife Brook Impoundment	46.8	55.89	57.02	60.03	63.43	57.87	59.70	58.26	61.54	45.61	**56.61**
Fife Brook Impoundment Deep Water	47.50	56.57	64.18	66.85	70.05	67.55	70.21	66.09	62.51	52.61	**62.41**
Fife Brook Tailrace	47.32	54.34	64.60	67.17	69.71	66.27	68.05	67.10	62.46	53.04	**62.01**
Zoar Picnic Area	46.72	58.46	68.31	71.91	72.50	63.68	66.04	69.80	63.57	47.41	**62.84**
Zoar Outdoor	48.85	60.10	71.74	76.21	76.64	63.68	66.99	71.40	63.37	44.64	**64.36**
Purinton Road	49.33	60.26	70.48	80.69	76.01	67.89	69.24	70.84	58.14	43.16	**64.60**

(Source: BSPC, 2017a, as modified by staff)

Daily measurement that exceeded Massachusetts State Water Quality Standards (the state regulatory maximum threshold is based on the mean of the daily maximum temperature over a seven-day period that exceeds 68ºF).

Table 6. Results of *in situ* dissolved oxygen measurements for the 2016 water quality monitoring study.

Dissolved Oxygen (mg/L)											
Monitoring Station	**4/28**	**5/25**	**6/24**	**7/13**	**7/28**	**8/09**	**8/25**	**9/06**	**9/26**	**10/27**	**Mean**
Upper Extent of Fife Brook Impoundment	11.35	10.41	9.87	9.64	9.32	9.74	10.50	10.29	10.12	12.16	**10.34**
Fife Brook Impoundment Deep Water	11.47	10.27	8.88	8.24	7.72	7.95	8.42	8.44	8.62	9.71	**8.97**
Fife Brook Tailrace	11.61	10.50	9.07	8.61	8.34	8.17	8.29	9.20	9.42	10.54	**9.38**
Zoar Picnic Area	11.75	10.53	8.81	8.53	8.66	9.20	9.45	9.28	10.00	12.04	**9.83**
Zoar Outdoor	11.11	10.38	9.10	8.35	8.90	9.20	9.67	9.32	10.32	12.31	**9.87**
Purinton Road	11.55	10.44	9.07	8.89	9.09	9.04	9.43	9.46	10.90	12.57	**10.04**

(Source: BSPC, 2017a, as modified by staff)

Table 7. Results of *in situ* pH measurements for 2016 water quality monitoring study.

	pH value										
Monitoring Station	**4/28**	**5/25**	**6/24**	**7/13**	**7/28**	**8/09**	**8/25**	**9/06**	**9/26**	**10/27**	**Mean**
Upper Extent of Fife Brook Impoundment	5.91	6.59	7.04	7.42	7.55	6.11	7.15	6.08	6.09	6.53	**6.65**
Fife Brook Impoundment Deep Water	6.04	5.77	6.64	7.63	7.50	7.95	6.52	6.24	5.94	6.39	**6.66**
Fife Brook Tailrace	6.87	6.42	6.81	7.00	7.23	6.04	6.78	5.86	6.21	6.68	**6.59**
Zoar Picnic Area	5.88	6.55	6.66	7.33	7.82	6.20	6.03	6.28	6.64	6.21	**6.56**
Zoar Outdoor	5.87	6.65	7.08	7.75	8.24	6.20	6.39	6.72	6.82	6.50	**6.82**
Purinton Road	6.08	6.87	7.02	8.68	8.43	6.67	7.12	6.84	6.83	6.61	**7.12**

(Source: BSPC, 2017a, as modified by staff)

Measurement that were outside of the Massachusetts State Water Quality Standards for pH (6.5 through 8.3).

Aquatic Habitat

Upper Reservoir of the Bear Swamp PSD

The upper reservoir of the Bear Swamp PSD is a man-made reservoir that is impounded by a series of four earth and rockfill dikes and existing bedrock. The upper reservoir has a surface area of approximately 118 acres and a 1.9 mile shoreline at a normal maximum elevation of 1,600 feet NGVD. The aquatic habitat of the upper reservoir is generally classified as lentic. The upper reservoir experiences frequent water level fluctuations, as much as 44.5 feet on a daily basis due to the Bear Swamp PSD operation (generation and pumping). Submerged aquatic vegetation was not observed within the upper reservoir when BSPC conducted the Fish Assemblage Study; however some emergent vegetation occurs at the upper elevations of the reservoir, and within the more gradually sloped shorelines. Shoreline slopes range from gradual (1 to 5 degrees) to vertical, with steep slopes occurring along approximately 88 percent of the shoreline.

In its 2015 Aquatic Mesohabitat Assessment and Mapping Study, BSPC mapped aquatic substrate along the shoreline of the upper reservoir between pond elevations of

1,559.8 feet NGVD and the ordinary high water elevation of 1,600 feet NGVD. A total of 22.51 acres of aquatic habitat was mapped in the upper reservoir (Figure 6). Riprap substrate comprised a total of 9.66 acres (42.9 percent of total aquatic habitat area), followed by cobble (23.7 percent), coarse gravel (18.4 percent), bedrock (7.2 percent), small boulder (7.1 percent), and fine gravel (0.6 percent) (BSPC, 2016a).

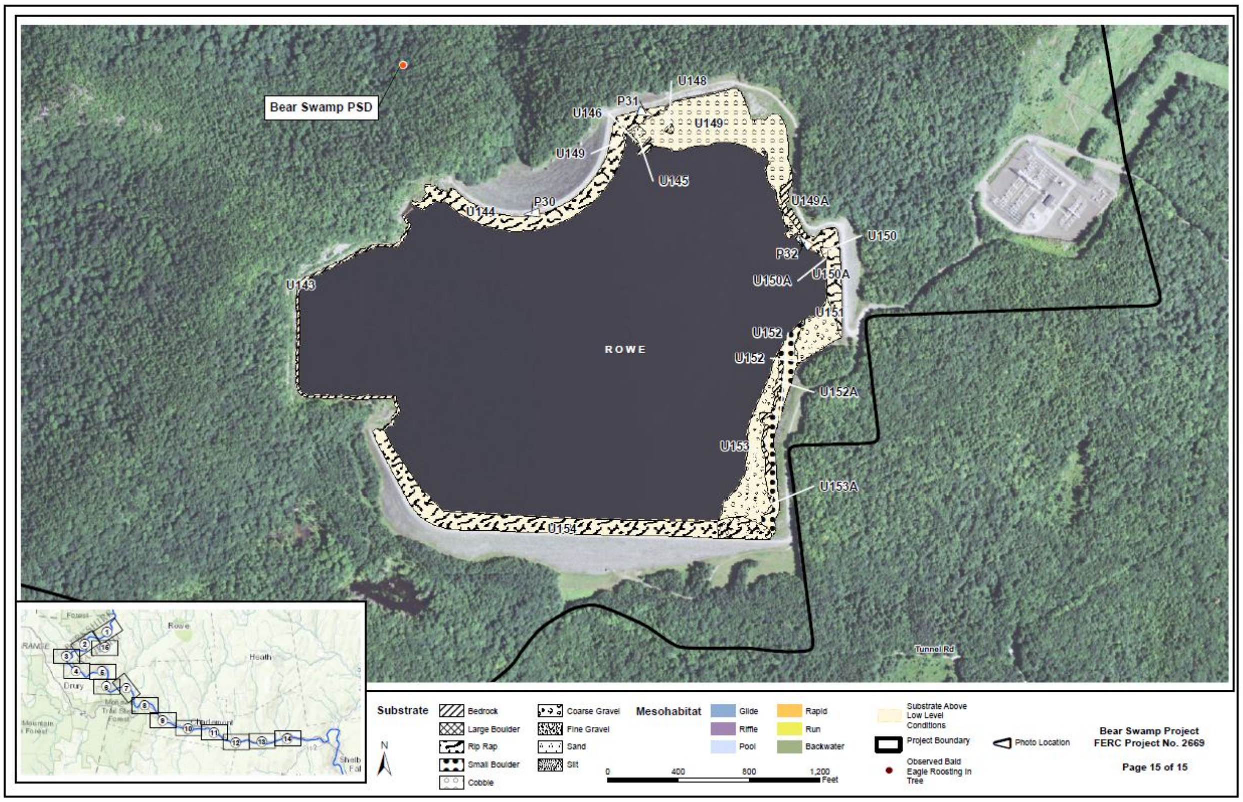


Figure 6. Upper reservoir aquatic habitat (Source BSPC, 2017b).

Fife Brook Impoundment

The Fife Brook dam impounds a 152-acre, 2.5-mile-long reservoir that has a 3.9-mile-long shoreline and a gross storage capacity of 6,900 acre-feet at a maximum allowable elevation of 870 feet NGVD. The Fife Brook impoundment has a usable storage capacity of 4,900 acre-feet and an allowable daily fluctuation of 40 feet between the maximum water surface elevation of 870 feet NGVD and the minimum elevation of 830 feet NGVD (BSPC, 2018).

The aquatic habitat in the Fife Brook impoundment is characterized primarily as lentic habitat. Submerged aquatic vegetation is nearly absent from the Fife Brook impoundment; however, some emergent vegetation occurs at the upper elevations. Shoreline slopes ranged from gradual to vertical with steep slopes occurring along approximately 93.1 percent of the shoreline. BSPC mapped aquatic substrate along the shoreline of the Fife Brook impoundment between elevations of 841 feet NGVD and the ordinary high water elevation of 870 feet NGVD. A total of 31.92 acres of aquatic habitat was delineated in the Fife Brook impoundment. The majority (66.5 percent) of the mapped area consists of cobble, followed by riprap (15.4 percent), large boulder (10.4 percent), bedrock (7.0 percent), and sand (0.6 percent).

<u>Riverine</u>

Riverine habitat is generally divided into three distinct reaches: (1) the approximately 1.2-mile-long section of the impoundment that lies between the Deerfield Station No. 5 powerhouse and the Dunbar Brook Picnic Area (upper extent of the Fife Brook impoundment);[34] (2) the riverine reach extending from Fife Brook dam downstream to a point just upstream of the confluence of the Deerfield River and the Cold River (Deerfield River Upper Study Reach);[35] and (3) the riverine reach extending from the downstream end of the Deerfield River Upper Study Reach to the upper extent of the Deerfield Station No. 4 impoundment (Deerfield River Lower Study Reach).

Upper Extent of the Fife Brook Impoundment

In its 2015 Aquatic Mesohabitat Assessment and Mapping Study, BSPC mapped 0.8 mile of the upper extent of the Fife Brook impoundment from approximately RM 38.8 (at a boater take-out site downstream of the Dunbar Brook Picnic Area) to approximately RM 39.6 (at the upstream extent of the project boundary). This 0.8-mile segment has 0.73 mile of riverine habitat extending across a range of elevations from approximately 878 to 834 feet NGVD. This reach has a mean gradient of approximately 60.1 feet per mile, and a slope of approximately 1.14 percent.

The upper extent of Fife Brook impoundment has a total of 5.55 acres of aquatic habitat. Riffle habitat makes up about 23.9 percent of the aquatic habitat (1.33 acres), followed by glade habitat at 20.6 percent (1.14 acres), pool habitat at 20.5 percent (1.14

---

[34] Staff refers to this 1.2-mile-long section of the impoundment as the "upper extent of the Fife Brook impoundment" throughout this document. This designation is based on the interceding flows from the Deerfield Station No. 5 powerhouse that enter the impoundment at the downstream end of the 1.2-mile segment, and the fact that the 1.2-mile-long segment of the impoundment overlaps with a portion of the bypassed reach of Deerfield Station No. 5. In turn, we refer to the 1.3-mile-long segment from the Deerfield Station No. 5 powerhouse to the Fife Brook dam as the "lower extent of the Fife Brook impoundment."

[35] The Deerfield River Upper Study Reach extends approximately 7.65 miles downstream of Fife Brook Development to a point just upstream of the confluence with the Deerfield and Cold Rivers at approximate RM 29.3.

acres), rapid habitat at 19.7 percent (1.09 acres), and run habitat at 15.3 percent (0.85 acres). Most of the substrate in this reach is dominated by large boulders (51.3 percent, or 2.85 acres of total aquatic habitat area). Stream width averages approximately 66 feet, and ranges in width from 25.0 to 201.0 feet. Embankments are steep sided and dominated by small to large boulders.

Deerfield River Upper Study Reach

The Deerfield River Upper Study Reach consists of approximately 7.58 miles of riverine habitat extending through a range of elevations from approximately 750 to 590 feet NGVD, with a mean gradient of approximately 21.1 feet per mile, and a slope of 0.40 percent.

The Deerfield River Upper Study Reach has a total of 129.12 acres of total aquatic habitat. Riffle habitat makes up about 56.4 percent of the aquatic habitat (73.74 acres), followed by glide habitat at 28.5 percent (37.22 acres), pool habitat at 12.5 percent (16.35 acres), rapid habitat at 1.1 percent (1.38 acres), run habitat at 1.0 percent (1.37 acres), and backwater habitat at 0.5 percent (0.65 acre). The majority of this reach is dominated by cobble, with a subdominant substrate of small boulders. Stream width averages 83.7 feet, and ranges from 3.03 to 228.0 feet.

Deerfield River Lower Study Reach

The Deerfield River Lower Study Reach is approximately 9.12 miles long, and extends through a range of elevations from approximately 590 to 473.7 feet NGVD, with a mean gradient of about 12.8 feet per mile, and a slope of 0.24 percent.

The Deerfield River Lower Study Reach has a total of 173.4 acres of aquatic habitat. Riffle habitat makes up about 51.2 percent of the aquatic habitat (89.25 acres), followed by glide habitat at 33.4 percent (58.19 acres), pool habitat at 13.2 percent (23.07 acres), backwater at 1.9 percent (3.23 acres), run at 0.3 percent (0.51 acre), and rapids at 0.1 percent (0.14 acre) of total aquatic habitat area. The majority of this reach is dominated by cobbles, with a subdominant substrate of coarse gravel. Stream width averages 123.4 feet, and ranges from 5.0 to 251.1 feet.

Fishery Resources

Fish Community

The Deerfield River provides habitat for a diverse assemblage of resident fish ranging from coldwater to warm water species. Warm water species include smallmouth bass, yellow perch, bluegill, minnow species, and yellow bullhead. Migratory species of fish are confined to the reach of the Deerfield River below the dam for Deerfield Project

Station No. 2 (RM 13.2) to the confluence of the Connecticut River. However, the natural movements of migratory fish in the Deerfield River have been restricted by the lack of effective fish passage at other hydropower developments below the project.

Hydropower developments immediately below the Fife Brook dam include the Deerfield Project's Station Nos. 2, 3, and 4 Developments, and the Gardners Falls Project No. 2334 (see Table 1). In two license orders issued April 4, 1997, the Commission required: (1) Western Massachusetts Electric Company to submit a plan to construct and install a downstream fish passage facility at the Gardners Falls Project; [36] and (2) New England Power Company to install downstream fish passage facilities at the Deerfield Project's Station Nos. 2, 3, and 4 Developments and upstream passage at the Deerfield Project Station No. 2 to support the migration of stocked Atlantic salmon, which was the target of restoration efforts by FWS. [37] The Commission approved Western Massachusetts Electric Company's downstream fish passage plan on November 12, 1997[38] and New England Power Company's downstream fish passage plan on August 21, 1998.[39] Downstream fish passage facilities were installed and operational at the Deerfield Project and Gardners Falls Project in 1999. In 2013, FWS discontinued its Atlantic salmon restoration efforts due to poor returns. Subsequently, the Commission suspended the license articles requiring upstream fish passage at the Deerfield Project Station No. 2 in an order issued June 22, 2015,[40] and suspended articles requiring downstream passage at Deerfield Project's Station Nos. 2, 3, and 4 Developments.[41] Downstream fish passage was suspended at the Gardners Falls Project in 2016.[42] To this date, upstream or

---

[36] The license for the Gardners Falls Project was issued with an effective date of April 1, 1997, for a term of 40 years. *Western Massachusetts Electric Company*, 79 FERC ¶ 61,007 (1997).

[37] The license for the Deerfield Project was issued with an effective date of April 1, 1997, for a term of 40 years. *New England Power Company*, 79 FERC ¶ 61,006 (1997).

[38] *Western Massachusetts Electric Company*, 81 FERC ¶ 61,130 (1997).

[39] *New England Power Company*, 84 FERC ¶ 62,171 (1998).

[40] *TransCanada Hydro Northeast, Inc.,* 151 FERC ¶ 62,200 (2015).

[41] *TransCanada Hydro Northeast, Inc.*, 54 FERC ¶ 62,193 (2016).

[42] *Essential Power Massachusetts LLC.*, 155 FERC ¶ 62,117 (2016).

downstream fish passage at the Deerfield and Gardners Falls Projects has not been reinstated.

Coldwater Fishery

Massachusetts DFW manages the entire Deerfield River as a coldwater fish resource from the Vermont border to the confluence of the Deerfield River and Connecticut River in Greenfield, Massachusetts.[43] Massachusetts DFW defines the following fish species as coldwater fish: longnose sucker (*Catostomus catostomus*), slimy sculpin (*Cottus cognatus*), lake chub (*Couesius plumbeus*), American brook lamprey (*Lampetra appendix*), burbot (*Lota lota*), rainbow trout (*Oncorhynchus mykiss*), rainbow smelt (*Osmerus mordax*), landlocked salmon (*Solmo salar*), brown trout (*Solmo trutta*), brook trout (*Salvelinus fontinalis*), and lake trout (*Salvelinus namaycush*). Coldwater species found at the project include rainbow trout, brook trout, longnose sucker, and slimy sculpin.

Coldwater species such as trout reside or migrate locally by season in the Deerfield River, and seek refuge in the winter in deepwater pools. Massachusetts DFW manages two sections of the Deerfield River downstream from Fife Brook dam as catch-and-release fisheries: Fife Brook dam (RM 37) to the Hoosac Tunnel (RM 35), and Pelham Brook (RM 31) to the Mohawk Campground (RM 28).[44] Each year, Massachusetts DFW stocks approximately 7,400 to 10,900 trout of various species into the reach of the Deerfield River downstream of Fife Brook dam to support a recreational trout fishery. Most of the trout stocked are brown and rainbow trout (11 to over 14 inches in size). However, brook trout (12 inches or more in size) were also stocked from 2012 to 2015; and tiger trout (*Salmo trutta* x *Salvelinus fontinalis*) were stocked in 2013 and 2015. The life history of cold water species is provided below.

---

[43] Title 321 of the Code of Massachusetts Regulations (CMR), section 5.00. A cold water fish is a fish species that is sensitive to increases in temperature and require cold water to fulfill one or more life stage requirements. A cold water fish resource is a waterbody (stream, river, or tributary thereto) that contains cold water fish that were reproduced in that waterbody and use such waters to meet one or more of their life history requirements. See 321 CMR § 5.00.

[44] The two sections of the Deerfield River that are managed as catch-and-release fisheries are approximately 5.0 miles long.

Brook Trout

Brook trout are native Massachusetts salmonids that inhabit flowing, highly-oxygenated cold-water streams in mostly western and central Massachusetts. In general, brook trout are found in a wide variety of habitats from high-gradient mountain streams to low-gradient meadow brooks that are kept cool by groundwater or springs. Brook trout prefer water temperatures between 55ºF and 65ºF, but can tolerate temperatures exceeding 68ºF for brief periods of time.

Brook trout spawn from late September through November depending on water temperature and elevation (Whitewater to Bluewater, 2019). Females construct redds[45] in low- to moderate-flowing stream reaches (*i.e.*, riffles) over streambeds composed of coarse sand or stones up to 4 inches in diameter. The free floating, non-adhesive eggs fall into the depression in the substrate where they are fertilized by a dominant male. Following a maturation period, the fry emerge from February to April depending on water temperature. Juvenile trout then seek different substrate and habitat types, including cobble and boulder stream bottoms, small undercut banks and pools where they feed on insects and reach a total length of 3 to 6 inches within one or two years. Juveniles become more piscivorous as they reach maturity at the end of their second year of life. Adult brook trout reach a total maximum adult length of 6 to 8 inches in the wild and seldom live more than three growing seasons.

Brown Trout

Brown trout are a non-native salmonid species that are stocked state-wide in Massachusetts. Like brook trout, brown trout require highly-oxygenated cold-water streams and often compete with brook trout for food and habitat. Brown trout can tolerate higher water temperatures than brook trout and are found in stream reaches with cover and deep pools. Large woody debris, boulders, and undercut banks have been described as key cover components for trout (USDA, 2008).

Brown trout spawn from October to December in tributary streams and small rivers. Females construct redds on streambeds composed of stones ranging from 0.25 to 3 inches in diameter. After hatching, fry emerge and remain in their natal redds for several weeks as they continue to develop. Larvae in redds are vulnerable to the same threats as eggs, but additional mortality occurs from the failure of some individuals to transition from feeding on yolks to feeding on live prey (USDA, 2008). Feeding habits of brown trout are similar to brook trout.

---

[45] A redd is shallow depression in stream gravel that a female trout constructs prior to spawning to lay its eggs.

Rainbow Trout

Rainbow trout are a non-native salmonid species that are stocked state-wide in Massachusetts streams and rivers. Rainbow trout are typically stocked in the spring, and generally do not hold over.[46] Rainbow trout prefer water temperatures between 65°F and 69°F and are the only spring-spawning salmonids reproducing in Massachusetts streams. Reproducing populations in Massachusetts streams are restricted to cold water streams with a high gradient (more than 75 feet per mile), where they prefer swifter currents and actively feed during the day. Reproducing populations of rainbow trout are found in the Deerfield, Connecticut, Westfield, and Housatonic Rivers (Hartel *et al*., 2002).

As part of the Fish Assemblage Study, BSPC measured the length and weight of all sampled trout species in project waters to determine the age of fish, reproductive success, and the overall health of the fishery. Overall, in the upper reservoir, Fife Brook impoundment, and the Deerfield River downstream of the Fife Brook dam, the catch was dominated by brown trout (n=67), followed by brook trout (n=26) and rainbow trout (n=18). BSPC used relative weight (Wr), a noninvasive tool, to assess condition of fish based on length and weight.[47] The largest-sized group of brown trout sampled (>400 millimeter (mm)) were observed in Fife Brook impoundment; these fish were in very good condition despite being slightly below the 100 Wr threshold. The next largest-sized group represent fish in the optimal stocked size range; these fish were large (300-375 mm) and robust with Wr values in excess of 100-130. The smallest-sized group of brown trout likely represents naturally-reproduced fish, as these fish are generally smaller (<275 mm) and thinner, with Wr values less than 100. The size class trend was not as apparent for brook trout and rainbow trout as the total number of fish in the sample was much less than brown trout.

Using length, fish were separated into two cohorts of age classes. See Table 8. Cohort 1 consisted of fish that were young-of-year (YOY), one year old, and two years old (total length <305 mm). Cohort 2 consisted of fish that were greater than two years of age (total length >305 mm).

---

[46] A holdover trout is a trout that is stocked and lives in a stream for over a year beyond the original stocking.

[47] Wr can serve as a surrogate for estimating fish body composition, as a measure of fish health, and to assess prey abundance, fish stockings, and management actions. A Wr value of 95-100 is considered optimal. Stocked fish tend to have Wr values greater than 100 due to their robust hatchery-based diet while wild fish tend to have Wr values less than 100 because their diet is prey-based.

Table 8. Summary of estimated trout age classes by species.

	Rainbow Trout		Brown Trout		Brook Trout	
Age	*n*	*Proportion*	*n*	*Proportion*	*n*	*Proportion*
Cohort 1 - YOY, 0, 1, and 2	12	0.67	46	0.69	26	1.00
Cohort 2 - 2+	6	0.33	20	0.31	0	0.00
Total	***18***	***1.00***	***66***	***1.00***	***26***	***1.00***

(Source: BSPC, 2017b)

Longnose Sucker

Longnose sucker is listed by Massachusetts as a Species of Special Concern. Longnose suckers are found in the western part of Massachusetts in the Deerfield, Housatonic, Hoosac, and Westfield Basins. Longnose suckers prefer cool streams and rivers with clean oxygenated water and rocky substrates. (Massachusetts DFW, 2019). Rivers with poor water quality and altered habitat have driven populations to tributaries with more favorable water quality and habitat, which has led to the decline in longnose sucker numbers in New England.

Longnose suckers spawn from mid-April to July and may migrate several kilometers before reaching their spawning grounds. Longnose suckers spawn in areas that have moderate to fast currents and gravel substrates. Unlike trout, they do not build nests, but release adhesive sinking eggs. Longnose sucker eggs hatch in 8 to 10 days, and young move into midwater depths to feed on plankton (Hartel *et al.*, 2002). YOY fish can be found midwater feeding on plankton. Longnose sucker reach maturity around 5 to 7 years of age and feed on benthic macroinvertebrates, insect larvae, and algae (Massachusetts DFW, 2019).

Catadromous Fish

American eel is the only catadromous fish species that occurs at the project.[48] The American eel spends most of its life in fresh or brackish water before migrating to the Sargasso Sea to spawn. It occurs throughout warm and cold waters of the Atlantic Ocean and Atlantic coastal drainages in North America (Boschung and Mayden, 2004). Within its range, it is most abundant throughout the Atlantic coastal states (ASMFC, 1999).

Spawning likely occurs from February through April in the Sargasso Sea, although the act of spawning has never been observed (Boschung and Mayden, 2004). Fertilized

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

eggs and larvae, known as the planktonic phase, drift with the Gulf Stream currents along the east coast of the United States (Jenkins and Burkhead, 1993). Following this phase, the planktonic leptocephali, ribbon-like eel larvae, metamorphose (or transform) into what is termed a "glass" eel as it approaches coastal waters. Glass eels are completely transparent and make their way into brackish waters by the use of flood tides. Once skin pigments develop in glass eels, they are considered "elvers."[49]

As eels mature, elvers become juvenile, or "yellow" eel. The majority of eels collected in freshwater rivers are typically yellow eel, which is considered the primary growth phase of its life cycle (Ross *et al*., 2001). Yellow eel are typically sedentary during the day, often burying in mud or silt, and becoming active at night to feed (Jenkins and Burkhead, 1993). They associate with pools or backwater habitats, and often have relatively small home ranges (Gunning and Shoop, 1962). The juvenile stage can last from five to 40 years before finally maturing into the silver eel and out-migrating in the fall and mid-winter months to spawning grounds (*i.e.*, Sargasso Sea) (Boschung and Mayden, 2004).[50] Adult eels are presumed to die after spawning (Boschung and Mayden, 2004; Jenkins and Burkhead, 1993).

Eels are known to occur in the Deerfield River downstream of the Bear Swamp Project in small numbers. BSPC documented one adult eel within the project boundary in the reach of the Deerfield River downstream of Fife Brook dam. As discussed below, Massachusetts documented 20 eels in its survey of the Deerfield River downstream of Fife Brook dam. BSPC has not observed any eel mortalities at the project and no mortalities have been reported on the record.

Massachusetts DFW 2016 Fish Community Survey

In the late summer and early fall of 2016, Massachusetts DFW surveyed the reach of the Deerfield River downstream of Fife Brook dam to downstream of the Deerfield Station No. 4. Massachusetts DFW collected a total of 7,045 fish, consisting of 21 species. Minnow species (Cyprinidae) dominated the Massachusetts DFW fish collection with blacknose dace (*Rhinichthys atratulus*) accounting for approximately 48 percent of the total catch. Some species that were collected are not present throughout the entire study reach. For instance, the catch downstream of Deerfield Station No. 4 included Atlantic salmon (*Salmo salar*), which does not occur upstream of the Deerfield Station No. 4 dam. Within the Deerfield Station No. 4 impoundment, the catch included yellow

[49] Elvers often serve as important forage fish for striped bass and other large piscivores.

[50] Juvenile eels that reside in estuaries reach maturity and migrate earlier than juveniles found in freshwaters. These eels can reach full maturity without migrating to freshwater (FWS, 2009).

bullhead (*Ameiurus natalis*); and the catch at a specific location adjacent to the Charlemont Water Treatment Facility included sea lamprey (*Petromyzon marinus*), rock bass (*Ambloplites rupestris*), and American eel (*Anguilla rostrata*). The longnose sucker, a Massachusetts Species of Special Concern, was also collected in the fishery survey.

Fish Assemblage Study

In 2016, BSPC surveyed the fish community in the Fife Brook impoundment, upper reservoir of the Bear Swamp PSD, and the reach of the Deerfield River extending from Fife Brook dam downstream to the upstream extent of the Deerfield Station No. 4 impoundment during two seasonal events (late spring/early summer, and late summer/early fall). The study area was divided into seven study reaches based on habitat types that were determined by mesohabitat data collection, including:

- The Upper Reservoir (lacustrine habitats);
- The Fife Brook impoundment (lacustrine habitats);
- The Upper Extent of the Lower Reservoir - riverine habitat in the approximately 1.2-mile-long section of the Fife Brook impoundment that lies between the Deerfield Station No. 5 powerhouse and the Dunbar Brook Picnic Area;
- The Deerfield River Upper Study Reach - riverine habitats from the tailrace of the Fife Brook dam to the confluence of the Deerfield River with the Cold River; and
- The Deerfield River Lower Study Reach - riverine habitats from the Cold River to the upstream extent of the Deerfield Station No. 4 impoundment.

The upper reservoir and Fife Brook impoundment were further divided into littoral and deep-water habitat[51] types. The Deerfield Upper and Lower Study Reaches were further divided by aquatic mesohabitat types (*e.g.*, riffle, run, pool/glide).

A total of 7,881 fish representing 18 species were collected from the study area in 2016 (BSPC, 2017b). Table 9 provides the species composition, number of individuals collected, and relative abundance of the fish species collected during the two seasonal survey events. Table 9 also provides these parameters by sampled reaches, and combines the results of both seasonal sampling events and all survey gear types used for surveying. Diversity and abundance were highest in the Deerfield River Upper Study Reach and the

[51] Depths of the deep water habitat in Fife Brook impoundment range from 24 feet to 64 feet depending on the water surface elevation of the Fife Brook impoundment

Deerfield River Lower Study Reach, with 16 species comprising 82.7 percent of the total catch (BSPC, 2017b). Minnow species (*Cyprinidae*) were the most abundant and diverse group, comprising nearly 60 percent of the total combined catch, and consisting of six species. The family of Cyprinids occurred primarily in the riverine reaches. Yellow perch dominated the reservoir communities, but were not collected in the Deerfield River Upper or Lower Study Reaches because yellow perch prefer lake and pool habitat rather than fast flowing riverine habitat.

Upper Reservoir

Boat electrofishing was used to survey the littoral zone habitat and gillnets were deployed to sample deep water habitat in the upper reservoir. The late spring/early summer survey collected few fish in either habitat (littoral or deep water) and consisted of yellow perch (96 to 164 mm in length) and a single smallmouth bass in the littoral zone, and white sucker and a single brown trout (415 mm and 700 mm) in the deeper water habitat (Table 9).

The late summer/early fall survey collected a large number of juvenile yellow perch and a smallmouth bass in the littoral zone; and four white suckers, two yellow perch, and a single smallmouth bass in the deep water habitat. Total lengths of the yellow perch ranged from 46 to 174 mm with most of the yellow perch being YOY. These YOY perch appeared to be utilizing the few areas of the upper reservoir where any type of significant structure existed. These fish were captured in two main areas, the first being a craggy, bedrock/boulder area and the second was in a small cove with some small overhanging and inundated vegetation.

Fife Brook Impoundment

Boat electrofishing was used to survey the littoral zone habitat and gillnets were deployed to sample deeper water habitat in the Fife Brook impoundment. The late spring/early summer survey collected few fish in either habitat and consisted of white sucker, brown trout, and yellow perch (Table 9). The late summer/early fall survey collected smaller numbers of white sucker than the late spring/early summer survey, but much higher numbers of yellow perch were caught in the littoral zone. The length frequency for yellow perch reflect multiple year classes from YOY to adults with total lengths ranging from 50 to 217 mm. Like the upper reservoir survey, these YOY perch appeared to be utilizing the few areas of the lower reservoir where any type of significant structure existed. These fish were captured among emergent and inundated vegetation in one area within the littoral zone. Four adult brown trout were collected from each of the littoral zone and deeper water habitats. The trout measured 437 to 535 mm and weighed 700 to 1,700 grams (g).

Table 9. Results of the 2016 Fish Assemblage Study.

Species		Reservoir		Riverine				
Scientific Name	**Common Name**	**Upper Reservoir**	**Fife Brook Impoundment**	**Upper Extent of Fife Brook Impoundment**	**Deerfield River Upper Study Reach**	**Deerfield River Lower Study Reach**	**Total**	**Relative Abundance (%)**
Anguilla rostrate	American Eel				1		1	<0.1
Catostomus commersonii	White Sucker	12	45	10	22	553	842	10.7
Catostomus	Longnose Sucker				17	7	24	0.3
Micropterus dolomieu	Smallmouth Bass	3	3			7	13	0.2
Micropterus salmoides	Largemouth Bass					1	1	<0.1
Notropis cornutus	Common Shiner				144	222	366	4.6
Notropis hudsonius	Spottail Shiner			2	51	370	423	5.4
Rhinichthys cataractae	Longnose Dace			10	803	809	1,622	20.6
Rhinichthys atratulus	Blacknose Dace			6	954	1,149	2,109	26.8
Semotilus atromaculatus	Creek Chub			1	36	101	138	1.8
Semotilus corporalis	Fallfish		6		23	3	32	0.4

Species		Reservoir		Riverine				
Scientific Name	**Common Name**	**Upper Reservoir**	**Fife Brook Impoundment**	**Upper Extent of Fife Brook Impoundment**	**Deerfield River Upper Study Reach**	**Deerfield River Lower Study Reach**	**Total**	**Relative Abundance (%)**
Ictalurus nebulosus	Brown Bullhead							
Perca flavescens	Yellow Perch	1,142	77	2			1,221	15.5
Etheostoma olmstedi	Tessellated Darter				73	211	284	3.6
Oncorhynchus mykiss	Rainbow Trout			6	6	6	18	0.2
Salvelinus fontinali	Brook Trout			16	4	6	26	0.3
Salmo trutta	Brown Trout	1	8	11	28	19	67	0.9
Cottus cognatus	Slimy Sculpin			6	566	121	693	8.8
Total Captured		**1,158**	**139**	**70**	**2,929**	**3,585**	**7,881**	**100.0**
Total Species		**4**	**5**	**10**	**15**	**15**	**18**	

(Source: BSPC 2018, as modified by staff)

Upper Extent of the Fife Brook Impoundment

Trout species dominated the catch in the Upper Extent of the Fife Brook impoundment. The late spring/early summer survey collected seven brown trout, six of which were YOY with lengths ranging 47 to 64 mm and weights ranging from 4 to 7 g. The remaining brown trout was an adult (392 mm; 785 g). While late summer/early fall sampling still showed low abundance, it resulted in substantially higher diversity with 10 species. A total of 26 trout (brown trout, brook trout, and rainbow trout) were collected during the fall sampling. The lengths and weights for brook trout, rainbow trout, and brown trout indicates multiple year classes occur in this reach. Lengths for brook trout range from 51 to 275 mm and weights range from 3 to 250 g. Total lengths for rainbow trout ranged from 81 to 207 mm and weights ranged from 4 to 90 g. For brown trout, lengths ranged from 84 to 224 mm and weight ranged 4 to 120 g.

Deerfield River Upper Study Reach

A total of 2,929 fish consisting of 15 species were collected in the Upper Study Reach of the Deerfield River, downstream of Fife Brook dam. Blacknose dace, longnose dace, and slimy sculpin dominated the fish collection. All three trout species (brown trout, brook trout, and rainbow trout) were collected within this study reach. Brown trout ranged in length from 76 to 370 mm and in weight from 4 to 700 g, which included YOY, juvenile, and adult age classes, with younger age classes being the most abundant. Brook trout ranged from 115 to 198 mm in length and weighed 11 to 74 g. A mix of age classes of rainbow trout were collected, with the smallest ranging from 181 mm to 208 mm (40 to 90 g) in length and several larger fish ranging from 315 to 415 mm in length and 300 to 819 g. The larger rainbow trout are within the stocking ranges used by Massachusetts DFW. The longnose sucker, a state-listed Species of Special Concern, was also captured in this reach and ranged in size from 76 to 190 mm. Other species of interest collected within this study reach were a single American eel (*Anguilla rostrata*) and a single brown bullhead (*Ameiurus nebulosus*).

Deerfield River Lower Study Reach

A total of 3,585 fish consisting of 15 species were collected in the Deerfield River Lower Study Reach. Similar to the upper reach, the fish catch was dominated by blacknose dace and longnose dace, followed by white sucker. In contrast to the Deerfield River Upper Study Reach, slimy sculpin were much less represented as a proportion of the catch in the Deerfield River Lower Study Reach. All three trout species were also collected. The measured sizes for brook trout ranged from 80 to 150 mm and weights from 5 to 28 g; the brown trout catch was indicative of YOY, ranging in length from 44 to 53 mm and in weight from 1 to 4 g; and rainbow trout were slightly larger with lengths ranging from 145 to 152 mm and weights ranging from 25 to 29 g. In addition, smallmouth bass and longnose sucker were captured within this study reach.

Freshwater Mussels

There are four species of mussel that are known to occur in the Deerfield River Basin. These species include the eastern pearlshell (*Margratifera margratifera*), eastern elliptio (*Elliptio complanata*), eastern floater (*Pyganodon cataracta*) and Alewife floater (*Anodonata implicata*).

In 2016, BSPC surveyed 17 miles of the Deerfield River for freshwater mussels, from the upstream extent of the Fife Brook impoundment to the upstream extent of the Deerfield Station No. 4 impoundment. No freshwater mussels or mussel shells were observed at any of the survey sites investigated.

Benthic Macroinvertebrates

Benthic macroinvertebrates include aquatic insects (such as dragonflies, mayflies, stoneflies, caddisflies, midges, beetles), snails, worms, freshwater clams, mussels, and crayfish. Benthic macroinvertebrates are an important food source for fish and are an indicator species of ecosystem health. Dragonflies, mayflies, stoneflies, and caddisflies are all found in the Deerfield River. Stoneflies are found in cold-running waters, while mayflies and caddisflies are found in both standing and cool flowing waters. A robust population of mayflies, stoneflies, and caddisflies is indicative of good water quality.

Dragonflies

Dragonflies have a two-part life cycle with an aquatic larval stage and an aerial adult stage. Adult dragonflies mate in mid- to late summer. After mating, females lay eggs over water, in submerged or emergent aquatic vegetation, or in sandy or muddy substrate of lakes, streams, and rivers. The eggs of some species hatch after a few days, while others may overwinter before hatching. The larval stage lasts from several months to 3 to 5 years depending on the species. Larvae are ambush predators and burrow in or sprawl over the substrate or cling to aquatic vegetation and wait for prey to pass by. Prey include other aquatic insect larvae, small fish, and tadpoles.

At the end of the larval period, the larvae crawl out of the water (*i.e.*, emergence) onto vegetation, rocks, shoreline substrate, or bridge abutments to metamorphose into adults. After emergence, the eclosure period begins, which is when the larva sheds its exoskeleton and metamorphoses into an adult. Some species eclose right at the water's surface while others climb considerable distances vertically and/or horizontally from the water's edge. After shedding its larval exoskeleton, the larva becomes a teneral, which is an adult with an exoskeleton that has not fully hardened. Because its exoskeleton has not hardened, the teneral cannot fly and is susceptible to predation and being washed away and drowned by waves or rising water levels. The adult leaves the eclosure substrate once its exoskeleton hardens enough to allow it to fly away.

Abundance and Locations

BSPC conducted a study in 2016 to locate state-listed dragonflies and suitable habitat within and adjacent to the Deerfield River in the reach of the Deerfield River from the upper extent of the Fife Brook impoundment to the upstream extent of the Deerfield Station No. 4 impoundment. BSPC identified 10 transects in the survey area and visited the transects every two weeks from mid-May 2016 through mid-September 2016, for a total of 10 surveys per transect. Pursuant to the approved study plan, BSPC searched each 100-foot-long transect along the shoreline for discarded exoskeletons of dragonfly nymphs, known as exuviae. BSPC searched accessible substrate in the water and on suitable substrate on land wherever dragonflies had the potential to reach during emergence along the 100-foot-long stretch of shoreline. BSPC generally conducted the surveys beginning at dawn when the Deerfield River downstream from Fife Brook dam was typically at a minimum flow of 125 cfs and the Fife Brook impoundment was often at its lowest daily elevation.

At each transect, BSPC recorded bank slope, bank height, bank stability, dominant substrate types, dominant plant species and percent cover, tree canopy height and density, woody debris cover, presence of anthropogenic structures, land use, and representative photographs.

BSPC found a total of 223 exuviae on eclosure substrate and an additional 74 exuviae that had been dislodged from eclosure substrate (Table 10). These exuviae belonged to seven dragonfly species: (1) ocellated darner (*Boyeria grafiana*), (2) fawn darner (*B. vinosa*), (3) mustached clubtail (*Gomphus adelphus*), (4) Uhler's sundragon (*Helocordulia uhleri*), (5) northern pygmy clubtail (*Lanthus parvulus*), (6) riffle snaketail (*Ophiogomphus carolus*), and (7) Maine snaketail (*Ophiogomphus mainensis*). Two *Boyeria* and 14 *Ophiogomphus* found were missing important diagnostic features needed for species-level identification. BSPC also found a single rusty snaketail (*Ophiogomphus rupinsulensis*) exuvia that had become dislodged from eclosure substrate.

Approximately 87 percent of the exuviae found on eclosure substrate belonged to *O. mainensis*, and BSPC found over half of the total number of exuviae at Site 5 (Table 10). Site 5 also had the greatest number of species (six) based on exuviae found on substrate and dislodged exuviae. Site 3 was the most upstream site where dragonflies were found, although only one *O. mainensis* exuvia was found on eclosure substrate. Dislodged exuviae of three additional common species (*B. vinosa*, *H. uhleri*, and *O. rupinsulensis*) and *B. grafiana* were also found at Site 3, which suggests that dragonflies emerged at the site or at upstream locations and had become dislodged. BSPC did not find any exuviae on eclosure substrate at Sites 1 and 2, which were located in the Fife Brook impoundment, or at Site 9; however, a few dislodged exuviae were found at Site 9. The only other invertebrate exuviae observed at Sites 1 and 2 were a single stonefly

Table 10. Dragonfly exuviae collected by site.

Site	**Approximate Distance from Fife Brook Dam (miles)**	***Boyeria grafiana****	***Boyeria vinosa***	***Boyeria* sp.**	***Gomphus adelphus***	***Heterocordulia uhleri***	***Lanthus parvulus***	***Ophiogomphus carolus****	***Ophiogomphus mainensis***	***Ophiogomphus rupinsulensis***	***Ophiogomphus* sp.**	**Total**
3	1	(4)	(1)			(1)			1 (2)	(1)	(1)	1 (10)
4	5	(1)			1	(2)		5 (3)	35 (6)		(6)	41 (18)
5	6	(2)	1 (1)		1 (1)	4 (4)	1	8 (2)	101 (2)		1	117 (12)
6	7	(2)	(2)		1			1	39		(2)	41 (6)
7	8	1 (5)	(1)	(1)	1			1	12 (1)			15 (8)
8	10	(1)	(1)						2 (2)	(1)	(1)	2 (6)
9	11	(1)							(3)			(4)
10	16	(3)	1 (1)	(1)				(1)	4 (3)		1 (1)	6 (10)
Total		1 (19)	2 (7)	(2)	4 (1)	4 (7)	1	15 (6)	194 (19)	(2)	2 (11)	223 (74)

(Source: BSPC 2017, modified by staff)
* State-listed species.
Numbers in parentheses indicate dislodged exuviae that may have come from upstream of the site.
BSPC found no exuviae at Sites 1 and 2.
Zeros for where no exuviae were found are omitted for clarity.

exuvia and a single caddisfly exuvia, respectively. Site 9 was typical of other cobble bars surveyed and had the greatest abundance of stonefly exuviae of all survey sites.

BSPC found only one *B. grafiana*, a state-listed Species of Special Concern, on eclosure substrate. BSPC found 15 *O. carolus*, state-listed as threatened, across 4 sites, which were also the sites with the greatest dragonfly abundance (117 exuviae) and diversity (7 species). BSPC observed a single *Boyeria sp*. larva under cobble exposed at low flows during surveys at Sites 4 and 9. However, no *Boyeria sp*. exuviae were found on eclosure substrate at either site. The remaining dragonfly species were found in low numbers.

State-listed Dragonflies

There are five dragonfly species that are protected by the Massachusetts Endangered Species Act[52] (*i.e.*, state-listed species) and that have been documented at the project or that may occur at the project based on the habitat present (BSPC, 2017d). These species include the harpoon clubtail (*Gomphus descriptus*), ocellated darner (*Boyeria grafiana*), rapids clubtail (*Gomphus quadricolor*), riffle snaketail (*Ophiogomphus carolus*), and spine-crowned clubtail (*Gomphus abbreviatus*). BSPC's 2016 dragonfly survey documented two of the five state-listed species, *B. grafiana* and *O. carolus*.

The range of *B. grafiana* includes the northeastern U.S. and southeastern Canada extending west to the Great Lakes (Blair *et al*., 2003). The species is uncommon in Massachusetts and found primarily in the northwestern part of the state. Larvae are found clinging to the underside of rocks or submerged sticks in swiftly-flowing, rocky forest streams and rivers and rocky shored lakes (Blair *et al*., 2003; Massachusetts DFW, 2015a). Larval development time is unknown, but similarly-sized dragonfly species in the same family develop in 1 to 4 years (Massachusetts DFW, 2015a). When ready to eclose, larvae crawl out of the water onto exposed rocks, emergent vegetation, or shoreline vegetation. Peak emergence of *B. grafiana* is July 8 through August 31. The time between emergence and flight is approximately 1 to 2 hours. Adults are found in shady areas near streams from July through mid-October (Blair *et al*., 2003).

The range of *O. carolus* is similar to that of *B. grafiana* described above. Larvae are found in swiftly-flowing, sandy or rocky streams and rivers. Larval development time for this species is unknown, but similarly-sized species develop in about 1 year. (Massachusetts DFW, 2015b). Larvae burrow in the sediment to avoid predators and to camouflage themselves from prey. Larvae climb up on exposed rocks, logs jutting out of the water, or the stream bank to eclose. Peak emergence of *O. carolus* is May 15 through

[52] *See* 321 CMR § 10.00 (2017).

June 15. The time between emergence and flight is approximately 1 to 2 hours. Unlike *B. grafiana*, adult *O. carolus* adults hunt in forest clearings away from the water. Adults are typically observed from mid-May through July (Massachusetts DFW, 2016b).

3.3.1.2 Environmental Effects

Water Quantity

<u>Effects on Aquatic Habitat in the Reservoirs</u>

BSPC proposes to continue to operate the Bear Swamp PSD in a store and release mode by pumping water from the Fife Brook impoundment (*i.e.*, the lower reservoir) during periods of low electricity demand, storing the water until periods of high electricity demand, and then generating electricity by discharging water back into the Fife Brook impoundment during periods of high electricity demand. BSPC proposes to fluctuate the upper reservoir of the Bear Swamp PSD by as much as 50 feet on a daily basis (between 1,550 and 1,600 feet NGVD) and to fluctuate the Fife Brook impoundment by as much as 40 feet on a daily basis (between 830 and 870 feet NGVD). However, BSPC would continue to hold a portion of its useable storage capacity in the upper reservoir between elevations 1,555.5 and 1,550 feet NGVD for emergency/reserve conditions, which would reduce the useable storage in the upper reservoir from 5,260 acre-feet to 4,600 acre-feet.

BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5."[53] BSPC also proposes to continue releasing a minimum flow of 125 cfs from the Fife Brook dam to protect aquatic habitat in the Deerfield River.

BSPC proposes to continue to provide 106 scheduled whitewater flow releases from the Fife Brook dam according to the existing release schedule (*i.e.*, whitewater releases between 9:30 a.m. and 12:00 p.m. on 50 weekend days and 56 weekdays from April 1 to October 30, for a minimum duration of three hours). BSPC also proposes to discontinue its current practice of holding generation at 3 MW for 15 minutes before increasing generation to higher output levels.

Massachusetts DFW recommends under section 10(j) that BSPC operate the project in a "year-round, run-of-release mode." Similarly, Interior recommends under section 10(j) that BSPC operate the Fife Brook Development as a "run-of-release facility, passing inflow it receives from the upstream Deerfield Project's Deerfield [Station] No. 5 development below Fife Brook dam on a near instantaneous basis." Massachusetts DFW and Interior also recommend under section 10(j) certain flow releases and operational

---

[53] BSPC also proposes to continue using inflow to Fife Brook impoundment to replenish water in the upper and lower reservoir lost through occasional evaporation.

limits to protect downstream aquatic resources, including: (1) a continuous minimum flow of 125 cfs from April 16 through October 31; (2) a continuous minimum flow of 350 cfs from November 1 through April 15; and (3) up-ramping limitations (*i.e.*, limits to the hourly rate of change in flow releases). These recommendations could affect the elevations of Fife Brook impoundment and the upper reservoir of the Bear Swamp PSD.

The Connecticut River Conservancy (CRC) recommends using a staged ramping process for increasing flows, which would include a 1-hour hold at an intermediate flow that is equivalent to the midpoint of the total scheduled flow. CRC recommends additional intermediate flow release of one hour for "higher flows."[54]

Trout Unlimited recommends releasing flows from Fife Brook dam with a one-hour ramp up to generation and a one-hour ramp down from generation from March 15 through June 30 when newly emerged trout fry are vulnerable to changes in flow.

Our Analysis

Water levels in the upper reservoir and the Fife Brook impoundment are not stable and can fluctuate rapidly. BSPC generates at the Bear Swamp PSD on a daily basis during peak demand periods, which causes water levels in the upper reservoir to drop by as much as 45.5 feet from 1,600 to 1,555.5 feet NGVD. The water from the upper reservoir flows directly into the Fife Brook impoundment, which causes water levels in the impoundment to rise by as much as 40 feet from 830 to 870 feet NGVD. Then, during periods of low demand, BSPC pumps water from the Fife Brook impoundment to the upper reservoir, which causes water levels in the Fife Brook impoundment to drop by as much as 40 feet and water levels in the upper reservoir to rise by as much as 45.5 feet. Figure 7 shows an example of the daily Bear Swamp PSD operation from May to October 2016.

The large daily fluctuations associated with the Bear Swamp PSD operation create unstable conditions for fish and aquatic resources in the upper and lower reservoirs. There is only minimal aquatic habitat in the littoral zone of either reservoir that can be utilized by aquatic organisms. Continuing to operate the Bear Swamp PSD in a store and release mode with the existing daily reservoir fluctuations would continue to limit the amount of stable, useable aquatic habitat to an elevation of 830 feet NGVD in the Fife Brook impoundment, and 1,555.5 feet NGVD in the upper reservoir.

---

[54] CRC does not define what higher flows would necessitate two intermediate releases or the magnitude of these two intermediate releases.

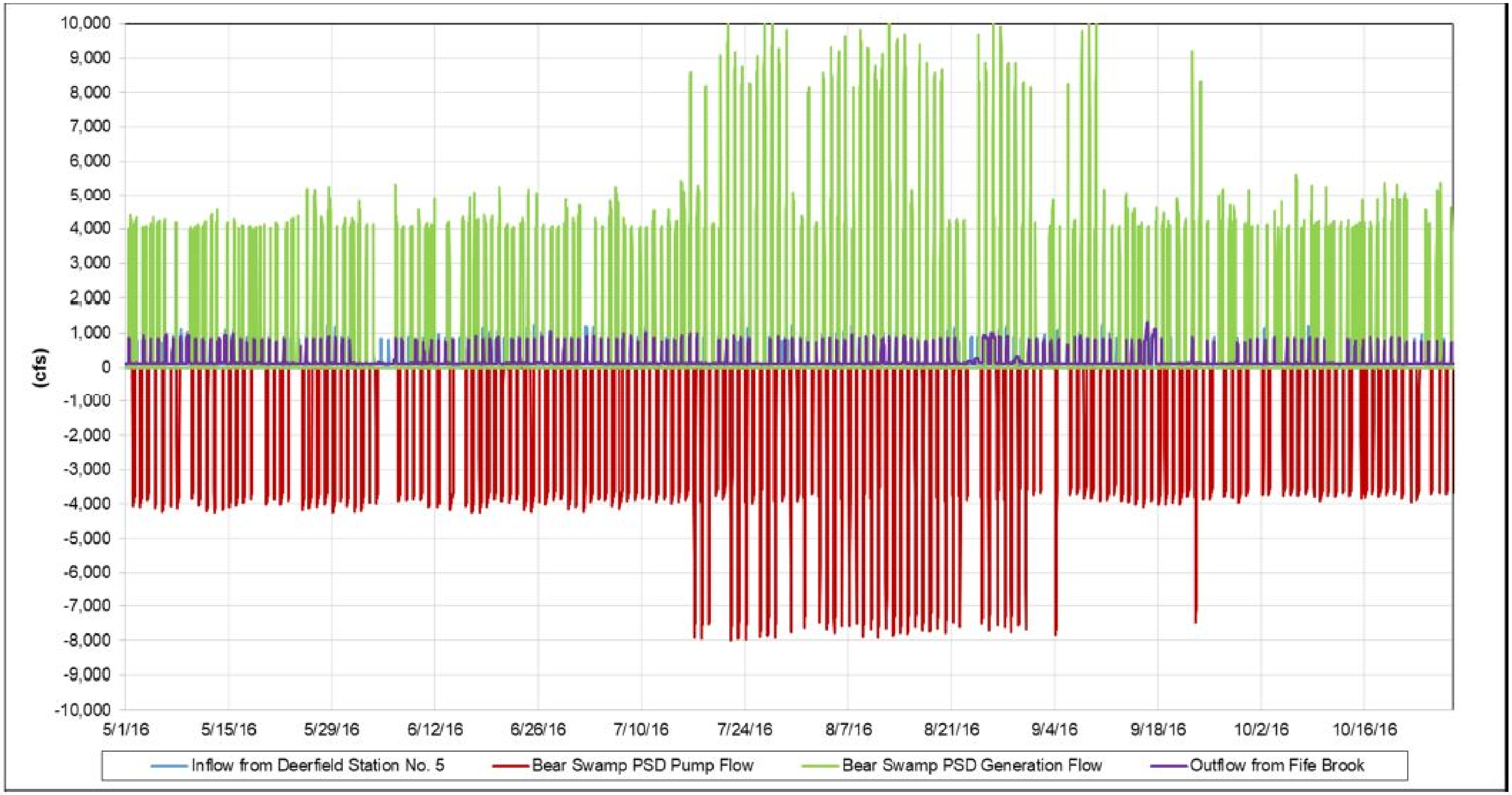


Figure 7. Composite 15-minute operations within the Fife Brook impoundment (May 1, 2016 – October 27, 2016) (Source: BSPC 2018a, as modified by staff).

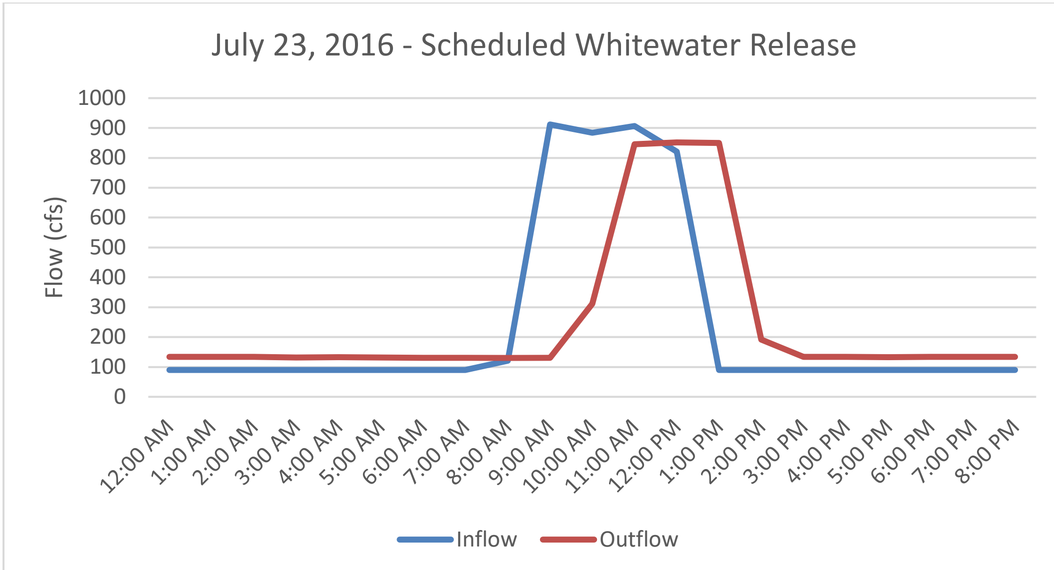
Fluctuations of the Fife Brook impoundment reservoir also affect available habitat in the upper extent of the impoundment. When the Fife Brook impoundment elevation is at 830 feet NGVD, there is riffle habitat made available in the upper extent of the Fife Brook impoundment that provides habitat for fish and aquatic resources. Water flowing over exposed rocks in the river bed also oxygenates water. When Bear Swamp PSD is generating, water levels the Fife Brook impoundment increase to an elevation of 870 feet NGVD, which creates a significant backwater effect that changes the lotic riffle habitat to a more lentic habitat consisting of pools.

Besides the fluctuation associated with the Bear Swamp PSD, additional fluctuations in the Fife Brook impoundment result from differences between impoundment inflow and outflow. The license for the Deerfield Project requires a 73-cfs minimum flow release from the dam of Deerfield Station No. 5, and additional flows of up to 1,250 cfs are discharged from the Deerfield Station No. 5 powerhouse directly into the Fife Brook impoundment.[55] BSPC states that it operates the Fife Brook impoundment in a "run-of-release" mode[56] by passing inflows from Deerfield Station No. 5 to the downstream Deerfield Station No. 4, while also holding 4,600 acre-feet of water in storage for the Bear Swamp PSD. BSPC states that the operation of the Fife Brook Development is limited to a "run-of-release" operation because the Bear Swamp Project is located in the middle of the Deerfield Project's "peaking flow regime." However, BSPC does not operate the Fife Brook Development in a "run-of-river" or "run-of-release" mode on an instantaneous basis and occasionally deviates from such an operation daily. The deviation can be substantial. Figure 8 presents representative inflow and outflow data from Fife Brook impoundment on a typical scheduled whitewater release day and day with no scheduled whitewater release. On a typical day with no scheduled whitewater release, BSPC stores inflow to maintain the minimum flow release requirement of 125 cfs and also to replenish water lost through evaporation. Figure 8 also shows several days when the inflow to the Fife Brook impoundment is greater than the outflow from the impoundment, and *vice versa* by implication. When inflow does not equal outflow, additional fluctuations occur in the impoundment. These additional fluctuations add to the instability of the aquatic habitat and contribute to the adverse effects of the project on the aquatic resources in the impoundment. Continuing to operate the project in this manner during the term of any new license, as proposed by

[55] *New England Power Company*, 79 FERC ¶ 61,006 (1997).

[56] As discussed in greater detail above, BSPC voluntarily agreed in the March 2005 off-license agreement to operate the Fife Brook impoundment in a "run-of-river" mode. BSPC and stakeholders refer to this operation as a "run-of-release" operation, since the Bear Swamp Project depends on flow releases from the Deerfield Station No. 5 for inflow.

BSPC, would continue to limit aquatic habitat in the Fife Brook impoundment during the term of the license at or below the minimum reservoir elevation of 830 feet NGVD.



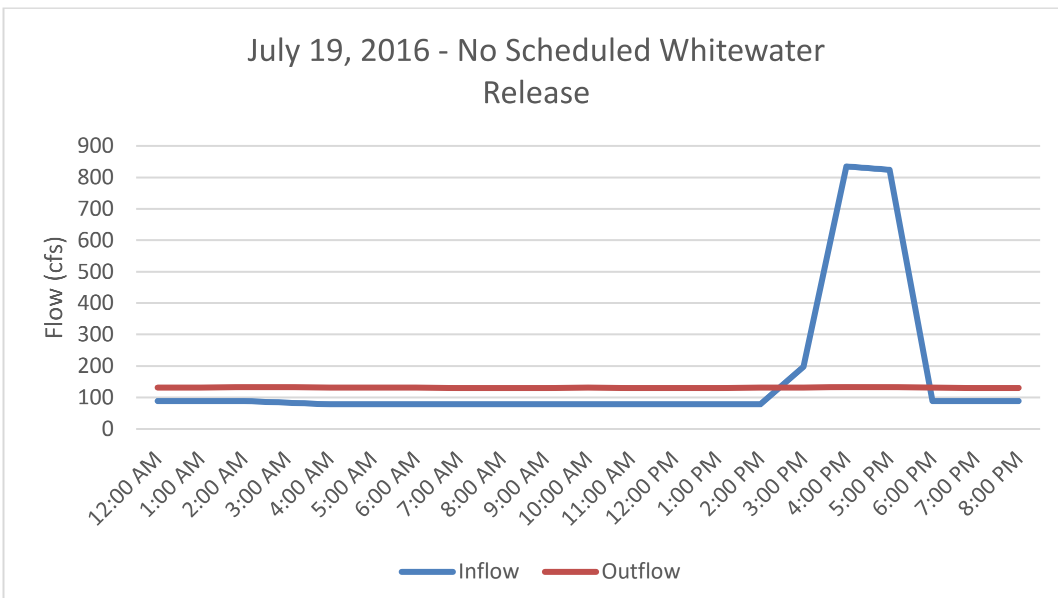


Figure 8. Inflow and outflow data from the Fife Brook Development for a scheduled whitewater release day and a day with no scheduled release (Source: staff).

Releasing generation flows from the Bear Swamp PSD into the Fife Brook impoundment would continue to provide only short-term and temporary increases in the minimal available aquatic habitat available above 830 feet NGVD during times of peak demand (*i.e.*, when Bear Swamp PSD is generating) and during times when it is uneconomic to pump water to the upper reservoir (during the day). Any gains in aquatic habitat in the Fife Brook impoundment would be subsequently lost when BSPC pumps water from the Fife Brook impoundment to the upper reservoir during periods of off-peak demand (*i.e.*, when it is economically feasible to operate the pump-turbines) or when stored water is released to maintain minimum flows and whitewater flow releases. Therefore, the temporary gains in aquatic habitat in the Fife Brook impoundment provided by the generation flows from the Bear Swamp PSD would be lost when pumping (at night) and therefore would not provide any meaningful benefit to fish species inhabiting the lower reservoir. Releasing generation flows would continue to inundate riffle habitat in the upper extent of the Fife Brook impoundment when the elevation rises above 830 feet NGVD.

Continuing to operate the upper reservoir in a store and release mode would continue to provide only short-term and temporary increases in the minimal aquatic habitat available in the upper reservoir above 1555.5 feet NGVD during times of off-peak demand (*i.e.*, when Bear Swamp PSD stores water during the night) and during times when it is uneconomic to generate. Any gains in aquatic habitat in the upper reservoir would be subsequently lost when BSPC releases water from the upper reservoir to the Fife Brook impoundment to generate during periods of peak demand. Therefore, the temporary gains in aquatic habitat in the upper reservoir provided by the pumped flows from the Fife Brook impoundment would be lost during peak demand periods and therefore would not provide any meaningful benefit to fish species inhabiting the upper reservoir.

BSPC's proposal to discontinue its current practice of holding generation at 3 MW for 15 minutes, and the recommendations submitted by Massachusetts DFW, Interior, CRC, and Trout Unlimited involving instantaneous "run-of-release" operation, minimum flow releases, and ramping limits, could affect the timing of fluctuations in the Fife Brook impoundment. However, neither BSPC's proposal nor the recommendations offered by stakeholders would significantly change the availability and quality of aquatic habitat in the impoundment. The adverse effects of the 40-foot daily fluctuation on the impoundment substantially limit the amount of aquatic habitat above 830 feet NGVD. Even if additional stability was provided during certain portions of the day by, for example, reducing the ramping rate of the Fife Brook generator, these benefits would only last temporarily until the aquatic habitat above 830 feet NGVD becomes dewatered during off-peak periods of electricity demand, which typically occurs on a nightly basis. The following discussion addresses the recommendations in detail.

Effects of Flow Attenuation on Reservoir Levels

To avoid sudden increases in flow downstream of Fife Brook dam, BSPC currently ramps the Fife Brook Development's generator up to a 3-MW output level,[57] and holds the generator at 3 MW for 15 minutes before increasing generation to higher output levels. BSPC proposes to discontinue its practice of holding generation at 3 MW for 15 minutes.

When generating under existing conditions, BSPC opens the wicket gates in the turbine and releases generation flows up to 3 MW. Upon reaching 3 MW, BSPC pauses for 15 minutes and then begins ramping the flow release to a desired generation set point which can be as high as 10 MW. Releasing flows in this manner takes approximately 1.1 hours to reach a generation flow of 900 cfs, including the 15-minute pause at 3 MW. BSPC provides the 15-minute pause as an in-water safety measure to alert fishermen to rising water levels from a generation flow release. BSPC proposes to discontinue the 15-minute pause at 3 MW because it states that the measure has not been effective in providing an adequate signal to alert fisherman to rising water levels. Discontinuing the 15-minute pause would lower water levels in the Fife Brook impoundment by less than one foot from existing conditions over 15 minutes and would also speed the rate that water levels fall in the Fife Brook impoundment by 15 minutes. Under BSPC's proposal, it would take less than one hour (51 minutes) to reach the desired generation output. Operating in this manner would not result in a meaningful reduction in the amount of aquatic habitat in the Fife Brook impoundment, as any aquatic habitat above 830 NGVD is limited only available on a temporary basis.

Operating the Fife Brook Development with a one-hour ramp to generation as proposed by Trout Unlimited would be essentially equivalent to BSPC's proposed mode of operation and would have similar effects to aquatic habitat as the existing operation discussed above.

The up-ramping rates recommended by Interior and Massachusetts DFW restrict BSPC from increasing flow releases from the Fife Brook Development to no more than 130 cfs per hour from 7 a.m. to 4 p.m. from May 15 through June 30 and to no more than 158 cfs per hour from July 1 through August 31. The recommended up-ramping rates would be in place only when there is not a scheduled whitewater release. On the 106

---

[57] As discussed in section 2.1.4 (*Existing Project Operation*), BSPC does not run the turbine-generator at the Fife Brook Development below an output of approximately 3 MW due to rough operating conditions that are encountered when output reaches this level.

scheduled whitewater release days, the agencies do not recommend a limit to the up-ramping rate at the Fife Brook Development.

If ramping were to be limited in the manner recommended by Massachusetts DFW, then BSPC would not necessarily be able to provide outflows from the Fife Brook Development that equal inflows from Deerfield Station No. 5 at all times, but would instead have to store inflows to the Fife Brook impoundment if the rate of those inflows increased by more than 130 cfs per hour or 158 cfs per hour from 7 a.m. to 4 p.m. Then, after 4 p.m., BSPC would be required to provide outflows from the Fife Brook Development that equal inflows from Deerfield Station No. 5 on a near instantaneous basis. Any inflow not released between 7 a.m. and 4 p.m. would have to be stored in the Fife Brook impoundment until BSPC could potentially release the stored inflow during a scheduled recreation day. Commission staff estimate that approximately 10 acre-feet of inflow (primarily from Deerfield Station 5 generation flows) could accumulate in the Fife Brook impoundment on a daily basis during non-scheduled whitewater release days from May 15 through June 30, and 8 acre-feet of inflow could accumulate in the Fife Brook impoundment on a daily basis from July 1 through August 31. The accumulated storage of inflow would raise water levels in the Fife Brook impoundment by approximately 5 feet or more during the long periods between schedule whitewater releases (*e.g.,* from May 15 through June 30). In addition, any inflow from potential storm events that occurs between 7 a.m. and 4 p.m. and that exceed 130 cfs per hour or 150 cfs per hour would also be stored in the lower reservoir.

Many species of fish found in the Fife Brook impoundment spawn in the spring. Although there is limited spawning habitat in the Fife Brook impoundment, the eggs of fish that spawn in the 5-foot band of water stored in the Fife Brook impoundment could be lost when BSPC releases the stored 5-foot band of inflow for scheduled whitewater releases. In a similar way, any additional foraging habitat created by the extra 5 feet of water in the Fife Brook impoundment could also be lost during a scheduled recreation day. Collectively, any gains in the limited littoral zone habitat in the lower reservoir created by storage of inflows would only be short-term and temporary and there would be no net benefit to aquatic habitat in the lower reservoir by operating with the up-ramping rates proposed by Interior and Massachusetts DFW.

CRC proposes releasing all flows from Fife Brook dam using a staged ramping process for increasing flows, which would include a 1-hour hold at an intermediate flow that is equivalent to the midpoint of the total scheduled flow. CRC recommends additional intermediate flow release of one hour for "higher flows." Operating the Fife Brook Development in this manner would increase the amount of time temporary aquatic habitat is available in the Fife Brook impoundment by approximately 45 minutes over existing operation. Providing an additional 45 minutes of aquatic habitat in the lower reservoir as compared to existing conditions also would not provide any meaningful enhancement of aquatic habitat in the littoral zone is generally unsuitable for fish and aquatic organisms. Any increase in aquatic habitat in the lower reservoir by operating in this manner would also be short-term and temporary.

Aquatic Habitat in the Deerfield River Downstream of Fife Brook Dam

Minimum Flows

The current license requires the licensee to release a continuous minimum flow of 125 cfs from the Fife Brook Development to protect aquatic habitat in the Deerfield River.[58] The license requires water to be released from "reservoir storage," if necessary, to ensure that the minimum flow of 125 cfs is met.[59] BSPC proposes to continue providing a continuous minimum flow of 125 cfs from Fife Brook dam into the Deerfield River. Specifically, during unplanned generator outages, BSPC proposes to release water from storage in the Fife Brook impoundment if necessary, "as quickly as is reasonable to ensure that the minimum flow of 125 cfs is met to the extent practicable." BSPC proposes to temporarily modify the minimum flow if required by operating emergencies beyond its control, or for short periods upon agreement between the licensee Massachusetts DFW. If the flow is so modified, BSPC states that it would notify the Commission as soon as possible, but not later than ten days after each such incident.

Massachusetts DFW recommends under section 10(j) that BSPC release a continuous minimum flow of 125 cfs from April 16 through October 31, and 350 cfs from November 1 through April 15 from the Fife Brook impoundment to the Deerfield River for the protection of fish and aquatic habitat.[60] Interior recommends under section 10(j) that BSPC continue to release a minimum flow of 125 cfs from April 16 through October 31 and release a minimum flow of 350 cfs from November 1 through April 15. The CRC recommends the same measures as Interior to ensure adequate water depth for trout nests. Similarly, Trout Unlimited recommends releasing a continuous minimum flow of 350 cfs from November 1 through April 15 for the protection of spawning trout, incubating eggs, and emerging fry.

---

[58] *New England Power Company,* 79 FERC ¶ 61,009 (1997).

[59] The minimum flow requirement for Deerfield Station No. 5 into the Fife Brook impoundment is 73 cfs, which is less than the minimum flow requirement of 125 cfs for the Bear Swamp Project. *New England Hydropower Company*, 79 FERC ¶ 61,006 (1997).

[60] Massachusetts DFW recommends releasing the minimum flow from the project into the bypassed reach; however; the project has two developments and no bypassed reach. Staff interprets Massachusetts DFW's recommendation to be a schedule of minimum flow releases from the Fife Brook dam to the Deerfield River.

CRC recommends that BSPC conduct an Instream Flow Incremental Methodology (IFIM) modeling study now and when the Deerfield Project begins relicensing in 2032. CRC states that an IFIM is needed to evaluate alternative flow scenarios during relicensing and during the next relicensing proceeding for the Deerfield Project in order to balance project operation with habitat and recreation interests. Similarly, Trout Unlimited states that an IFIM study is needed to evaluate the effects of hydropower peaking operation and minimum flow releases on trout redds downstream of Fife Brook dam.

Our Analysis

BSPC conducted an instream flow assessment in the spring and summer of 2016 to determine the relationship between aquatic habitat and flow in the reach of the Deerfield River extending from Fife Brook dam downstream to a location upstream from the Deerfield Station No. 4 impoundment. Water surface elevation, depth, velocity, and river bed substrate were recorded at two foot intervals in each of the 14 representative cross sections in the main channel of the Deerfield River.[61] The study evaluated the existing minimum flow release of 125 cfs as well as flow releases of 239 cfs and 328 cfs.[62] The study incorporated existing biological information, including Habitat Suitability Index model data from FWS and binary criteria[63] to determine the suitability of velocities, depths, and substrates along each of the 14 flow transects for spawning, juvenile, and adult life stages of brown trout, brook trout, rainbow trout, and longnose sucker. Data from all surveyed transects was integrated to determine suitable habitat

---

[61] Transect numbers T1 to T8 were in the project boundary within the Deerfield River Upper Study Reach from Fife Brook dam to the confluence of the Cold River (7.9 river miles downstream of Fife Brook dam) and transect numbers T9 to T14 were located outside the project boundary in the Deerfield River Lower Study Reach that extends approximately 8 miles downstream of the confluence to Cold Brook to the upstream extent of Deerfield Station No. 4 impoundment.

[62] BSPC released the existing 125 cfs minimum flow from the minimum flow pipe at Fife Brook dam. While BSPC attempted to evaluate minimum flow releases of 200 cfs and 275 cfs, these test flows were released by opening the tainter gate, which is was less precise than a minimum flow pipe release. As a result, the actual flows evaluated in the study were 239 cfs and 328 cfs.

[63] The binary format establishes a suitable range for each variable as it pertains to a life stage of interest, and is presented graphically as a step function. The quality rating for a variable (*e.g.*, depth, velocity) is 1.0 if it falls within the range of the criteria, and 0.0 if it falls outside the range. This study utilized a binary cutoff value of ≥ 0.5 suitability for spawning, juvenile, and adult life stages.

availability for adult and juvenile life stages at the three test flows. Spawning habitat suitability was evaluated at transects with suitable spawning substrate and also at transects located near the location of active redds documented in a 2017 Deerfield River Watershed Trout Spawning Survey (Trout Spawning Study) that was conducted by Trout Unlimited (Cole, 2017).

Table 11 presents a summary of total wetted width and change in water surface elevation at each transect under the three test flows. At the existing minimum flow of 125 cfs, the mean wetted width for the 14 transects was 166.9 feet. Increasing flow generally did not significantly increase wetted width. At a flow of 239 cfs, mean wetted width was 168.7 feet, representing an average wetted width increase of 1.8 feet. At more than 2.5 times the minimum flow (328 cfs), the mean wetted width was 169.5 feet, which represented an average wetted width increase of 1.5 percent (2.6 feet).

Table 11. Wetted width and depth in study transects in the Instream Flow Assessment Study.

Transect (Mesohabitat)	Wetted Width (ft.)				Change in Local Water Surface Elevation (ft.)	
	125 cfs	239 cfs	328 cfs	Maximum Change	125 cfs to 239 cfs	239 cfs to 328 cfs
Upper Deerfield River Reach						
1 (Glide)	109.4	110.4	110.8	1.4	0.5	0.2
2 (Riffle)	202.1	202.8	203.2	1.1	0.2	0.1
3 (Riffle)	137.0	140.4	140.5	3.5	0.2	0.2
4 (Glide)	155.3	157.6	158.2	2.9	0.4	0.1
5 (Riffle)	227.2	227.2	227.2	0*	0.4	0.1
6 (Riffle)	120.7	130.5	134.7	14	0.4	0.2
7 (Glide)	102.8	102.8	102.8	0*	0.3	0.2
Lower Deerfield River Reach						
8 (Riffle)	160.5	161.7	163.1	2.6	0.3	0.2
9 (Glide)	177.7	178.9	178.4	0.7	0.1	0.1
10 (Glide)	181.5	181.8	183.4	1.9	0.2	0.2
11 (Riffle)	201.9	204.0	205.9	4.0	0.2	0.1
12 (Riffle)	178.1	179.2	179.4	1.3	0.1	0.1
13 (Glide)	177.7	179.3	180.6	2.9	0.2	0.1
14 (Riffle)	204.5	205.0	205.4	0.9	0.1	0.1
Mean	**166.9**	**168.7**	**169.5**	**2.6**	**0.1**	**0.2**

(Source: BSPC, 2017c as modified by staff)
* Transect located in an area of the Deerfield River with vertical banks and rocks, there were no changes in total wetted width under all three study flows.

The greatest increase in wetted width from the 125 to 328-cfs test flow was 14 feet, which was observed at Transect 6. However, Transect 6 has a small backwater area that became inundated under the higher test flows, which was unique among the transects. In general, the Deerfield River downstream of Fife Brook dam does not have many of these backwater areas that could provide additional habitat, as evidenced by results of the wetted width measurements in other transects. Wetted width at 57 percent of the study transects (8 of 14 transects) increased by less than two feet as flow increased to 328 cfs.

Similar to the wetted width measurements, water depth at the study transects also did not substantially change with increasing flow. The greatest observed increase in water depth was 0.5 foot or less across all transects and study flows. The water depth in most transects only changed by 0.1 or 0.2 foot. Increasing flow from 125 to 239 cfs increases water depth by an average of only 0.1 feet. Increasing flow from 239 cfs to 238 cfs increases water depth by an average of only 0.2 feet.

Habitat Availability at 125 cfs Minimum Flow

A flow of 125 cfs provides a suitable depth at 67.9 percent of the monitoring stations and a suitable velocity at 54.8 percent of the monitoring stations for all life stages of brook trout, according to the Instream Flow Assessment Study. When the habitat suitability data are combined for depth and velocity, the 125-cfs minimum flow provides suitable habitat[64] for brook trout at 34.6 percent of all surveyed transects (Figure 9).

For brown trout, a flow of 125 cfs provides suitable depth and velocity for all life stages at 77.0 and 76.9 percent, respectively, of all monitoring stations. Combined, a flow of 125 cfs provides suitable habitat at 60.7 percent of all surveyed transect stations for all life stages of brown trout (Figure 10).

For rainbow trout, a flow of 125 cfs provides suitable depth and velocity for all life stages at 59.7 and 74.9 percent, respectively, of all monitoring stations. Combined, a flow of 125 cfs provides suitable habitat for all life stages of rainbow trout at 39.7 percent of all surveyed transect stations (Figure 11).

A flow of 125 cfs provides suitable depth and velocity for all life stages of longnose sucker at 63.1 and 93.8 percent, respectively, of all surveyed transect stations. Combined, a flow of 125 cfs provides suitable habitat for all life stages of longnose sucker at 56.6 percent of all surveyed transect stations (Figure 12).

---

[64] Suitable habitat is defined as the percentage of all transect stations with depth, velocity, and substrate conditions that met the binary criteria for all life stages of the target species, including spawning.

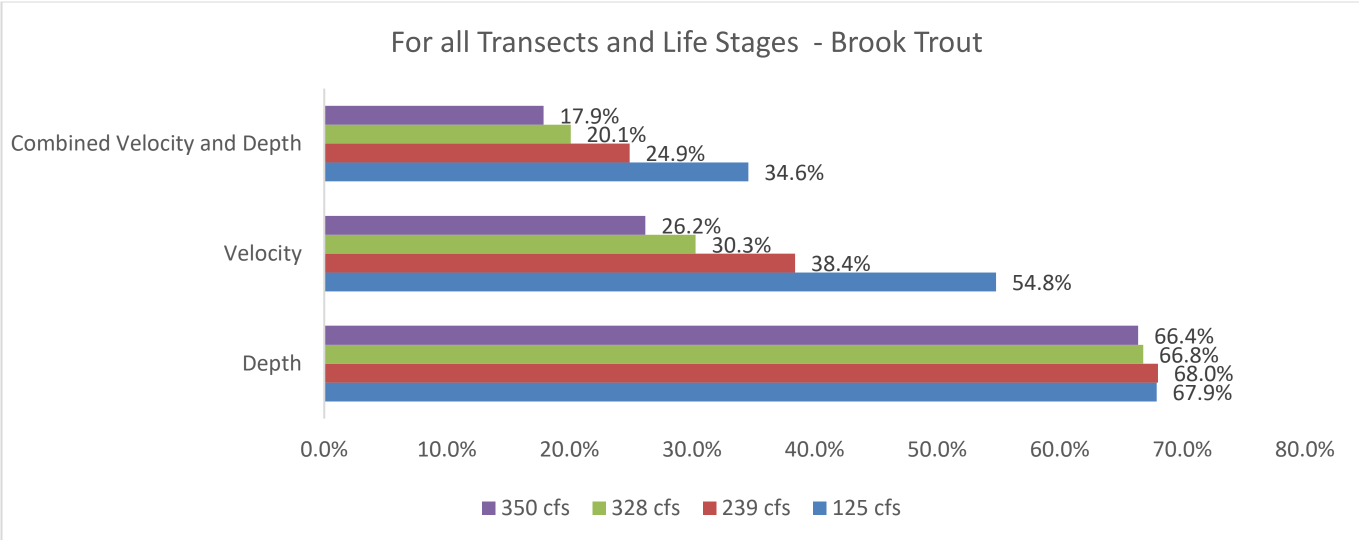


Figure 9. Composite of habitat suitability data for brook trout (Source BSPC, 2018, as modified by staff).

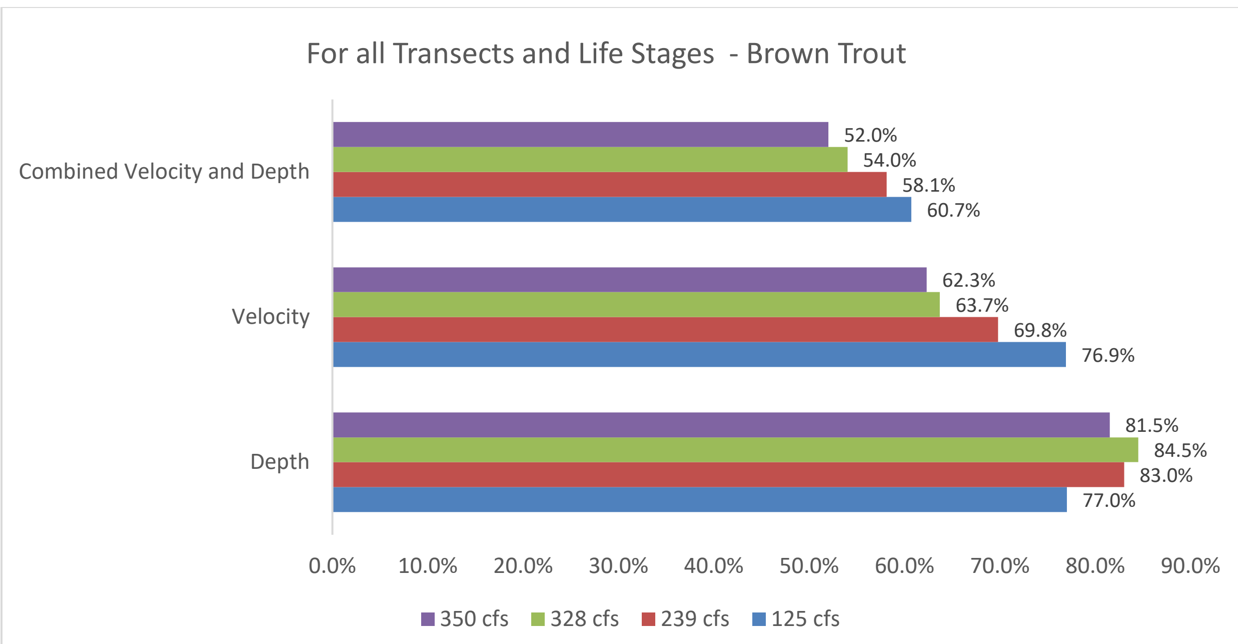


Figure 10. Composite of habitat suitability data for brown trout (Source BSPC, 2018, as modified by staff).

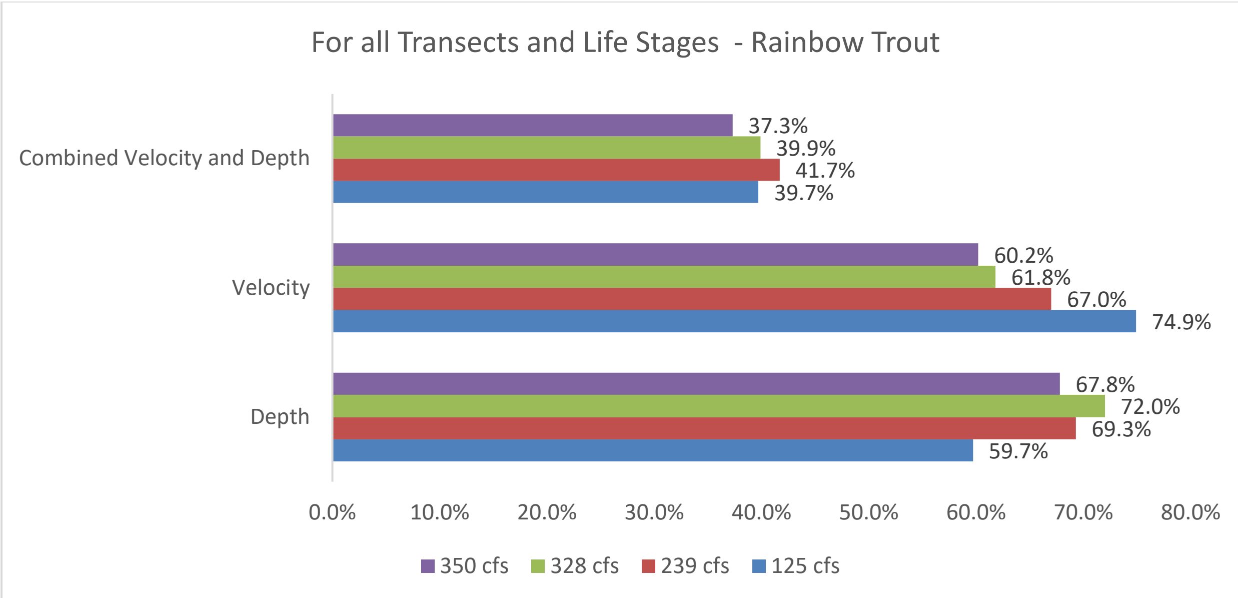


Figure 11. Composite of habitat suitability data for rainbow trout (Source BSPC, 2018, as modified by staff).

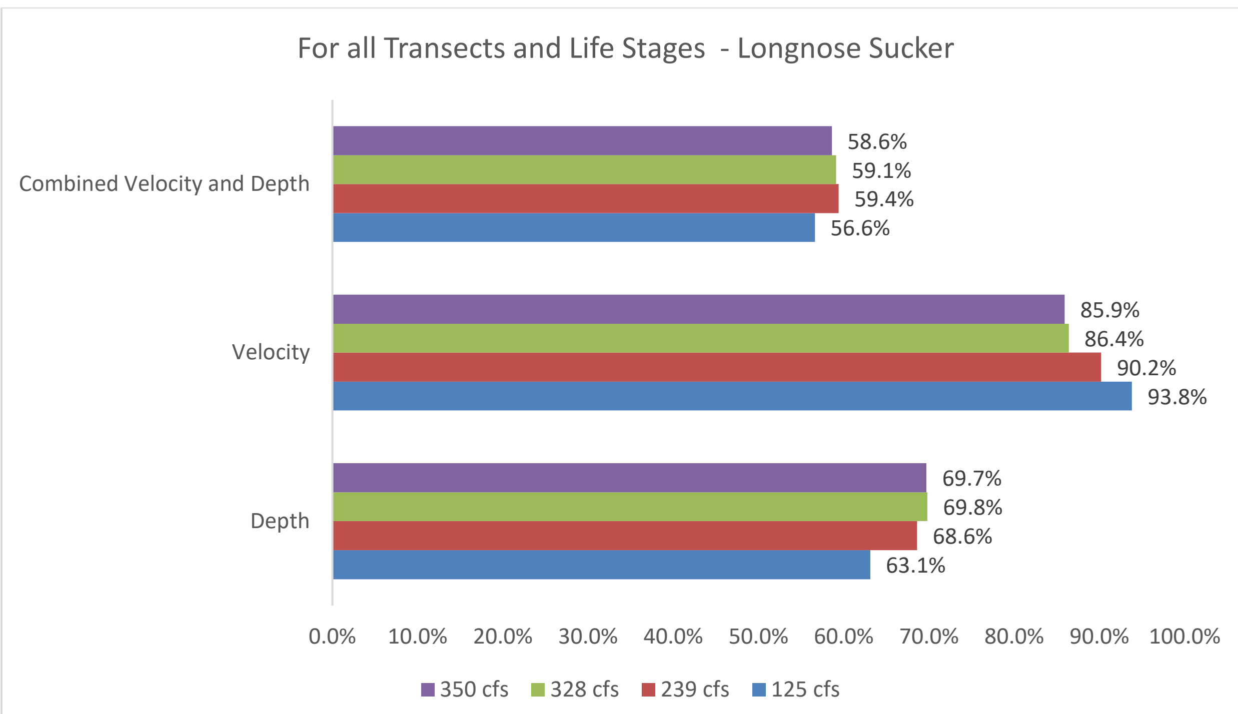


Figure 12. Composite of habitat suitability data for longnose sucker. (Source BSPC, 2018, as modified by staff).

Habitat Availability at 239 cfs Minimum Flow

A flow of 239 cfs provides approximately the same percentage of suitable depth for brook trout (68.0 percent of all transect stations) as the existing 125-cfs minimum flow (67.9 percent of all transect stations). However, a flow of 239 cfs decreases the overall percentage of transect stations with suitable velocity. A flow of 239 cfs provides suitable velocity at only 38.4 percent of the surveyed transect stations, which represents a reduction in suitable velocity of 16.4 percent when compared to the existing 125-cfs minimum flow. Combined, a flow of 239 cfs only provides suitable habitat at 24.9 percent of the surveyed transect stations, which represents a 9.7 percent decrease in the amount of suitable habitat (Figure 9).

For brown trout, the additional flow of 239 cfs marginally increases the overall percentage of stations with suitable depth. A flow of 239 cfs provides suitable depth at 83.0 percent of the surveyed transect stations, which represents an increase in suitable depth of 6.0 percent over the existing 125-cfs minimum flow (Figure 10). As observed with brook trout, a flow of 239 cfs decreases the percentage of stations with suitable velocity. A flow of 239 cfs provides suitable velocity at 69.8 percent of the surveyed transect stations, which represents reduction in suitable velocity of 7.1 percent to the existing 125-cfs minimum flow. Combined, a flow of 239 cfs provides suitable habitat at 58.1 percent of the surveyed transect stations, which represents 2.6 percent decrease in the amount of suitable habitat (Figure 10).

For rainbow trout, the additional flow of 239 cfs provides a moderate increase in the percentage of stations with suitable depth. A flow of 239 cfs provides suitable depth at 69.3 percent of the transect stations, which represents an increase in suitable depth of 9.6 percent over the existing 125-cfs minimum flow (Figure 11). A 239-cfs minimum flow, however, would reduce areas with suitable velocity for rainbow trout, as was observed with the other trout species. A 239-cfs flow provides suitable velocity at 67.0 percent of the transect stations which represents a reduction in suitable velocity, of 7.9 percent when compared to the existing 125-cfs minimum flow. Combined, a flow of 239 cfs provides suitable habitat at 41.7 percent of the transect stations which is approximately the same amount of suitable habitat available the existing at 125 cfs minimum flow (39.7 percent of transect stations) (Figure 11).

For longnose sucker, a flow of 239-cfs flow provides suitable depth at 68.6 percent of the transect stations, which represents an increase in suitable depth of 5.5 percent over the existing 125-cfs minimum flow (Figure 12). A flow of 239 cfs provides suitable velocity at 90.2 percent of the transect stations, which represents a 3.6 percent decrease in the amount of suitable velocity relative to the 125-cfs minimum flow. Combined a flow of 239 cfs provides suitable habitat at 59.4 percent of the surveyed transect stations, which represents a 2.8 percent increase in the amount of suitable habitat (Figure 12).

Habitat Availability at 328 cfs Minimum Flow

A flow of 328 cfs provides approximately the same percentage of suitable depth for brook trout (66.8 percent of all transect stations) as the existing 125-cfs minimum flow (67.9 percent of all transect stations). However, a flow of 328 cfs decreases the overall percentage of transect stations with suitable velocity (Figure 9). A flow of 328 cfs provides suitable velocity at only 30.3 percent of the surveyed transect stations, which represents a reduction in suitable velocity of a 24.5 percent when compared to the existing minimum flow. Combined, a flow of 328 cfs only provides suitable habitat at 20.1 percent of the surveyed transect stations, which represents 14.5 percent decrease in amount suitable habitat relative to the minimum flow (Figure 9).

For brown trout, a flow of 328 cfs marginally increases the overall amount of water depth suitable for brown trout in the Deerfield River. A flow of 328 cfs provides 84.5 percent of the transect stations with suitable depth, which represents an increase in suitable depth of 7.5 percent when compared to the 125-cfs existing minimum flow (Figure 10). As observed with brook trout, a flow of 328 cfs decreases the percentage of transect stations with suitable velocity. A flow of 328 cfs provides 63.7 percent of the surveyed transect stations with suitable velocity, which represents a reduction in suitable velocity of 13.2 percent when compared the existing 125-cfs minimum flow. Combined, a flow of 328 cfs provides suitable habitat at 54.0 percent of the surveyed transect stations, which represents an 6.7 decrease in the amount of suitable habitat (Figure 10).

Additional flow provided a moderate increase in areas with suitable depth for rainbow trout. A flow of 328 cfs provides suitable depth at 72.0 percent of the transect stations, which represents an increase in suitable depth of 12.3 percent when compared to the existing 125-cfs minimum flow. A 328-cfs minimum flow however decreases the overall percentage of stations with suitable velocity. A flow of 328 cfs provides suitable velocity at 61.8 percent of the transect stations which represents a reduction in suitable velocity of 13.1 percent when compared to the existing minimum flow. Combined, a flow of 328 cfs provides 39.9 percent of the station transects with suitable habitat, which is approximately the same amount of suitable habitat provided by the existing minimum flow (Figure 11).

For longnose sucker, a flow of 328 cfs provides suitable depth at 69.8 percent of the transect stations which represents an increase in suitable depth of 6.7 percent when compared to the existing 125-cfs minimum flow (Figure 12). A flow of 328 cfs provides suitable velocity at 86.4 percent of the transect stations, which represents a reduction in suitable velocity of 7.4 percent when compared to the 125-cfs existing minimum flow. Combined a flow of 328 cfs provides suitable habitat at 59.1 percent of the surveyed transect stations, which represents an increase in the amount suitable habitat of 2.5

percent when compared to the amount of habitat available at the existing minimum flow (Figure 12).

Habitat Availability at 350 cfs Minimum Flow

The Instream Flow Assessment Study did not evaluate a flow of 350 cfs. However, staff extrapolated from the existing dataset provided by BSPC's instream flow assessment to estimate how well 350 cfs provides suitable depth, velocity, and overall habitat for the target species.[65]

A flow of 350 cfs provides approximately the same percentage of suitable depth for brook trout (66.4 percent of all transect stations) as the existing 125-cfs minimum flow (67.9 percent of all transect stations). The increased velocity associated with a flow of 325 cfs, however, decreases the overall percentage of transect stations with suitable velocity. A flow of 350 cfs provides suitable velocity at approximately 26.2 percent of the surveyed transect stations, which represents a reduction in suitable velocity of 28.6 percent when compared to the existing 125-cfs minimum flow. Combined, a flow of 350 cfs only provides suitable habitat at approximately 17.9 percent of the surveyed transect stations, which represents a 16.7 percent decrease in the amount of suitable habitat relative to the minimum flow (Figure 9).

For brown trout, a flow of 350 cfs marginally increases the overall amount of depth suitable for brown trout. A flow of 350 cfs provides approximately 81.5 percent of the transect stations with suitable depth, which represents an increase suitable depth of 4.5 percent when compared to the existing 125-cfs minimum flow. As observed with brook trout, a flow of 350 cfs reduces the percentage of stations with suitable velocity. A flow of 350 cfs provides suitable velocity at approximately 62 percent of the surveyed transect stations, which represents a reduction in suitable velocity of 14.6 percent when compared the existing minimum flow. Combined, a flow of 350 cfs provides suitable habitat at approximately 52 percent of the surveyed transect stations, which represents a 8.7 percent decrease in overall suitable habitat relative to the minimum flow (Figure 10).

For rainbow trout, a flow of 350 cfs provides approximately the same amount of suitable depth (67.8 percent of the transect stations) as 328 cfs (72.0 percent of transect stations), and an increase of 8.1 percent from the existing 125-cfs minimum flow. A flow

---

[65] Staff plotted the percentage of transect stations with suitable depth, velocity, and combined velocity and depth for each test flow and then used linear regression to calculate the equation that minimizes the distance between the fitted line and all of the data points. Staff used the linear equation from each dataset (depth, velocity, and combined velocity and depth) to estimate the percentage of stations with suitable depth, velocity, and combined depth and velocity at 350 cfs.

of 350 cfs would reduce areas with suitable velocity for rainbow trout, as was observed with the other trout species. A flow of 350 cfs provides approximately 60.2 percent of the transect stations with suitable velocity, a 14.7 percent loss in areas with suitable velocity relative to the minimum flow. Combined, a flow of 350 cfs provides approximately the same amount of suitable habitat as the existing minimum flow (37.3 percent versus 39.7 percent of station transects, respectively) (Figure 11).

For longnose sucker, a flow of 350 cfs provides approximately the same level of suitable depth (69.7 percent of transect stations) for all life stages as 328 cfs, and increase the amount of stations with suitable depth by 6.6 percent relative to the existing 125-cfs minimum flow. However, a flow of 350 cfs reduces the amount of suitable velocity available at the existing minimum flow. A minimum flow of 350 cfs provides suitable velocity at 85.9 percent of the transect stations, which represent a 7.9 percent loss in the amount of suitable velocity available at the 125 cfs minimum flow. Combined, a minimum flow of 350 cfs would provide suitable habitat at 58.6 percent of the surveyed transect stations, which would increase suitable habitat by 2.0 percent compared with the existing 125 cfs minimum flow (Figure 12).

Conclusions on Habitat Analyses

In summary, the existing 125-cfs minimum flow provides the highest percentage of transect stations that met both the velocity and depth criteria for brown trout (60.7 percent) and brook trout (34.6 percent) at all applicable life stages (Figures 9 and 10). The 239-cfs flow provides the highest percentage of stations that met both the velocity and depth criteria for rainbow trout (41.7 percent) at all applicable life stages; however, the total difference between the existing 125-cfs minimum flow (39.7 percent), 239-cfs (41.7 percent), 328-cfs (39.9 percent), and 350-cfs (37.3 percent) flows was less than 4.4 percent. Similarly, the 239-cfs flow provides the highest percentage of stations (59.4 percent) that met both the velocity and depth criteria for longnose sucker at all applicable life stages; however, the total difference between the existing 125-cfs minimum flow (56.6 percent), 239-cfs (59.4 percent), 328-cfs (59.1 percent), and 350-cfs (58.6 percent) flows was less than 2.8 percent.

A flow of 350 cfs from November 1 through April 15, as recommended by Massachusetts DFW, Interior, CRC, and Trout Unlimited, would reduce the percentage of transect stations that met the suitable depth criteria for the native brook trout relative to the existing 125-cfs minimum flow (66.4 percent versus 67.9 percent, respectively). For brown trout, a flow of 350 cfs would provide an increase in the percentage of transect stations that met depth criteria relative to the existing 125-cfs minimum flow (81.5 percent versus 77.0 percent, respectively). For rainbow trout, a flow of 350 cfs provides an increase in the percentage of transect stations that met depth criteria relative to the existing 125-cfs minimum flow (67.8 percent versus 59.7 percent, respectively). Similarly, for longnose sucker, a flow of 350 cfs provides an increase in the percentage of transect stations that met depth criteria relative to the existing 125-cfs minimum flow (69.7 percent versus 63.1 percent). While a flow of 350 cfs increases the number of stations with suitable depth for brown trout, rainbow trout, and longnose sucker, a flow of 350 cfs decreases the number of stations with suitable velocity. The combined amount of suitable velocity and depth decreases for all trout species at a flow of 350 cfs versus the existing flow of 125 cfs.

CRC and Trout Unlimited recommend conducting an IFIM study to evaluate alternative flow scenarios during relicensing and evaluate the effects of hydropower peaking operation and minimum flow releases on aquatic habitat downstream of Fife Brook dam. The purpose of an IFIM study is to determine the relationship between streamflows and fish habitat for different fish species and their life stages. Commission staff addressed the need for a full IFIM study on May 1, 2018 when it issued a determination on BSPC's Instream Flow Assessment Study. Staff determined that BSPC's proposed instream flow assessment, as modified by staff, was sufficient for an evaluation of the effects of the project on streamflow and that an IFIM study was not needed. Conducting an IFIM study post-licensing would provide little-to-no benefit to fish and aquatic organisms, as the existing study provides sufficient data for understanding the effects of flow on fish and aquatic organisms.

With regard to CRC's recommendation to complete an IFIM study of the Deerfield River when the Deerfield Project begins relicensing in the future, attempting to define the scope or need for such a study now is premature. Baseline conditions could change between now and the time the project is relicensed in the future, which could lead to modifications to the scope and need for such a study. The environmental benefits of an IFIM study are therefore unclear at this time, and the matter is best handled in the context of the Deerfield Project's relicense proceeding in 2032.

Additional Flows in the Deerfield River Downstream of Fife Brook Dam

BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5." BSPC also proposes to continue to provide 106 scheduled whitewater flow releases of 800 cfs[66] from the Fife Brook dam according to the existing release schedule (*i.e.*, whitewater releases between 9:30 a.m. and 12:00 p.m. on 50 weekend days and 56 weekdays from April 1 to October 30, for a minimum duration of three hours). Separately, BSPC

[66] Article 404 of the current license requires 106 periodic, scheduled whitewater flow releases of 700 cfs from April 1 through October 31. However, BSPC states that it voluntarily provides a recreational release of 800 cfs instead of 700 cfs. *See* March 30, 2018 final license application at E-67.

proposes to discontinue its current practice of holding generation at 3 MW for 15 minutes before increasing generation to higher output levels.

Massachusetts DFW recommends under section 10(j) that BSPC operate the project in a "year-round, run-of-release mode." Similarly, Interior recommends under section 10(j) that BSPC operate the Fife Brook Development as a "run-of-release facility, passing inflow it receives from the upstream Deerfield Project's Deerfield [Station] No. 5 development below the Fife Brook dam on a near instantaneous basis." Massachusetts DFW and Interior also recommend up-ramping limitations (*i.e.*, limits to the hourly rate of change in flow releases) under section 10(j).

CRC recommends releasing all flows from Fife Brook dam in two-stages: a one-hour intermediate flow release that is equivalent to the midpoint of the total flow, and then a following ramp up to the total desired flow release. CRC recommends an additional intermediate flow release of one hour for "higher flows."[67]

Trout Unlimited recommends releasing flows from Fife Brook dam with a one-hour ramp up to generation and a one hour ramp down from generation from March 15 through June 30 when newly emerged trout fry are vulnerable to changes in flow. Trout Unlimited also recommends releasing 700 cfs for whitewater flow releases instead of 800 cfs.

Our Analysis

Currently, outflows from the Fife Brook dam can change from 125 cfs to 900 cfs in an average of 1.1 hours. This change in outflows results in a corresponding change of 2.62 feet in the depth of the Deerfield River. These rapid changes in the velocity and stage of the river can affect fish directly by displacing juvenile and small fish, affecting spawning behavior, and dewatering spawning sites (Young *et al*., 2011). Fluctuating velocity and water levels can also indirectly affect fish by causing physiological stress, scouring sediments near the dam, increasing turbidity, and affecting feeding rates (Young *et al*., 2011). In addition, fluctuating velocity and water levels can displace benthic macroinvertebrates as well as mobilize fine sediment that can cover the substrate or fill in the spaces that benthic macroinvertebrates occupy between the rocks on the streambed. Both effects can also potentially reduce the abundance of benthic macroinvertebrates, which serve as a food source for fish.

Although BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5," as discussed above in the context of the effects of the project on aquatic habitat in the Fife

[67] CRC does not define what higher flows would necessitate two intermediate releases or the magnitude of these two intermediate releases.

Brook impoundment, BSPC does not actually operate the Fife Brook Development in a "run-of-release" mode on an instantaneous basis and occasionally deviates from such an operation on a daily basis. The deviation can be substantial, especially on days with no scheduled recreation release (Figure 8). Specifically, BSPC stores inflow to maintain the minimum flow release requirement of 125 cfs and also to replenish water lost through evaporation. To the extent that BSPC did actually "pass inflows from Station No. 5" on an instantaneous basis, the resulting outflows from the Fife Brook dam would not necessarily provide stability to the aquatic habitat in the Deerfield River. The Fife Brook impoundment receives inflow primarily from Deerfield Station No. 5, which operates in a store and release (peaking) mode. Flows from Deerfield Station No. 5 can oscillate between the required minimum flow of 73 cfs to the maximum hydraulic capacity of 1,250 cfs, and there are no limitations to generator ramping at Deerfield Station No. 5.[68] In a "run-of-release" mode, water levels could fluctuate by as much as 3.42 feet downstream of Fife Brook dam as outflow increases from the 125-cfs minimum flow to the combined total outflow from Deerfield Station No. 5 (*i.e.*, 1,323 cfs). Based on the potential for rapid fluctuations in flows from Deerfield Station No. 5, operating the Fife Brook Development in a "run-of-release" mode as proposed by BSPC and recommended by Massachusetts DFW and Interior would provide no benefit to aquatic habitat in the Deerfield River downstream of Fife Brook dam compared with current operation.

A "run-of-release" operation would also affect minimum flow releases from the Fife Brook impoundment to the Deerfield River. An instantaneous "run-of-release" operation would require inflows from Deerfield Station No. 5 to be released to the Deerfield River downstream of Fife Brook dam on an instantaneous basis, such that the licensee for the Bear Swamp Project would not be able to store flows from Deerfield Station No. 5. If inflow from Deerfield Station No. 5 dropped below 125 cfs (which occurred approximately 78.5 percent of the time from May 1 to October 28, 2016),[69] the licensee for the Bear Swamp Project would need to begin using the 4,600 acre-feet of storage that is dedicated to the Bear Swamp PSD to meet the 125-cfs minimum flow. Over time, the use of the 4,600 acre-feet of stored water and the inability to replenish that water under a run-of-river operation could deplete useable storage and adversely affect the operation of the pumped storage development. If the elevation of the impoundment were allowed to continue to decrease, it would eventually drop below the 817.5-foot NGVD intake for the minimum flow release pipe, such that the licensee could no longer release minimum flows from the project to meet the 125-cfs minimum flow requirement.

---

[68] *New England Power Company*, 79 FERC ¶ 61,006 (1997).

[69] *See* October 9, 2019 Memo between Commission staff and BSPC discussing the data request for the Bear Swamp Project No. 2669, available at http://elibrary.ferc.gov:0/idmws/doc_info.asp?document_id=14804773

BSPC provides 106 scheduled whitewater flow releases from the Fife Brook dam according to the existing release schedule (*i.e.*, whitewater releases between 9:30 a.m. and 12:00 p.m. on 50 weekend days and 56 weekdays from April 1 to October 30, for a minimum duration of three hours). Article 404 of the existing license requires BSPC to release whitewater flows of 700 cfs. However, BSPC state that it voluntarily provides whitewater flow releases of 800 cfs from Fife Brook dam rather than 700 cfs. Continuing to release whitewater flows (either 700 cfs or 800 cfs) for recreation would result in unnatural water level changes below Fife Brook dam during the spring, summer, and fall. On whitewater release days, water levels in the Fife Brook dam tailrace rise approximately 2.5 feet over the course of 1.1 hours. Downstream of the tailrace, the magnitude of the water level fluctuations decreases with distance downstream. Rapid changes in the velocity and stage of the river displace juvenile and small fish. The cessation of whitewater flows at the end of the 3-hour release period can also dewater spawning sites, as discussed below.

Currently, BSPC increases flows from the Fife Brook Development in a staged manner by holding generation at 3 MW for 15 minutes before ramping to a generation flows up to a 10-MW generation flow of 1,540 cfs.[70] BSPC initially started this procedure as a safety measure to alert fishermen and other recreationists of rising water levels from a generation flow release. A generator output of 3 MW is equivalent to a discharge of between 270 cfs and 650 cfs from the Fife Brook dam, depending on the elevation of the impoundment. Under this mode of operation, it takes an average of 1.1 hours to ramp up to a generation outflow, which increases outflow from the minimum flow of 125 cfs to 900 cfs and water levels in the Deerfield River downstream of Fife Brook dam could continue to fluctuate by as much as 3.42 feet when releasing flows up to 1,323 cfs (the maximum hydraulic capacity of Deerfield Station 5 plus the bypassed reach flow).

BSPC proposes to discontinue releasing flows from Fife Brook dam in a staged manner because it states that the 15-minute pause at 3 MW does not provide enough of a signal to alert anglers of rising waters from a generation flow release. Instead, BSPC would increase generation outflows from the minimum flow of 125 cfs to as much as 1,540 cfs without holding generation at 3 MW for 15 minutes. Operating the Fife Brook Development in this manner would reduce the time it takes to achieve full generation output by 15 minutes. The magnitude of the stage change would remain the same, but the rate of change would increase. For instance, it would only take 51 minutes to ramp up to

[70] BSPC operates the Fife Brook Development "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5." The maximum hydraulic capacity of Deerfield Station No. 5 is 1,250 cfs plus 73 cfs from the bypassed reach for a total of 1,323 cfs. BSPC would only utilize the maximum hydraulic capacity if inflow exceeds 1,323 cfs.

900 cfs, versus 1.1 hours under the existing conditions. This reduction in total ramp time would slightly increase the adverse effects of the project on aquatic habitat in the downstream reach relative to existing conditions, including displacing juvenile fish and macroinvertebrates, and scouring sediments downstream of Fife Brook dam.

Under the Interior and Massachusetts DFW's recommendation, flow releases from Fife Brook dam would be restricted from May 15 through August 31 during the hours of 8 a.m. to 4 p.m. on days with no scheduled whitewater releases. BSPC would be required to release flows at a rate of no more than 138 cfs per hour from May 15 through June 30 and no more than 158 cfs from July 1 through August 31. As with existing and proposed operation, the up-ramping rate recommended by the agencies would not affect the magnitude of the stage change but would affect the rate of change. In the Flow Attenuation Study, the greatest change in river stage was observed in the tailrace and the effects of flow changes diminish or attenuate when moving downstream. The time it would take for a 3.42-foot increase in river stage in the tailrace would be substantially longer. From May 15 through June 30, Commission staff estimate it would take approximately 8.0 hours to reach a stage change of 3.42 feet in the Fife Brook dam tailrace (an equivalent flow of 1,323 cfs) from May 15 through June 30 and approximately 7.5 hours to reach the 3.42-foot stage change from July 1 through August 31. On days with scheduled whitewater releases during this period, there would be no limit to the ramping rate and water levels could increase by 3.42 feet within 1.1 hours at the Fife Brook dam tailrace. Similarly, from September 1 to May 14, there would be no limit to the ramping rate.

CRC recommends that BSPC increase outflow in a staged manner by holding outflow at the midpoint of the total flow for one hour before increasing flow to the total desired generation outflow. When the total generation output is higher (*e.g.*, up to the full output of 10 MW), CRC recommends implementing another 1-hour step in the ramping process before reaching the total outflow. Similar to the other recommendations, the Deerfield River could still fluctuate downstream of Fife Brook dam tailrace by as much as 3.42 feet; however, the time it takes to reach this stage would be extended by as much as 3.1 hours. CRC's proposed mode of operation for the Fife Brook Development would be year-round and inclusive of whitewater flow releases. Operating the Fife Brook Development in this manner could attenuate water level fluctuations downstream of Fife Brook dam more consistently than BSPC's existing and proposed modes of operation and reduce the effects of rapidly-changing water levels on aquatic habitat downstream. The specific effect of CRC's recommendation on dragonflies and fish are discussed in detail below.

Operating the Fife Brook Development with a one-hour ramp to generation, as recommended by Trout Unlimited, would have approximately the same effect as the existing operation (which takes approximately 1.1 hours). Currently, BSPC reduces generation down to the minimum flow of 125 cfs in approximately 1 hour. Under Trout

Unlimited's recommended mode of operation, aquatic habitat would be dewatered at a rate similar to existing conditions.

BSPC currently provides a flow of 800 cfs for whitewater flow releases. Operating the Fife Brook Development with a maximum whitewater flow release of 700 cfs, as recommended by Trout Unlimited and Massachusetts DFW, could provide a marginal benefit to aquatic habitat downstream of Fife Brook dam by reducing the magnitude of water level fluctuations associated with whitewater flows. As shown in the results of the Flow Attenuation Study, a whitewater flow release of 700 cfs would results in a stage change of approximately two feet at the Fife Brook dam tailrace compared to a flow release of 800 cfs that results in a stage change of approximately 2.5 feet. The 2-foot fluctuation would attenuate with distance downstream of Fife brook dam. Providing a flow of 700 cfs would provide more stable habitat for fish and aquatic resources on whitewater release days. This effect, however, would only be short-term and temporary as Trout Unlimited's and Massachusetts DFW's proposal would only provide a benefit to aquatic habitat for a total of 106 days from April 1 through October 31 during the 3-hour timespan for whitewater flow releases.

Water Quality

BSPC proposes to continue to operate the Bear Swamp PSD in a store and release mode by pumping water from the Fife Brook impoundment (*i.e.*, the lower reservoir) during periods of low electricity demand, storing the water until periods of high electricity demand, and then generating electricity by discharging water back into the Fife Brook impoundment during periods of high electricity demand. BSPC proposes to use 4,600 acre-feet of storage in the upper reservoir for generation (representing a 44.5-foot fluctuation between 1,555.5 and 1,600 feet NGVD) and to reserve an additional 660 acre-feet of storage for emergency/reserve conditions (representing a 5.5-foot fluctuation between elevations 1,550 and 1,555.5 feet NGVD). BSPC proposes to use 4,600 acre-feet of storage the Fife Brook impoundment for operation of the Bear Swamp PSD, which would result in a fluctuation of as much as 40 feet on a daily basis (between 830 and 870 feet NGVD).

BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5." BSPC also proposes to continue releasing a minimum flow of 125 cfs from the Fife Brook dam to protect aquatic habitat in the Deerfield River.

BSPC proposes to continue to provide 106 scheduled whitewater flow releases from the Fife Brook dam according to the existing release schedule (*i.e.*, whitewater releases between 9:30 a.m. and 12:00 p.m. on 50 weekend days and 56 weekdays from April 1 to October 30, for a minimum duration of three hours). BSPC also proposes to discontinue its current practice of holding generation at 3 MW for 15 minutes before increasing generation to higher output levels.

Massachusetts DFW recommends under section 10(j) that BSPC operate the project in a "year-round, run-of-release mode." Similarly, Interior recommends under section 10(j) that BSPC operate the Fife Brook Development as a "run-of-release facility, passing inflow it receives from the upstream Deerfield Project's Deerfield [Station] No. 5 development below Fife Brook dam on a near instantaneous basis." Massachusetts DFW and Interior also recommend under section 10(j) limits to the hourly rate of change in flow releases.

CRC further recommends releasing all flows from Fife Brook dam using a staged ramping process for increasing flows, which would include a 1-hour hold at an intermediate flow that is equivalent to the midpoint of the total scheduled flow. CRC recommends an additional intermediate flow release of one hour for "higher flows."[71]

Trout Unlimited recommends that BSPC ramp up and ramp down all flow releases from Fife Brook dam over the course of one hour (*i.e.*, ramp up to the desired flow release within one hour and ramp down to the minimum flow over the course of one hour) from March 15 through June 30. Trout Unlimited also recommends a continuous minimum flow of 350 cfs from November 1 through April 15 for the protection of spawning trout, incubating eggs, and emerging fry. Interior, Trout Unlimited, and CRC also recommend that BSPC release whitewater flows before 10 a.m.

Our Analysis

Operating a dam on a riverine system has the potential to affect water temperature, including by increasing the residence time of water in an impoundment and openly exposing water at the surface to the heat of the sun, without cover from the streambank. Higher water temperatures reduce levels of dissolved oxygen, which can be harmful to fish and other aquatic organisms. Dissolved oxygen is an important indicator of water quality and is required at an adequate concentration to sustain aquatic resources. Staff's analysis below includes a discussion the effects of project operation on water quality in Fife Brook impoundment, and in the Deerfield River downstream of Fife Brook dam. Staff's analysis does not include the upper reservoir because BSPC generally cycles 4,600 acre-feet water between the upper reservoir and Fife Brook impoundment on a daily basis, which is almost half of the gross storage capacity of the upper reservoir (*i.e.*, 8,300 acre-feet). Therefore, water quality in the upper reservoir should be similar to water quality the lower reservoir.

---

[71] CRC does not define what higher flows would necessitate two intermediate releases or the magnitude of these two intermediate releases.

Fife Brook Impoundment

Based on the water quality monitoring study that was conducted from May 1 to October 17, 2016, project operation results in a well-mixed and well-oxygenated lower impoundment (*i.e.*, the Fife Brook impoundment). Water is continually moving through the project and cycling between the upper reservoir and the Fife Brook impoundment. Routine mixing the Fife Brook impoundment helps to prevent thermal stratification of Fife Brook impoundment during warm summer months and helps maintain uniform temperature (and dissolved oxygen) throughout all depths of the Fife Brook impoundment.

The gross storage capacity of the Fife Brook impoundment is 6,900 acre-feet. BSPC typically uses approximately 4,600 acre-feet of the 6,900 acre-feet of gross storage (66.7 percent) on a daily basis by cycling up to 4,600 acre-feet of stored water between the upper and lower reservoirs. As a result of this daily cycling, average water temperatures vary by less than 4°F between the surface and maximum depth of the Fife Brook impoundment. Maintaining uniform water quality prevents shifts in water temperature and low dissolved oxygen can be harmful to fish and other aquatic organisms.

Monitoring data shows that even with routine mixing from Bear Swamp PSD generation flows and a relatively short residence time, water temperature in the Fife Brook impoundment can exceed 68ºF for short periods of time in the summer (July and August). This is likely the result of solar radiation warming water in the Fife Brook impoundment during the summer. Although water temperatures exceeded the state standard of 68°F for cold water fisheries on a daily basis, the mean of the daily maximum temperature over a seven-day period did not exceed state water quality standards for temperature in Fife Brook impoundment. In addition, water temperatures dropped below 68°F on most days during the evening and morning. Continuing to operate the Bear Swamp PSD as a pumping and storage facility would likely result in an occasional increase in the water temperatures above 68°F.

Monitoring data showed that dissolved oxygen concentrations in the upper extent of the Fife Brook impoundment ranged from 6.6 to 12.1 mg/L, and the median dissolved oxygen concentration in the deep water habitat of the Fife Brook Development was 7.63 mg/L, which was greater than the state standard of 6.0 mg/L. Near the bottom of Fife Brook impoundment, dissolved oxygen concentrations were at or near 0 mg/L. Low dissolved oxygen measurements in the Fife Brook impoundment were recorded primarily (although not always) when pond elevations fell below approximately 855 feet NGVD. BSPC attributes the low dissolved oxygen measurements to the probe resting on the sediment at the bottom of the reservoir or the probe entering the hypoxic zone that forms at the sediment-water interface. The low dissolved oxygen concentrations were isolated to the sediment-water interface, and were never observed at shallower depths in the water column. Therefore, oxygen loss in the deepest area of the Fife Brook impoundment appears to be the result of biological oxidation in the water column immediately above the sediment-water interface.

BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5." As discussed above, BSPC does not actually operate the Fife Brook Development in a "run-of-release" mode on an instantaneous basis and occasionally deviates from such an operation on a daily basis. Massachusetts DFW and Interior recommend operating the project in a run-of-release mode by passing inflows received from Deerfield Station No. 5 on a near instantaneous basis. Operating the Fife Brook Development in an instantaneous "run-of-release" mode would pass the majority of the peaking inflows to the Deerfield River downstream of Fife Brook dam. Operating in an instantaneous "run-of-release" mode would not be expected to affect water quality because the Fife Brook impoundment is already routinely mixed by Bear Swamp PSD operation and from the inflow from the Deerfield Station No. 5 peaking flows. Operating in an instantaneous run-of-release mode would have similar effects on water quality as the existing and proposed operation; *i.e.*, temperature would occasionally exceed 68ºF for periods that would be less than seven days in duration and dissolved oxygen levels would be greater than 6.0 mg/L except near the water/substrate boundary of the impoundment.

BSPC's proposal to discontinue releasing flows from Fife Brook dam in a staged manner (*i.e.*, to no hold generation at 3 MW for 15 minutes) would not likely affect dissolved oxygen in the Fife Brook impoundment. The Fife Brook impoundment is well-mixed by the Bear Swamp PSD. Dissolved oxygen levels in the Fife Brook impoundment are also uniform from the surface to the level of withdraw for generation. Operating without a staged increase in flow would be expected to have nearly the same effect on water quality as existing operation. Releasing generation and whitewater flows 15 minutes faster would only reduce time water remains in the Fife Brook impoundment by a fraction and the effects on water quality would be similar to existing conditions.

The generator ramping rates recommended by Interior and Massachusetts DFW would restrict BSPC from releasing water from the Fife Brook Development from 7 a.m. to 4 p.m. at a rate no greater than 130 cfs per hour from May 15 through June 30 and no more than 158 cfs per hour from July 1 through August 31. The ramping rates recommended by the agencies would significantly extend the time it currently takes for BSPC to release flows from Fife Brook dam. For example, currently it takes BSPC 1.1 hours to release an average flow of 900 cfs from Fife Brook dam. Under the agency-recommended up-ramping rate, it would take BSPC approximately 8.0 hours to release the same flow from May 15 through June 30 and 7.5 hours to release the same flow from July 1 through August 31 on days without scheduled whitewater releases. Under this mode of operation, water would be retained in the Fife Brook impoundment approximately 7 times longer than it is under existing operation. The increased residence time would increase the exposure of the surface layer of the impoundment to solar radiation, which could decrease dissolved oxygen and increase temperature in the impoundment. These effects would be most profound during the hottest summer months of July and August. However, the Fife Brook impoundment is well-mixed by the Bear Swamp PSD on a daily basis, which would reduce the effects of the increased residence time on temperature and dissolved oxygen.

CRC recommends a staged release from Fife Brook dam, including by holding outflow at the midpoint of the total expected flow for one hour before increasing flow to the total desired generation outflow. CRC's recommendation would increase the residence time of water in the impoundment, but would not be expected to adversely affect water quality in the impoundment based on the relatively minor increase in residence time (2 hours) and the fact that water within the impoundment is well mixed by operation of the Bear Swamp PSD.

Trout Unlimited's recommendation for a 1-hour up-ramp to generation and a one hour ramp down to minimum flows is approximately equal to the existing operation, and would affect water quality in a similar matter as existing conditions.

Deerfield River Downstream of Fife Brook Dam

The Fife Brook Development withdraws water for generation between elevations of 807 feet NGVD to 831 feet NGVD, and withdraws minimum flows from an elevation of 817.5 feet NGVD. These elevations are in the deep section of the Fife Brook impoundment where data was collected during the water quality monitoring study (an elevation of 806 feet). As discussed above, the Fife Brook impoundment did not undergo thermal or dissolved oxygen stratification during the study period, and dissolved oxygen was relatively uniform throughout the water column of the Fife Brook impoundment.

The discharge of water from the deep section of the Fife Brook impoundment to the Deerfield River does not appear to have an adverse effect on water quality in the Deerfield River. The mean dissolved oxygen level measured in the tailrace, Zoar Picnic Area, and Zoar Outdoor monitoring stations[72] ranged from 9.2 to 9.4 mg/L, which were higher than the median dissolved oxygen measured in the deep section of the Fife Brook impoundment from which flow is released (7.6 mg/L). The observed increase in dissolved oxygen levels in the tailrace was likely the result of turbulence from water flowing over rocks in the tailrace.

[72] The Zoar Picnic Area is 5 miles downstream of Fife Brook dam. Zoar Outdoor and Purinton Road are 12 and 14 miles downstream of Fife Brook dam, respectively.

The lowest observed dissolved oxygen reading in the Deerfield River downstream of the Fife Brook dam was measured at the Purinton Road monitoring station in late September and October. The Purinton Road monitoring station is outside of the project boundary, approximately 14 miles downstream of Fife Brook dam. BSPC states that the low dissolved oxygen levels at this location were likely from the accumulation of leaf litter and debris fouling on the monitoring probe. The water quality monitoring data collected from the Purinton Road monitoring station during this time period did not have dissolved oxygen readings below 6.8 mg/L, which is additional evidence that the occasional low dissolved oxygen levels observed 14 miles downstream of Fife Brook dam were unrelated to a project effect.

Water temperature generally increases with distance downstream of the Fife Brook dam as the Deerfield River approaches Deerfield Station No. 4 and the river becomes broader and shallower with less vegetative cover. As a result, water temperatures measured at the Zoar Picnic Area, Zoar Outdoor, and Purinton Road monitoring stations were higher than water temperature measured upstream locations, regardless of the river flow, and exceeded state water quality criteria during warm summer months. Altogether, the water quality data suggests that the observed increase in water temperature with distance downstream of Fife Brook dam is a natural process unrelated to operation of the project.

BSPC's proposal to continue releasing a 125-cfs minimum flow and to continue releasing whitewater flows for 106 days per year would result in similar water quality conditions in the Deerfield River downstream of Fife Brook dam. Under the current project operation, water withdrawn for whitewater releases and the 125-cfs minimum flow would continue to provide adequate dissolved oxygen and water temperature conditions for fish and aquatic organisms in the Deerfield River downstream of Fife Brook dam.

Interior and Massachusetts DFW recommend that BSPC operate the Fife Brook Development in a run-of-release mode passing inflow received from Deerfield Station No. 5 on a near instantaneous basis. As discussed above, Fife Froom impoundment does not thermally stratify and has uniform water temperature and dissolved oxygen levels from the surface of the impoundment to near the bottom. Operating the Fife Brook Development in this manner would not affect water quality downstream of Fife Brook dam because of the similarity in water temperature between the Fife Brook impoundment and in the tailrace. The effects of operating in a "run-of-release" mode on water quality would be similar to existing conditions and would help to maintain adequate dissolved oxygen concentrations and water temperature in in the Deerfield River downstream of the Fife Brook dam.

Interior, CRC, and Trout Unlimited recommend that BSPC release flows for whitewater recreation from the Fife Brook Development earlier in the day (by 10:00

a.m.) to mitigate for higher water temperatures occasionally observed downstream of Fife Brook dam during the summer months. CRC suggests that releasing water from Fife Brook dam earlier in the day could provide a cooling effect downstream and reduce the number of days where temperature exceeds state water quality standards for temperature. To better understand how releases from Fife Brook dam affect temperature downstream, Commission staff used discrete temperature monitoring data at Purinton Road (the furthest downstream monitoring station) for the days that exceeded Massachusetts water quality standards for temperature and then compared it to the time of day when BSPC released a peaking flow from Fife Brook dam.[73]

There were a total of five days in the discrete monitoring dataset when temperature exceeded state water quality standards for temperature. Of the five days, there were four days where water was released from Fife Brook dam earlier than 10:00 a.m. (Table 12). From this analysis, it appears that releases from Fife Brook dam before 10 a.m. still result in water temperatures above 68°F and that this additional measure would not significantly benefit water temperature.

Table 12 Discrete temperature monitoring exceedances at Purinton Road and release timing from Fife Brook dam.

Date of Temperature Excursion	Time of Observed Peak at Charlemont	Time of Release at Fife Brook Dam
6/24/2016	3:00 p.m.	9:00 a.m.
7/13/2016	3:15 p.m.	9:15 a.m.
7/28/2016	3:45 p.m.	9:45 a.m.
8/25/2016	12:00 p.m.	6:00 a.m.
9/6/2016	10:15 p.m.	4:15 a.m.

(Source: staff)

BSPC proposes to discontinue releasing flows from Fife Brook dam in a staged manner. Instead, BSPC would increase generation outflow from the minimum flow of 125 cfs to as much as 1,540 cfs without holding generation at 3 MW for 15 minutes. Discontinuing the staged release would not likely affect dissolved oxygen. The Fife Brook impoundment has uniform levels of dissolved oxygen from the surface to just above the bottom, and is well-mixed by the Bear Swamp PSD and inflow from Deerfield Station No. 5. Operating without a staged increase in flow would be expected to have nearly the same effect as existing operation. There would only be a difference of 15

[73] Staff used flow data from the Charlemont USGS gage to determine when a peaking flow was first detected at the Charlemont gage. Water released from Fife Brook dam takes 6 hours to travel to the Charlemont gage. Subtracting 6 hours from the time of detection at the Charlemont gage provides the approximate time when peaking flows would be released at Fife Brook dam.

minutes between BSPC's existing operation and its proposal. Any benefits of releasing water without a staged increase would be likely be indistinguishable from existing operation and dissolved oxygen levels downstream of Fife Brook dam would remain the same under BSPC's proposal.

The generator ramping rates recommended by Interior and Massachusetts DFW would restrict BSPC from releasing water from the Fife Brook Development from 7 a.m. to 4 p.m. at a rate no greater than 130 cfs per hour from May 15 through June 30 and no more than 158 cfs per hour from July 1 through August 31. The ramping rates recommended by the agencies would significantly extend the time it currently takes for BSPC to release flows from Fife Brook dam, as discussed above. However, releasing flows from Fife Brook dam at a rate of 130 cfs per hour or 158 cfs per hour during the summer (from May 15 through August 31) would not likely affect dissolved oxygen levels downstream because the Fife Brook impoundment is mixed by the operation of Bear Swamp PSD. Dissolved oxygen levels in the Deerfield River downstream of Fife Brook dam would likely be similar to existing operation. For these same reasons, releasing flows from the Fife Brook Development as recommended by CRC and Trout Unlimited would not be expected to affect dissolved oxygen levels downstream of Fife Brook dam.

Operation Compliance and Monitoring

BSPC proposes to develop and implement an Operation Compliance Monitoring Plan that describes: (1) mechanisms and structures that would be used to provide minimum flow releases and scheduled whitewater flow releases; (2) periodic maintenance and calibrations necessary for installed measuring devices; and (3) procedures for recording and reporting data to FERC and resource agencies.

Interior recommends under section 10(j) that BSPC prepare and file a plan for monitoring flow releases from Fife Brook dam within 6 months of license issuance that includes details of the mechanisms and structures used to provide flow releases, maintenance and calibration procedures, a description of manual and automatic operation, an implementation schedule, and recording and reporting of data to FERC and the resource agencies.

Massachusetts DFW recommends under section 10(j) that BSPC prepare a plan for monitoring "run-of-release" operation at the Fife Brook Development, including procedures for calibrating and maintaining monitoring equipment and reporting to resource agencies and other interested non-governmental agencies. Massachusetts DFW further recommends under section 10(j) that the licensee allow Massachusetts DFW and FWS to inspect the project and obtain operation records for the purpose of monitoring compliance with all the terms and conditions of any new license issued by the Commission.

Trout Unlimited recommends that BSPC install and maintain a flow gage immediately downstream of Fife Brook dam to ensure compliance with minimum flows and whitewater flow releases.

Our Analysis

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

Prior to August 29, 2011, BSPC had a formalized plan for monitoring minimum flow releases from Fife Brook dam using a flow gage station that was located immediately downstream of the powerhouse. However, Hurricane Irene destroyed the flow gage monitoring station in August 2011. BSPC determined that the flow gage monitoring station could not be rebuilt and instead designed the two existing minimum flow pipes to release the 125-cfs minimum flow.[74] Although BSPC is required to provide whitewater releases of 700 cfs, BSPC states that it voluntarily provides whitewater releases of 800 cfs from Fife Brook dam. BSPC releases whitewater flows of 800 cfs by using the turbine discharge rating curve. BSPC's schedule for daily generation releases and the required whitewater release from the Fife Brook Development are published online as a means to inform the public of the daily operation at the Fife Brook Development.

Formalizing BSPC's existing monitoring protocol for minimum flow and whitewater flow releases in an Operation Compliance Monitoring Plan would help BSPC document its compliance with the operational provisions of any new license, provide a mechanism for reporting operational data and deviations, and facilitate administration of the license. With the development of an Operation Compliance Monitoring Plan, there would not be a substantial environmental benefit associated with an inspection of the project operation by Massachusetts DFW. However, the Commission's standard terms and conditions for a hydropower license require the licensee to provide employees of the U.S. Government access to project land and works in performance of their official duties. This standard article would apply to site access for FWS employees and its designated representatives.

Installation of a gage downstream of Fife Brook dam would provide BSPC a secondary means to monitor its operations to ensure that the minimum flow pipe is releasing 125-cfs and that the proposed whitewater release is 800 cfs. In addition, a gage

[74] *Bear Swamp Power Company,* 140 FERC ¶ 62,079 (2012).

downstream provides stakeholders a clear and transparent way to monitor operations to ensure that BSPC releases flows according to the terms of any new license issued by the Commission. However, BSPC posts its 24-hour flow release schedule and current flow information on the Safe Waters website,[75] and provides access to flow information via Safe Waters' toll-free phone line (1-844-430-3569). In addition, the USGS gage at Charlemont, 12 miles downstream of the project, provides instantaneous flow information about the Deerfield River. There is also no evidence that BSPC is unable to comply with the minimum flow requirements and whitewater flow release requirements of the current license, as the minimum flow pipes at the Fife Brook dam have a capacity equal to the 125-cfs minimum flow and BSPC uses its turbine-discharge rating curve to release the appropriate amount of whitewater flows. For these reasons, installing a flow gage would not likely benefit environmental resources at the project.

Fisheries Resources

Reservoir Fluctuations

BSPC proposes to continue to operate the Bear Swamp PSD in a store and release mode by pumping water from the Fife Brook impoundment (*i.e.*, the lower reservoir) during periods of low electricity demand, storing the water until periods of high electricity demand, and then generating electricity by discharging water back into the Fife Brook impoundment during periods of high electricity demand. BSPC proposes to fluctuate the upper reservoir of the Bear Swamp PSD by as much as 50 feet on a daily basis (between 1,550 and 1,600 feet NGVD) and to fluctuate the Fife Brook impoundment by as much as 40 feet on a daily basis (between 830 and 870 feet NGVD). However, BSPC would continue to hold a portion of its useable storage capacity in the upper reservoir between elevations 1,555.5 and 1,550 feet NGVD for emergency/reserve conditions, which would reduce the useable storage in the upper reservoir from 5,260 acre-feet to 4,600 acre-feet.

BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5." BSPC also proposes to continue releasing a minimum flow of 125 cfs from the Fife Brook dam to protect aquatic habitat in the Deerfield River. In addition, BSPC proposes to discontinue its current practice of holding generation at 3 MW for 15 minutes before increasing generation to higher output levels.

---

[75] BSPC provides daily flow information for the Fife Brook Development on-line to inform the public of flow releases on the Safe Waters website at https://www.safewaters.com/facility/22. The public uses this information to plan specific recreational activities such as fishing, whitewater boating, and tubing.

Massachusetts DFW recommends under section 10(j) that BSPC operate the project in a "year-round, run-of-release mode." Similarly, Interior recommends under section 10(j) that BSPC operate the Fife Brook Development as a "run-of-release facility, passing inflow it receives from the upstream Deerfield Project's [Deerfield] Station No. 5 below Fife Brook dam on a near instantaneous basis." Massachusetts DFW and Interior also recommend under section 10(j) certain flow releases and operational limits to protect downstream aquatic resources, including: (1) a continuous minimum flow of 125 cfs from April 16 through October 31; (2) a continuous minimum flow of 350 cfs from November 1 through April 15; and (3) up-ramping limitations (*i.e.*, limits to the hourly rate of change in flow releases). These recommendations could affect the elevations of Fife Brook impoundment and the upper reservoir of the Bears Swamp PSD.

The CRC recommends releasing all flows from Fife Brook dam using a staged ramping process for increasing flows, which would include a 1-hour hold at an intermediate flow that is equivalent to the midpoint of the total scheduled flow. CRC recommends additional intermediate flow release of one hour for "higher flows."[76]

Trout Unlimited recommends releasing flows from Fife Brook dam with a one-hour ramp up to generation and a one-hour ramp down from generation from March 15 through June 30 when newly emerged trout fry are vulnerable to changes in flow.

Our Analysis

As discussed above, water levels in the upper reservoir and in Fife Brook impoundment are not stable and can fluctuate rapidly by as much as 45.5 feet in the upper reservoir and as much as 40 feet in the lower reservoir. Results of the Fish Assemblage Study show that yellow perch and white sucker dominate the upper reservoir and Fife Brook impoundment. These species prefer a more lentic habitat for their life history requirements or have the ability to adapt to a lentic habitat.

Stable aquatic habitat in both the upper and lower reservoirs is limited because the frequent, rapid water level fluctuations in the upper reservoir and Fife Brook impoundment that result from the normal operation of Bear Swamp PSD require fish to move between areas with suitable habitat on a daily basis. The involuntary movement of fish in the upper reservoir and Fife Brook impoundment requires expending energy to locate suitable habitat. Because habitat is limited in both the upper reservoir and Fife Brook impoundment, fish would be expected to expend additional energy seeking areas with suitable habitat as water levels fluctuate during operation. However, the availability of food resources for resident fish to replenish lost energy from daily movements is

---

[76] CRC does not define what higher flows would necessitate two intermediate releases or the magnitude of these two intermediate releases.

limited because the littoral zone is armored and routine fluctuations of the reservoirs reduce the numbers of endemic benthic macroinvertebrates, a valuable food source for fish. Resident fish populations in the reservoirs are likely less fit than fish downstream of Fife Brook dam because of the need to adapt to unstable habitat in order to carry out life functions.

Unlike the main body of the Fife Brook impoundment and the upper reservoir, the upper extent of the Fife Brook impoundment is more riverine in nature and provides better habitat for lotic fish species such as trout and minnows. Water fluctuations in the upper extent of the Fife Brook impoundment do, however, create a backwater effect above a reservoir elevation of 834 feet NGVD. This backwater effect inundates a portion of the riverine habitat on a daily basis. However, water level fluctuations in the upper extent of the Fife Brook impoundment appear to have less of an effect on resident fish, as evidenced by the large numbers of trout and minnows collected in this area during the Fish Assemblage Study. The additional species in this area reflects the fact that fish can either move upstream to access additional food resources in the shallower stretches of the bypassed reach for Deerfield Station No. 5 or move downstream to the more lentic environment in the Fife Brook impoundment. In addition, the backwater effect in the upper extent of Fife Brook impoundment would be expected to have less of an effect on food sources for fish, as a drop in water levels to elevations below 834 feet msl creates riverine conditions suitable for the propagation of benthic macroinvertebrates.

Continuing to operate the Bear Swamp PSD in a store and release mode with the existing daily reservoir fluctuations would continue to limit the amount of stable, useable aquatic habitat in Fife Brook impoundment to an elevation of 830 feet NGVD in the Fife Brook impoundment, and 1,555.5 feet NGVD in the upper reservoir. On a daily basis, resident fish would continue to expend energy seeking suitable habitat as water levels fluctuate during normal operation. Resident fish in the main body of Fife Brook impoundment and the upper reservoir would have less food resources and foraging habitat to replenish energy reserves expended while searching for suitable habitat, which could contribute to a reduced level of fitness or increased predation.

Effects of Generator Ramping

To avoid sudden increases in flow downstream of Fife Brook dam, BSPC currently ramps the Fife Brook Development's generator up to a 3-MW output level, and holds the generator at 3 MW for 15 minutes before increasing generation to higher output levels. BSPC proposes to discontinue its practice of holding generation at 3 MW for 15 minutes. Releasing flows in this manner takes approximately 1.1 hours to reach a generation outflow of approximately 900 cfs. BSPC proposes to discontinue this practice because it states that the practice has not been effective in providing an adequate signal to alert fisherman to rising water levels. Discontinuing this practice would lower water levels in the Fife Brook impoundment by less than one foot from existing conditions over

15 minutes and speed the rate that water levels fall in the Fife Brook impoundment by 15 minutes. Under the proposed mode of operation, it would take less than one hour (51 minutes) to cease the minimum flow release and begin releasing a flow of 900 cfs.

Resident fish in the upper reservoir would be unaffected by the proposed mode of operation. In the Fife Brook impoundment, reducing the rate at which water levels recede by 15 minutes would not significantly affect resident fish, as the rate of change is nearly the same as existing conditions and fish would likely expend a similar amount of energy searching for suitable habitat as water levels fluctuate. Foraging habitat and food resources would also be limited to substantially the same degree under the proposed mode of operation, and fitness would be affected similarly over time.

Operating as Interior and Massachusetts DFW recommend would limit the ramping rate for generation outflows to either 130 cfs per hour or 158 cfs per hour, from 7 a.m. to 4 p.m. from May 15 through August 31. Reducing the ramping rate would result in a corresponding reduction in the rate of water level fluctuations, which would reduce the effects of the project on fisheries by providing fish with additional time to search for suitable habitat as water levels fluctuate. However, these benefits would not be available during whitewater flow releases, outside of the 7 a.m. to 4 p.m. time period from May 15 through August 31, or outside of the May 15 through August 31 time period. BSPC would then be required to provide outflows from the Fife Brook Development that equal inflows from Deerfield Station No. 5. As such, inflow that could not be released between 7 a.m. and 4 p.m. due to the ramping restrictions would need to be stored in the Fife Brook impoundment. The accumulated storage of inflow would raise water levels in the Fife Brook impoundment by approximately 5 feet or more during the long periods between schedule whitewater releases (*e.g.,* from May 15 through June 30). In addition, the inflow from potential storm events that occurs between 7 a.m. and 4 p.m. and that exceeds 130 cfs per hour (May 15 through June 30) or 150 cfs per hour (July 1 through August 31) would also be stored in the lower reservoir.

Inflows not released by 4 p.m. would remain in the lower reservoir until BSPC could potentially release the stored inflow as a peaking flow to match the inflow from Deerfield Station No. 5 or for scheduled whitewater releases. The daily storage of inflow could increase water levels creating some additional habitat for fish during the spring and summer. Many species of fish found in Fife Brook impoundment spawn in the spring. Although there is limited spawning habitat in the lower reservoir, the eggs of fish that spawn in the band of water stored in the lower reservoir would be lost when BSPC releases the stored inflow for scheduled whitewater releases. In a similar way, any additional foraging habitat for fish created a stored band water in Fife Brook impoundment would also be lost during a scheduled whitewater release or peaking flow release.

As with existing operation, water levels would still fluctuate in Fife Brook impoundment under Interior's and Massachusetts DFW's proposal. Fish would still have to expend energy to locate suitable habitat as water levels fluctuate; however, fish would have additional time to locate suitable habitat (up to 8 hours from May 15 through June 30), which could reduce stress and improve fitness. Any benefits to resident fish in Fife Brook impoundment from operating under this scenario would be short-term and temporary, as the recommended mode of operation would only be effective from May 15 through August 31.

Massachusetts DFW and Interior's recommended ramping rates would also affect fish in the upper reservoir. Under the recommended release schedule, water levels in the Fife Brook impoundment would be higher than they would be under existing operation particularly during the day when BSPC generates electricity with the Bear Swamp PSD. BSPC would only be able to release enough water from the upper reservoir to fill Fife Brook impoundment to elevation 870 feet NGVD and would also be required to provide some storage within Fife Brook impoundment to accommodate peaking inflow from Deerfield Station No. 5. During the course of the day, inflows could be as high as 1,323 cfs and would accumulate in Fife Brook impoundment because the maximum recommended release rate from Fife Brook dam would be much less than inflow from Deerfield Station No. 5. This, in turn, would raise water levels in the Fife Brook impoundment above 830 feet NGVD, which would restrict BSPC's ability to release the 4,600 acre feet of water stored in the upper reservoir. Water levels in the upper reservoir therefore would be higher than 1,555.5 feet NGVD creating additional habitat for fish. Similar to effects on fish in the Fife Brook impoundment, fish would still be forced to find suitable habitat on a daily basis as water levels fluctuate on a daily basis. Suitable habitat would be limited in the upper reservoir, and any gains in habitat that would benefit fish would be short-term and temporary, as the recommended generator ramping rates would only occur at certain times between May 15 and August 31.

Trout Unlimited's generator ramping release schedule would have similar effects to fish as the proposed mode of operation. Under the existing mode of operation, ramping to generation takes approximately 1.1 hours, which is nearly the same as Trout Unlimited's proposal. Ramping down from generation currently takes approximately one hour, which is also the same as the rate proposed by Trout Unlimited.

CRC's proposed ramp to a generation releases would take up to 3.1 hours total, which is an additional 2.0 hours more than the existing mode of operation and 2.25 hours more than the proposed mode of operation. Fish would have slightly more time to locate suitable habitat (an additional 2.0 hours), which may require less expenditure of energy over existing conditions. This could provide a marginal benefit to fitness, which could benefit resident fish in the Fife Brook impoundment. However, fluctuating the Fife Brook impoundment 2.0 hours slower than existing conditions and 2.25 hours slower than proposed conditions would not likely provide significant benefits to fish in Fife

Brook impoundment, as fish would still be required to find suitable habitat over a relatively short period of time as water levels fluctuate by up to 40 feet on a daily basis. Fish in the upper reservoir would not likely be affected by CRC's proposal.

Entrainment and Impingement

BSPC proposes to continue to operate the Bear Swamp PSD in a store and release mode by pumping water from the Fife Brook impoundment (*i.e.*, the lower reservoir) during periods of low electricity demand, storing the water until periods of high electricity demand, and then generating electricity by discharging water back into the Fife Brook impoundment during periods of high electricity demand. BSPC also proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5."

On August 13, 2008, the Commission authorized the rehabilitation of the existing turbine units to increase the hydraulic capacity of each of the turbines from 5,430 cfs to 6,200 cfs, for a combined hydraulic capacity of 12,400 cfs.[77] When complete, the changes will result in an additional 770 cfs going through the project turbines. The maximum turbine discharge will increase by approximately 14 percent and the maximum pumping rate will increase by 13 percent.

BSPC does not propose any measures to mitigate fish entrainment mortality associated with operation of the Fife Brook Development or Bear Swamp PSD. In addition, no stakeholders filed comments or recommendations to reduce project effects on fish entrainment.

Our Analysis

Fife Brook Development

The passage of large volumes of water through trash racks and turbines can result in fish impingement and entrainment mortality at conventional and pumped storage hydroelectric projects. Blade strikes are thought to be the primary source of mortality for fish entrained through both pumped storage and conventional hydropower projects (Franke *et al*., 1997; Pracheil *et al*., 2016). Pressure-induced mortality is more frequent at pumped storage hydroelectric projects, especially if the area where fish exit the pump-turbine units has a much lower pressure than the point of entrainment (*e.g.*, passing from a deep to shallow reservoir) (Cada *et al*., 1997). Fish life history, size, swimming ability,

[77] *See Bear Swamp Power Company, LLC*, 124 FERC ¶ 62,127 (2008). On December 9, 2016, the Commission granted an extension of time until August 13, 2022 for BSPC to complete the rehabilitation of the turbine units.

operating regimes, inflow, intake velocities, trashrack bar spacing, and intake/turbine configurations all play an important role in entrainment susceptibility and turbine mortality. Smaller-sized fish are more likely to be entrained, but experience lower turbine mortality, although the physical properties of turbine units also plays a role in turbine mortality (Winchell *et al*., 2000; Cada *et al*., 1997; Pracheil *et al*., 2016).

The single intake at the Fife Brook dam is equipped with a 24.2-foot-tall (normal to flow), 11.2-foot-wide trashrack panel consisting of 0.5-inch-wide bars having 3.0-inch clear spacing. BSPC proposes to continue using the existing trashrack at the generator intake at the Fife Brook dam. Due to the wide spacing of the trash racks covering the Fife Brook Development intake, there is little potential for impingement at the development because even the largest adult fish present in the project reservoirs could easily fit through the trash rack bars. For example, a 10-inch brown trout is approximately 1.2 inches wide (Nistor *et al.*, 2014) and could fit through the trashracks.

BSPC calculated approach velocities to the trashrack at the maximum elevation of 870 feet NGVD and the minimum elevation of 830 feet NGVD using the maximum hydraulic capacity of the turbine at the Fife Brook Development (1,540 cfs). At the maximum water surface elevation of 870 feet NGVD, the approach velocity within the flow area at 1 foot in front of the trashrack would be 0.18 feet per second (fps). At the minimum water surface elevation of 830 feet NGVD, the approach velocity within the flow area at 1 foot in front of the trashrack would be 0.68 fps.

BSPC measured intake velocity in front of the trashracks at the surface, mid-depth and the bottom when the Fife Brook impoundment was at 862 feet NGVD (near maximum reservoir elevation) and 836 feet NGVD (near minimum reservoir elevation), respectively to verify the calculated approach velocities at a distance of one foot in front of the trashrack. Measured velocities in flow field in front of the intake were all less than 1.0 fps.

The adult and juvenile life stages of most fish species present in the Fife Brook impoundment can avoid entrainment because their burst swimming speeds exceed the measured approach velocities at the Fife Brook intakes (Table 13). The calculated maximum approach velocity and measured approach velocity one foot in front of the intake at Fife Brook dam were low [less than 1.0 fps]. Fish are able to detect obstacles using stimuli such as flow acceleration, turbulence, and sound (Coutant and Whitney, 2000). As fish approach the intake and the trashrack, they would sense flow acceleration near the trashrack and sound from the turbine operation. Fish sensing these cues would typically respond by swimming away from the intake at burst speed. However, some species of juvenile fish would be susceptible to entrainment because their burst speeds are at or less than the maximum approach velocities at the Fife Brook Development intake; specifically, fallfish, slimy sculpin, rainbow trout, and brook trout are susceptible to entrainment. Nevertheless, due to their small size, the blade strike model presented by

Franke *et al.*, 1997, predicts fish in this size range (less than 4-inches) would survive entrainment through the Fife Brook Development's Francis turbine. Therefore, under existing project operation, the total entrainment mortality at the Fife Brook Development would be expected to be minimal and not adversely affect fish populations in the Fife Brook impoundment.

Table 13. Burst speeds of fish species in the Fife Brook impoundment.

Family	Fish Species	Life Stage	Burst Swim Speed (fps)	Length (inches)
Catostomidae (suckers)	White Sucker[1]	Adult	5.2 – 10.2	
		Juvenile	2.4 – 3.8	7.0 – 9.0
Centrachidae (bass)	Smallmouth Bass[1]	Adult	3.5 – 5.6	10.0 – 15.0
		Juvenile	2.0 – 3.2	3.0 – 3.5
Cyprinidae (minnows and carps)	Spottail Shiner[1]	Adult	2.2 – 2.5	3.0 – 4.0
		Juvenile	1.0 – 1.3	2.0 – 2.5
	Longnose Dace[1]	Juvenile	1.4 – 3.2	1.7
	Blacknose Dace[1]	Adult	1.3	1.7
	Creek Chub[1]	Juvenile	1.5	2.2
	Fallfish[2]	Adult/Juvenile	0.6 – 3.6	7.1-11.8
Percidae (perches)	Yellow Perch[1]	Adult/Juvenile	1.0 – 1.5	3.7

Family	Fish Species	Life Stage	Burst Swim Speed (fps)	Length (inches)
Cottidae (sculpins)	Mottled Sculpin[3] (substitute for Slimy Sculpin)	Adult/Juvenile	0.8 – 2.8	1.2 – 3.5
Salmonidae (Trout and Salmon)	Rainbow Trout[1]	Adult/Juvenile	0.3 – 4.9	15.0
	Brown Trout[1]	Adult	7.0 – 12.7	6.0 – 14.0
		Juvenile[4]	1.8	2.0
	Brook Trout[1]	Adult	7.0 – 12.7	6.0 – 16.0
		Juvenile	0.1 – 2.0	3.0 – 5.0

(Source: staff)
[1] NYPA, 2017
[2] Bell, 1991
[3] Katopodis and Gervais, 2016
[4] Scruton *et al*., 1998

Bear Swamp PSD

Both of the reversible Francis-type, pump-turbine units at the Bear Swamp PSD have a maximum pump flow rating of 4,520 cfs. The pump-turbine units convey water from the Fife Brook impoundment to the upper reservoir through a four-bay intake/outlet structure. Each of the four bays of the inlet/outlet structure is equipped with a 15-foot-wide by 26.7-foot-tall trashrack consisting of 15/16-inch-wide bars with 6-inch clear spacing.

BSPC calculated approach velocities within a trapezoidal-shaped flow area 1.6 feet upstream from the trashrack at the maximum and minimum Fife Brook impoundment elevations of 870 feet and 830 feet NGVD, respectively, using the maximum pump flow rating. At the maximum water surface elevation, the calculated approach velocity within the flow area 1.6-feet in front of the trashrack would be 0.86 fps. At minimum water surface elevation, the calculated approach velocity within the flow area 1.6 foot upstream from the trashrack would be 2.1 fps.

BSPC measured intake velocity in front of the trashracks at the inlet/outlet structure at the surface, mid-depth, and the bottom when the Fife Brook impoundment was at 862 feet NGVD (near the maximum elevation) and 836 feet NGVD (near the minimum elevation), respectively, to verify the calculated approach velocities at a distance of 1.6 feet in front of the trashracks. Measured velocities in flow in front of the intake/outlet structure were all less than 1.0 fps.

Similar to the Fife Brook Development, the wide spacing of the trash racks covering the intake/outlet structure of the Bear Swamp PSD (clear spacing of 6.0 inches) reduces the potential for impingement at Bear Swamp PSD because even the largest adult fish present in the Fife Brook impoundment (*i.e.*, brown trout) could easily fit through trash racks.

The Bear Swamp PSD is known to entrain adult and juvenile fish. There are no other inflows to the upper reservoir except for the inflow that is pumped from the Fife Brook impoundment by the Bear Swamp PSD. The presence of yellow perch, smallmouth bass, white sucker, and brown trout in the upper reservoir indicates that these fish species were likely entrained during pumping.

Yellow perch appear to be most susceptible to entrainment as this group has the highest number of individuals in the Fish Assemblage Study. The range of lengths of yellow perch in the upper reservoir (46-174 mm in total length) is evidence that both adult and juvenile fish are present in the upper reservoir. Based on the observed numbers and sizes of yellow perch, it is possible that yellow perch can reproduce in the upper reservoir. Juvenile and adult yellow perch have burst speeds similar to the measured approach velocity in front of the inlet/outlet structure (Table 13). Incidental numbers (less than 20 individuals) of other species of adult fish (brown trout, smallmouth bass, white sucker) also made up the catch in the upper reservoir; however, these species have burst speeds that exceed the measured approach velocity at the inlet/outlet structure (Table 13). Overall, based on the large distribution of juvenile fish in the upper reservoir, it appears that juvenile fish are most susceptible to entrainment. As discussed above, the blade strike model presented by Franke *et al*. (1997) predicts fish less than 4 inches would survive entrainment through a Francis turbine, as evidenced by the numbers of juvenile yellow perch in the upper reservoir.

At pumped storage projects such as the Bear Swamp PSD, where entrained fish are moved (passed) fairly rapidly between two different reservoirs with potentially different environments and water pressures (depending on project operation and water levels), pressure-induced mortality represents an additional source of entrainment mortality. This is especially the case when fish are entrained at high pressures and released into relatively low pressure environments because fish (especially physoclistous fish that lack a connection between their esophagus and swim bladder, such as percids and centrarchids) have difficulty releasing gas when moved rapidly to a lower pressure environment (Bond, 1996). Cada *et al*. (1997) suggest that, as a general fish protection measure, exposure pressures should fall to no less than 60 percent of the value to which entrained fish are acclimated. At the Bear Swamp PSD, under the worst case scenario while the project is generating (and the upper reservoir is at full pool, 1,600 feet NGVD) and the Fife Brook impoundment is at its minimum operating elevation of 830 feet NGVD), the pressure a fish would experience upon release into the Fife Brook impoundment (5.8 pounds per square inch, (psi)) is lower than that experienced at the point of entrainment (26.0 psi). Under the worst case scenario when the project is pumping (and the Fife Brook impoundment is at full pool and the upper reservoir is at its normal operating level of 1,555 feet), the pressure a fish would experience upon release into the upper reservoir (29.4 psi) is considerably less, only 47 percent of that experienced at the point of entrainment (61.6 psi), which could be detrimental based on the 60 percent threshold suggested by Cada *et al*. (1997).

As discussed above, the measured approach velocities in the Fife Brook impoundment inlet/outlet structure are low (less than 2 fps) and adult and juvenile yellow perch is the species most susceptible to entrainment. At Bear Swamp PSD, velocity at the inlet/outlet structure decreases over time as the upper reservoir fills because the pump turbines have to overcome increasing head of the filling upper reservoir. Therefore, fish are most susceptible to entrainment at the beginning of a pump cycle when the upper reservoir starts filling. Effects of entrainment mortality (either pressure-induced or from blade strike) would not be expected to be detrimental to populations of yellow perch, as these fish are highly abundant at the project under current operation. Therefore, under existing project operation the total entrainment mortality at the Bear Swamp PSD would be expected to be minimal and not adversely affect fish populations in the upper and lower reservoirs.

As discussed in the August 2008 environmental assessment for the rehabilitation of the existing turbine units,[78] the Commission-approved changes to the hydraulic capacities of the turbines at the Bear Swamp PSD will increase the intake velocities at the trashracks (by 0.5 fps under high tailwater conditions and by 0.3 fps under low tailwater conditions). In the August 2008 environmental assessment, Commission staff concluded that this increase in flow velocities during the pumping cycle could result in increased fish entrainment and any attendant mortality. However, the intake velocities of the trashracks would be below the prolonged speeds (*i.e.*, speeds that can be maintained for up to 200 minutes) for rainbow and brown trout at 2.95 - 5.9 fps and 2.29 - 6.23 fps, respectively. Thus, these species have the capability to swim against the currents associated with the pumping mode and avoid entrainment. Commission staff concluded in the August 2008 environmental assessment that the increased intake velocities

[78] *See Bear Swamp Power Company, LLC*, 124 FERC ¶ 62,127 (2008).

associated with the turbine rehabilitation would not be expected to significantly increase entrainment.

Deerfield River Downstream of Fife Brook Dam

BSPC proposes to continue to operate the Bear Swamp PSD in a store and release mode by pumping water from the Fife Brook impoundment (*i.e.*, the lower reservoir) during periods of low electricity demand, storing the water until periods of high electricity demand, and then generating electricity by discharging water back into the Fife Brook impoundment during periods of high electricity demand. BSPC proposes to fluctuate the upper reservoir of the Bear Swamp PSD by as much as 50 feet daily (between 1,550 and 1,600 feet NGVD) and to fluctuate the Fife Brook impoundment by as much as 40 feet on a daily basis (between 830 and 870 feet NGVD). However, BSPC would continue to hold a portion of its useable storage capacity in the upper reservoir between elevations 1,555.5 and 1,550 feet NGVD for emergency/reserve conditions, which would reduce the useable storage in the upper reservoir from 5,260 acre-feet to 4,600 acre-feet.

BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5." BSPC also proposes to continue releasing a minimum flow of 125 cfs from the Fife Brook dam to protect aquatic habitat in the Deerfield River.

BSPC proposes to continue to provide 106 scheduled whitewater flow releases from the Fife Brook dam according to the existing release schedule (*i.e.*, whitewater releases between 9:30 a.m. and 12:00 p.m. on 50 weekend days and 56 weekdays from April 1 to October 30, for a minimum duration of three hours). BSPC also proposes to discontinue its current practice of holding generation at 3 MW for 15 minutes before increasing generation to higher output levels.

Massachusetts DFW recommends under section 10(j) that BSPC operate the project in a "year-round, run-of-release mode." Similarly, Interior recommends under section 10(j) that BSPC operate the Fife Brook Development as a "run-of-release facility, passing inflow it receives from the upstream Deerfield Project's Deerfield [Station] No. 5 development below Fife Brook dam on a near instantaneous basis." Massachusetts DFW and Interior also recommend under section 10(j) certain flow releases and operational limits to protect downstream aquatic resources, including: (1) a continuous minimum flow of 125 cfs from April 16 through October 31; (2) a continuous minimum flow of 350 cfs from November 1 through April 15; and (3) up-ramping limitations (*i.e.*, limits to the hourly rate of change in flow releases). The CRC and Trout Unlimited also recommend a minimum flow of 350 cfs from November 1 through April 15 for the protection of spawning trout, incubating eggs, and emerging fry.

The CRC recommends releasing all flows from Fife Brook dam using a staged ramping process for increasing flows, which would include a 1-hour hold at an intermediate flow that is equivalent to the midpoint of the total scheduled flow. CRC recommends additional intermediate flow release of one hour for "higher flows."[79] Trout Unlimited recommends releasing flows from Fife Brook dam with a one-hour ramp up to generation and a one-hour ramp down from generation from March 15 through June 30 when newly emerged trout fry are vulnerable to changes in flow.

Our Analysis

Effects on the Fish Community

The existing project operation, including 106 annual whitewater flow releases of approximately 800 cfs, generation flows up to 1,540 cfs, and the 125-cfs minimum flow, affects the fish community in the Deerfield River downstream of Fife Brook dam. The fishery in this stretch of the Deerfield River is managed as a valuable catch-and-release fishery that is supplemented by annual stocking efforts by Massachusetts DFW. A diverse range of fish species occurs downstream of Fife Brook dam, including sunfishes, carps, minnows, catfishes, perches, sculpins, American eel, and suckers, including the Massachusetts Species of Special Concern longnose sucker. Three species of trout (brook trout, brown trout, and rainbow trout) are reproducing in the mainstem Deerfield River under the existing environmental conditions.

Rapidly fluctuating water levels and flow velocities have the potential to adversely affect fish in a river system because fish have to expend energy to relocate to areas with suitable cover and habitat when water levels and flow velocities change. These effects can be especially pronounced in the winter when fish have limited access to food sources to replenish energy by moving to areas with suitable cover and habitat. Under existing operation, fish seek refuge from velocity created by increased flows on a daily basis and move to areas of the Deerfield River with features that create suitable velocity breaks such as the backwater areas behind large rocks, log jams, and near the bottom of deep pools. Fish seeking velocity refuge may also move into local tributaries. Fish in the Deerfield River also expend energy seeking refuge in reaction to generation and whitewater flow releases that must be replaced in order for fish to survive.

The results of the Fish Assemblage Study show that there is a diverse variety of lotic species present downstream of Fife Brook dam. In addition, gamefish species such as trout are reproducing as evidenced by the age classes of fish reported in the Fish Assemblage Study. The benthic macroinvertebrate community in the Deerfield River

[79] CRC does not define what higher flows would necessitate two intermediate releases or the magnitude of these two intermediate releases.

provides an important food source for fish and downstream of Fife Brook dam. Based on survey data collected by Massachusetts DEP in 2014, the benthic macroinvertebrate community is diverse and appears to have adapted to the daily changes in velocity and water levels.

BSPC proposes and Interior and Massachusetts DFW recommend that BSPC operate the Fife Brook Development in a run-of-release mode passing inflow from Deerfield Station No. 5 on a near instantaneous basis. BSPC states that it operates the Fife Brook impoundment in a "run-of-release" mode[80] by passing inflows from Deerfield Station No. 5 to the downstream Deerfield Station No. 4, while also holding 4,600 acre-feet of water in storage for the Bear Swamp PSD. BSPC states that the operation of the Fife Brook Development is limited to a "run-of-release" operation because the Bear Swamp Project is located in the middle of the Deerfield Project's "peaking flow regime." However, BSPC does not operate the Fife Brook Development in a "run-of-river" or "run-of-release" mode on an instantaneous basis and occasionally deviates from such an operation daily. The deviation can be substantial, especially on days with no scheduled recreation release (Figure 8). Specifically, BSPC stores inflow to maintain the minimum flow release requirement of 125 cfs and also to replenish water lost through evaporation.

Deerfield Station No. 5 operates in a peaking mode and flows can be as high as 1,323 cfs on a daily basis. As discussed above, peaking generation flows require fish to move to seek refuge from high velocity created by generation flow releases. Operating in an instantaneous run-of-release mode would essentially pass peaking flows from Deerfield Station No. 5 to the downstream reach of the Deerfield River below Fife Brook dam on a near instantaneous basis without any attenuation. Fish would have to respond quickly and to seek refuge from peaking flows. Operating in this manner could concentrate fish in areas of the Deerfield River that provide suitable nearby velocity refuge because fish would have limited time to escape to refuge habitat as flows increase from releasing inflow in an instantaneous run-of-release mode. Concentrating fish in areas with nearby suitable refuge would lead to overcrowding, which could deplete or limit local food sources. This effect would be more pronounced during certain times of the year when additional food is necessary to replenish energy lost from spawning in the spring and during the fall when fish are expending more energy to move to overwintering areas and adding mass in preparation to overwinter. Juvenile fish could also be displaced from shallow water habitat along the margins of the river to deep water where they could be preyed upon by other piscivorous fish. Over time, operating in an instantaneous run-

[80] As discussed in greater detail above, BSPC voluntarily agreed in the March 2005 off-license agreement to operate the Fife Brook impoundment in a "run-of-river" mode. BSPC and stakeholders refer to this operation as a "run-of-release" operation, since the Bear Swamp Project depends on flow releases from the Deerfield Station No. 5 for inflow.

of-release mode could adversely affect fish relative to the existing environmental conditions.

BSPC currently increases flows from the Fife Brook Development in a staged manner by holding generation at 3 MW for 15 minutes before ramping to a generation flow of 1,540 cfs. BSPC initially started this practice to avoid sudden increases in flow downstream of Fife Brook dam that could affect the safety of recreation users in the Deerfield River. Under this mode of operation, it takes an average of 1.1 hours to ramp up to a generation outflow, which increases outflow from the minimum flow of 125 cfs to 900 cfs.

BSPC proposes to discontinue releasing flows from Fife Brook dam in a staged manner. Water levels would rise 15 minutes quicker than they do under existing operation and fish may have to move faster to locate velocity refuge or suitable habitat in another area of the river. Operating without a staged release for generation and peaking flows could force fish to expend more energy to find suitable cover. Although the elimination of a staged release reduces the time fish have to seek cover, the overall time reduction is only 15 minutes and the effects of eliminating the staged release would likely be insignificant compared with the effects of the existing staged release.

Interior and Massachusetts DFW recommend up-ramping limitations (*i.e.*, limits to the hourly rate of change in flow releases) from May 15 through August 31 from 7 a.m. to 4 p.m. on days where there are no scheduled whitewater releases. It currently takes BSPC 1.1 hours to release up to 900 cfs from Fife Brook dam. Under the agency-recommended up-ramping rate, it would take BSPC approximately 8.0 hours to release the same flow from May 15 through June 30 and 7.5 hours to release the same flow from July 1 through August 31 on days without scheduled whitewater releases. The proposed up-ramping rate would provide fish a significantly longer time to seek cover and find suitable habitat during the summer relative to the existing operation. Operating with this limitation could disperse fish over longer distances in the river, which could reduce competition for cover and provide fish with better access to food resources over time. As fish move to other preferred habitat in the river, pressure on existing food resources would be reduced, which could increase the overall fitness of resident fish during the summer period. From September 1 to May 14, there would be no limitations to ramping and fish would have to compete for cover and food resources as they do under current operation, which could adversely affect fish preparing to overwinter and during the spring when additional food resources are necessary to replace lost energy.

CRC recommends a staged release from Fife Brook dam, including by holding outflow at the midpoint of the total expected flow for one hour before increasing flow to the total desired generation outflow. Operating the Fife Brook Development in this manner would provide resident fish more time to respond to increasing water levels and seek cover than what is currently available under existing operation. Providing a year-round up-ramping rate that is inclusive of all flow releases could allow fish more time to find habitat with suitable cover. Over time, operating the Fife Brook Development in this manner could benefit fish by increasing the overall fitness of the resident fish population.

Trout Unlimited recommends that BSPC release all flows within a one-hour ramp up and a one-hour ramp down for all flow releases from March 15 through June 30 to protect newly emerged fry. Under this mode of operation, flows would reach their maximum velocity and stage change increase within one hour, which is approximately the same as the existing mode of operation. Therefore, fish would be affected in a similar manner as the existing mode of operation.

Effects on Trout Spawning Habitat and Egg Development

The Deerfield River downstream of Fife Brook dam fluctuates regularly from hydropower peaking flows and from whitewater flow releases. Rivers affected by hydropower peaking can support spawning (Person *et al.*, 2012). The existing operation of the Fife Brook Development does not appear to prevent trout from spawning in the Deerfield River downstream of Fife Brook dam. Results from the 2017 Trout Spawning Study that was conducted by Trout Unlimited found a total of 101 redds in the Deerfield River upstream of Charlemont, 98 of which were fully constructed, and 37 of which contained eggs. Redds containing eggs were identified as brown trout. The Trout Spawning Study did not identify brook trout or rainbow trout eggs; however, the fish size class data in the Fish Assemblage Study shows that YOY rainbow trout and brook trout are found in the Deerfield River, which indicates these species of trout are also spawning in the Deerfield River. Geographically, trout spawning activity was heaviest in the uppermost reach closest to Fife Brook dam and lightest in the reach farthest from the dam. The river channel in the areas of concentrated spawning is braided to some extent, and braided channels have been found to buffer the effects of hydropower peaking impacts by creating conditions that meet fish habitat requirements for a large range of varying discharges (Person *et al.*, 2012). As such, the braided channels in these sections of the Deerfield River downstream of Fife Brook dam appear to provide suitable habitat for spawning by reducing the effects of peaking flows and whitewater flow releases from Fife Brook dam (Figure 13).

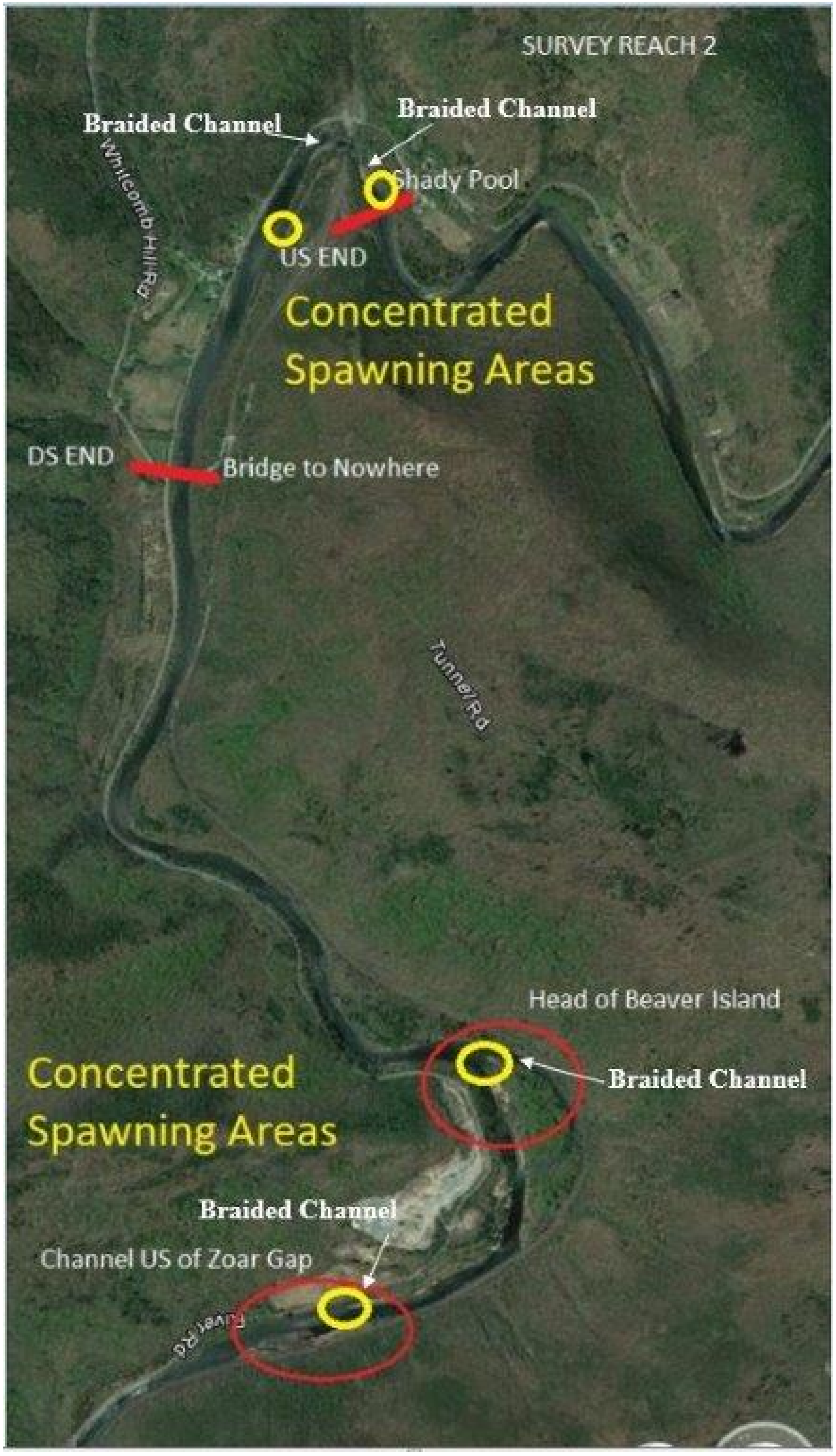


Figure 13. Brown trout redd locations downstream of Fife Brook dam (Source: Trout Unlimited 2018, modified by staff).

Regular changes in water levels from hydropower peaking flow releases can dewater redds as flows decrease from generation/whitewater flow releases (800 cfs and up) to minimum flows at 125 cfs. In Trout Unlimited's Trout Spawning Study, three of the 37 redds were found with viable eggs after overwintering. The results of Trout Unlimited's Trout Spawning Study show that current project operation partially dewaters constructed trout redds. Results of the study showed that 12 of the 25 constructed trout reeds were partially dewatered. Trout redds require adequate water circulation through the gravel to provide sufficient dissolved oxygen for egg development (Sear *et al.*, 2014). When there is insufficient water moving through redd gravel during periods of low flow, reduced dissolved oxygen levels could kill incubating trout eggs. In addition, for brook and brown trout, insufficient flow through redds during the fall could subject incubating eggs to freezing conditions, which can kill trout eggs. Trout egg viability is also influenced by several factors unrelated to project operation, such as colder than average temperatures and spawning location selection.

The results of the Trout Spawning Study and the Fish Assemblage Study show that all species of trout are reproducing and there is a diverse population of trout of all age classes. Existing project operation does not appear to affect trout health and fitness as evidenced by data for weight. Relative weight values meet or exceed 100, which is evidence that trout have access to enough food sources and are thriving. Collectively, the study data suggests that existing project operation and the minimum flow release of 125 cfs provides a suitable amount of habitat for reproduction and the survival of all age classes of trout species. BSPC proposes to continue to operate the project in the same manner as it does today under the existing license, which would continue the same level of project effects on spawning and egg development discussed above over the term of a new license.

Interior, Massachusetts DFW, CRC, and Trout Unlimited recommend releasing a minimum flow of 350 cfs from November 1 through April 15 to provide additional depth to protect trout eggs from dewatering. Increasing the minimum flow to 350 cfs could potentially increase the reproductive success of trout in the Deerfield River and reduce the number of fish that need to be stocked annually in the Deerfield River. However, a minimum flow of 350 cfs would not significantly decrease the amount of trout redd dewatering because the wetted width and depth of the Deerfield River does not significantly increase from 125 cfs to 350 cfs. An increase in flow from 125 cfs to 328 cfs only increases the average wetted width in the Deerfield River from 179 feet to 182.4 feet, respectively, in habitat that is most likely to contain trout redds, *i.e.*, riffle habitat (see Table 11). Similarly, an increase in flow from 125 cfs to 328 cfs only increases the elevation of the Deerfield River in riffle habitat by an average of 0.37 feet. Therefore, while there would be a slight increase in the amount of habitat available at a minimum flow of 350 cfs, that habitat would not be substantially more than the habitat that is available at the existing minimum flow of 125 cfs.

A flow of 350 cfs from November 1 through April 15 would provide an increase in the suitable depth for all life stages of brown trout; however, there would only be a 4.5 percent increase in suitable depth over the existing minimum flow. For rainbow trout, a flow of 350 cfs would provide a moderate increase in the suitable depth for all life stages of rainbow trout. A flow of 350 cfs would provide an 8.1 percent improvement in suitable depth over the existing minimum flow. For brook trout, a flow of 350 cfs provides nearly the same amount of suitable depth habitat (66.4 percent) as the existing minimum flow (67.9 percent). A flow of 350 cfs would improve or provide stable depth habitat for all species of trout found in the Deerfield River, but the increased velocity associated with a flow of 350 cfs would decrease the amount of habitat that provides suitable velocity when compared to the existing minimum flow. Brook trout, a native species, would be most affected by a flow of 350 cfs. A flow of 350 cfs reduces the amount of suitable velocity habitat for brook trout by 28.6 percent when compared to the existing 125-cfs minimum flow. Over time, the trout population in the Deerfield River could shift to more non-native species, as there would be more suitable habitat for brown trout and rainbow trout. In addition, operating the project to enhance the brown trout population could have long-term adverse effects on the brook trout population. Brown trout successfully outcompete brook trout for food and spawning sites. As adults, brown trout also feed largely on other fish, and smaller life stages of brook trout are prey items. These behavioral tendencies could result in a decline in the numbers of native brook trout if project operation enhances brown trout more than native brook trout.

Effects on Young-of-Year Trout

Artificial flow fluctuations from hydropower operations can reduce the complexity of the fish community. Frequent water level changes resulting from hydropower peaking operations can strand fish in pools and affect recruitment by displacing juvenile trout from their preferred habitat (*i.e.*, waters with low velocity). Over time, trout age classes in a regulated stream can shift towards higher numbers of adult fish and lesser numbers of juvenile and YOY fish (Almodovar and Graciela, 1999).

Hydropower peaking operations can have a greater effect on YOY trout than adults. After their emergence, YOY search for a territory where they can feed and grow. YOY trout prefer shallow habitat near the riverbank, were the flow velocity is reduced. However, the bank habitat of rivers affected by hydropower peaking flow regimes is very unstable because water levels and wetted area are constantly changing as flows fluctuate between the minimum flow and peaking flows. In rivers affected by hydropower peaking, juvenile density and growth rate can be reduced and mesohabitat can become disturbed (Jensen & Johnsen, 1999; Flodmark *et al.*, 2006; Korman & Campana, 2009). The rapid discharge associated with peaking flows also can cause juveniles to drift or get stranded in pools. However, existing project operation does not appear to effect juvenile density in the Deerfield River downstream of the Fife Brook dam. The proportion of

YOY, and one- and two-year old trout species was greater than the proportion of 2-year old adult fish (Table 13).

Effects on American Eel

There are no existing upstream fish passage facilities at the project for American eel and there are no operational upstream eel passage facilities at the four hydropower projects located downstream of Fife Brook dam. However, migrating juvenile eels can reach Fife Brook dam by scaling the dams for the Deerfield Project's Station Nos. 2, 3, and 4, and the dam for the Gardners Falls Project No. 2334 (Gardners Falls Project). Climbing over or around dams is a well-documented behavior for juvenile eels (GMCME, 2007). Eels reaching the Fife Brook Development must first scale the 70-foot-high Deerfield Station No. 2 dam, the 30-foot-high Gardners Falls Project, the 15-foot-high Deerfield Station No. 3 dam, and the 50-foot-high Deerfield Station No. 4 dam.

One individual eel was found upstream of Deerfield Station No. 4 during the 2016 Fish Assemblage Study. This and any other eel that successfully passes the four dams below the project would encounter the 130-foot-high Fife Brook dam during upstream migration. The results of the Fish Assemblage Study showed that no eels were found in the Fife Brook impoundment, which suggests that any eels that are able to make it past the lower four dams on the Deerfield River are then unable to scale the height of the Fife Brook dam. Therefore, the Fife Brook dam likely adversely affects eels by impeding upstream migration. Outside of the impediment to upstream migration, however, the project would not likely affect eels in the Deerfield River, as eels can tolerate a wide range of flows and thrive in a variety of habitats available in the Deerfield River (Canadian Wildlife Federation, 2019).

Effects on Benthic Macroinvertebrates

Hydropower peaking releases can potentially reduce the density and abundance of mayfly populations by altering the thermal properties and flow regime in rivers affected by hydropower peaking operations (Kjaerstad *et al.*, 2018). The results of the water quality monitoring study suggest that, in general, water temperature increases with distance downstream of Fife Brook dam and as discussed above, the project operation does not affect water temperature.

A reduction in the richness and abundance of certain species of benthic macroinvertebrates could adversely affect the food chain. Caddisflies, stoneflies, and mayflies eat leaves and other organic matter that enters the water. Because of their abundance and position in the aquatic food chain, benthic macroinvertebrates play a critical role in the balance and natural flow of energy and nutrients. A reduction in the species richness of benthic macroinvertebrates could therefore upset the balance of natural energy and nutrients in the food chain. For instance, a reduction in the abundance of benthic macroinvertebrates could lead to a reduction in predators that rely on mayflies as their primary food source, or could result in adverse effects to water quality as greater amounts of organic material would not be recycled by the benthic macroinvertebrates and would instead be degraded by bacteria, which could reduce dissolved oxygen levels in the Deerfield River.

The benthic macroinvertebrate community, however, appears to have adapted to fluctuating water levels and benefits from the 125-cfs minimum flow. The population of benthic macroinvertebrates also appears to provide a good food source for fish, as evidenced by a high fitness level of trout and reproducing numbers of trout species in the Deerfield River downstream of Fife Brook dam. Continuing to release a minimum flow of 125 cfs would help maintain a diverse population of benthic macroinvertebrates.

Effects on Mussels

BSPC proposes to develop and implement an Invasive Mussel Species Monitoring and Management Plan in consultation with the Massachusetts DFW, Interior, and local municipal conservation groups that includes measures to minimize the spread of invasive species at the project, including dreissenid mussels (*e.g.*, zebra mussels and quagga mussels). The proposed measures include educational training for maintenance staff, educational signage, and best management practices for minimizing the spread of invasive mussel species during project-related construction and maintenance activities. BSPC also proposes to include measure to "address rapid notification, coordination, and response with appropriate federal and state resource agencies" if invasive mussels are detected. Massachusetts DFW recommends BSPC's plan under section 10(j) in order to minimize the spread of invasive mussels at the project.[81]

BSPC conducted a survey in 2016 to collect baseline information regarding the presence of freshwater mussels and their habitat in 17 miles of the Deerfield River, from the upper extent of the Fife Brook impoundment to the upper extent of the Deerfield Station No. 4 impoundment. BSPC did not locate any live mussels or shells in the study. Invasive mussels were not documented in the survey. However Massachusetts reported zebra mussels within, or in waters adjacent to, its state borders (FWS, 2019). Invasive mussels can be spread easily from watercraft exposed to contaminated waters. Once established, invasive mussels will alter ecosystems and food sources that are critical to trout and other fish. The preferred habitat for invasive mussels is calm water, such as the Fife Brook impoundment.

[81] Massachusetts DFW identifies this plan as an Invasive Wildlife Species Monitoring Plan. However, based on the discussion provided in its section 10(j) recommendation, we interpret this recommendation to apply specifically to invasive mussel species.

Recreation at the project could potentially introduce invasive mussels to the project. The Deerfield River is a highly popular area for both recreational boaters and fishermen. The results of the Recreation Survey show that users come from distances outside the project area including states such as New York where zebra mussels have already been detected in local waters. This increases the probability that users could unintentionally transport invasive mussel species to the Deerfield River when recreating on the river. Once established in the Deerfield River, invasive mussels could outcompete benthic macroinvertebrates, a critical food resource for trout and other fish. Establishing a management plan that includes measures to reduce the potential for invasive mussels to be introduced to the project and to minimize the spread of invasive mussels at the project would reduce the potential introduction and spread of invasive mussel species in project waters.

Dragonfly Ramping Rates

BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5." BSPC also proposes to continue releasing a minimum flow of 125 cfs from the Fife Brook dam to protect aquatic habitat in the Deerfield River. BSPC proposes to continue to provide 106 scheduled whitewater flow releases from the Fife Brook dam according to the existing release schedule (*i.e.*, whitewater releases between 9:30 a.m. and 12:00 p.m. on 50 weekend days and 56 weekdays from April 1 to October 30, for a minimum duration of three hours). BSPC also proposes to discontinue its current practice of holding generation at 3 MW for 15 minutes before increasing generation to higher output levels.

To protect state-listed dragonflies emerging and eclosing from May 15 through June 30, Massachusetts DFW recommends that BSPC release flows from the Fife Brook powerhouse with an up-ramping rate of no greater than either: (1) an increase of 0.060 foot per hour in water surface elevation at the Fife Brook dam, or (2) an increase of 130 cfs per hour and no greater than 32 cfs per 15-minute period.[82] Massachusetts DFW recommends this up-ramping rate for the hours of 7 a.m. to 4 p.m., inclusive. Massachusetts DFW recommends allowing exceptions to these ramping rates during whitewater flow releases as specified below.

---

[82] If the ramping rate is not allowed to exceed 32 cfs during a 15-minute period, the overall change in flow during the course of an hour would be 128 cfs rather than 130 cfs. A similar discrepancy exists for the recommended flow-based ramping rate for July 1 through August 31. However, staff assume that the hourly and 15-minute ramping rates are equivalent because the discrepancy between the two is only 2 cfs, which is likely less than the operational precision of the generating equipment (*e.g.*, gates, turbines, and controllers).

May:	a) Continue whitewater flow releases as specified in the 1994 Settlement Agreement (*i.e.*, 2 weeks of Wednesday through Sunday releases and 2 weeks of Saturday and Sunday releases) such that the Wednesday through Sunday releases are scheduled in the first half of the month; b) Weeks with Wednesday through Sunday releases are restricted to weeks where Wednesday has a calendar day prior to May 15; and c) Memorial Day may be substituted for a Saturday or Sunday whitewater flow release between the dates of May 18 through May 31, inclusive.
June:	a) Continue whitewater flow releases as specified in the 1994 Settlement Agreement (*i.e.*, 2 weeks of Wednesday through Sunday releases and 2 weeks of Saturday and Sunday releases) such that the Wednesday through Sunday releases are scheduled in the latter half of the month; b) Weeks with Wednesday-Sunday releases are restricted to weeks where Wednesday has a calendar day after June 14.

To protect state-listed dragonflies emerging and eclosing from July 1 through August 31, Massachusetts DFW recommends that BSPC release flows from the Fife Brook powerhouse with an up-ramping rate of no greater than either: (1) an increase of 0.334 foot per hour in water surface elevation at the Fife Brook dam, or (2) an increase of 158 cfs per hour and no greater than 40 cfs per 15-minute period. Massachusetts DFW recommends this up-ramping rate for the hours of 7 a.m. to 4 p.m., inclusive. Massachusetts DFW recommends allowing exceptions to these ramping rates during whitewater flow releases as specified below.

July:	a) Continue recreational releases as specified in the 1994 Settlement Agreement (*i.e.*, 3 weeks of Wednesday through Sunday releases and 1 week of Saturday and Sunday releases) such that the Wednesday through Sunday releases are scheduled in the first half of the month; b) Weeks with Wednesday-Sunday releases must occur prior to July 23.
August:	a) Continue recreational releases as specified in the 1994 Settlement Agreement (*i.e.*, 4 weeks of Thursday through Sunday releases).

Massachusetts DFW states that these flows may be temporarily modified, if required, by operating emergencies, natural low flows, or natural high flows beyond the control of BSPC, or for short periods upon mutual agreement with FWS and Massachusetts DFW.

Interior recommends under section 10(j) that BSPC adhere to the ramping protocol recommended by Massachusetts DFW.

CRC recommends releasing all flows from Fife Brook dam in two-stages, a 1-hour intermediate flow release, which is the midpoint of the total flow, followed by a ramp up to the total desired flow release. CRC recommends two intermediate flow releases of one hour for "higher flows."[83] Lastly, CRC recommends a down-ramping hold period of 30 minutes.

Trout Unlimited recommends releasing flows from Fife Brook dam with a one-hour ramp up to generation and a one-hour ramp down from generation from March 15 through June 30. Interior, Trout Unlimited, and CRC also recommend that BSPC release whitewater flows before 10 a.m.

Our Analysis

Dragonflies that are shedding their larval exoskeleton are vulnerable to being washed away from rising water levels, either from project generation, wave action, or increases in water level following precipitation events. Several factors affect the vulnerability of eclosing dragonflies to rising water levels: (1) the rate the larvae climb out of the water, (2) the distance the larvae climb out of the water, (3) the rate at which the water level increases at the eclosure site, (4) the time of day larvae eclose compared to when water levels rise, and (5) the time required for larvae to shed their exoskeleton and fly away.

Changes in Water Level and Dragonfly Climbing Heights and Rates

To determine how generation flows released from the Fife Brook Development affect the water level of the Deerfield River downstream of Fife Brook dam, BSPC conducted a flow attenuation study during August and September 2014. BSPC installed 10 water level loggers between the Fife Brook powerhouse and the downstream extent of the project boundary, located approximately 6.8 miles downstream of the powerhouse (Table 14). In addition, BSPC analyzed the gage height data collected by the USGS Charlemont gage located approximately 12.1 miles downstream of the powerhouse.

[83] CRC does not define what higher flows would necessitate two intermediate releases or the magnitude of these two intermediate releases.

Table 14. Effect of proposed and recommended generation flow releases on water levels downstream in the Deerfield River downstream of Fife Brook dam.

Station	Miles Downstream from Fife Brook Dam	Average Stage Change (feet)	Average Rate of Change (feet/hour)	Average Rate of Change under BSPC's Proposal (feet/hour)	Average Rate of Change under CRC's Recommendation (feet/hour)
Fife Brook Powerhouse	0	2.62	2.34	3.01	1.24
Site 3*	1.1	1.82	1.90	2.56	0.93
Site 4*	5	1.52	1.58	2.14	0.78
Zoar Picnic Area	5.4	1.65	2.06	3.00	0.92
Site 5*	6	1.43	1.49	2.01	0.73
Downstream Project Boundary	6.8	1.44	1.64	2.25	0.77
Site 6*	7	1.35	1.41	1.90	0.69
Site 7*	8	1.28	1.33	1.80	0.65
Site 8*	10	1.15	1.20	1.62	0.59
Site 9*	11	1.1	1.15	1.55	0.56
USGS Charlemont Gage	12.1	1.04	1.20	1.70	0.56
Site 10*	16	0.8	0.84	1.14	0.41
Overall Average**		**1.69**	**1.84**	**2.59**	**0.88**

(Source: BSPC (2016b) and BSPC (2017d), as modified by staff)
* Values for the dragonfly survey sites were estimated via regression analysis. In addition, the distances downstream from Fife Brook dam are approximate.
** The overall averages correspond to the averages of the flow attenuation stations, and do not include data estimated by staff's regression analysis at Sites 3, 4, 5, 6, 7, 8, 9, and 10.

Based on the time of generation and the water level data, BSPC calculated: (1) the stage change from the water level at the 125-cfs minimum flow to the water level at a generation flow of 900 cfs (*i.e.*, the peak flow); and (2) the rate of change of the water level (Table 14).

Staff used the data from the flow attenuation study to determine how generation flows released from the Fife Brook dam affect the water level of the Deerfield River where BSPC surveyed for dragonflies in 2016. The dragonfly survey sites are labeled in Table 14 as "Sites" 3-10. Since the flow attenuation study sites were not at the same locations as the dragonfly survey sites, staff applied a regression analysis to the study results to estimate the effect of the project on water levels at the dragonfly survey sites.[84] The stage change that results from an increase in flow from the 125-cfs minimum flow to a generation flow of 900 cfs ranges from 2.62 feet at the Fife Brook dam to 0.8 foot at Site 10. The rate of change in water levels that results from an increase in flows from the project ranges from 2.34 feet per hour at the Fife Brook dam to 0.84 foot per hour at Site 10. The average rate of change would increase under BSPC's proposal to eliminate the staged 15-minute ramping process, while the average rate of change would decrease under CRC's recommendation to hold flows at the midpoint of the total scheduled flow for 1 hour.

In the 2016 dragonfly study, BSPC found that most of the dragonfly exuvia (*i.e.*, the discarded exoskeletons of dragonfly nymphs) at a vertical distance of 2 feet or less from the water (Table 15). Based on the average stage change shown for each station in Table 14, the increase in flows associated with project discharge could wash away and drown at least some eclosing larvae and tenerals at each location.[85] The potential for dragonflies to be washed away in the Deerfield River downstream of Fife Brook dam before they are ready to fly depends on: (1) the timing of the stage change compared with the timing of the dragonfly eclosure; and (2) the rate of change of the water level compared with the rate at which the dragonfly nymphs crawl up the eclosure substrate, shed their exoskeleton, and fly away.

---

[84] Specifically, staff used exponential regression to estimate the stage change at the dragonfly survey stations, which provided a better fit to the data than a linear regression. In addition, staff used linear regression to estimate the rate of change of the water level at for the dragonfly survey sites.

[85] While no water level logger data are available for Sites 1 and 2, located near the upstream extent of the Fife Brook impoundment, BSPC states that it appears that water levels fluctuate by at least 30 feet vertically at these sites due to flows from Deerfield Station No. 5 and operation of the Bear Swamp PSD (BSPC, 2017d), which would likely wash away emerging dragonflies and exuviae.

Table 15. Median horizontal and vertical distances from the water for eclosing dragonflies.

Species	Sample Size	Horizontal Distance from the Water (feet)	Vertical Distance from the Water (feet)
*Boyeria grafiana**	1	12.0 (NA)	2.0 (NA)
Boyeria vinosa	2	0.5 (0.0-1.0)	2.3 (2.0-2.5)
Gomphus adelphus	4	1.3 (0.7-5.0)	0.7 (0.3-1.0)
Lanthus parvulus	1	0.0 (NA)	3.0 (NA)
*Ophiogomphus carolus**	15	0.1 (0.0-4.0)	0.3 (0.0-0.5)
Ophiogomphus mainensis	195	0.0 (0.0-15.0)	0.3 (0.0-1.5)
Helocordulia uhleri	4	12.5 (1.0-18.0)	3.8 (3.0-5.0)

(Source: BSPC (2017d), as modified by staff)
* State-listed species.
Ranges are shown in parenthesis.
NA indicates that a range could not be calculated.

In letters filed on January 30, 2019 and April 1, 2019, Massachusetts DFW provided a table of rates of change in the water levels that would protect different percentiles of the *B. grafiana* and *O. carolus* populations downstream of Fife Brook dam (Table 16). Massachusetts DFW based these "critical rates" on dragonfly nymph climb height data collected by the Massachusetts Natural Heritage and Endangered Species Program and BSPC, and data collected by FirstLight on the time required for dragonflies to shed their larval exoskeleton and fly away.[86] Massachusetts DFW used these data as a basis for its section 10(j) recommendation to limit ramping rates at the project to 0.334 foot per hour for the protection of *B. grafiana* and 0.060 foot per hour for the protection of *O. carolus*.

[86] FirstLight Hydro Generating Company (FirstLight) collected emergence and eclosure data for 173 dragonflies near the Turners Falls Project (FERC No. 1889) on the Connecticut River. *See* FirstLight, Study Report, Docket No. P-1889-000, Appendix F (filed May 30, 2017) and Massachusetts DFW January 30, 2018 Comment Letter at 4 & 5.

Table 16. Critical rates for emerging *B. grafiana* and *O. carolus*.

MHR-95% Exceeds CPR at that Percentile

Species	Percentile of Species Protected	Critical Height (ft)	Critical Rate (ft/hr)	Critical Rate (in/hr)	Modeled FBD Critical Rate (CFS/hr)	Maximum Hourly Rate of Change (ft/hr, in/hr, CFS/hr): 95th Percentile (MHR -95%)			
						Fife Brook Dam	Hoosic Trestle	Zoar Gap	Charlemont Gage
						2.951 ft	**1.795 ft**	**1.936 ft**	**1.257 ft**
						35.4 in	**21.5 in**	**23.24 in**	**15.08 in**
						952 CFS			**937 CFS**
B. grafiana	*Includes only natural eclosure substrate. NHESP data.*								
n = 22	CPR-95%	0.667	**0.334**	**4.002**	**172**				
	CPR-90%	0.675	**0.338**	**4.050**	**174**				
	CPR-80%	1.017	**0.509**	**6.102**	**205**				
	CPR-70%	1.240	**0.620**	**7.440**	**227**				
	CPR-50%	1.792	**0.896**	**10.752**	**287**				
	CPR-30%	2.000	**1.000**	**12.000**	**311**				
	CPR-20%	2.000	**1.000**	**12.000**	**311**				
	CPR-10%	2.300	**1.150**	**13.800**	**348**				
B. grafiana	*Includes bridge abutments and dislodged specimens. NHESP data.*								
n = 40	CPR-95%	0.742	**0.371**	**4.452**	**180**				
	CPR-90%	1.163	**0.582**	**6.978**	**219**				
	CPR-80%	1.644	**0.822**	**9.864**	**270**				
	CPR-70%	2.000	**1.000**	**12.000**	**311**				
	CPR-50%	2.250	**1.125**	**13.500**	**343**				
	CPR-30%	2.250	**1.125**	**13.500**	**437**				
	CPR-20%	2.943	**1.472**	**17.658**	**437**				
	CPR-10%	7.167	**3.584**	**43.002**	**1280**				
O. carolus	*BSPC Data, collected by SWCA*								
n= 15	CPR-95%	0.119	**0.060**	**0.714**	**129**				
	CPR-90%	0.170	**0.085**	**1.020**	**133**				
	CPR-80%	0.234	**0.117**	**1.404**	**138**				
	CPR-70%	0.250	**0.125**	**1.500**	**145**				
	CPR-50%	0.330	**0.165**	**1.980**	**147**				
	CPR-30%	0.330	**0.165**	**1.980**	**147**				
	CPR-20%	0.348	**0.174**	**2.088**	**156**				
	CPR-10%	0.468	**0.234**	**2.808**	**156**				

(Source: Massachusetts DFW)

"MHR-95%" refers to the 95th percentile of the maximum rate of change of the water level at Fife Brook dam, Hoosac Trestle, Zoar Gap Picnic Area, and the USGS Charlemont Gage resulting from the release of generation flows.

The red areas indicate that the MHR-95% rate exceeds the critical rate for the species, and indicates that eclosing dragonflies and tenerals could be washed away by rising water levels.

Based on the average rate of change shown in Table 14, the rate of water level increase associated with generation under the current project operation exceeds the critical rates for protecting 95 percent of the species at every surveyed location for both *O. carolus* and *B. grafiana* eclosing on natural substrate (Table 16). According to the data filed by Massachusetts DFW, under the existing project operation, the rate of change of the water level at Sites 9 and 10 would protect between 10 and 50 percent of *B. grafiana* on natural substrate; whereas the rate of change of the water level at all other sites would protect less than 10 percent of *B. grafiana* on natural substrate. Under the existing project operation, the rate of change of the water level at all of the survey sites would protect less than 10 percent of *O. carolus* on natural substrate.

The average rate of change would increase at all locations downstream of Fife Brook dam under BSPC's proposal to discontinue the 15-minute staged ramping process, which would increase the risk of dragonflies getting washed way before completing emergence and eclosure. For example, if BSPC no longer holds generation at 3 MW for 15 minutes, the average rate of change at Site 10 would increase from 0.84 to 1.14 feet per hour, which would decrease the percentage of *B. grafiana* that would protected at that site from approximately 50 percent to approximately 10 percent, according to the data filed by Massachusetts DFW (Table 14 and Table 16).[87]

Based on the critical rates shown in Table 16, the ramping rates recommended by Massachusetts DFW (0.334 foot per hour for *B. grafiana* and 0.060 foot per hour for *O. carolus*) would protect 95 percent of emerging and eclosing *B. grafiana* and *O. carolus* downstream of Fife Brook dam on days when no whitewater flows are released. By protecting a larger proportion of the population during the emergence and eclosure process, Massachusetts DFW's recommended ramping rates could result in population growth for both species since the recommended ramping rates would allow more state-listed dragonflies to survive to adulthood and produce more offspring. In addition, BSPC found only one attached dragonfly exuvia at Site 3, but found ten detached exuviae, which suggests that habitat at Site 3 and areas upstream appears to be suitable for dragonfly nymphs. However, the water level likely increases too quickly to allow dragonflies that emerge while water levels are rising to fly away after shedding their larval exoskeleton. Massachusetts DFW's recommended ramping rates would allow the state-listed dragonflies to emerge and eclose successfully at any available habitat found in the Deerfield River downstream of Fife Brook dam to Deerfield Station No. 4 because the rate of change in water level generally (but not uniformly) decreases downstream from Fife Brook dam. Lastly, Massachusetts DFW's ramping rate recommendations

[87] Since 15 minutes equals 0.25 hours, the rising limb time at Fife Brook dam would decrease from 1.12 hours to 0.87 hours. The average rate of change = the average stage change / the rising limb time. In this case that would be 2.62 feet / 0.87 hours = 3.01 feet per hour.

would protect non-state-listed dragonflies that have combined climb and eclosure rates that are similar or faster than the two state-listed species.

Massachusetts DFW does not recommend limitations to the generator ramping rates on days when BSPC is scheduled to release whitewater flows. On these scheduled whitewater days, project operation would be the same as current operation, and any state-listed dragonflies emerging and eclosing while water levels are rising could be washed away and drowned. However, Massachusetts DFW's recommendation does include certain restrictions to the scheduling of whitewater release days, which is discussed in the next subsection of this EA.

CRC's recommendation to hold flows for 1 hour at the midpoint between the minimum flow and generation flow would benefit emerging and eclosing dragonflies, particularly *B. grafiana*. Water levels would rise approximately halfway to the peak water level and hold steady for an hour. Since the average increase in water level ranged from 0.80 feet to 2.62 feet (Table 14), water levels would hold at 0.4 to 1.31 feet for an hour, which is less than the median vertical distance *B. grafiana* climbs out of the water to eclose (Table 15). Therefore, any *B. grafiana* that reached the median climb height before eclosing would remain above the water level until the release of additional flow an hour later. During the dragonfly survey, *O. carolus* climbed up to 0.5 feet out of the water to eclose, so some members of this species would be protected as well. While CRC did not specifically define "higher operational flows" in its recommendation, having a two-staged ramping process at intermediate flows would add another 1-hour period during which some dragonflies could complete emergence and eclosure. A higher proportion of *B. grafiana* would be protected, but the rate of water level change would still not be low enough to protect *O. carolus*.

Trout Unlimited's recommendation of a 1-hour ramp up time is intermediate between BSPC's current practice of ramping up to 3MW and holding for 15 minutes and BSPC's proposal to eliminate that practice. Current operation results in a ramp up time of 1.12 hours at Fife Brook dam, and BSPC's proposed operation would result in a ramp up time of 0.87 hours. Therefore, the average rate of change of the water level at locations downstream of Fife Brook dam would be between the values shown in Table 14 for BSPC's current and proposed operation, and would similarly result in a large percentage of emerging and eclosing dragonflies getting washed away.

The down ramping rates recommended by CRC and Trout Unlimited would not provide any benefit to dragonfly nymphs or adults. Dragonfly nymphs are not very mobile and are unlikely to move to areas where they could be stranded by rapidly falling water levels. Once dragonflies begin emerging and eclosing, a slowly falling water level is no more protective than a rapidly falling one.

Seasonal Timing of Emergence and Eclosure

The majority of emergences that were observed in the dragonfly study occurred during the first week of June 2016. A total of 194 *O. mainensis* and 15 *O. carolus* exuviae were found on eclosure substrate on June 2 and 3. Other exuviae were found on June 16 (*L. parvulus* and *H. uhleri*), July 12 (*H. uhleri* and *B. vinosa*), July 25 (*B. grafiana* and *B. vinosa*), and August 8 (*Ophiogomphus sp*.).

In a letter filed April 1, 2019, Massachusetts DFW states that peak emergence of *O. carolus* is May 15 through June 15, while peak emergence of *B. grafiana* is July 8 through August 31. Limiting the rate of rising water levels during these periods would likely: (1) increase survival to adulthood, (2) improve reproductive success, and (3) increase the population size of each species. By restricting whitewater flow release days to before May 15 and after June 14, Massachusetts DFW's recommendation would reduce the likelihood that any emerging and eclosing *O. carolus* would be washed away on whitewater flow release days. Restricting whitewater flow release days in July to the period before July 23, as recommended by Massachusetts DFW, would protect emerging and eclosing *B. grafiana* for only 27.3 percent of the species' peak emergence period (*i.e.*, 15 out of 55 days).

Trout Unlimited's recommended one-hour ramp up period would apply from March 15 through June 30, which overlaps the peak emergence period for *O. carolus* (*i.e.*, May 15 through June 15). However, as described above, Trout Unlimited's recommended up ramping period is similar to BSPC's current and proposed operation and would similarly result in a large percentage of emerging and eclosing dragonflies getting washed away.

Because BSPC's current and proposed operation do not have a seasonal aspect, the effects of current and proposed operation described above would apply throughout the peak emergence period.

Similarly, CRC's ramping recommendation applies year-round. Therefore, any protection provided to state-listed dragonfly species by CRC's recommendation would apply to the entire emergence and eclosure period for each species.

Daily Timing of Emergence and Eclosure

Massachusetts DFW analyzed emergence and eclosure times for 173 dragonflies collected by FirstLight near the Turners Falls Project No. 1889 on the Connecticut River to evaluate the time of day when the most emergence and eclosure activity occurs in the

Deerfield River.[88] Based on Massachusetts DFW's analysis, peak emergence occurs at noon and 90 percent of dragonflies have emerged by 2:45 p.m. Data collected by FirstLight indicate that most dragonflies complete the emergence and eclosure process in 1 to 2 hours (FirstLight, 2016). Therefore, assuming an emergence and eclosure time of 2 hours, 90 percent of dragonflies complete eclosure and fly away by 4:45 p.m. (Figure 14). While the species represented in the data Massachusetts DFW analysis differ from those in BSPC's study, the emergence and eclosure data BSPC collected appears consistent with Massachusetts DFW's analysis.

Because dragonfly emergence peaks around 12 p.m., the delay between when BSPC releases generation or whitewater flow releases at Fife Brook dam and when the leading edge[89] of that flow arrives at downstream locations allows some dragonflies to complete the emergence and eclosure process under current operation despite the rate at which the water level rises. Water released at Fife Brook dam takes approximately 2 to 3.5 hours to reach Sites 4 through 7 where BSPC found nearly all of the dragonfly exuvia (BSPC, 2016b). If BSPC releases generation and/or whitewater flows at 9:00 a.m., the leading edge of the flows would not arrive at Sites 4 through 7 until approximately 11:00 a.m. through 12:30 p.m., which would allow approximately 10 to 25 percent of emerging dragonflies to complete the eclosure process and fly away before the flows arrive (Figure 14). While BSPC's proposal to discontinue the ramp and hold protocol would increase the rate at which the water level rises from generation and whitewater flow releases, the timing of when the leading edge of the flow reaches downstream locations should remain unchanged. Therefore, BSPC's proposal would likely have the same effect on emerging and eclosing dragonflies at these sites as under current operation.

In contrast, Massachusetts DFW's recommendation to maintain the critical rates until 4:00 p.m. would protect nearly 90 percent of dragonflies on non-scheduled whitewater flow release days by restricting ramping rates so that the water level rises slow enough to allow the dragonflies that emerge prior to 2:00 p.m. to complete eclosure and fly away. Massachusetts DFW's recommended ramping rates would protect emerging dragonflies close to Fife Brook dam, such as at Site 3, that are not currently protected by the delayed arrival of generation flows described above. In addition, the amount of protection provided by Massachusetts DFW's recommendations would increase with increasing distance from Fife Brook dam because of the delay in the arrival

[88] *See* FirstLight, Study Report, Docket No. P-1889-000, Appendix F (filed May 30, 2017) and Massachusetts DFW January 30, 2018 Comment Letter at 4 & 5.

[89] The "leading edge" travel time refers to the duration between the time the flow was released and the time when the water surface began to rise at each logger.

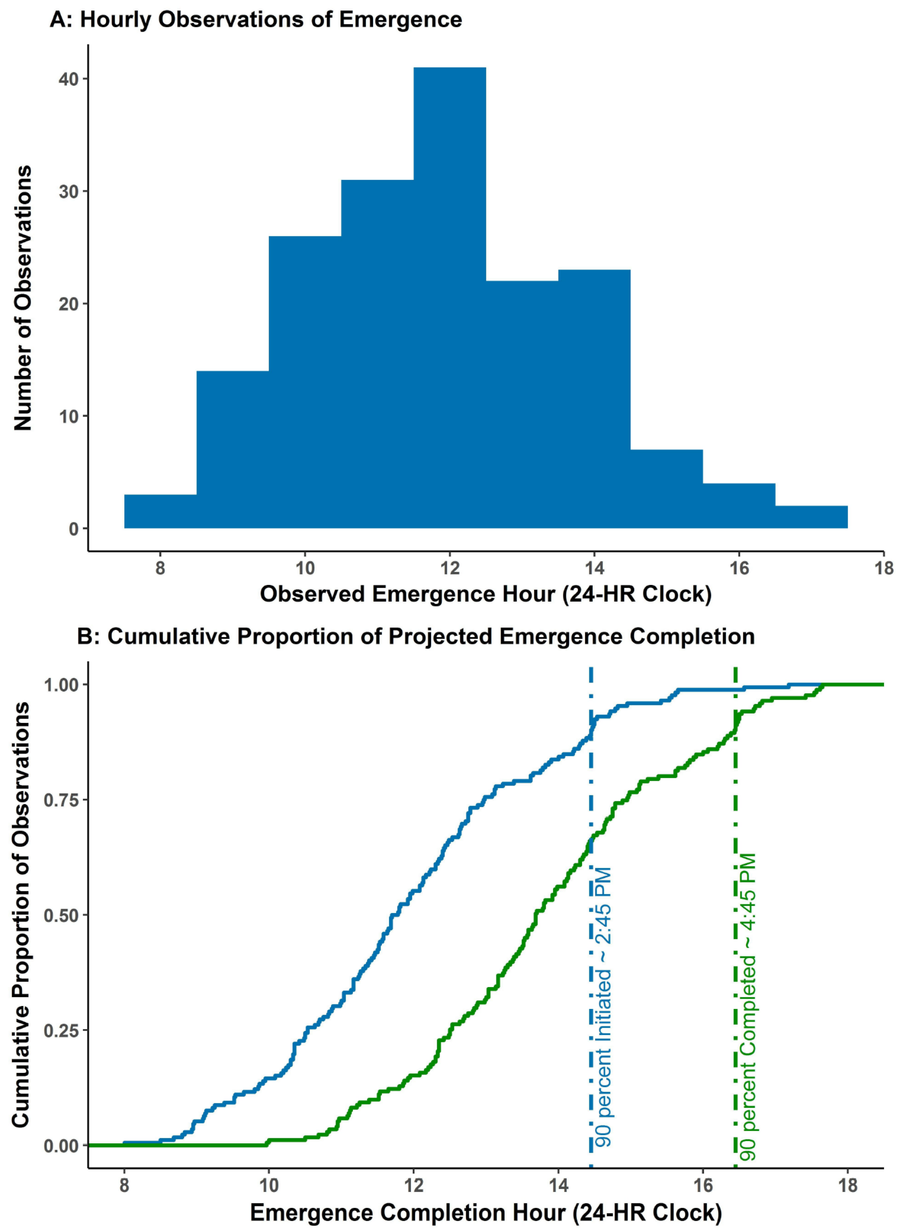


Figure 14. (A) Hourly observations of emergence and (B) cumulative proportion of emergence initiation (blue line) and projected eclosure completion (Source: Massachusetts DFW).

time of generation flows to downstream locations. By protecting a larger proportion of the population during the emergence and eclosure process, Massachusetts DFW's recommended ramping rates could result in population growth for dragonfly species since the recommended ramping rates would allow more state-listed dragonflies to survive to adulthood and produce more offspring. Furthermore, Massachusetts DFW's recommendation would likely increase that amount of habitat where dragonflies could complete the emergence and eclosure process successfully.

The hour of stable flow at the intermediate water level that would be provided by CRC's ramping recommendation would allow any *B. grafiana* that began eclosing when the leading edge of the flow arrived to remain above the water level, complete eclosure, and fly away. Furthermore, FirstLight (2016) found that most dragonflies complete the emergence and eclosure process in 1 to 2 hours. Therefore, some dragonflies could complete emergence and eclosure during the 1-hour period when flows are stable. The proportion of emerging and eclosing dragonflies that would be protected by an hour of stable flow would depend on when the hour of stable flow occurred relative to the time of peak emergence shown in Figure 14.

Trout Unlimited's ramping proposal would not significantly change the ramp time that is currently in place and would therefore have a minimal effect compared to current operation. The effect of Trout Unlimited's recommendation to release whitewater flows no later than 10 a.m. would depend upon whether BSPC reached the whitewater flow level at or before 10 a.m. or began releasing the flow at 10 a.m. If BSPC began the release at 10 a.m., whitewater flow levels would be reached by approximately 11 a.m. at Fife Brook dam. At Site 4, which is the most upstream location where BSPC found a large number of dragonfly exuviae (Table 10), the water level would begin rising at approximately 12 p.m., and the peak water level would occur approximately 1 hour later. Approximately 25 percent of dragonflies that emerge on a particular day would be completing emergence and eclosure during this period (Figure 14), but water levels would likely be stable before and after this period, which would allow dragonflies to complete eclosure. Rising water levels would arrive at Sites 5, 6, and 7 later in the day when a smaller fraction of dragonflies emerge. The effect of releasing whitewater flows prior to 10 a.m. would depend upon the timing of the release relative to the timing of peak emergence as shown in Figure 14, with stable flows earlier in the morning allowing a greater proportion of dragonflies to complete emergence and eclosure.

Summary of Project Effects on Dragonflies

Based on the dragonfly survey and flow attenuation study that BSPC conducted, the increase in water levels at the dragonfly survey locations downstream of Fife Brook dam (Table 14) generally exceeds the vertical climbing distance of most of the observed dragonfly species, including *O. carolus* and *B. grafiana* (Table 15). In addition, the rate at which the water level increases (Table 14) exceeds the critical rate that would protect the species' populations in the Deerfield River downstream of the Fife Brook dam (Table 16). Despite these conditions, a portion of the dragonflies that emerge and eclose at Sites 4, 5, 6, and 7 survive to adulthood because of the time required for generation flows released from Fife Brook dam to reach these sites. Given that the delay in the stage change increases with distance downstream, it is unclear why BSPC found fewer dragonfly exuviae at Sites 8, 9, and 10. However, the number of dragonflies successfully completing the emergence and eclosure process at Sites 4, 5, 6, and 7 will likely remain the same under BSPC's proposal to discontinue the 15-minute staged ramping process because the amount of time for the leading edge of the generation flow to reach these sites will not likely change significantly relative to existing conditions.

Massachusetts DFW's recommendation to limit ramping rates would reduce the rate of change in the water level to allow approximately 95 percent of dragonflies to complete emergence and eclosure throughout the river, even in areas close to Fife Brook dam that have a minimal delay in the arrival of generation flows. This benefit to the population would occur on days that do not have scheduled whitewater flow releases. To reduce the effects of whitewater flow releases on emerging and eclosing state-listed dragonflies, Massachusetts DFW's recommendation restricts whitewater flow releases during the peak emergence period of each state-listed species. In a letter filed April 1, 2019, Massachusetts DFW states that its recommendations would reduce the percentage of *O. carolus* that is at risk of being washed away during the emergence and eclosure period from 90 percent under current operation to 20 percent. Similarly, Massachusetts DFW states its recommendations would reduce the percentage of *B. grafiana* at risk from 90 percent to 54 percent. However, Massachusetts DFW likely overestimates both the percentage of each species at risk under current operation and under its recommendation because the delay in arrival of generation flows at Sites 4, 5, 6, and 7 allow dragonflies that emerge early in the morning to complete emergence and eclosure before generation flows arrive. Regardless, Massachusetts DFW's recommendations would likely increase the number of state-listed dragonflies that survive to adulthood downstream of Fife Brook dam, increase the area where state-listed dragonflies can successfully complete emergence and eclosure, and allow the populations of each species to increase.

CRC's recommended ramp and hold procedure would not change the timing of the arrival of the released flow's leading edge or the change in water level height. However, the 1-hour hold would reduce the water level rate of change and allow a greater proportion of *B. grafiana* to compete emergence and eclosure compared to current operation, but would not benefit *O. carolus*. Having two hold periods for higher operational flows would further benefit *B. grafiana*, but the reduced rate of change would still not be low enough to benefit *O. carolus*. In addition, CRC's recommendation would allow some dragonflies to complete emergence and eclosure during the 1-hour period when flows are stable, but the proportion of emerging and eclosing dragonflies that would be protected by an hour of stable flow would depend on when the hour of stable flow occurred. Regardless, an extra hour of stable flow would likely allow more dragonflies to complete emergence and eclosure than under current operation. CRC's recommended down ramping procedure would not provide any benefit to dragonfly nymphs or adults because a slowly falling water level is no more protective than a rapidly falling water level once dragonflies begin emerging and eclosing.

Trout Unlimited's recommended 1-hour ramp up procedure would have a similar effect on emerging and eclosing dragonflies as BSPC's current and proposed operation. As with CRC's down ramping recommendation, Trout Unlimited's down ramping recommendation would likely not provide any benefit to emerging and eclosing dragonflies. Similar to the effects of current operation, the effect of Trout Unlimited's recommendation to release whitewater flows no later than 10 a.m. depends on when the rising water levels associated with whitewater flow releases reach locations where dragonflies are emerging and eclosing. If BSPC begins the whitewater flow release at 10 a.m., approximately 25 percent of dragonflies that emerge on a particular day at Site 4 could be affected by rising water levels, but stable water levels before and after this period would allow dragonflies to complete eclosure. Rising water levels would arrive at Sites 5, 6, and 7 later in the day when a smaller fraction of dragonflies emerge.

Dragonfly Flight and Emergence Survey Plan

Massachusetts DFW recommends under section 10(j) that BSPC develop, in consultation with Massachusetts DFW and FWS, a Dragonfly Flight and Emergence Survey Plan to be implemented every three years to assess state-listed dragonfly populations and ensure that state-listed dragonfly habitat utilization along the river remains stable or increases.

BSPC does not propose any post-licensing activity regarding dragonflies.

Our Analysis

As described in section 3.3.1.2 *Aquatic Resources, Environmental Effects, Dragonfly Ramping Rates*, rapidly rising water levels downstream of Fife Brook dam can wash away and drown emerging and eclosing state-listed and non-state-listed dragonflies. However, BSPC found seven species of dragonflies, including two state-listed species, between 5 and 8 miles downstream of Fife Brook dam. Dragonfly survival to the adult stage is likely higher in this reach than in upstream reaches because the time required for generation flows to reach this part of the river allows some dragonflies to complete eclosure before water levels begin to rise.

Any change to project operation that affects the timing of generation flows or the rate at which water levels rise downstream of Fife Brook dam could affect dragonfly survival and the length of the reach in the river they occupy downstream of the dam. While a regularly-scheduled dragonfly survey could be used to detect changes in the abundance and distribution of state-listed dragonfly species, it is unclear if any observed changes could necessarily be directly attributed to project operation. While project operation can affect dragonfly survival during emergence and eclosure, larval abundance and survival and adult survival after eclosure could be affected by environmental conditions unrelated to project operation, such as high flow events resulting from storms, variability in the abundance of predators, and high precipitation or wind events during eclosure. In addition, the larval development time is unknown for both species and could be as long as 4 years for *B. grafiana*. Therefore, the number of *B. grafiana* larvae that begin emergence and eclosure represents the combined effects of variability in environmental conditions on survival during a relatively long larval development period, which greatly complicates directly linking the abundance of dragonfly exuviae to project operation. Further, the recommended study is not specifically tied to any operational or other project-related performance measure that would be used to reduce the effects of the project on populations of dragonflies, and therefore, would not serve any licensed, project-related purpose.

In addition, Massachusetts DFW recommends that BSPC conduct the survey every 3 years. However, a minimum of three surveys, and likely five or more, would be required to rule out the possibility that a high or low number of exuviae observed during any single survey resulted from environmental variability unrelated to project operation.[90] Assuming a persistent change in abundance or distribution can be rigorously quantified and a project-related cause identified, any change in operation would have to be implemented for multiple survey cycles to confirm that the change in operation produced the intended result. Such a process would require the majority of the term of any new license before any improvement in the abundance and distribution of state-listed dragonfly species could be confirmed.

Special Status Dragonfly Habitat Enhancement Plan

To enhance the habitat for state-listed dragonfly species, Massachusetts DFW recommends under section 10(j) that BSPC develop a plan to increase the population of state-listed dragonflies on project lands and lands over which conservation easements are established or re-established. Massachusetts DFW states that the plan must include a list of species to be enhanced and identification of suitable habitat sites for site-specific enhancement measures. Massachusetts DFW states that enhancement measures may include removal of flow restrictions in the watershed, restoring native vegetation to riparian corridors and floodplains, measures to retain large woody debris within the Deerfield River, mid-channel emergence habitat enhancements to raise substrate above spring flood levels, and other conservation measures to benefit state-listed dragonflies directly.

BSPC does not propose any measures regarding dragonfly habitat.

---

[90] A line is defined by two points, and the results from two consecutive surveys could appear to be a trend. Therefore, at least three consecutive surveys would be needed to determine if a trend or change in abundance is persistent.

Our Analysis

B. grafiana and *O. carolus* use a variety of habitat during their life cycle: rocky riffles or soft sediment as larvae; rocks, emergent vegetation, logs, and stream banks during emergence and eclosure; fields and forests as adults; and treetops for mating. Massachusetts DFW's recommendations are focused on the addition or maintenance of emergence habitat and preservation and enhancement of vegetated riparian areas. In addition to providing emergence substrate and mating habitat for dragonflies, vegetated riparian zones help reduce sediment input into rivers and streams, slow and filter storm runoff, reduce erosion along the banks, conserve and enhance species diversity, maintain wildlife movement corridors, and protect aesthetic values (Wenger, 1999; Fischer *et al*., 2000). Riparian trees help lower water temperatures by providing shade (Wenger, 1999; Fischer *et al*., 2000). Riparian trees also provide woody debris, which is used by resident fish, such as brook trout, and other aquatic organisms for cover and foraging habitat. Similarly, adding mid-channel or streamside rocks or large woody debris would provide additional dragonfly emergence habitat and would likely benefit resident fish that could use the added structure for cover and foraging habitat.

However, while current operation can inundate and wash away emerging and eclosing dragonflies, nothing in the record that suggests that a lack of larval, emerging, foraging, or mating habitat limits the populations of *B. grafiana* and *O. carolus* in the Deerfield River downstream of Fife Brook dam. Given that these species emerge and eclose relatively close to the water's surface, there is no indication that providing additional emergence habitat would mitigate the effects of rising water levels. In fact, a photo of Site 9 of the dragonfly survey showed large woody debris relatively near the edge of the water; however, BSPC found no exuviae attached to these structures at the site (BSPC, 2017d). In addition, there is no available information about what proportion of emerging dragonflies are found along the edge of the stream versus found mid-channel, which makes quantifying the need and benefit of mid-channel emergence substrate difficult. Lastly, Massachusetts DFW provides no information about how BSPC would remove flow restrictions in the watershed at dams or other infrastructure it does not own or how the effects of these removals on the state-listed dragonfly populations would be quantified in relation to project effects on those species. Therefore, while maintaining and enhancing riparian and instream habitat could benefit fish and water quality, the benefits for state-listed dragonfly species are unclear.

200-foot Vegetated Riparian Buffer Zone

To protect fish and wildlife resources and allow for habitat management, Massachusetts DFW recommends under section 10(j) that BSPC establish a 200-foot, natively vegetated buffer zone on all riverfront land within the project boundary. Massachusetts DFW also recommends that BSPC acquire permanent conservation easements on non-project lands within 200 feet of the Deerfield River as measured from the top of the banks. Massachusetts DFW states that permanent conservation easements along the primary tributaries upstream of Shelburne Falls[91] would also be "protective." Massachusetts DFW recommends that BSPC establish a fund for this purpose.

BSPC states that the land downstream from the Fife Brook Development has already been placed in permanent conservation easement, and BSPC does not propose to expand the existing conservation easement at this time. BSPC also states that additional land is not necessary for project purposes.

Our Analysis

The riparian zone along the Deerfield River downstream of Fife Brook dam includes forests, agricultural lands, residential areas, roads, and other types of development. However, much of the river, including agricultural and developed areas, has at least some riparian vegetation. As described in the previous section, vegetated riparian zones help reduce sediment input into rivers and streams, reduce erosion along the banks, help lower water temperatures by providing shade, slow and filter storm runoff, conserve and enhance species diversity, maintain wildlife movement corridors, provide woody debris for fish and other aquatic organisms, and protect aesthetic values.

Under the current license, conservation restrictions protect 201 acres of river corridor lands downstream of the Fife Brook Development, which are included in the project boundary. Based on the maps in Exhibit G, the project boundary primarily runs along the river's shoreline, but some additional riparian land is included in areas such as around Beaver Island and the area upstream of the Zoar Whitewater Access Area. Acquiring additional land or conservation easements around the Deerfield River and including those lands in the project boundary would protect more land around the river for fish and wildlife protection, recreation, and aesthetic purposes. However, in order to protect a 200-foot riparian buffer along both banks of the Deerfield River, BSPC would have to purchase or acquire conservation easements for approximately 129 acres of additional land along the river to the downstream edge of the project boundary and an additional 678 acres of land downstream of the project boundary to Shelburne Falls.[92]

---

[91] Shelburne Falls is a town located approximately 20.8 miles downstream of Fife Brook dam.

[92] The distance from Fife Brook dam to the downstream extent of the project boundary and to Shelburne Falls is approximately 6.8 miles and 20.8 miles, respectively. Staff calculated the area within the project boundary as follows: 6.8 miles × 5,280 feet per mile × 200 feet (width of the riparian buffer) × 2 (for buffers on both sides of the river) = 14,361,600 square feet × 43,560 square feet per acre = 329.7 acres. Staff then subtracted the 201 acres already included in the project boundary from the 329.7 acres.

Because Massachusetts DFW did not identify the tributaries upstream of Shelburne Falls referenced in its recommendation, staff cannot estimate the acreage associated with these tributaries. Given that multiple areas along the river appear to be privately owned and developed or include infrastructure, such as roads and railroads, it is unclear how much of the riparian zone would be available for purchase or a conservation easement. In addition, the cost of purchasing or developing conservation easements for this land is also unknown. Part of the consideration for valuing this type of measure would depend on the development threat. Nothing in the record indicates any potential future development plans along the riparian area, and Massachusetts DFW did not state how the buffer would mitigate any specific project effect. Therefore, it is unclear what fisheries and wildlife benefits Massachusetts DFW intends to achieve by recommending the acquisition of the additional riparian buffer.

Rare Species Mitigation Fund

Massachusetts DFW recommends under section 10(j) that BSPC create a Rare Species Mitigation Fund to "fund survey, conservation, and enhancement actions for Special Status odonates [*i.e.*, dragonflies] in the Deerfield Watershed." Massachusetts DFW recommends that BSPC model the fund after the Deerfield River Settlement Agreement Enhancement Fund.[93] Massachusetts DFW states that the fund would be administered by BSPC and Massachusetts DFW as voting members, and each voting member could invite one person from academic or non-profit organizations with taxonomic expertise. Massachusetts DFW states these two invited members would be non-voting members, but could make recommendations. Massachusetts DFW states that a "proposed project must have a clear benefit to Special Status odonates and project must be located within the Deerfield River Basin; or in other major river basins in Massachusetts only if the project directly benefits *O. carolus* and/or *B. grafiana*."

BSPC does not propose any restoration projects to benefit state-listed dragonflies.

Staff calculated the area of riparian buffer between Fife Brook dam and Shelburne Falls in a similar manner.

[93] The Deerfield River Enhancement Fund was established in the 1994 Settlement Agreement to: (1) finance watershed conservation; (2) develop low-impact recreational and educational projects and facilities; and (3) plan, design, maintain, and monitor such facilities and projects. Projects must be located in the Deerfield River Basin or in towns with some portion within the basin.

Our Analysis

In general, when funds are proposed to be paid to a non-licensee entity for a mitigation or enhancement measure, staff analyzes the actual measure itself to determine whether the measure addresses an identified project effect or would enhance a resource affected by the project. However, there is no specific measure to analyze in this case because no entity has proposed a specific project to be funded. Consequently, there is no method for staff to determine the benefits of any future survey, conservation action, or enhancement action on special status dragonfly species.[94]

Cumulative Effects

Based our review of the license application, as well as agency and public comments, we have identified water quality, water quantity, aquatic resources (fish, benthic macroinvertebrates, and mussels), as resources that could be cumulatively affected by activities in the Deerfield River Basin. The activities that could potentially affect fish, benthic macroinvertebrates, mussels, water quality, and water quantity include the operation and maintenance of numerous hydropower projects on the Deerfield River.

<u>Water Quantity</u>

The Somerset and Harriman Developments of the Deerfield Project provide the predominant flow regulation for the river basin. The Somerset Development is the uppermost hydropower development in the basin and is used for seasonal storage. The reservoir retains most flow during spring runoff (with the exception of a 30 cfs minimum flow release), enhances peaking operations for downstream hydropower projects, and augments summer flows to enhance recreational boating, fisheries habitat, and hydropower operations downstream. The Harriman Development also serves to regulate flows in the Deerfield River. The Harriman Reservoir is the largest reservoir on the river and, similar to the Somerset Development, functions to retain flow during spring runoff, enhance peaking operations, and augment summer flows to enhance recreational boating, maintain fisheries resources downstream, and enhance hydropower operating during the summer.

Seasonal flow regulation by the Somerset and Harriman reservoirs results in generally lower spring flows in the Deerfield River than those experienced in nearby unregulated river systems. During the spring months (March through May), much of the flow is retained in the reservoirs. Conversely, Deerfield River flows during the summer, fall, and winter months (July through February) are typically higher than those in nearby

[94] The Rare Species Mitigation Fund measure is discussed further in section 5.1.3, *Measures Not Recommended*.

unregulated river systems. These higher flows are the result of augmented flow releases from the Somerset and Harriman reservoirs.

In addition to altering seasonal flow regimes, the management and operation of the Deerfield Project results in diurnal flow fluctuations both upstream and downstream of the Bear Swamp Project.

Our Analysis

As discussed in section 3.3.1.2, *Aquatic Resources, Environmental Effects, Aquatic Habitat in the Reservoirs*, BSPC operates the Bear Swamp PSD in a store and release mode with up to 45.5-foot daily fluctuations in the upper reservoir and up to 40-foot daily fluctuations in the Fife Brook impoundment. BSPC uses inflow to the lower reservoir to replenish water lost through occasional evaporation. BSPC manages the 4,600 acre feet of water in the Fife Brook impoundment to maintain a volume that can be regularly pumped to fill the upper reservoir for storage and subsequently released back to the Fife Brook impoundment for generation such that there would be no net loss of water as spill over Fife Brook dam from overtopping the Fife Brook dam. Operating the Bear Swamp PSD in this manner is similar to a closed loop where the only water that is lost from the system (upper and lower reservoirs) would be from evaporation. Therefore, operation of the Bear Swamp PSD creates no appreciable net loss of water or any net gain from storage.

BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5." BSPC also proposes to continue releasing a minimum flow of 125 cfs from the Fife Brook dam to protect aquatic habitat in the Deerfield River. In addition, BSPC proposes to continue to provide 106 scheduled whitewater flow releases from the Fife Brook dam according to the existing release schedule (*i.e.*, whitewater releases between 9:30 a.m. and 12:00 p.m. on 50 weekend days and 56 weekdays from April 1 to October 30, for a minimum duration of three hours). BSPC also proposes to discontinue its current practice of holding generation at 3 MW for 15 minutes before increasing generation to higher output levels.

Inflows to the Fife Brook impoundment come primarily from the discharge of the Deerfield Station No. 5, which operates in a peaking mode. The bypassed reach of the Deerfield Station No. 5 also provides inflow to Fife Brook impoundment. BSPC manages inflow such that the total volume of water for the Bear Swamp PSD operations remains stable (*i.e.*, no net loss from releasing minimum flows or whitewater releases) and also to provide the continuous minimum flow of 125 cfs and scheduled whitewater releases of 800 cfs. BSPC releases the majority of the inflow from Deerfield Station No. 5 to the Deerfield River downstream of the Fife Brook dam on a daily basis, but can temporarily store up to 300 acre feet of inflow for emergency/reserve conditions, minimum flows, and whitewater releases. Flows downstream of Fife Book dam therefore vary on a regular basis according to the generation release at Deerfield Station No. 5 and attenuate with distance downstream.

Releasing all flows from Fife Brook dam in stages, with a one-hour intermediate flow release that is equivalent to the midpoint of the total flow, followed by a ramp up to the total desired flow release as recommended by CRC, would attenuate peaking flow from Deerfield Station No. 5. Operating the Fife Brook Development in this manner would provide resident fish more time to respond to increasing water levels and seek cover than what is currently available under existing operation. Providing a year-round up-ramping rate that is inclusive of all flow releases could allow fish move greater distances and locate areas with suitable habitat in the Deerfield River. This would reduce competition for food and habitat with suitable cover, which could provide a benefit to aquatic resources downstream of the project.

Downstream of the project, fluctuations in flow due to peaking operation affect water velocity downstream of the dam; however, these effects would dissipate with increasing distance from the tailrace.

BSPC's proposal and Commission staff's recommendation to continue providing a continuous minimum flow of 125 cfs would maintain adequate flows in the Deerfield River downstream of Fife Brook dam. There is no indication that the proposed project would add to the cumulative effects of other activities on flows in the Deerfield River downstream of Fife Brook dam that have historically occurred or that may occur in the future by any new activities in the basin.

Water Quality

Water quality in the Deerfield River has been affected by the construction and operation of hydroelectric facilities, and their impoundments for more than 100 years. In addition, the Deerfield River receives inputs of nitrogen and phosphorus, which can contribute to eutrophication, from point sources, including treated wastewater effluents from the Charlemont, Shelbourne Falls, and Deerfield wastewater treatment facilities; and nonpoint sources including illegal dumping, acid mine drainage, stormwater runoff, failing septic systems, and agricultural activities. Localized issues with fecal coliform counts that occasionally exceed state standards occur during wet weather events due to nonpoint sources in the watershed.

The Massachusetts DEP completed a comprehensive assessment of water quality conditions in the Massachusetts portion of the Deerfield River Basin in 2003. The report assessed the status of certain designated uses as defined in the State Water Quality Standards (MEOEEA, 2004). The designated uses include aquatic life, fish consumption, primary and secondary contact recreation, and aesthetics. Each use, within a given segment, was individually assessed as (1) support, (2) partial support, or (3) non-support.

According to Massachusetts DEP's report, the Deerfield River upstream and downstream of the project supports aquatic life, primary and secondary contact recreation, and aesthetics; however, the Deerfield River is in a "non-support" status for fish consumption as a result of mercury contamination.

Previous water quality data that was collected in 1995, 1996, and 2000 showed that all water quality data upstream and downstream of the project met existing state water quality criteria except the pH, which was below the minimum criteria range of 6.5 to 8.3 units.[95] The combined results of these sampling efforts show that overall, water quality in the Deerfield River Watershed is quite good, despite the influence of point and nonpoint source pollution.

Our Analysis

The presence of self-sustaining populations of brook trout, brown trout, and rainbow trout in the Deerfield River and its tributaries suggests that the water is clean, cool, and well-oxygenated. In addition, eutrophication does not appear to be occurring in the lower reservoir based on the 2016 study results. Therefore, land-use and human activities within the basin appear currently compatible with aquatic life water quality needs.

As described in section 3.3.1.1, *Aquatic Resources, Affected Environment, Water Quality*, the Fife Brook impoundment does not stratify and is regularly mixed by the operation of the Bear Swamp PSD. The shoreline of the Fife Brook impoundment is armored by cobble and large boulders and there is no evidence of erosion. Dissolved oxygen levels in the Fife Brook impoundment meet state water quality standards except in the deepest part of the reservoir just above the bottom. Downstream of Fife Brook dam, dissolved oxygen meets state water quality standards. Water temperature in the lower reservoir supports state water quality standards. Downstream of Fife Brook dam, water temperature generally warms with distance downstream of Fife Brook and also occasionally exceeds state water quality standards in the summer. Releasing additional flow and releasing flow earlier in the day does not prevent warming with distance downstream of Fife Brook dam, as described in section 3.3.1.2, *Aquatic Resources, Environmental Effects, Water Quality, Deerfield River Downstream of Fife Brook Dam*.

BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5." BSPC also proposes to continue releasing a minimum flow of 125 cfs from the Fife Brook dam to protect aquatic habitat in the Deerfield River. BSPC also proposes to continue to provide 106 scheduled whitewater flow releases from the Fife Brook dam according to the existing release schedule (*i.e.*, whitewater releases between 9:30 a.m. and 12:00 p.m.

[95] *See* 314 CMR § 4.05.

on 50 weekend days and 56 weekdays from April 1 to October 30, for a minimum duration of three hours). BSPC also proposes to discontinue its current practice of holding generation at 3 MW for 15 minutes before increasing generation to higher output levels.

Operating the project in this manner would continue to maintain dissolved oxygen levels in project waters and in the Deerfield River downstream of Fife Brook dam which cumulatively could benefit fish and aquatic resources. Under the recommended mode of operation, water temperature would occasionally exceed 68ºF; for brief periods of time in the summer (on the order of a few days); however, based on the numbers of coldwater fish species inhabiting the Deerfield River, occasional water temperature excursions do not appear to negatively affect cold water fish population.

Based on the water quality study that BSPC conducted in 2016, the project appears to have minimal effect on dissolved oxygen concentrations and water temperature. BSPC proposes and staff recommends a continuous minimum flow release of 125 cfs to provide consistent temperature and adequate dissolved oxygen for fish and aquatic resources downstream of the project. There is no indication that the proposed project would significantly add to the cumulative effects on water quality associated with wastewater treatment plant effluents, stormwater runoff, failing septic systems, and hydropower operations or any additional cumulative effects that may occur in the future from any new activities in the basin.

Fisheries

The project's dam, in combination with 10 other dams on the Deerfield River, have adversely affected fish populations and fish habitat by fragmenting aquatic habitat and reducing streamflow in bypassed reaches. In addition, the two other hydropower projects on the Deerfield River have the potential to kill or injure fish that are impinged or entrained in the projects' turbines, or otherwise injured by flow-regulating equipment (*e.g.*, sluice gates and spillways). In addition, dams within the Deerfield River Watershed have historically blocked the upstream passage of anadromous fish species, and delayed or completely blocked passage of catadromous species (American eel).

Our Analysis

Although no anadromous fish have been found between in the Deerfield River between Fife Brook dam and Deerfield Station No. 4, eels have been found downstream of the project. Fife Brook dam likely adversely affects eels by impeding upstream migration. The results of the Fish Assemblage Study showed that no eels were found in the Fife Brook impoundment, which suggests that any eels that are able to make it past the lower four dams on the Deerfield River are then unable to scale the height of the Fife Brook dam.

As described in section 3.3.1.2, *Aquatic Resources, Environmental Effects, Entrainment and Impingement* the adult and juvenile life stages of most fish species present in the Fife Brook impoundment are able to avoid entrainment because their burst swimming speeds exceed the measured approach velocities at both the Fife Brook and Bear Swamp PSD intakes; however, juvenile fish species would still be subject to entrainment. While the project would continue to entrain juvenile resident fish and fragment fish habitat during the term of a new license, BSPC's proposal to maintain the minimum flow released downstream of Fife Brook dam would continue to provide suitable habitat downstream of Fife Brook dam for all life stages of brook trout, brown trout, rainbow trout, and longnose sucker year-round.

The proposed project would not increase the ongoing effects discussed above, or otherwise significantly add to the cumulative effects on fisheries that have been historically caused by the project and other activities in the basin, or that may be caused by new activities in the basin in the future.

Benthic Macroinvertebrates

There are 11 FERC-licensed dams on the Deerfield River (Table 1), and 10 of these dams, including the Bear Swamp Project, operate as daily peaking projects or pass peaking flows downstream. Mayflies, stoneflies, dragonflies, and caddis flies are all found in the Deerfield River.

Previous surveys of the macroinvertebrate population of the Deerfield River show that the Deerfield River supports a robust and diverse macroinvertebrate community. In 2005, Massachusetts DEP conducted a benthic macroinvertebrate assessment of the Deerfield River Watershed to determine the biological health of the streams in the watershed. The upper Deerfield River reach was represented by a monitoring site downstream of Fife Brook dam at approximately RM 28.5, and the lower Deerfield reach was represented by a monitoring site near the Town of Greenfield at approximately RM 7.

Results of the 2005 macroinvertebrate assessment downstream of Fife Brook dam indicated a resident macroinvertebrate community similar to the reference stream and a water quality rating of "non-impacted." Massachusetts DEP indicated that "…the total metric score out-performed that of the reference site." The Taxa Richness was high relative to most of the large-stream stations, including the reference. The lower reach of the Deerfield River at Greenfield also received a determination of "non-impacted." Habitat conditions here were determined to be the best attainable in the watershed (Mitchell, 2009). The results of the assessment are all indicative of a diverse, healthy resident macroinvertebrate community in the Deerfield River.

Our Analysis

Releasing a minimum flow of 125 cfs from the Fife Brook dam to the Deerfield River, generation flows up to 1,540 cfs, and 106 scheduled whitewater release flows of 800 cfs would continue to maintain a diverse population of benthic macroinvertebrates, albeit there would continue to be less abundance and diversity of mayflies. Maintaining a diverse population of benthic macroinvertebrates downstream would continue to provide a stable food source for fish in the downstream reach of Fife Brook dam.

As discussed in section 3.3.1.2, *Aquatic Resources, Environmental Effects, Dragonfly Ramping Rates*, rapidly rising water levels from hydropower generation flows and whitewater flow releases can wash away and drown emerging and eclosing dragonflies. Therefore, the dragonfly populations downstream of each dam likely experience reduced survival during emergence and eclosure. Similarly, fluctuating water levels in each impoundment caused by any water storage associated with peaking operation may reduce survival of any dragonflies in the impoundment during emergence and eclosure. However, there are likely locations downstream from each dam where the delay between the release of generation or whitewater flow at the dam and the arrival of that flow at the downstream location is long enough to allow some of the population to complete emergence and eclosure, thereby allowing the population to persist. In the case of the Bear Swamp Project, BSPC found no dragonfly exuviae at the upstream extent of the 2.5-mile-long Fife Brook impoundment, and exuviae abundance at the dragonfly survey site located approximately 1 mile downstream of Fife Brook dam was greatly reduced compared to the sites located 5 to 8 miles downstream of the dam. This suggests that project operation reduces dragonfly habitat in the Deerfield River by at least 3.5 river miles. The operation of the other dams on the Deerfield River may similarly reduce the amount of available dragonfly habitat depending upon the magnitude of water level increase associated with generation flows and whitewater flow releases, how the water level increase attenuates with distance from the dam, and the timing of generation flow releases relative to the timing of peak emergence.

Because the Bear Swamp Project does not moderate the peaking flows released by Deerfield Station No. 5, the Bear Swamp Project contributes to the cumulative effects experienced by dragonflies in the Deerfield River. However, the proposed project would not significantly add to the cumulative effects on benthic macroinvertebrates that have been historically caused by the project and other activities in the basin, or that may be caused by new activities in the basin in the future.

Mussels

There are four species of mussels that are known to occur in the Deerfield River Basin. Of the four species, two species are currently listed as Species of Greatest

Conservation Need in Massachusetts. For the Deerfield River, only the lowermost reach near the Town of Deerfield was found to support mussel populations.

From 1994 to 1996, 37 tributaries of the Connecticut River were surveyed for freshwater mussels, including four major tributaries (Deerfield, Millers, Westfield, and Chicopee rivers). The habitat in the majority of sites was characterized as rapid, rocky, and unsuitable for most mussel populations. Of the 22 tributaries surveyed in 1996, which included the Deerfield River mainstem and several tributaries, no mussels were found in 15 of the rivers and brooks. The substrate conditions and steep gradient of the upper reach of the Deerfield River provide challenging habitat for mussels and only the lowermost reach of the Deerfield River near the Town of Deerfield was found to support mussel populations, consisting primarily of eastern elliptio (*Elliptio complanata*) and alewife floater (*Anodonta implicata*). Other mainstem Deerfield River sites surveyed included sites near Shelburne, Charlemont, and Rowe/Monroe, as well as the Cold River, Green River, and the Fall River tributaries, none of which was found to support freshwater mussels. These areas also have a steep gradient with a rocky substrate that does not provide suitable habitat for mussels.

Our Analysis

No mussels or mussel shells were found in the 2016 survey of the Deerfield River within the project boundary and downstream of Fife Brook dam. The steep gradient of the Deerfield River and unsuitable habitat in the project-affected reach of the Deerfield River downstream of Fife Brook dam does not support the propagation of freshwater mussels. The Deerfield River and several tributaries upstream of the Town of Deerfield are rapid and rocky, and do not provide sufficient habitat to support freshwater mussels. Project operation therefore would have no effect on mussels in the reach of the Deerfield River downstream of Fife Brook dam to the upper extent of Deerfield Station No. 4. Peaking flows released from Fife Brook dam that reach the boundary of the geographic scope of cumulative effects near the Town of Deerfield would be largely attenuated by the reservoirs of the hydroelectric developments downstream. Therefore, the project would not significantly add to the cumulative effects on mussels that have may have been caused by other activities in the basin, or that may be caused by new activities in the basin in the future.

3.3.2 Terrestrial Resources

3.3.2.1 Affected Environment

<u>Botanical Resources</u>

The project is located in the Green Mountains/Berkshire Highlands eco-region (Griffith *et al.*, 2009), and is part of the Deerfield River Basin. The upper half of the river basin is characterized by forested uplands and steep, narrow valleys; while the lower half of the basin is characterized by low, open hills. Forestland dominates the region, and land cover predominantly consists of northern hardwood forests with species such as sugar maple, beech, and yellow birch. Floodplain forests are also common along rivers and streams, and generally consist of a mixture of hardwood species such as maples and hickories. In addition, spruce-fir forests occur at higher elevation. Land within the project boundary is predominately forested upland and forested wetland.

Upland Vegetation

A Baseline Study of Terrestrial Wildlife and Botanical Resources was conducted in 2016 to identify wildlife and plant communities in the project boundary. Natural plant communities identified during surveys include: Northern Hardwoods-Hemlock-White Pine Forest (732.1 acres), High-Terrace Floodplain Forest (84.7 acres), Rich Mesic Forest (67.4 acres), and Hemlock Forest (44.3 acres).

The Northern Hardwoods-Hemlock-White Pine Forest habitat type is present around the upper and lower reservoirs, as well as along the Deerfield River downstream of Fife Brook dam. The habitat contains a closed canopy dominated by a mix of deciduous and evergreen trees, with a sparse shrub and herbaceous understory. Canopy species include sugar maple, American beech, yellow birch, red oak, eastern hemlock, and white pine. The shrub layer contains hobblebush, elderberry, honeysuckle, and currant. Herbaceous species include Christmas fern, Canada mayflower, clubmosses, asters, trillium, violet, and bluebead lily.

The High-Terrace Floodplain Forest habitat type is present downstream of Fife Brook dam, on large islands in the Deerfield River, and on raised bands adjacent to the channel. Although the habitat is not flooded annually, it is located within the 100-year floodplain and influenced by the river. Typical canopy species include red maple, silver maple, sugar maple, and a variety of birch, hickory, ash, butternut, sycamore, cottonwood, black cherry, basswood, and elm. The shrub layer contains northern arrowwood, nannyberry, and winterberry. The herbaceous layer includes ferns, wood nettle, white snakeroot, jack-in-the-pulpit, and bellwort. Some grasses and vines are also present.

The Rich Mesic Forest is present in ravines and slopes of lower elevations at three locations near the upper and lower reservoirs within the project boundary. The habitat is dominated by sugar maple, white ash, basswood, yellow birch, American beech, and red oak. Ironwood, dogwood, and elderberry are found below the canopy layer. This habitat type also contains a diverse herbaceous layer.

The Hemlock Forest habitat type occurs within four areas in the project boundary, including three near the upper and lower reservoirs and one near the downstream portion of the project boundary. The habitat contains a dense cover of at least 50 percent eastern hemlock. Other canopy species include red spruce, white pine, maples, American beech, birch, and oaks. The shrub layer is typically sparse, including mountain laurel, witch hazel, striped maple, and hobblebush.

<u>Upland Vegetation Management</u>

Current vegetation management within the project boundary is primarily limited to the transmission lines, Fife Brook dam, and the four dikes and spillway at the upper reservoir. Routine maintenance is also conducted at project recreation facilities and other project facilities. BSPC has developed a vegetation management plan in consultation with the Massachusetts Department of Agricultural Resources to describe the use of mechanical vegetation removal and herbicide application, and provide a schedule for vegetation maintenance (BSPC, 2016c).

Wetland Vegetation

About 32 acres of palustrine wetland habitat are located within the project boundary, including emergent wetlands (15.4 acres), forested wetlands (12.8 acres), and scrub-shrub wetlands (3.8 acres). Emergent wetlands are present along the shorelines of the upper and lower reservoirs, and the downstream reach of the Deerfield River. Vegetation in these wetlands includes sensitive fern, cinnamon fern, several species of sedges, and invasive species such as purple loosestrife and phragmites.

Forested wetlands within the project boundary are located in backwaters, point bars, and the lower reaches of some tributary streams. Common species include red maple, silver maple, American elm, eastern sycamore, and green ash, with an understory of ostrich fern, sensitive fern, blue flag iris, clearweed, false nettle, and poison ivy.

Scrub-shrub wetlands within the project boundary occur along the outer edge of the emergent wetlands along the shorelines, or intermixed in open canopy areas near forested communities. Scrub-shrub wetland species include alder, button bush, winterberry, and dogwood.

Massachusetts Plant Species of Concern

Two state-listed and two state special concern plant species were identified during 2016 and 2017 surveys, including: shore sedge (*Carex lenticularis*), pale green orchis (*Platanthera flava* var. *herbiola*), mountain alder (*Alnus viridus* ssp. *crispa*), and American ginseng (*Panax quinquefolius*). Nine additional plant species on the state watch list were also identified during surveys, including: frog orchid (*Coeloglossum viride*), Loesel's twayblade (*liparis loeselii*), variegated scouring rush (*Equisetum variegatum* ssp. *variegatum*), mountain sedge (*Carex deflexa*), round-leaved orchis

(*Platanthera orbisculata*), clasping-leaf twistedstalk (*Streptopus amplexifolius*), narrow triangle grape-fern (*Botrychium angustisegmentum*), daisy leaf moonwort (*Botrychium matricariifolium*), and swamp moonwort (*Botrychium tenebrosum*).

Invasive Species

Thirteen invasive botanical species were identified at the project during survey efforts in 2015 and 2016: black locust (*Robinia pseudoacacia*), Tatarian honeysuckle (*Lonicera tartarica*), Morrow's honeysuckle (*Lonicera morrowii*), coltsfoot (*Tussilago farfara*), *Phragmites spp.*, Japanese barberry (*Berberis thunbergii*), Japanese knotweed (*Fallopia japonica*), multiflora rose (*Rosa multiflora*), oriental bittersweet (*Celastrus orbiculatus*), purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), autumn olive (*Elaeagnus umbellata*), and winged euonymus (*Euonymus alata*). Over 30 acres of discrete stands of invasive plant species were identified along shorelines and on islands throughout the project.

Wildlife Resources

The project provides various wildlife habitat types, including wooded upland, wetland, and riparian areas. Mammals observed at the project during 2016 survey efforts include white-tailed deer, raccoon, black bear, American mink, beaver, coyote, eastern chipmunk, squirrel, moose, porcupine, woodchuck, and vole. A diverse variety of bird species use the riverine and riparian habitats along the Deerfield River for feeding and nesting habitat, including American black duck, mallard, common merganser, and Canada goose.

The federally protected[96] and state threatened bald eagle (*Haliaeetus leucocephalus*) was observed in flight, roosting, and foraging during 2016 survey efforts in the project reach of the Deerfield River downstream of Fife Brook dam. However, no active nests were observed during field surveys.

Acoustic bat surveys conducted in 2016 identified the likely presence of several bat species, including the federally threatened and state endangered NLEB (*Myotis septentrionalis*) and the state endangered little brown bat (*Myotis lucifugus*). Forested habitat at the project was found to provide moderate potential for bat use and roosting, based on the presence of large trees and snags that were documented during the 2016 survey.

[96] The bald eagle was delisted from the ESA in 2007, but remains federally protected under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act (FWS, 2007a).

3.3.2.2 Environmental Effects

Upland Vegetation

As part of a Recreation Facilities Management Plan, BSPC proposes certain improvements to recreation facilities. Ground disturbance could be associated with these recreation improvements, including: (1) developing an additional parking area at the Fife Brook Fishing and Boating Access Area; (2) constructing a new boater egress trail that begins downstream from the Showtime rapid and extends upstream to the existing vehicle turnaround at Great River Hydro's Dunbar Brook Picnic Area, which is part of Deerfield Station No. 5; (3) construction of a second set of stairs between the parking lot and the river at the Zoar Picnic Area; and (4) widening the access trail at the Zoar Whitewater Access Area.

Our Analysis

Proposed improvements to project recreation facilities would cause some land disturbance. However, because the site-specific details of these improvements will be developed as part of BSPC's Recreation Facilities Management Plan, staff is unable to quantify vegetation disturbance associated with these improvements at this time. Nevertheless, because these recreation improvements are located at/near areas that are already disturbed by ongoing project activities, we anticipate that additional land disturbance and human activity associated with project recreation would not significantly affect wildlife habitat or wildlife populations at the project relative to current conditions.

Wetlands

BSPC proposes to continue to operate the Bear Swamp PSD in a store and release mode, and the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5." BSPC also propose to continue releasing a minimum flow of 125 cfs from the Fife Brook dam.

Massachusetts DFW recommends under section 10(j) that BSPC operate the project in a "year-round, run-of-release mode." Similarly, Interior recommends under section 10(j) that BSPC operate the Fife Brook Development as a "run-of-release facility, passing inflow it receives from the upstream Deerfield Project's Deerfield [Station] No. 5 development below Fife Brook dam on a near instantaneous basis."

Our Analysis

As currently licensed, the Bear Swamp PSD is operated in a store and release mode. Water is pumped from the lower reservoir (*i.e.,* Fife Brook impoundment) to the upper reservoir and then released from the upper reservoir through the Bear Swamp powerhouse back to the Fife Brook impoundment. The upper reservoir experiences frequent water level fluctuations of as much as 50 feet, due to project operation.

BSPC states that it operates the Fife Brook impoundment in a "run-of-release" mode by passing inflows from Deerfield Station No. 5 to the downstream Deerfield Station No. 4. However, BSPC does not operate the Fife Brook Development in a "run-of-release" mode on an instantaneous basis and occasionally deviates from such an operation on a daily basis. When inflow does not equal outflow, additional fluctuations occur in the impoundment. Besides the fluctuation associated with the Bear Swamp PSD, additional fluctuations in the Fife Brook impoundment result from differences between impoundment inflow and outflow. Water levels in the Fife Brook impoundment upstream of Fife Brook dam are not stable and are influenced by peaking operations associated with the Deerfield Station No. 5 and the Bear Swamp PSD. The Fife Brook impoundment has an allowable daily fluctuation of 40 feet.

Currently, outflows from the Fife Brook dam can change from a minimum flow of 125 cfs to a total outflow of up to 1,323 cfs (combined total outflow from Deerfield Station No. 5). This change in outflows results in a corresponding change of 3.42 feet or more in the depth of the Deerfield River. Operating the Fife Brook Development in an instantaneous "run-of-release" mode, as recommended by the agencies, would pass the majority of these peaking inflows to the Deerfield River downstream of Fife Brook dam.

The upper reservoir and Fife Brook impoundment shorelines are dominated by natural bedrock, rip-rap armoring, and areas of cobble, course gravel, and fine sediments. Steep slopes occur along much of the shorelines (88 percent at the upper reservoir, and 93.1 percent at Fife Brook impoundment). As such, wetlands are limited to a narrow fringe along the shorelines. These wetland areas generally occur within 1 to 2-feet of the maximum impoundment level and are subject to daily water level fluctuations. Wetlands areas along the reservoirs appear stable and have adapted to the existing project operation.

As discussed in section 3.3.1.2, *Aquatic Resources, Environmental Effects,* BSPC's proposal, Massachusetts DFW's recommendation, and Interior's recommendation for project operations would not significantly change the availability or quality of aquatic habitat in the impoundments relative to current project operation. Similarly, BSPC's proposed project operation, Massachusetts DFW's recommendation, and Interior's recommendation would have similar effects to wetlands relative to current conditions.

Downstream of Fife Brook dam, wetlands are located in backwaters and point bars, on islands, and along portions of the shoreline. These wetlands are mostly forested and scrub-shrub, and appear well adapted to current project operation. Daily fluctuations in the river stage by as much as 3.42 feet can result in the inundation of emergent and scrub-shrub wetlands, while forested wetlands are typically inundated by the increase in river flows during spring rains. BSPC's proposed project operation, Massachusetts DFW's recommendation, and Interior's recommendation would have similar effects to wetlands relative to current conditions.

Special-Status Plants

BSPC proposes to develop a State-Listed Rare Plants Management Plan in consultation with Massachusetts DFW. The plan would include measures to minimize adverse effects on state-listed and special status plants within the project boundary that may result from project-related construction or land-clearing activities. This plan is consistent with Massachusetts DFW's section 10(j) recommendation to develop a Special Status Plant Management Plan.

Our Analysis

BSPC recorded observances of state-listed plants and other special status plant species during its Baseline Study of Terrestrial Wildlife and Botanical Resources, State-listed Rare Plants Baseline Data Collection Study, and Rare Plant Survey during 2016 and 2017. Two state-threatened plants, two species of concern, and nine state watch plant species were identified in a variety of habitats within the project boundary. These species are of concern because their populations are rare, declining, or vulnerable in the State of Massachusetts. Construction and maintenance activities that include soil disruption or material storage could affect these species if suitable protection measures are not implemented.

Developing a plan that provides specific measures (*e.g*., marking off areas to protect rare plants from construction-related activities and routine vegetation maintenance) would minimize adverse effects on state-listed and special status plants within the project boundary. Consulting with the resource agencies would allow these agencies to make recommendations for appropriate protective solutions. The proposed measures discussed below to reduce the spread of invasive plant species would also provide some additional protection for special-status plant species.

Invasive Plant Species

BSPC proposes to develop and implement an Invasive Plant Species Monitoring and Management Plan to reduce the spread of invasive species at the project, in consultation with Interior and Massachusetts DFW. The plan would include the following measures: (1) educate recreational users on ways to reduce the spread of invasive species; (2) implement "best management practices," such as identifying invasive species that may be introduced by a given project-related activity, identifying critical control points (locations and times), and implementing measures to prevent the spread of invasive species during routine project operation and maintenance activities; (3) record incidental observations of invasive species; and (4) use only seed and plant materials outside of lawn areas to those found to be native to the county in the then-current Vascular Plants of Massachusetts.

Massachusetts DFW recommends an Invasive Plant Species Monitoring and Management Plan under section 10(j). In addition to the provisions included in BSPC's proposed plan, Massachusetts DFW recommends: (1) a comprehensive survey of invasive plants every 5 years that would be used to develop site-specific control/management actions to reduce the spread of invasive species at the project; and (2) plant and seed areas after implementing invasive species control techniques.

Our Analysis

Non-native invasive plant species are able to out-compete and displace native species, thereby reducing biodiversity and altering compositions of existing native plant and animal communities. Once established, invasive plant species can be difficult to remove from an area.

Invasive plant species are widespread in the Deerfield River Basin, including at the project. More than 30 acres of discrete stands of invasive species were found during 2015 and 2016 survey efforts, including existing populations of Japanese knotweed, purple loosestrife, reed canary grass, and other invasive plants along the shorelines of the Deerfield River downstream of the Fife Brook dam. The majority of existing, mapped invasive species populations are located along several miles of discontinuous portions of the shoreline downstream of Fife Brook dam. Project-related recreation, as well as construction and maintenance activities, have the potential to introduce and spread invasive species at the project.

Developing an Invasive Plant Species Monitoring and Management Plan that provides measures to educate recreation users and employ best management practices, as well as the use of native seed and plant materials for revegetation, could reduce the potential for further introduction or spread of invasive species within the project boundary. An Invasive Species Monitoring and Management Plan, as proposed by BSPC, could protect native vegetation, wildlife habitat, and recreational resources by minimizing adverse effects associated with the spread of invasive plants within the project boundary.

Massachusetts DFW's additional provisions to conduct a comprehensive survey of invasive plants every 5 years in order to develop site-specific control/management actions to reduce the spread of invasive species at the project would likely be very costly. Massachusetts DFW does not specify which invasive plant species it would target for control/management, nor does it provide specific measures for control (*i.e.*, chemical control or physical removal). Further, given the distribution of invasive plant populations within the project boundary along long-stretches of the Deerfield River, attempting to reduce the prevalence of these species and replanting these areas within the project boundary may not be technically feasible.

BSPC proposes to include approximately 1,305.3 acres of land and water within the project boundary, including 1,305.3 acres that consists of approximately 900 acres of forest and 30 acres of wetland habitat. Although more than 30 acres of discrete stands of invasive species were found at the project, the invasive species do not appear to be significantly affecting project operation or other environmental resources, and there is no indication that additional monitoring and/or site-specific control/management actions, as proposed by Massachusetts DFW, are needed to protect fish and wildlife resources at this time.

Bald Eagle

BSPC proposes to develop a Bald Eagle Protection Plan in consultation with Interior and Massachusetts DFW. The plan would include provisions to avoid killing, injuring, or harassing bald eagles during tree cutting or thinning operations that are undertaken for project infrastructure and recreation enhancements. The plan would also include a description of measures for avoiding or minimizing the effects of project-related activities on nesting bald eagles within the project boundary. This plan is consistent with Massachusetts DFW's section 10(j) recommendation to develop a Bald Eagle Protection Plan.

Our Analysis

Project maintenance activities have the potential to disturb resident eagles if tree cutting or thinning were to occur during nesting and other phases in their reproductive life cycle. Although no active bald eagle nests were located during the wildlife survey in July 2016, eagles were observed roosting and foraging in the surveyed area.

FWS's 2007 *National Bald Eagle Management Guidelines* (FWS, 2007b) provides detailed guidance on how to minimize effects to bald eagles, including disturbances to nesting eagles. The guidelines include the following measures to avoid disturbances to nesting eagles: (1) keeping a distance of at least 330 feet between the activity and the nest (distance buffers); (2) maintaining forested (or natural) areas between the activity and around nest trees (landscape buffers); and (3) avoiding construction and maintenance activities during the breeding season.

Developing a Bald Eagle Protection Plan in accordance with the *National Bald Eagle Management Guidelines* would ensure that bald eagle nesting habitat is protected from project-related activities.

Special-Status Bat Species

BSPC proposes to develop and implement a Bat Management Plan in consultation with Interior and Massachusetts DFW. The plan would include measures to avoid or minimize adverse effects on the NLEB, the little brown bat, and any associated foraging and roosting habitat from maintenance, construction, and land-clearing activities at the project. This plan is consistent with Interior's section 10(j) recommendation to develop a Bat Management Plan and Massachusetts DFW's section 10(j) recommendation to develop a Special Status Bat Management Plan.

Our Analysis

BSPC conducted an acoustic bat survey in July and August 2016. Acoustic sampling positively identified calls for the NLEB and the little brown bat at the project. Project maintenance activities and proposed recreation site improvements have the potential to disturb bats if tree cutting or thinning were to occur during roosting or other phases in their reproductive life cycle. Ground disturbance and some tree-clearing activities could be associated with recreation site improvements, including: (1) developing an additional parking area at the Fife Brook Fishing and Boating Access Area; (2) constructing a new egress trail that begins downstream from the Showtime rapid and extends upstream to the existing vehicle turnaround at Great River Hydro's Dunbar Brook Picnic Area, which is part of Deerfield Station No. 5; (3) construction of a second set of stairs between the parking lot and the river at the Zoar Picnic Area; and (4) widening the access trail at the Zoar Whitewater Access Area. Further, project maintenance activities during the term of any new license could require periodic tree removal that may affect bat habitat (*e.g.*, vegetation maintenance at project recreation sites and along the transmission line right-of-way).

BSPC does not propose, and Interior and Massachusetts DFW do not provide, specific measures as part of a Bat Management Plan that would be used to avoid or minimize adverse effects. As discussed below in section 3.3.3, *Threatened and Endangered Species*, prohibiting the removal of occupied maternity roost trees or any trees within 150 feet of an occupied roost tree from June 1 – July 31 would protect the NLEB from project-related activities. Because the little brown bat has similar habitat requirements as NLEB, restricting tree removal activities to time periods outside of the NLEB pup season would also protect the little brown bat from project-related activities. Staff has not identified any additional measures that would be needed to protect bat species at the project; therefore it is unclear how developing a Bat Management Plan would provide additional benefit to the species.

Conservation Easement

BSPC proposes to not renew or grant another conservation easement for 1,256 acres of land that is protected under a conservation easement. This includes 1,206 acres of land located within the project boundary near the upper reservoir and Fife Brook impoundment, and 50 acres outside of the project boundary. In addition, BSPC is proposing to remove 161.77 acres of these lands from the project boundary.

Interior recommends and Massachusetts DFW recommends under 10(j) that all 1,256 acres of land continue to be protected under future conservation easements.

Our Analysis

As discussed in section 3.3.4, *Land Use, Recreation, and Aesthetics*, the land that is protected under the conservation easement is part of a larger, mostly intact forested landscape in the Berkshire Mountain range. Removing the conservation easement from 1,206 acres of project land, including the removal of 161.77 acres of land from the project boundary, would ease some restrictions for future development. This could result in some fragmentation of forested habitat, which could reduce the quality of wildlife habitat in the area. However, the remaining 1044.23 acres of land would continue to provide a large unfragmented forest area to protect sensitive species within the project boundary.

3.3.3 Threatened and Endangered Species

Commission staff obtained the official list of federally threatened and endangered species from FWS's IPaC system on August 20, 2019. FWS's IPaC system indicates that the federally threatened NLEB could occur in the project vicinity. Acoustic bat surveys in 2016 identified the NLEB as likely being present at the project. No critical habitat has been designated for the NLEB.

Three other federally listed species were identified in the final license application for the Bear Swamp Project: the federally endangered dwarf wedgemussel (*Alasmidonta heterodon*) and northeastern bulrush (*Scirpus ancistrochaetus*), and the federally threatened bog turtle (*Glyptemys muhlenbergii*). These species do not occur on the official species list for the project that was generated from the FWS's IPaC system on August 20, 2019. Further review indicates that although these species are listed for Franklin and/or Berkshire County, Massachusetts, these species and their habitats are not expected to occur in the area of the proposed action. Therefore, the project would have no effect on these species, and are removed from further discussion.

3.3.3.1 Affected Environment

The NLEB was listed as a federally threatened species under the ESA on May 4, 2015. Massachusetts has also designated the NLEB as an endangered species. In January 2016, the FWS finalized the 4(d) rule for this species, which focuses on preventing effects on bats in hibernacula associated with the spread of white-nose syndrome[97] and effects of tree removal on roosting bats or maternity colonies (FWS, 2016a). As part of the 4(d) rule, FWS proposes that take incidental to certain activities conducted in accordance with the following habitat conservation measures, as applicable, would not be prohibited: (1) occurs more than 0.25 mile from a known, occupied hibernacula; (2) avoids cutting or destroying known, occupied maternity roost trees during the pup season (June 1 – July 31);[98] and (3) avoids cutting or destroying any tree within a 150-foot radius of a known, occupied maternity tree during the pup season. The 4(d) rule provides flexibility to landowners, land managers, government agencies, and others as they conduct activities in areas that could be NLEB habitat.

Traditional ranges for the NLEB include most of the central and eastern U.S., as well as the southern and central provinces of Canada, coinciding with the greatest abundance of forested areas. The NLEB, whose habitat includes large tracts of mature, upland forests, typically feeds on moths, flies, and other insects. These bats are flexible in selecting roost sites, choosing roost trees that provide cavities and crevices, and trees with a diameter of 3 inches or greater at breast height.[99] Winter hibernation typically occurs in caves and areas around them that can be used for fall swarming[100] and spring

---

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

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

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

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

staging.[101] The project is located within the white-nose syndrome buffer zone for this species.[102] No critical habitat has been designated for this species.

3.3.3.2 Environmental Effects

BSPC proposes to develop and implement a Bat Management Plan in consultation with Interior and Massachusetts DFW. The plan would include measures to avoid or minimize adverse effects on the NLEB and any associated hibernacula from maintenance, construction, and land-clearing activities at the project. This plan is consistent with Interior's section 10(j) recommendation to develop a Bat Management Plan and Massachusetts DFW's section 10(j) recommendation to develop a Special Status Bat Management Plan.

Our Analysis

BSPC conducted an acoustic bat survey in July and August 2016. Over a period of 44 nights, 385 bat calls were recorded. Of these, 87 calls sequences were consistent with the genus *Myotis*.[103] Based on this data, NLEB are believed to be present at the project.

Project maintenance activities and proposed recreation site improvements have the potential to disturb bats if tree cutting or thinning were to occur during roosting or other phases in their reproductive life cycle. Ground disturbance and some tree-clearing activities could be associated with recreation site improvements, including: (1) developing an additional parking area at the Fife Brook Fishing and Boating Access Area; (2) constructing a new egress trail that begins downstream from the Showtime rapid and extends upstream to the existing vehicle turnaround at Great River Hydro's Dunbar Brook Picnic Area, which is part of Deerfield Station No. 5; (3) construction of a second set of stairs between the parking lot and the river at the Zoar Picnic Area; and (4)

---

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

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

[103] Surveys targeted three species with the genus *Myotis*, including NLEB, little brown bat, and Indiana bat. Based on a review of the acoustic data, habitat, and known range of the Indiana bat, FWS concluded that it is unlikely the call sequences represented this species.

widening the access trail at the Zoar Whitewater Access Area. Further, project maintenance activities during the term of any new license could require periodic tree removal that may affect NLEB habitat (*e.g.*, vegetation maintenance at project recreation sites and along the transmission line right-of-way).

While no occupied maternity roost trees are known to occur in the project vicinity, no surveys have been conducted to verify the absence of maternity roost trees. However, because the NLEB is likely present in the project area, maternity roosts could potentially occur in the project boundary and be affected by project maintenance.

BSPC does not propose, and Interior and Massachusetts DFW do not provide, specific measures as part of a Bat Management Plan that would be used to avoid or minimize adverse effects to NLEB and its habitat. However, removing occupied maternity roost trees or any trees within 150 feet of an occupied roost tree is prohibited during the NLEB pup season (June 1 – July 31) (FWS, 2016a). To avoid prohibited incidental take of NLEB, BSPC could restrict tree removal activities to time periods outside of the pup season. Staff has not identified any additional measures that would be needed to protect NLEB at the project; therefore, it is unclear how developing a Bat Management Plan would provide additional benefit to NLEB.

With the implementation of the tree-cutting restriction measure, we conclude that the project is not likely to adversely affect NLEB. We will follow FWS's optional streamlined consultation framework that allows federal agencies to rely on the 4(d) rule to fulfill section 7(a)(2) consultation requirements for NLEB (FWS, 2016b).

3.3.4 Land Use, Recreation, and Aesthetics

3.3.4.1 Affected Environment

<u>Land Use</u>

The Bear Swamp Project is located on the Deerfield River, in Berkshire and Franklin Counties, Massachusetts. The Deerfield River Basin is predominantly forested (approximately 88 percent), with less than 10 percent agricultural lands. Other land uses include residential, commercial, and urban areas in the lower reaches of the Deerfield River Basin. Berkshire County remains largely undeveloped, with 93 percent (approximately 564,742 acres) of all land both undeveloped, or reserved for recreational/open space, and agricultural use (Berkshire Regional Planning Commission, 2014). Berkshire County is characterized by extensive forestlands, agricultural lands in river valleys, rural residential development, and small villages. Franklin County is known for its agricultural production, rural towns, forested mountains, creeks and rivers, and recreation areas. Just north of the Bear Swamp Project near the town of Rowe, in Franklin County, is the site of the former Yankee Nuclear Power Station, one of the nation's first nuclear power plants, which closed in 1992. The site continues to store radioactive waste.

Land use in the immediate vicinity of the project is predominantly rural and largely forested. The current project boundary for the Bear Swamp Project, as established in the Commission's April 28, 1970 License Order and revised on November 17, 2006,[104] encompasses 1,474 acres and includes all project facilities described in section 2.1.1, *Existing Project Facilities* associated with the Bear Swamp PSD and Fife Brook Development, including the two reservoirs that have a total surface area of approximately 270 acres.

A total of 1,407 acres of land within the project boundary is protected by conservation easements. Approximately 1,206 acres of protected land occurs near the project's upper and lower reservoirs, and 201 acres of the protected land occurs along the river corridor for approximately 7.5 miles downstream of the Fife Brook dam.[105] The 201 acres of river corridor are subject to in-perpetuity conservation easements, while the 1,206 acres near the project's upper and lower reservoirs are subject to conservation easements that expire with the current license on April 1, 2020. The conservation easements restrict use of the property to agricultural, forestry, educational, non-commercial recreation, open space, and electric transmission and hydroelectric generation purposes.

<u>Recreation</u>

Statewide Recreation Plan

The 2017 Massachusetts Statewide Comprehensive Outdoor Recreation Plan (SCORP) identifies outdoor recreation as central to the state's economic, environmental, and community values (MEOEEA, 2017). The SCORP helps guide the distribution of federal funding to state agencies and municipalities for the acquisition of open space, renovation of parks, and the development of new parks. The SCORP recommends increasing recreation access for underserved populations, expanding all types of recreation trails, increased availability of water-based recreation, and supporting the creation and renovation of neighborhood parks.

---

[104] *Bear Swamp Power Company,* 117 FERC ¶ 62,164 (2006).

[105] Article 405 of the current license requires the licensee to protect 1,257 acres of land. The licensee chose to establish a conservation easement for an additional 200 acres, including 50 acres outside of the project boundary. *See New England Power Company*, 79 FERC ¶ 61,009 (1997).

Regional Recreation Opportunities

There is an abundance of year-round recreation opportunities in the Berkshire Mountain region, which include skiing, snowmobiling, snowshoeing, hiking, biking, hunting, whitewater boating, camping, picnicking, sightseeing, swimming, tubing, fishing, trail running, and horseback riding in state parks, forests, wildlife management areas, and protected open spaces. Tourism and recreation are important economic drivers in Franklin and Berkshire Counties, attracting tourists to the area from New York City, Albany, Hartford, New Haven, and Boston.

Recreation facilities within ten miles of the Bear Swamp Project include Green Mountain National Forest, Savoy Mountain State Forest, Mohawk Trail State Forest, Kenneth Dubuque Memorial State Forest, Monroe State Forest, Somerset Reservoir, and Harriman Reservoir, which have a variety of campgrounds and camping shelters; rivers, ponds, and creeks for fishing; hiking, biking, and horseback riding trails; cross-country and downhill skiing; golf courses; swimming areas; and a plethora of opportunities for boating and whitewater recreation.

Recreation at the Project

There are numerous recreation opportunities at project. The approved project recreation facilities include the Bear Swamp Visitor Center, Fife Brook Fishing and Boating Access Area, Zoar Whitewater Access Area, Zoar Picnic Area, Bear Swamp Public Hunting Area, and Bear Swamp and Hoosac Tunnel Trail (Figure 15). These sites provide non-motorized boating, fishing, tubing, hiking, hunting, biking, whitewater boating, picnicking, and trail running.

- **Bear Swamp Visitor Center:** Provides visitor information, parking, and educational experiences. Amenities at the Bear Swamp Visitor Center include static and interactive exhibits, restrooms, drinking fountains, a 20-car parking area, an outdoor information kiosk, and a picnic table. The Visitor Center has capacity for approximately 30 people.

- **Fife Brook Fishing and Boating Access Area:** Provides river access for bank and wade fishing, and for non-motorized boats, including drift boats, self-bailing rafts, canoes, kayaks, catarafts, and stand-up paddleboards. Amenities at the Fife Brook Fishing and Boating Access Area include two seasonal restrooms (one is Americans with Disabilities Act (ADA) compliant), one boat slide (which can accommodate a variety of boats, including self-bailing rafts), a shoreline access trail, parking for 8-10 vehicles, two sets of stairs to the river, two boat put-in areas, and an information kiosk. Wi-Fi access was added to the kiosk in 2017 to allow visitors to view real-time flow schedules posted online at the "Safe Waters" website (Brookfield, 2018). An informal overflow parking area for the Fife Brook

Fishing and Boating Access Area that can accommodate approximately 25 vehicles is located across River Road.

- **Zoar Whitewater Access Area:** Colloquially known as "Last Chance Eddy," the Zoar Whitewater Access Area is a popular take-out and put-in location for boaters located upstream from the Class III Zoar Gap whitewater rapids. Amenities at the Zoar Whitewater Access Area include a shoreline access trail, unimproved boat launch/take-out, an information kiosk, and parking for approximately 7-10 vehicles.

- **Zoar Picnic Area:** The Zoar Picnic area is a popular put-in/take-out location for tubers and boaters, and is also popular with anglers. The Zoar Picnic Area provides parking for 25-30 vehicles, three seasonal restrooms (one is ADA compliant), an information kiosk, 22 grills, 22 picnic tables, shoreline access trails, and stairs to the river.

- **Bear Swamp Public Hunting Area:** A 900-acre hunting area is located south and west of the project's upper reservoir and is accessible via Tunnel Road. In addition to seasonal hunting, the Bear Swamp Public Hunting Area provides opportunities for hiking, jogging, wildlife viewing, snowshoeing, and cross-country skiing. The Bear Swamp Public Hunting Area is forested and includes informal parking areas with a 6-8 car capacity and an access road.

- **Bear Swamp and Hoosac Tunnel Trail:** The Bear Swamp and Hoosac Tunnel Trail was completed in 2016, and provides over 15 miles of recreational hiking near the upper reservoir with scenic views overlooking the Deerfield River Valley (see Figure 16). The Bear Swamp and Hoosac Tunnel Trail includes a system of formalized hiking trails, signage, and information kiosks. The Bear Swamp and Hoosac Tunnel Trail is accessible in the winter for cross-country skiing and snowshoeing. Parking for the trail is located at the Zoar Picnic Area. In addition, a 4-5 car capacity informal parking area is located within the Bear Swamp Public Hunting Area. A loop section of the Bear Swamp and Hoosac Tunnel Trail includes: (1) the Fife Brook Overlook Hiking Trail, a 1.3-mile section accessible from Tunnel Road near the upper reservoir, which provides views of the Deerfield Valley, Fife Brook impoundment, and the Fife Brook dam; and (2) the Hoosac Loop Hiking Trail, which is an approximately 10-mile loop trail.

There are ten informal undeveloped public access areas that occur downstream of Fife Brook dam. These areas provide access to the river, and are mainly used by anglers. See Figure 15. There is currently no direct public access to the upper or lower reservoirs.

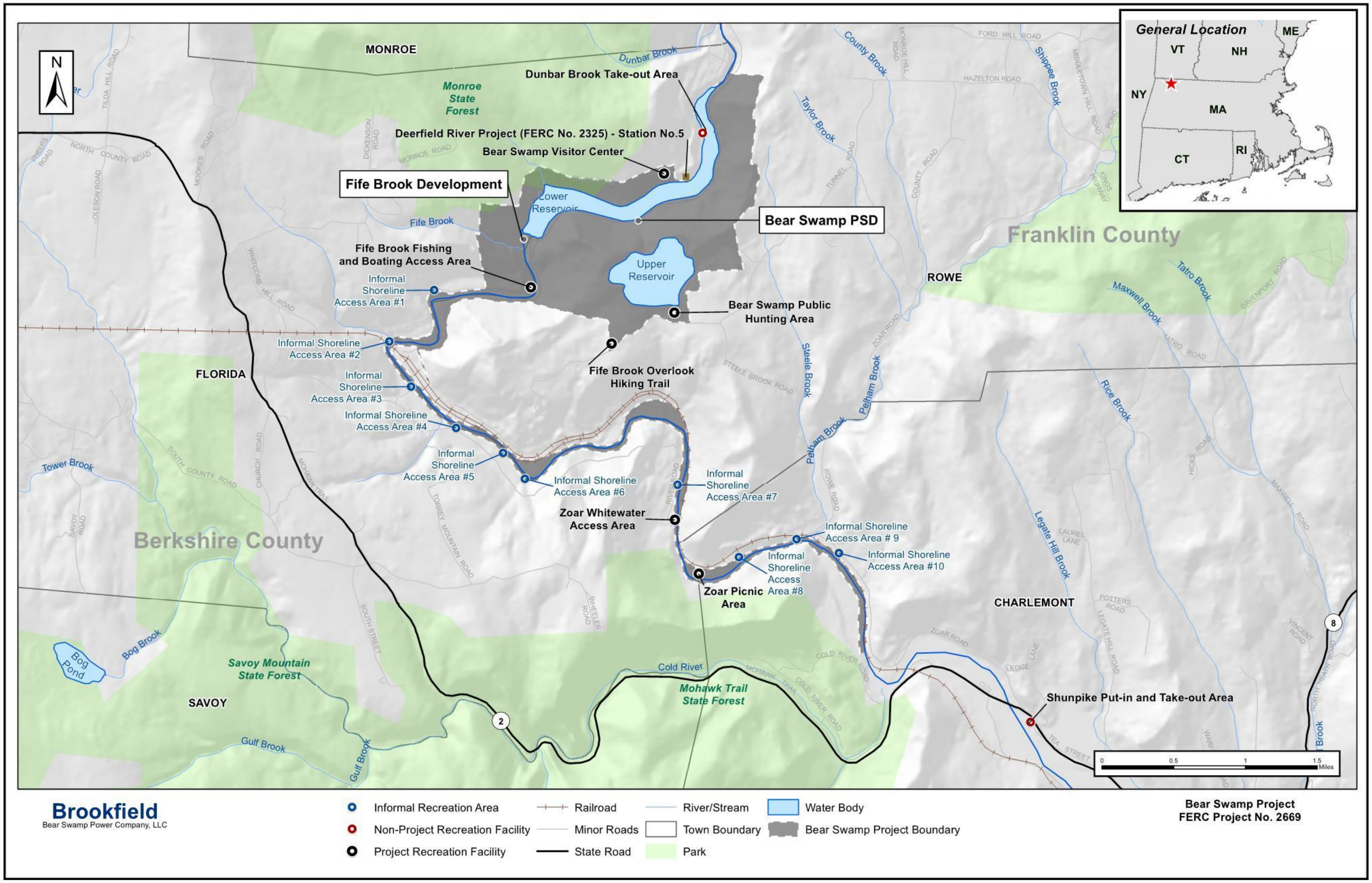


Figure 15. Project and non-project recreation areas in the vicinity of the project (Source: BSPC, as modified by staff).

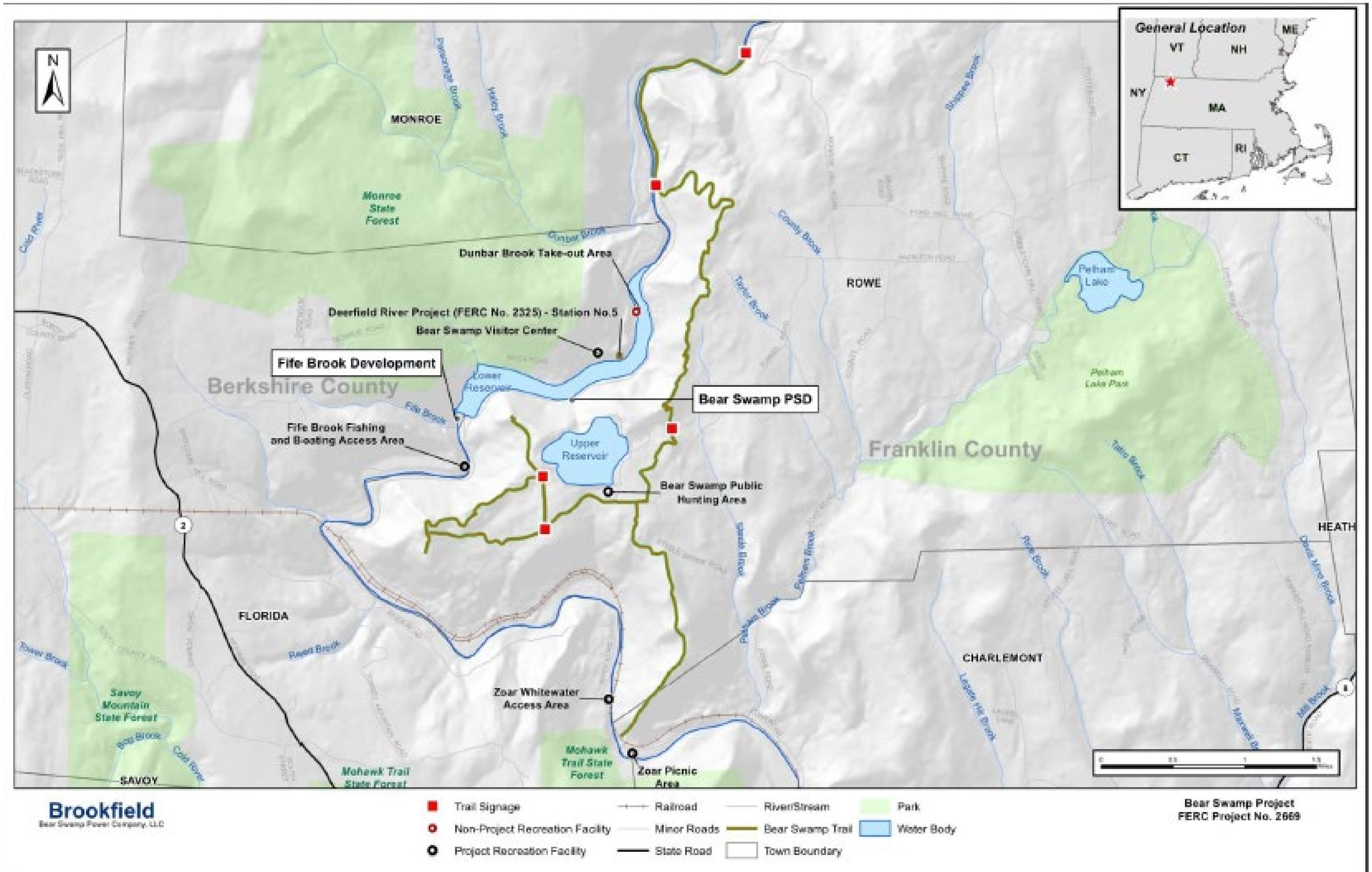


Figure 16. Map of Bear Swamp and Hoosac Tunnel Trail (Source: BSPC, as modified by staff).

The Shunpike Rest Area is a non-project recreation site owned and maintained by the Massachusetts Department of Transportation. It is located on Route 2, downstream from the project (see Figure 15), and is a popular take-out area for float and paddle trips originating within the project boundary, including commercial and guided trips. The Shunpike Rest Area provides parking for approximately 50 vehicles, several picnic tables, and an information kiosk.

Fishing

The Deerfield River is considered a premier trout stream, and the tailwater fishery downstream of Fife Brook dam is proven to support a healthy and naturally wild trout population as well as excellent habitat for stocked rainbow and brown trout. Massachusetts DFW has an annual stocking program, which provides trout releases in the spring and fall along the Deerfield River (Trout Unlimited, 2016). Approximately 4.1 miles of the Deerfield River downstream of Fife Brook dam is managed by Massachusetts DFW as a catch-and-release fishery. The stocking program and the catch-and-release program attract a variety of anglers to the Deerfield River with varying skills, fishing experience, and familiarity with the river. Additionally, the Deerfield River offers opportunities for professional anglers to provide guide services to recreational anglers using non-motorized drift boats, wading, or shoreline fishing.

Whitewater Recreation

Commercial whitewater boating, tubing, and whitewater kayaking are major sources of summer recreation on the Deerfield River. The Deerfield River downstream from Fife Brook dam provides opportunities for Class I through Class III whitewater boating (Code of Massachusetts Regulations, 2018). Whitewater recreation trips take place in the three reaches described below, on the Deerfield River downstream from the Fife Brook dam:

- Reach 1 begins at the Fife Brook Fishing and Boating Access Area and extends approximately 5.3 river miles to the Zoar Picnic Area. This 5.3-mile-long upper reach has an average gradient of about 29 feet/mile and includes the Class III Zoar Gap rapids, as well as a number of smaller rapids and whitewater "play areas." This reach is frequented by commercial rafting companies, and experienced to intermediate canoeists, and kayakers.

- Reach 2 extends from the Zoar Gap Picnic Area to the Shunpike Rest Area (downstream of the project boundary). Reach 2 is approximately 3.4 river miles in length and provides opportunities for tubers and novice canoeists/kayakers and recreationists using inflatable tubes ("tubers"), as well as more highly-skilled boaters. The final 1,300 feet of Reach 2 extend beyond the project boundary.

- Reach 3 extends 7.5 river miles from the Shunpike Rest Area, downstream to the Deerfield Station No. 4 impoundment and is used predominantly by tubers and novice canoeists/kayakers (MEOEEA, 2004). This reach has a lower gradient and fewer rapids.

To provide flows for whitewater recreation opportunities, the current license requires BSPC to provide 106 scheduled whitewater releases from Fife Brook dam. These scheduled and predictable whitewater releases have resulted in an increasing demand for guided rafting trips, kayak and inflatable tube rentals, whitewater clinics, individual kayakers, canoeists, and tubers on the Deerfield River. Several commercial recreational boating outfitters provide rental services and shuttles for tubers, whitewater rafters, kayakers, and guided trips. The stretch of the Deerfield River below the Fife Brook dam to the Shunpike Rest Area is the most popular section of the river for whitewater boaters.

After launching at the Fife Brook Fishing and Boating Access Area, boaters encounter a series of Class II and Class III rapids, including "Hangover Helper," "Carbis Bend," "Freight Train," "Pinball" or "Rock Garden," "Island Rapid," and "Zoar Gap." Below Zoar Picnic Area, a wide, shallow, slow 11-mile stretch of Class I water continues to East Charlemont.

The Fife Brook Fishing and Boating Access area is the primary put-in location for commercial and private whitewater boaters, tubers, and boating anglers. Additionally, other boaters and tubers use the put-in at the Zoar Gap Picnic Area and continue downstream on the Deerfield River, beyond the project boundary. Whitewater boating occurs year-round, but is highly flow-dependent, as water levels affect the conditions, availability, and exposure of whitewater features. Tubing is another very popular whitewater recreation activity, which occurs almost exclusively in the summer. Tubing trips utilize the put-ins at Fife Brook Fishing and Boating Access Area and Zoar Picnic Area.

In addition to the whitewater boating activities that occur downstream of the Fife Brook dam, there are a series of highly technical rapids that occur in the upper extent of the Fife Brook impoundment and the bypassed reach of Deerfield Station No. 5. To access the rapids, whitewater boaters put-in at Monroe Bridge or the Deerfield Station No. 5's Dunbar Brook Picnic Area. These put-in areas are located upstream of the Bear Swamp Project boundary. Great River Hydro provides scheduled whitewater releases to the bypassed reach of Deerfield Station No. 5 on 26 weekend days/holidays and six Fridays from May 1 to October 21 annually.[106] The whitewater releases are required to last for four continuous hours on Fridays starting at 11:00 a.m., five continuous hours on

[106] *New England Hydropower Company*, 79 FERC ¶ 61,006 (1997).

Saturdays starting at 10:00 a.m., and four continuous hours on Sundays starting at 10:00 a.m. The flow levels for the whitewater release periods are required to be between 900 and 1,100 cfs, with an annual average of 1,000 cfs.[107] Because of the intermittent flows in the bypassed reach of Deerfield Station No. 5, this stretch of the Deerfield River is known by whitewater boaters as "the Dryway."

The Dryway is a popular destination for advanced boaters because of the numerous Class III and Class IV rapids over its 2.65-mile length. The three rapids that are located within the project boundary are known as Dragon's Tooth, Labyrinth, and Showtime (American Whitewater, 2019). These Class IV rapids are located in the upper reaches of the Fife Brook impoundment, at elevations of 845 feet, 840 feet, and 834 feet NGVD, respectively. Currently, the only formal exit point for boaters is a set of steps on the river right that are located just upstream of the Showtime rapid, at mile 2.55 of the 2.65-mile-long whitewater stretch. This formal whitewater take out is operated and maintained as part of the Deerfield Station No. 5's Dunbar Brook Picnic Area. The takeout is clearly marked with a "portage/takeout" sign that directs boaters to a set of stone stairs that lead to an adjacent parking area, which can accommodate approximately 6 cars.

Whitewater Flow Releases and Schedule

The current license requires BSPC to provide 106 scheduled whitewater releases from Fife Brook dam. The 106 whitewater releases must include 50 weekend days and 56 weekdays, from 9:30 a.m. to 12 p.m., at a minimum flow of 700 cfs,[108] for a duration of at least three continuous hours. These scheduled releases were negotiated as part of the 1994 Settlement Agreement for the Deerfield Project, and were approved by the Commission in the April 7, 1997 amendment order.[109] The 1994 Settlement Agreement also outlines the monthly whitewater release allocations, as shown below in Table 17.

---

[107] *New England Power Company*, 81 FERC ¶ 62,179 (1997).

[108] Article 404 of the project's existing license requires whitewater flow releases from Fife Brook dam to be a minimum of 700 cfs. At the request of whitewater outfitters, boaters, and whitewater interest groups, BSPC normally provides whitewater flow releases of 800 cfs from Fife Brook dam.

[109] *See New England Power Company,* 79 FERC ¶ 61,009 (1997).

Table 17. Fife Brook dam whitewater release schedule.

Month	Allocation
April	3 weeks of Wednesday through Sunday releases
May	2 weeks of Wednesday through Sunday releases, plus 2 weeks of Saturday and Sunday releases
June	2 weeks of Wednesday through Sunday releases, plus 2 weeks of Saturday and Sunday releases
July	3 weeks of Wednesday through Sunday releases, plus 1 week of Saturday and Sunday releases
August	4 weeks of Thursday through Sunday releases
September	3 weeks of Wednesday through Sunday releases
October	3 weeks of Wednesday through Sunday releases
Holidays	May be substituted for weekend days upon agreement between the Licensee and the citizens groups before April 1 of each year.

BSPC and Great River Hydro meet annually, prior to November 1, to plan the specific calendar dates for the flow releases from the Bear Swamp Project and the Deerfield Station No. 5 for the following year. In January, BSPC releases the proposed schedule for that year's flow releases. BSPC then meets with Great River Hydro, Trout Unlimited, and the Whitewater Interest Group to coordinate whitewater flows, maintenance activities, and other fishing and boating recreation activities (*e.g.*, the annual Massachusetts free fishing days and the Deerfield Riverfest).[110]

The whitewater flow release schedule is posted publicly on or before April 1 for the current year. The schedule is physically posted at the Bear Swamp Project, is available online to the public on the BSPC's Safe Waters website,[111] and is also available on the Safe Waters' toll-free phone line (1-844-430-3569).

When generating at the Fife Brook Development, BSPC releases between 270 cfs and 1,540 cfs from the Fife Brook impoundment to the Deerfield River. Depending on the

---

[110] A Whitewater Release Plan was approved by the Commission on December 10, 1997 and includes provisions for the licensee to: (1) meet with representative citizen groups to cooperatively develop whitewater release schedules; (2) provide river flow information to the public; and (3) reduce whitewater releases when natural low flow conditions are present. *See New England Power Company*, 81 FERC ¶ 62,179 (1997).

[111] BSPC provides daily flow information for the Fife Brook Development on-line to inform the public of flow releases on the Safe Waters website at https://www.safewaters.com/facility/22. The public uses this information to plan specific recreational activities such as fishing, whitewater boating, and tubing.

magnitude and duration of these releases, the public can use these flows for whitewater recreation on days that don't otherwise have scheduled flow releases for whitewater recreation. Whitewater recreation users can use the flow data provided by BSPC on the Safe Waters website to plan whitewater recreation in the Deerfield River on these unscheduled days.

Recreation Use

Recreation use of the Bear Swamp Project has been documented through FERC Form 80 reports.[112] To gather information on the capacity and demand of project recreation facilities, BSPC supplemented the 2015 FERC Form 80 data by performing a Recreation Use Survey in 2016. The study included: (1) a field inventory to document the project and non-project recreation facilities that occur within the project boundary; (2) in-person interviews and online surveys to gather information about existing facilities, demand, current use patterns, and user satisfaction; (3) trail camera deployment to document year-round visitor use at project recreation facilities; and (4) industry and law enforcement interviews to gather information about existing facilities, demand, current use patterns, and safety issues. Recreation use estimates for public access areas were based on field observations, traffic counts, spot counts, interview/survey data, trail camera data, and industry and law enforcement interviews. More than 280 recreationists participated in interviews and online surveys.

The 2016 Recreation Use Survey found that the project offers six formal recreation areas that are used by a variety of recreationists, including rafters, kayakers, anglers, tubers, picnickers, and hikers. While kayaking is the primary recreation activity at the project, shoreline fishing, rafting, picnicking, sightseeing, tubing, hiking, and relaxing all ranked high among activities that respondents participated in while visiting the project recreation facilities. The most popular recreation facilities at the project are the Fife Brook Fishing and Boating Access Area and the Zoar Picnic Area. These facilities are used by individual recreationists, families, commercial whitewater outfitters, and professional fishing guides.

According to the 2016 study, project recreation facilities provide an "acceptable" or "totally acceptable" recreation experience for visitors. Generally, usage of the project recreation sites is well below capacity and the sites are adequate to handle the level of use at the project. However, due to the popularity of the whitewater flow releases for whitewater rafting/tubing and the tendency of outfitter businesses to bring groups of people to river access sites, capacity at the Fife Brook Fishing and Boating Access Area, Zoar Whitewater Access Area, and the Zoar Picnic Area can be exceeded for several hours

---

[112] The most recent FERC Form 80 submitted for the project was filed on March 27, 2015.

at a time on summer weekends and holidays. This results in not enough parking, crowds, and wait times to enter the river.

Safety & Warning System for Recreation Users

BSPC's January 2012 *Public Safety Plan* requires the licensee to provide a variety of safety signage, gates and fencing, boater warning buoys around Fife Brook dam, and warning sirens to assure the safety of recreational users in the Deerfield River downstream of the Fife Brook dam. BSPC maintains flashing warning lights and sirens in the tailrace of the Fife Brook dam, in which a 30-second-long warning siren sounds, and a yellow light flashes to warn anglers and boaters before the Fife Brook Development begins releasing higher flows to the downstream reach.

Fishermen reported claims of being stranded on the opposing bank, as water conditions changed too quickly for them to safely return to the access area. No incidents were reported by BSPC or captured in the Recreation Use Survey. BSPC conducted a warning system effectiveness study in 2016. As part of this study, BSPC conducted audibility measurements in August and December at four locations downstream of the dam near project and non-project recreation sites (see Table 18). The study results indicate that environmental conditions (*e.g.*, leaves, humidity, wind, and birds) and ambient noises (*e.g.*, traffic and trains) greatly reduce the audibility of the warning siren. Under optimal conditions, the study determined that ambient noises exceeded the volume of the warning siren 18.4 to 42.9 percent of the time at the Fife Brook Fishing and Boating Access Area, which is 0.4 mile downstream from the Fife Brook dam. The siren was not audible at any of the other downstream locations, the closest of which was an additional 0.76 mile downstream from the Fife Brook Fishing and Boating Access Area. During the course of the study, BSPC also determined that the frequent cargo trains of the Pan Am Southern line that use the Hoosac Tunnel and tracks along the Deerfield River can drown out the warning siren.

Table 18. Warning System monitoring locations.

Location	**River Miles Downstream From Fife Brook Dam**
Fife Brook Fishing and Boat Access Area	0.4
Carbis Bend	1.16
Hoosac Tunnel Train Trestle	1.70
Location along River Road	2.31

Aesthetics

The project is located in a rugged and sparsely populated area within Berkshire and Franklin Counties, known for forested uplands with steep, narrow valleys. The Deerfield River is known as one of the cleanest and coldest rivers in the region and the surrounding area offers a scenic natural setting. The Deerfield River is also known as a "working river" that has been used for hydropower generation for over 100 years, with impoundments that are an "integral part of the river's ecologic and recreational character" (MEOEEA, 2004a).

Access to the project's impoundments, impoundment shorelines, and project facilities is restricted for public safety and security. However, these restricted access areas provide wildlife protection, as well as aesthetic benefits by shielding the industrial appearance of the project facilities from much of the public viewshed. The impoundment and project features are partially visible through vegetation, while traveling along Route 2 and local roads, including River Road. Additionally, the 1,256 acres of protected land along the upper reservoir and Fife Brook impoundment provides a variety of recreation opportunities within the natural scenic areas established as part of the project conservation easement.

3.3.4.2 Environmental Effects

Recreation Facilities

BSPC proposes to continue to operate and maintain the existing project recreation facilities, including the Bear Swamp Visitor Center, the Fife Brook Fishing and Boating Access Area, the Zoar Whitewater Access Area, the Zoar Picnic Area, the Bear Swamp Public Hunting Area, and the Bear Swamp and Hoosac Tunnel Trail. BSPC proposes to develop a Recreation Facilities Management Plan within 12 months of license issuance that includes the following provisions: (1) continue operating and maintaining the existing project recreation facilities; (2) design and construct a new boater egress trail that begins downstream from the Showtime rapid and extends upstream to the existing vehicle turnaround at Great River Hydro's Dunbar Brook Picnic Area, which is part of Deerfield Station No. 5; (3) enhance overflow parking at the Fife Brook Fishing and Boating Access Area; (4) widen the access trail at the Zoar Whitewater Access Area; (5) install additional seasonal restroom facilities, a stall-type changing facility, and an additional staircase at the Zoar Picnic Area; (6) install handrails on staircases at project recreation areas; and (7) install additional signage to educate recreationists on safety and the Deerfield River flow regime.

Our Analysis

The Bear Swamp Project provides a variety of recreation opportunities. Continuing to operate and maintain the existing project recreation facilities, as proposed by BSPC, would ensure that non-motorized boating, fishing, tubing, hiking, hunting, biking, whitewater boating, picnicking, and trail running activities can continue at the project. According to the 2016 Recreation Use Study, the existing project and non-project facilities are generally sufficient to meet demand in the project boundary, except during certain hours on summer weekends and holidays when demand for whitewater boating access causes congestion at put-in and take-out areas along the downstream reach of the Deerfield River.

Currently, there is no formal plan for managing project recreation facilities. The Recreation Facilities Management Plan would formalize the operation and maintenance of project recreation sites and ensure that project facilities are properly operated and maintained for the term of any new license issued for the project. The plan also includes measures for improving site access, safety, and sanitation at recreation sites in the project boundary, which would improve conditions at recreation sites during periods of high demand for whitewater boating. Site-specific recreation enhancements that are included in the plan and recommended by stakeholders are analyzed in detail in the following sections.

Recreation in the Fife Brook Impoundment

BSPC proposes to design and construct a new boater egress trail that begins downstream of the Showtime rapid and extends upstream to the existing vehicle turnaround at Great River Hydro's Dunbar Brook Picnic Area.

Several new portage routes were requested by interested parties. The Whitewater Interest Group comments that BSPC should be required to construct a portage trail around the Fife Brook dam. In addition, the CRC comments generally that access should be provided to the Fife Brook impoundment. Finally, the Whitewater Interest Group requests that BSPC be required to construct a trail between the Visitors Center and the Fife Brook impoundment to provide public access to the impoundment.

Our Analysis

There are no project recreation facilities that provide access to the Fife Brook impoundment, and there is currently no direct public access to the Fife Brook impoundment. However, boaters that use the Dunbar Brook Picnic Area or Monroe Bridge put-in locations to access the bypassed reach of Deerfield Station No. 5 can boat downstream to the Fife Brook impoundment. Three Class IV rapids (Dragon's Tooth, Labyrinth, and Showtime) occur in the bypassed reach of Deerfield Station No. 5, which is co-located with the upper extent of the Fife Brook impoundment.[113]

---

[113] See Section 2.1.4, *Existing Project Operation*, for additional information on the overlapping configurations of the Deerfield River and Bear Swamp Projects. For discussion purposes, the "upper extent of the Fife Brook impoundment" is the approximately 1.2-mile-long section of the impoundment that lies upstream of the Deerfield Station No. 5 powerhouse and the "lower extent of the Fife Brook

The last point of egress for boaters in the upper extent of the Fife Brook impoundment is a takeout downstream of Dunbar Brook along the access road to Deerfield Station No. 5, which is located between the Labyrinth and Showtime rapids. Boaters who use the Showtime rapid must exit from the Deerfield River and then carry their boats along rocky terrain on the shoreline for up to 1000 feet to gain access to the upstream takeout. The rough terrain and length of the walk with boating equipment present an egress issue for boaters. Constructing and maintaining a formal take-out site downstream of the Showtime rapid and installing signs guiding boaters to it, along with the new boater egress trail proposed by BSPC, would allow boaters to exit the river more easily after completing the whitewater run through the Showtime rapid. While the boater egress trail would increase recreation use at the Dunbar Brook Picnic Area, the increased demand would likely be relatively small based on the high level of experience required to boat the Class IV rapids.

In the lower extent of the Fife Brook impoundment, there are several safety hazards that limit the ability to provide safe access for public recreation. The Fife Brook impoundment functions as the lower reservoir for the Bear Swamp PSD and fluctuates rapidly on a daily basis by as much as 40 feet. In addition, there are strong currents within the lower extent of the impoundment that would be dangerous for any water-related recreation, including the outflow of the Deerfield Station No. 5 (up to 1,250 cfs),[114] the inflow/outflow of the Bear Swamp PSD (up to 10,860/9,040 cfs),[115] and the inflow of the Fife Brook Development (up to 1,540 cfs). Providing public access to the entire 2.5-mile-long Fife Brook impoundment, as suggested by the CRC, would expose recreation users to hazards associated with the large daily fluctuations and strong currents within the lower extent of the Fife Brook impoundment, which could increase the risk of injury or mortality at the project.

Although there are no project recreation facilities that provide direct access to the lower extent of the Fife Brook impoundment, boaters could theoretically continue

---

impoundment" is the approximately 1.3-mile-long section of the impoundment that lies downstream of the Deerfield Station No. 5 powerhouse.

[114] *New England Power Company*, 79 FERC ¶ 61,006 (1997).

[115] On August 13, 2008, the Commission authorized the rehabilitation of the existing turbine units to increase the hydraulic capacity of each of the turbines from 5,430 cfs to 6,200 cfs, for a combined hydraulic capacity of 12,400 cfs. The proposed changes will result in an additional 770 cfs going through the project turbines. *See Bear Swamp Power Company, LLC*, 124 FERC ¶ 62,127 (2008). On December 9, 2016, the Commission granted an extension of time until August 13, 2022 for BSPC to complete the rehabilitation of the turbine units.

downstream from the Showtime rapid to access the lower reach of the Fife Brook impoundment. To our knowledge, there are no physical barriers that prevent access to the lower extent of the impoundment, but safety and directional signage is installed upstream of the Deerfield Station No. 5 powerhouse to warn of the dam ahead and guide boaters away from the Fife Brook impoundment and to the boat takeout downstream from the Dunbar Brook Picnic Area.

The Whitewater Interest Group comments that BSPC should be required to construct a portage trail around the Fife Brook dam. Portaging around the Fife Brook dam is difficult and not feasible on foot. Currently, there is no point of egress near the Fife Brook dam, as discussed above. To portage around the dam, boaters would need to take their boats out of the river at the Deerfield Station No. 5 powerhouse. Because of the steepness of the terrain, the route requires backtracking over half of a mile upstream along the Deerfield Station No. 5 access road, and then travelling approximately 3 miles along River Road. The construction of a take-out and trail from the river to the Dunbar Brook Picnic Area would reduce the portage distance, but it would still require a portage of at least 1.5 miles along River Road. Constructing a new portage route around Fife Brook dam could greatly reduce the portage distance. However, as discussed above, safety hazards associated with recreation use in the lower 1.2 miles of the Fife Brook impoundment limit the ability to provide safe access downstream of Deerfield Station No. 5.

Constructing a new access trail from the Visitors Center to the Fife Brook impoundment, as requested by the Whitewater Interest Group, would provide public access to the Fife Brook impoundment. The trail would open the shoreline of the Fife Brook impoundment to recreation activities, such as hiking, angling, and sightseeing. The Whitewater Interest Group has not specified if the trail is intended for boating access, nor has it requested the construction of a put-in at the reservoir at the end of the trail. The trail would improve recreation at the project by creating recreational opportunities that are currently not available to the public. However, the 40-foot daily fluctuation of the Fife Brook impoundment would create safety issues for recreation users near the shoreline. The fluctuation of the impoundment would also limit public use and access in the impoundment. For instance, recreation users would only be able to access part of the trail and/or reservoir depending on the elevation of the reservoir. Additionally, the trail could encourage boating in the Fife Brook impoundment, which is inherently dangerous as stated above.

Recreation at the Fife Brook Fishing and Boating Access Area

BSPC proposes, as part of its Recreation Facilities Management Plan, to address overflow parking at the Fife Brook Fishing and Boating Access Area and/or enhance the existing overflow parking area.

Interior, Massachusetts DFW, and the Whitewater Interest Group recommend that BSPC improve the Fife Brook Fishing and Boating Access Area by: (1) establishing a new boat put-in site at the end of the access road; and (2) providing electric power for rafters to run air pumps. Interior further comments that BSPC should construct new stairs at the access area.

In its response to stakeholders' comments, BSPC states that it is not proposing to provide power for air pumps because it believes that subsidizing commercial whitewater outfitters is beyond the scope of relicensing.

Our Analysis

The Fife Brook Fishing and Boating Access Area provides river access for a variety of recreational opportunities, including in-river angling, tubing, and rafting. According to the 2016 Recreation User Survey, usage of the site is below capacity for most of the year; however, during scheduled whitewater flow release in the peak summer season, the existing boat slide, stairways, and parking area at the Fife Brook Fishing and Boating Access Area is frequently at or over capacity. During these times, visitors can experience crowding and delayed access to the water.

BSPC is proposing to address overflow parking at the Fife Brook Fishing and Boating Access Area due to crowding that it has observed in the parking area and along the road during the peak whitewater boating season. However, BSPC does not specify what measures it is proposing to implement to improve parking at the Fife Brook Fishing and Boating Access Area. The facility currently has parking for 8-10 vehicles on-site, and parking for an additional 25 vehicles at the unpaved, overflow area across River Road about 500 to 1,000 feet from the put-in. Increasing parking on-site, or at the overflow area would reduce the crowding that occurs at the Fife Brook Fishing and Boating Access Area during the peak summer season. It would also reduce the number of vehicles parked along the road. This would make the access area easier and safer to use, especially on peak-use days when the site is at capacity.

The amenities at the Fife Brook Fishing and Boating Access Area are at capacity during the peak whitewater boating season, but there is no data available on the length of the delays for river access. While adding a third boat put-in site would decrease the congestion for river access, there is no information in the record to indicate how much a third put-in would expedite river entry. A wait, while inconvenient, is not the same as a lack of access. The Fife Brook Fishing and Boating Access Area still provides recreation users with access to the Deerfield River for a variety of recreation uses, even during peak periods of demand. Also, while a new rafting put-in site at the Fife Brook Fishing and Boating Access Area would decrease crowding at the two existing put-ins, a third put-in site could result in more people entering the river at the same time along a short stretch of shoreline, which could result in crowding and dangerous boating conditions in the Deerfield River immediately around the Fife Brook Fishing and Boating Access Area.

With regard to the request for BSPC to provide electric power at the Fife Brook Fishing and Boating Access Area, none of the stakeholders indicate that there are insufficient recreation opportunities due to the lack of electric power at the Fife Brook Fishing and Boating Access Area. While electric power could make it easier to inflate rafts at the site, there is no evidence that the lack of electric power is reducing recreation opportunities for the public. Whitewater boaters have historically used battery and generator-powered pumps to inflate rafts and tubes at this site, and none of the stakeholders have presented information regarding why whitewater boaters cannot continue to do so during the term of any new license.

Interior did not describe why the existing stairs at the Fife Brook Fishing and Boating Access Area need to be replaced, such as existing safety or access issues involving the stairways. BSPC proposes to maintain the existing project recreation facilities, including the existing amenities provided at the Fife Brook Fishing and Boating Access Area. Periodic maintenance of the existing stairways would ensure that the stairs continue to provide safe access to the river during the term of any new license for the project.

Recreation at the Zoar Whitewater Access Area

Interior, Massachusetts DFW, and the Whitewater Interest Group state that BSPC should be required to improve and widen the trail leading to the river at the Zoar Whitewater Access Area above the Class III Zoar Gap rapid (also known as "Last Chance Eddy") so that rafts can be carried flat from the road to the river.

BSPC, in its response to comments, proposes to widen the access trail at the Zoar Whitewater Access Area.

Our Analysis

The Zoar Whitewater Access Area provides access to whitewater features in the Deerfield River. It is not clear how stakeholders specifically want BSPC to "improve" the foot path to the river, aside from widening it. Although there is no information on the exact width of the existing trail, it is apparent from comments that the trail is not currently wide enough to carry a raft flat through the trail. Widening the trail would make it easier for recreationists to travel between the parking area and the river, especially whitewater recreationists that are carrying wide inflatable rafts. Rafts are more easily carried flat because gear can be carried inside them at the same time, and because flat carrying makes it easier to keep the raft from dragging along the ground. Although none of the stakeholders specify an exact width for the trail, a typical inflatable raft used by a whitewater outfitter can be at least five feet wide, and as much as seven feet wide. Widening the trail to seven feet wide would allow for most rafts to be carried flat.

Recreation at the Zoar Picnic Area

BSPC is proposing to increase the number of seasonal restroom facilities, and provide a stall-type changing facility at the Zoar Picnic Area.

Interior, Massachusetts DFW, and the Whitewater Interest Group state that BSPC should provide seasonal waste receptacles to mitigate dumping along the riverbank and in the woods surrounding the picnic area. Stakeholders also state that BSPC should construct a second set of steps downstream of the existing set of stairs to improve river access. Trout Unlimited, CRC, and the Deerfield River Watershed Association state that BSPC should be required to prepare a succession plan for the aging trees at the Zoar Picnic Area so that shade is maintained by gradually replacing the trees instead of cutting down all of the trees at the same time.

In its response to comments, BSPC proposes to construct a second set of steps at the Zoar Picnic Area.

Our Analysis

The Zoar Picnic Area provides a number of recreation opportunities and is heavily used by anglers and boaters, especially during the whitewater recreation season. Visitor use data from the 2016 Recreation User Survey suggests that the existing three seasonal restrooms (*i.e.*, "porta-potties") at the Zoar Picnic Area may be inadequate for the peak summer recreation season and/or holiday weekend crowds. Additional seasonal restrooms would improve sanitation at the site and along the river. They would also reduce wait times for restroom use at the site, which, according to the Deerfield River Watershed Association, are long enough to cause some users to relieve themselves along the river. Given that most usage at this site occurs during the summer boating season, installing additional porta-potties between the months of April and October would accommodate crowding at this site.

Installing a changing facility at the Zoar Picnic Area, as proposed by BSPC, would increase privacy for recreation users that need to change out of wet clothes associated with water recreation. In addition, installing a changing facility would reduce the use of restrooms for changing clothes, thereby reducing wait times for restrooms. A facility with at least four changing stalls would provide the ability for multiple people to change at once as well as reduce restroom use.

Installing and maintaining seasonal trash receptacles between April and October would reduce litter at the site and improve sanitation and aesthetics, provided that the trash receptacles are emptied regularly and conveniently located to encourage use. Installing at least six receptacles, with one located close to approximately every five picnic tables and another one located by the site exit, would ensure that the trash receptacles are readily available and evenly distributed across the picnic site to encourage use.

There is currently one set of stairs from the parking area at the Zoar Picnic Area to the river. During peak boating and float times, the capacity of the single staircase is exceeded and a bottleneck occurs at the site that creates a delay in river access and egress. A second set of stairs would improve river access/egress during peak periods and therefore improve the recreational experience for users. While an extra access point from the parking area to the river could increase the number of people entering the river at the same time, dangerous crowding would not likely occur due to the width of the river at this site. Fife Brook Fishing and Boating Access Area has two staircases and these have not caused safety issues there.

The Zoar Picnic Area is heavily shaded by numerous trees. According to the CRC, the Dunbar Brook Picnic Area that is within the Deerfield Station No. 5 boundary was formerly heavily shaded, but a few years ago all of the trees were removed and the site was exposed to full sunlight with minimal shade for recreation users during the summer months. Trout Unlimited, CRC, and the Deerfield River Watershed Association are concerned that BSPC could take a similar action at the Zoar Picnic Area by clear cutting all of the trees at the recreation site at the same time. The Zoar Picnic Area is the last boat take-out along the Deerfield River at the downstream end of the project boundary, and provides shade for large groups of boaters that have been exposed to the sun for up to several hours while boating downstream from the Fife Brook Fishing and Boating Access Area. In its current state, the site can provide shaded conditions for dozens of recreation users on hot summer days that are using the 22 grills and 22 picnic tables at the site. Removal of all of the trees at one time would have an adverse effect on recreation because the shade would be eliminated and recreation users would be exposed to full sunlight on hot summer days. Limiting tree cutting at the Zoar Picnic Area to the selective cutting of hazardous trees would ensure that recreation use at the site is not adversely affected by significant changes in the amount of shade, while also ensuring that hazardous trees could be removed as needed to maintain safety at the project. To the extent that a hazardous tree needs to be removed from the Zoar Picnic Area during the term of any new license, that tree could be replaced by another tree that, upon maturity, would provide the same shade benefits as the tree that is removed. If tree cutting at the Zoar Picnic Area was limited to the selective cutting and replacement of hazardous trees, then there would be no additional benefit associated with Trout Unlimited's, CRC's, and the Deerfield River Watershed Association's recommended succession plan.

Additional Recreation Areas

There are ten undeveloped, non-project recreation areas that provide access to the Deerfield River in the project boundary downstream of Fife Brook dam. Because they are not currently part of the project, these areas were not studied by BSPC as part of the Recreation Use Survey in 2016. However, during the course of the relicensing proceeding, it became apparent through stakeholder comments at public meetings and through other studies (*e.g.*, the warning system effectiveness study, the Whitewater Boating Flow Study) that these informal sites provide important recreation access for anglers at the project. Specifically, these sites provide access to fishing areas that are not reachable from the project recreation sites. In addition, these sites can provide a quieter and more natural fishing experience than can be found at the developed project recreation sites that receive heavier use by other recreation users, such as rafters and kayakers.

The Carbis Bend and Bridge to Nowhere recreation sites[116] were referenced by stakeholders in correspondence with BSPC that is included in the FLA, and these sites were included in the Angler Wading Study after consultation with the Angler Wading Study Working Group. Operating and maintaining these two undeveloped sites as project recreation facilities would ensure that safe river access is provided for anglers in the Deerfield River downstream of the dam.

Shunpike Rest Area Improvements

Interior, Massachusetts DFW, Franklin Regional Council of Governments (Franklin Regional Government), town of Charlemont, the Whitewater Interest Group, Trout Unlimited, CRC, and Deerfield River Watershed Association state that BSPC should be required to fund the construction and maintenance of a restroom facility and trash receptacle at the Shunpike Rest Area. Trout Unlimited specifies that the sanitary facilities should be seasonal, and CRC and the Deerfield River Watershed Association recommend portable restrooms. BSPC is not proposing any payments to fund facilities at the Shunpike Rest Area. In its response to comments, BSPC states that it believes river safety and sanitation are the responsibility of all users and that a collaborative approach is necessary.

Our Analysis

The Shunpike Rest Area is not a project recreation site, and is owned and maintained by the Massachusetts Department of Transportation. The Shunpike Rest Area is a popular take-out and put-in location for boaters and rafters making use of project flows in the Deerfield River. The site offers a gazebo and several picnic tables next to a parking area for approximately ten vehicles, as well as another parking area that can accommodate approximately 50 vehicles. There are no trash receptacles or restroom facilities at the site for recreation users.

---

[116] In Figure 15, the Carbis Bend site is referred to as Informal Shoreline Access Area #1 and the Bridge to Nowhere site is referred to as Informal Shoreline Access Area #4. These sites are located 1.2 miles and 2.6 miles downstream of Fife Brook dam, respectively.

Because of the heavy public use and lack of restroom facilities, river users exiting at this site frequently relieve themselves along the river at the Shunpike Rest Area as documented by the Deerfield River Watershed Association in their March 21, 2019 letter. This creates unsanitary conditions at the Shunpike Rest Area. However, the unsanitary conditions at the Shunpike Rest Area do not appear to be the result of inadequate facilities at the project.

The project provides recreation opportunities on the Deerfield River between the Fife Brook Fishing and Boating Access Area (at approximately RM 36.6) and the Zoar Picnic Area (at approximately RM 31.2). Restroom and trash receptacles are available at the Zoar Picnic Area during the whitewater boating season, which is located about 1.8 miles upstream from the downstream extent of the project boundary. BSPC has proposed to increase the availability of sanitary facilities at the Zoar Picnic Area, as discussed above. The existing and proposed sanitation facilities at the project recreation sites are available for use by any members of the public and are adequate for providing sanitary conditions at the project.

The project boundary ends approximately 1.5 miles upstream of the Massachusetts Department of Transportation's Shunpike Rest Area. Boaters that choose to continue downstream past the project boundary to use the Shunpike Rest Area are participating in non-project recreation use on the Deerfield River. The unsanitary conditions that occur downstream of the project at the Shunpike Rest Area therefore do not appear to be directly associated with the project. Moreover, none of the proposals or recommendations discussed herein would be likely to significantly increase the unsanitary conditions at the Shunpike Rest Area.

Project-Wide Recreation Facility Access

The Whitewater Interest Group comments that BSPC should be required to improve trails leading to river access points.

In its response to comments, BSPC proposes to include trail maintenance at project recreation facilities as a routine activity in the proposed Recreation Facilities Management Plan.

Our Analysis

There are currently 14 formal and informal river access points in the project boundary, all of which have some length of trail between their parking areas and the river. The conditions of these trails varies between sites, but all are comprised of foot-compacted dirt. The project recreation facilities generally have trails that are in better condition. It is not clear how the Whitewater Interest Group specifically wants BSPC to improve the trails, and whether they are proposing widening the trails, reducing slopes, or upgrading the surface material. Therefore, we cannot analyze the benefits of their proposal to "improve" the trails.

Whitewater Flow Releases

Deerfield River Downstream of Fife Brook Dam

BSPC proposes to continue to provide 106 annual whitewater flow releases on 50 weekend days and 56 weekdays from April 1 through October 31. BSPC proposes to continue to provide whitewater flow releases between 9:30 a.m. and 12 p.m., for a minimum duration of 3 hours. BSPC proposes to increase the minimum flow for whitewater flow releases from 700 cfs to 800 cfs. In addition, BSPC commits to continued annual coordination with the Whitewater Interest Group, Great River Hydro, and Trout Unlimited regarding the scheduled whitewater flow releases.

Based on the high demand for whitewater boating that is experienced on an annual basis during the 106 scheduled whitewater flow releases, the Whitewater Interest Group recommends including 14 additional whitewater flow release days, either added or reallocated from weekdays in April and October to weekdays between June 16 and Labor Day to provide increased whitewater boating opportunities to meet demand for whitewater recreation in the Deerfield River, downstream of the Fife Brook dam.

Massachusetts DFW recommends a number of changes to the existing flow regime to protect emerging dragonflies under section 10(j), which could affect whitewater flow releases. While Massachusetts DFW does not provide any ramping rate restrictions on whitewater flow releases from April 1 through May 14 or September 1 through October 31, they recommend the following restrictions on whitewater flow releases between May 15 and August 31:

May	• The 2 weeks of Wednesday through Sunday whitewater flow releases must occur prior to May 15; • Continue to provide 2 weeks of Saturday and Sunday whitewater flow releases; and • Observed Memorial Day may be substituted for a Saturday or Sunday whitewater flow release between May 18 through May 31.
June	• The 2 weeks of Wednesday through Sunday whitewater flow releases must occur after June 14; and • Continue to provide 2 weeks of Saturday and Sunday whitewater flow releases.
July	• The 3 weeks of Wednesday through Sunday whitewater flow releases must occur prior to July 23.
August	• Continue to provide 4 weeks of Thursday through Sunday whitewater flow releases.

Additionally, Massachusetts DFW recommends the following specific ramping rates on days that do not have scheduled flow releases for whitewater recreation:

May 15 through June 30	• Provide releases between 7 a.m. and 4 p.m.; and • Provide an up-ramping rate no greater than 130 cfs per hour, and no greater than 32 cfs per 15 minute period.
July 1 through August 31	• Provide releases between 7 a.m. and 4 p.m.; and • An up-ramping rate no greater than 158 cfs per hour, and no greater than 40 cfs per 15 minute period.

The Whitewater Interest Group and commercial whitewater outfitters state that they would prefer higher whitewater flow releases of 900 cfs to 1,100 cfs, with a longer duration. The Whitewater Interest Group also recommends that BSPC provide outflow volumes that match the exact inflow volumes provided from the upstream Deerfield Station No. 5 on the 32 annual whitewater flow release days when flow releases from Deerfield Station No. 5 range from 900 to 1,100 cfs for 4 to 5 hours, provided that doing so will not cause BSPC to violate its minimum flow requirement at Fife Brook dam. In contrast to these recommendations, Massachusetts DFW and Trout Unlimited state that the 106 annual whitewater flow releases should continue at a minimum flow of 700 cfs.

Interior, Trout Unlimited, and the Whitewater Interest Group recommend that all of the 106 scheduled whitewater flow releases should begin at 10 a.m. daily, rather than between the 9:30 a.m. to 12 p.m. window that is currently required in the existing license. Interior and the Whitewater Interest Group also state that hydropower generation between June 16 and Labor Day should begin at 10 a.m. on days when scheduled whitewater releases are not already being provided. The Whitewater Interest Group contends that earlier scheduled releases would provide the general paddling public and commercial boaters with greater predictability when flows will be available.

Our Analysis

Several popular recreation-based activities occur on the Deerfield River, and each has a slightly different set of flow-dependent attributes. Commercial whitewater boating, tubing, and whitewater kayaking are major sources of summer recreation on the Deerfield River. The Deerfield River downstream from Fife Brook dam provides opportunities for Class I through Class III whitewater boating. There is a very high level of demand for whitewater recreation between May 15 through October 15, with recreation facilities often at or beyond capacity during the peak summer months of July and August.

BSPC's proposal to continue providing 106 annual whitewater flow releases from April 1 through October 31 would maintain the existing recreational opportunities for whitewater boating in the Deerfield River downstream of Fife Brook dam. The existing whitewater flow release schedule ensures regular, predictable flow releases for whitewater recreationists to plan outings on the Deerfield River downstream of Fife Brook dam. In addition to the 106 annual whitewater flow releases, BSPC regularly provides unscheduled flows greater than 700 cfs from the Fife Brook dam into the Deerfield River that provide additional whitewater recreation opportunities.[117] These scheduled and unscheduled flows provide approximately 145 days of whitewater flow release volumes annually, from May 1 through October 31.

The Whitewater Interest Group's recommendation to either: (1) add 14 additional whitewater flow release days; or (2) reallocate weekday whitewater flow release days from April and October to weekdays between June 16 and Labor Day, would provide additional opportunities for whitewater recreation during peak demand periods for whitewater boating. However, the additional days do not appear to be necessary to ensure adequate opportunities for recreation at the project. The 106 scheduled whitewater flow releases currently occur for 7 months of the year, and account for nearly every weekend of the recreation season, which BSPC proposes to continue.[118] The scheduled whitewater flow releases ensure that whitewater flows are provided for approximately 50 percent of the days between April 1 and October 31, which provide an abundance of whitewater recreation opportunities at the project. Although BSPC frequently releases additional whitewater flow volumes during the peak recreation season on unscheduled days, requiring additional whitewater flow releases could cause operational constraints, as the releases depend on inflows to the project that are provided by the upstream Deerfield Station No. 5. However, to relieve congestion at the whitewater access areas during the peak summer season and ensure adequate access is provided during scheduled flow release days, BSPC is proposing to: (1) improve parking at the Fife Brook Fishing and Boating Access Area; (2) widen the access trail at the Zoar Whitewater Access Area; and (3) install additional restrooms, changing facilities, and construct a second staircase at the Zoar Picnic Area.

BSPC conducted the Operations Model Study to determine ideal recreation flows for whitewater recreation in the Deerfield River downstream of Fife Brook dam, which included more than 65 flow scenarios. The study examined the effects of higher minimum flows and higher whitewater flow releases on BSPC's energy production, volumetric shortfalls, and ability to pass higher flows. In addition, BSPC conducted a three day, in-

---

[117] From May 1, 2016 through October 31, 2016, BSPC provided flows of 700 cfs or greater, for a duration of at least two hours on 37 days when whitewater flows were not already scheduled.

[118] In addition to the 106 scheduled whitewater flow release days, BSPC regularly provides flows that exceed 700 cfs for more than two hours on non-scheduled release days.

water, Whitewater Boating Flow Study in 2016 to evaluate a range of flows downstream of the Fife Brook Development for safety, adequacy, and quality of whitewater experience. The study included approximately 50 volunteer participants in kayaks, canoes, stand-up paddleboards, catarafts, tubes, and commercial rafts. Participants were asked to complete both pre-run and post-run surveys to evaluate the whitewater experience for each of the following whitewater flows: 700 cfs, 800 cfs, 900 cfs, 1,100 cfs, and 1,300 cfs.

The results of the Operations Model Study indicate that an increase of scheduled whitewater flow release days or an increase in volume of whitewater flow releases would result in volumetric shortfalls when either the minimum flow or whitewater flow releases could not be met, over the duration of any new license term. Any volumetric shortfalls would result in loss of BSPC's ability to generate, loss of whitewater flow release volume, or loss of whitewater flow release days. The results of the Whitewater Boating Flow Study indicate that the 700 cfs whitewater flow release that is required by the current license does not provide a quality[119] or safe[120] boating experience. A majority of the study participants identified 800 cfs as the lowest flow considered acceptable for both a quality and safe whitewater experience. The Deerfield River Guides Association state that flows between 700 and 800 cfs are ideal for drift boat fishing, but flows of 900 cfs or higher render the river unfishable. A participant in the 2016 Angler Wading Study and longtime Deerfield River user noted that whitewater flows above 1,000 cfs are dangerous for tubers downstream of Fife Brook dam, posing a risk of overturning tubers into the project waters. A whitewater boating outfitter and guide that participated in the study noted that 50,000 – 100,000 people currently run the Deerfield River at 800 cfs each year without incident, but that safety incidents have occurred at flows below 800 cfs.[121]

---

[119] The whitewater boating survey evaluated quality of the boating experience by the following criteria: (1) navigability, (2) depth, (3) maneuverability, (4) availability of challenging technical rapids, (5) powerful hydraulics, (6) availability of whitewater "play areas," (7) exposure of sand/gravel bars, (8) size/difficulty of rapids, (9) overall challenge, (10) safety (due to flow levels), (11) safety (due to debris or other in-channel hazards), (12) length of run, (13) aesthetic quality, and (14) overall rating. *See* March 31, 2017 Whitewater Boating Flow Study Report at 17.

[120] The whitewater boating study evaluated safety of the boating experience by determining which flows caused accidental rock/obstacle strikes, accidental rock/obstacle strikes that stopped the boat, accidental rock/obstacle strikes that required the boat to be dragged off rocks/obstacles, and any time a boat had to portage around rapids or river segments. *See* March 31, 2017 Whitewater Boating Flow Study Report at 17.

[121] *See* March 31, 2017 Whitewater Boating Flow Study Report at 21.

BSPC's proposal to increase the minimum flow from 700 cfs to 800 cfs for whitewater flow releases is supported by the results of the Whitewater Boating Flow Study, as the study results indicate that 800 cfs is the lowest acceptable whitewater boating flow for safety and whitewater boater enjoyment in the Deerfield River downstream of the Fife Brook dam. Limiting whitewater flow releases to a minimum of 700 cfs, as recommended by Massachusetts DFW and Trout Unlimited, would reduce the quality and safety of whitewater recreation, as the results of the 2016 Whitewater Boating Flow Study found that flows below 800 cfs were not enjoyable and caused whitewater recreationists to hit rocks and have to portage around obstacles within the river.

The Whitewater Interest Group recommends that BSPC match outflows at Fife Brook dam with inflows that are provided from the dam at Deerfield Station No. 5 on 32 days of the year. However, increasing whitewater flow releases at the project to as much as 1,100 cfs, as provided at Deerfield Station No. 5, would pose safety and navigability concerns for inexperienced whitewater recreationists or tubers that cannot guide the watercraft away from obstacles in the river.

Massachusetts DFW's recommendation to restrict the dates of whitewater flow releases from Fife Brook dam to protect dragonflies in the Deerfield River would adversely affect whitewater recreation opportunities at the project. Massachusetts DFW's recommendation would eliminate scheduled whitewater flow releases on Wednesdays, Thursdays, and Fridays from mid-May through mid-June and also at the end of July. Depending on which day of the week the first of the month occurs, there could be a loss of approximately five mid-week whitewater flow release days between May and August.[122] The loss of scheduled whitewater flow releases days would have an adverse effect on recreation by reducing the quantity of available whitewater flow releases downstream of the Fife Brook dam during the peak whitewater recreation season. Therefore, restricting ramping rates from May to August would adversely impact the whitewater recreation opportunities in the Deerfield River downstream of the Fife Brook dam.

Interior, Trout Unlimited, and the Whitewater Interest Group's recommendation to require the 106 scheduled whitewater flow releases to begin at 10 a.m. daily would provide greater predictability to the timing of whitewater flow releases. Currently, BSPC begins releasing scheduled whitewater flows between 9:30 a.m. and 12 p.m., and provides whitewater flows for a minimum of three continuous hours. Although BSPC already

[122] For example, in 2019, July 1 occurred on a Monday. Therefore, moving the whitewater flow release dates to occur prior to July 23 (3 weeks of Wednesday through Sunday whitewater flow releases) would have created a loss of two whitewater flow releases. However, in 2020, July 1 occurs on a Wednesday, therefore moving the whitewater flow release dates to occur prior to July 23 does not create a loss of any whitewater flow release days.

provides the timing of the flow release schedule on the Safe Waters website, consistently releasing whitewater flows beginning at 10 a.m. on all scheduled whitewater days would minimize the amount of variability in the flow release schedule, which could benefit commercial outfitters that are scheduling rafting trips in advance of the whitewater flow release day. Releasing whitewater flows beginning at 10 a.m. daily would also provide parity with the timing of whitewater flow releases from the Deerfield Station No. 5 that is located immediately upstream of the project. The licensee for Deerfield Station No. 5 is required to provide whitewater flow releases beginning at 10 a.m. on 26 weekend days.

Requiring hydropower generation to begin at 10 a.m. between June 16 and Labor Day on days when scheduled whitewater releases are not already being provided, as recommended by Interior and the Whitewater Interest Group, could increase whitewater recreation opportunities by ensuring that high flow releases occur during a time of the day when whitewater boaters can utilize the flows. However, as discussed above, the 106 scheduled whitewater flow releases that are required by the current license provide ample whitewater recreation opportunities on the Deerfield River downstream of Fife Brook dam. In addition, the Safe Waters website provides a 24-hour schedule of the timing and volume of flows to inform recreation users of potential whitewater recreation opportunities on the following day. Accordingly requiring all flows above the 125-cfs minimum flow to be released at 10 a.m. between June 16 and Labor Day would not provide any additional significant benefits to whitewater recreation.

Upper Extent of Fife Brook Impoundment

The Whitewater Interest Group recommends that BSPC hold the Fife Brook impoundment at 835 feet NGVD during the 32 scheduled whitewater flow releases that are provided on an annual basis from the Deerfield Station No. 5 Development's dam.[123] The Whitewater Interest Group states that holding the Fife Brook impoundment at 835 feet NGVD would provide more whitewater boating opportunities by exposing whitewater features that are inundated as a result of project operations in the upper reaches of the Fife Brook impoundment.

Our Analysis

The Fife Brook impoundment serves as the lower reservoir for the Bear Swamp PSD and has an allowable daily fluctuation of 40 feet between elevations of 830 and 870 feet NGVD. Three Class IV rapids (Dragon's Tooth, Labyrinth, and Showtime) occur in the upper extent of the Fife Brook impoundment between elevations 834 and 845 feet NGVD (Table 19).

[123] *New England Power Company*, 81 FERC ¶ 62,179 (1997).

When the Fife Brook impoundment is below 834 feet NGVD, the Class IV rapids are fully exposed and available for whitewater boating. When the elevation of the Fife Brook impoundment increases, a backwater effect occurs in the upper extent of the impoundment above the powerhouse of Deerfield Station No. 5. As the impoundment rises to an elevation of 834 feet NGVD and above, the impoundment inundates the rapids and reduces the opportunity for whitewater boating.

The upstream Deerfield Station No. 5 Development is required to provide 32 scheduled whitewater flow releases of 900 cfs to 1,100 cfs between May 1 and October 21 annually, for a duration of 4 to 5 hours (from as early as 10 a.m. to 3 p.m.). Encroachment of the impoundment on the Class IV rapids during a scheduled whitewater release from the Deerfield Station No. 5 dam diminishes the quality of the whitewater boating experience, or eliminates the opportunity altogether, depending on the level of inundation. As shown in Table 19, the operation of the project affects the Showtime rapid most often due to the elevation of the rapid.[124]

Table 19. Inundation of whitewater features in the upper extent of the Fife Brook impoundment.

Whitewater Feature	Approximate Elevation of Whitewater Feature (feet NGVD)	Percent of Time Elevation of Fife Brook Impoundment Exceeds Elevation of Whitewater Feature
Showtime	834	65%
Labyrinth	840	38%
Dragon’s Tooth	845	31%

Although continued operation of the project would result in the occasional inundation of the three whitewater features in the upper extent of the Fife Brook impoundment and reduce the opportunity for whitewater boating, these Class III and IV whitewater features are very technical and only the more highly skilled whitewater boaters can safely navigate these rapids.

The Whitewater Interest Group’s recommendation to hold the Fife Brook impoundment at 835 feet NGVD during the 32 scheduled whitewater releases from Deerfield Station No. 5 would reduce encroachment on the rapids during the releases and thereby increase whitewater recreation opportunities in the upper extent of the Fife Brook impoundment. However, the licensee would not be able to generate electricity with the

[124] *See* March 30, 2018 final license application at E-314 - E-315.

Bear Swamp PSD during this time because the generation flows from the upper reservoir would rapidly increase the elevation of the Fife Brook impoundment.

Project-Wide Recreation Safety

BSPC proposes to install additional signage downstream from the Fife Brook dam that will provide information on the flow regime and river safety. However, BSPC is proposing to discontinue its ramp-up procedure whereby it holds flows at 3 MW for 15 minutes before increasing further to avoid sudden increases in flow downriver of the Fife Brook dam.

The Franklin Regional Government states that the current measures that are used at the project to warn recreation users of increasing flow releases from the Fife Brook dam is ineffective and provides little warning to downstream anglers of rising waters. The CRC and Deerfield River Watershed Association comment that a new warning system is needed, and suggest the installation of warning lights along Zoar Road. Trout Unlimited also recommends installing a flow release warning system using light installations at formal and informal recreation areas.

CRC also requests a tiered up-ramp to provide for safety. This would involve: (1) increasing flows from the Fife Brook impoundment to a midpoint between the minimum flow and the total scheduled recreation/generation flows; and (2) holding flows constant for one hour at the midpoint. CRC also states that flows should be held at two intermediate levels for one hour each when the total scheduled flows are "higher."

The Whitewater Interest Group requests that BSPC install additional signage to educate recreationists on safety and the Deerfield River flow regime. The CRC states that BSPC should install hand rails on all stairways at project recreation facilities that lead to the Deerfield River to facilitate safe entry into the river.

CRC states that BSPC should install Wi-Fi or cellular phone coverage in the project area because a cellular signal is not available for emergency calls or access to the river flow information. Interior, the Whitewater Interest Group, and Massachusetts DFW state the BSPC should provide free Wi-Fi access at the Fife Brook Fishing and Boating Access Area to improve public safety by providing communications to and from emergency responders.

In its response to comments, BSPC states that the January 2012 Public Safety Plan for the project is the proper forum in which to address the warning system. BSPC proposes to work with the Commission's Division of Hydropower Administration and Compliance to ensure that the Public Safety Plan sufficiently addresses any safety issues related to the audibility of the existing downstream warning system. BSPC does not propose any revisions to its existing Public Safety Plan at this time. Separately, in its response to comments, BSPC proposes to install hand rails on stairways. BSPC is not proposing to install cellular phone infrastructure, or improve Wi-Fi infrastructure at the project, and states that it already provides recreation users at the Fife Brook Fishing and Boating Access Area with a dedicated Wi-Fi connection to the "Safe Waters" website, which provides information regarding real-time flow schedules.

Our Analysis

As determined by the warning system effectiveness study conducted from November 2016 to April 2017, BSPC's existing siren-based downstream warning system does not adequately warn recreation users when higher flows are being released from Fife Brook dam to the Deerfield River. The siren is located at the Fife Brook dam, and is only audible under ideal conditions at the Fife Brook Fishing and Boating Access Area, which is just 0.4 mile downstream of the dam. It is not audible at any of the other downstream recreation sites. Given the abundance of noise sources and the acoustics within the Deerfield River Valley (*e.g.*, traffic, trains, wildlife, recreation users), the lone siren at the Fife Brook dam is not adequate to ensure safety downstream of the project.

Improving the warning system at the project by installing warning systems at river recreation sites would increase safety at the project. The Trout Unlimited request for safety warning lights at formal and informal sites would cover all recreation areas. However, the informal sites are not maintained by BSPC. Installing warning systems at project recreation sites would ensure safety at well-used fishing and boating areas along the Deerfield River downstream of Fife Brook dam.

Warning systems that employed both auditory and visible signals, such as horns and flashing red lights, would be more noticeable to people on the river than just a sound or light alone. A warning system could be positioned at each site so as to be most visible and audible to both people entering the water and those already in the river. Decibel levels of any audible warnings could be lower than the current system installed at the dam, yet still reach a wider area because of the placement of the systems at the project recreation sites. Such warning systems could be either connected to the existing power line that runs along the road, or could be powered by alternative power sources, such as solar power. Signage attached to the warning system or nearby explaining the system and its warnings would inform users of what to be aware of and how to react to the warning signals. Sequential activation of each warning unit could be timed to coincide with the downstream advancement of rising waters, which could provide a more accurate indication of when rising waters would arrive at a site (*i.e.*, a warning unit could be activated a set period of time before the rising water was expected to reach that site). Installation of such warning systems would be an improvement over the existing warning system, and increase safety for recreationists downstream of the Fife Brook dam.

The CRC and Deerfield River Watershed Association's suggestion to install warning lights along Zoar Road would provide a visible warning of water releases for individuals located on Zoar Road. However, the CRC and Deerfield River Watershed Association did not specify how many lights, or at what interval the lights should be installed. Also, warning lights along the road also may not be visible to anglers and other individuals who are recreating on or near the river.

BSPC's proposal to discontinue its practice of holding the generator at 3 MW for 15 minutes before increasing generation to higher output levels would remove an additional safety measure for downstream river users. The 15-minute hold gives people in the river warning that a further increase is imminent, and that they should get out of the river. This increase is evident even if audible or visual warning systems are not, and would serve as an additional measure for public safety if those systems were installed. CRC's request for a tiered up-ramp to protect public safety would alert river users in stages that the water will be rising. While it would provide additional warning, the single 3-MW up-ramp combined with visual and audible warnings would likely be sufficient to protect public safety downstream of the Fife Brook dam.

There are eight signs warning of rising waters located along the Deerfield River downstream of Fife Brook dam. However, the signs do not provide information on the flow release regime from the Fife Brook dam, any warning systems at the project, or river safety (BSPC, 2009). Installing signs at project recreation facilities, as proposed by BSPC, would ensure that river users are informed of potential dangers and safety measures. The signs could describe warning systems, downstream travel times for flows, and how to obtain information on the timing of flow releases, all of which would educate river users of the river conditions they could expect to encounter at the project. Information describing safety concerns and precautions involving recreation in the river would increase public safety at the project.

BSPC's proposal and CRC's recommendation to install hand rails on stairways at project recreation facilities would provide stability and support for visitors that are accessing the river. Currently, there are no hand rails on any of the three staircases at the project. Hand rails on project stairways would improve project safety and ease of access, especially in wet conditions or when river users have wet feet.

Stakeholders recommend that the licensee provide Wi-Fi access or cellular service coverage at the project for emergency calls and access to river flow information. At present, BSPC only provides free Wi-Fi access to the Safe Waters website to provide visitors at the Fife Brook Fishing and Boating Access Area with real-time flow schedules that are posted online. There is currently no means of contacting emergency services at many, if not all, of the project recreation sites because of the rural nature of the project and the mountainous topography that blocks what cellular phone service is available. River use, especially whitewater rafting, has inherent danger. A dedicated emergency phone line or limited Wi-Fi service at the Fife Brook Fishing and Boating Access Area, Zoar Whitewater Access Area, and Zoar Picnic Area would allow for communications during emergencies, which would improve the timeliness of emergency services for recreation users at the project and would increase public safety for recreation users.

Whitewater Flow Release Information

CRC states that the Safe Waters website (www.safewaters.com), which provides information on flow releases from Fife Brook dam, does not provide information necessary for recreation users to know when flows from the Fife Brook impoundment will reach downstream locations for fishing and boating. CRC states that the Safe Waters website should include a graph of the flows in the Deerfield River downstream of Fife Brook dam over the previous 24 hours of operation. CRC and Trout Unlimited state that a flow gage should be installed below the dam and that information from the gage should be made available to the public on a real-time basis. Trout Unlimited comments that BSPC needs to better alert the public about releases from the project, including working directly with Great River Hydro to jointly report projected and actual flows. BSPC is not proposing any changes to its dissemination of flow information.

Our Analysis

The licensee provides up-to-date information on scheduled and current flows in the Deerfield River downstream of the Fife Brook dam. The whitewater flow release schedule is posted publicly on or before April 1 of the current year. The schedule is physically posted at the Bear Swamp Project, is available online at BSPC's Safe Waters website.[125] The Safe Waters website also provides a 24-hour schedule of the timing and volume of flows from the Fife Brook Development to the Deerfield River. The information provided by the Safe Waters website includes the start and end times for various flows that will be released over the 24-hour period, and the current outflow from the dam. Information on current flow is also available through the Safe Waters' toll-free phone line (1-844-430-3569). From a review of the information available on the Safe Waters website, it appears that BSPC updates the current flow every five minutes. It is not clear how posting a graph of flows on the Safe Waters website showing the previous 24 hours of operation would provide additional information that would be useful for project recreation or other public purposes.

Although current flow information is readily available, users may not be aware of when these outflows would be expected to reach a specific project recreation site downstream of the Deerfield River. Flows that are released from the dam reach project

[125] Brookfield Renewable Partners, L.P., *Fife Brook*, available at https://www.safewaters.com/facility/22.

recreation sites at different times, depending on how far downstream of the dam a site is located and the velocity of the flow. Project recreation sites occur between 0.2 mile and 5.4 miles downstream of Fife Brook dam. As an example, the Zoar Picnic Area is located 5.4 miles downstream of the dam and, according to the Flow Attenuation Study, flows take an average of 2.39 hours to reach the site. Posting a static map on the Safe Waters website and at each project recreation site that displays the amount of time it takes for flows (*e.g.*, whitewater flow releases of 800 cfs) to reach each project recreation site would ensure that recreation users have the information necessary to calculate the approximate time when flows from the Fife Brook impoundment would be expected to reach downstream locations for fishing and boating.

Installation of a flow gage at the project would provide exact, instantaneous flow information for the Deerfield River downstream of the Fife Brook dam. However, as discussed, BSPC posts whitewater schedules, 24-hour flow release schedules, and current flow information on the Safe Waters website, and provides access to flow information via Safe Waters' toll-free phone line (1-844-430-3569). In addition, the USGS gage at Charlemont, 12 miles downstream of the project, provides instantaneous flow information about the Deerfield River. There is also no evidence that BSPC is unable to comply with the minimum flow requirements and whitewater flow release requirements of the current license, as the minimum flow pipes at the Fife Brook dam have a capacity equal to the 125-cfs minimum flow and BSPC uses its turbine-discharge rating curve to release the appropriate amount of whitewater flows. For these reasons, installing a flow gage would not likely benefit recreation or environmental resources at the project.

Recreational Reporting

The CRC states that BSPC should file regular reports (*i.e.*, every five to ten years) with information on recreation use, shoreline public access, and recreational expenditures because the Form 80 requirement has been eliminated by FERC. BSPC is not proposing any recreation reporting, but states in its response to comments that if the Commission requires reporting that BSPC should provide reports equivalent to the Form 80 at ten-year intervals.

Our Analysis

The Commission no longer requires the filing of FERC Form 80.[126] Filing regular reports on recreation use, shoreline public access, and recreational expenditures would provide the Commission and the public with information on recreation at the Bear Swamp

---

[126] *See Elimination of Form 80 and Revision of Regulations on Recreational Opportunities and Development at Licensed Hydropower Projects,* Order No. 852, 165 FERC ¶ 61,256 (2018).

Project, but it is not clear what purpose this information would serve as the Commission has determined that regular reporting is no longer necessary. Any problems with recreation access at the Bear Swamp Project can be reported to the Commission's Division of Hydropower Administration and Compliance, which investigates problems that arise at projects during their license terms. Regularly filing a recreation report would not be likely to improve recreation at the project.

Removal of Project Land from the Conservation Easement

BSPC is not proposing to renew the conservation easement that expires on April 1, 2020 for 1,256 acres of land that is located near the upper reservoir and Fife Brook impoundment, 50 acres of which is located outside of the project boundary. BSPC is also proposing to remove 161.77 acres of land from the project boundary that are part of the current conservation easement.

Massachusetts DFW recommends under section 10(j), and the Whitewater Interest Group, and Franklin Regional Government request that the 1,256 acres of land be placed under a permanent conservation easement. Massachusetts DFW states that the 1,256 acres of land are part of a larger ecosystem that must remain unfragmented to maintain its long-term integrity, and that portions of the land contain state-listed species. Interior, CRC, and Deerfield River Watershed Association state that the entire 1,256 acres of land should be placed under a permanent conservation easement or another conservation easement for the term of any new license. Interior and CRC and the Deerfield River Watershed Association recommend that BSPC transfer the land it wishes to remove from the project boundary to a qualified conservation organization. Massachusetts DFW recommends that all of the conservation easement be transferred to a qualified conservation organization if BSPC does not want to renew its conservation easement.

Our Analysis

The conservation easement that is currently in place for the 1,256 acres of land restricts land use to agricultural, forestry, educational, non-commercial recreation, open space, and electric transmission and hydroelectric generation purposes. The majority of land held under the conversation easement is forested. Electric transmission and hydroelectric generation is the second biggest use.

Any land that is removed from the project boundary and not protected by a conservation easement, such as the 161.77 acres that BSPC proposes to remove from the project boundary and the additional 50 acres that are not within the current project boundary, could be developed during the term of any new license without prior Commission approval. Development of this land would result in a change to the existing land use, including the loss of forested land. The protected land is part of a larger, mostly intact forested landscape in the Berkshire Mountain range. Renewing the existing conservation easement for the term of any new license or placing the land in a permanent conservation easement, as suggested by stakeholders, would ensure that the 201.77 acres of land remains protected from development for at least the term of that license, along with the rest of the protected land that BSPC is proposing to keep within the project boundary. We evaluate whether or not the 161.77 acres of land is needed for project purposes, including for the protection of environmental resources, in the following section.[127]

To the extent that the conservation easement is not renewed (either for a specific term or permanently), as proposed by BSPC, then potential development could occur on the land during the term of a new license. However, much of the acreage that is currently held under the conservation easement is steep and would be difficult to develop, and BSPC is not proposing to develop any of the land that is held under the conservation easement at this time. The Commission's standard terms and conditions for a hydropower license require land within the project boundary to be retained in substantial conformity with the maps, plans, and other specifications that are designated as exhibits and approved by the Commission in the license order, unless changes are approved by the Commission during the license term. Unless otherwise approved by the Commission, a licensee cannot substantially alter the use of project land or water except for emergency purposes. For these reasons, even if the conservation easement is not renewed, the land within the project boundary would likely continue to be used in the same way that it is used under the current license, *i.e.*, for agricultural, forestry, educational, non-commercial recreation, open space, and electric transmission and hydroelectric generation purposes. Therefore, BSPC's proposal to not renew the conservation easement on 1,044.23 acres of land would not be likely to significantly affect existing land use in the project boundary.

Modification of the Project Boundary

Based on the Exhibit G filed on April 30, 2018, BSPC proposes a project boundary that encompasses approximately 1,305.3 acres of land and water, which is approximately 168.7 acres[128] less than the existing project boundary. BSPC proposes to remove land

---

[127] No recommendations have been submitted for, or evidence show as to why, the 50 acres of land that is currently outside of the project boundary is needed for project purposes. Therefore, Commission staff has not evaluated that alternative in the EA.

[128] BSPC's Exhibit G filed on April 30, 2018 states the proposed project boundary includes the removal of 165 acres of land and water and measures 1,309 acres. However, BSPC appears to have incorrectly summed the proposed acreage changes. Based on Commission staff's review of the Exhibit G maps and georeferenced shape files, BSPC is proposing to remove approximately 168.7 acres of land and water from the current project boundary, which results in a proposed project boundary measuring 1,305.3 acres.

from the project boundary that BSPC indicates are not needed for project purposes, including: (1) 109.74 acres of land northeast of the upper reservoir that is currently part of a conservation easement; (2) 20.04 acres of land west of the Fife Brook dam that is currently part of a conservation easement; (3) 31.99 acres of land associated with River Road and land north of Fife Brook impoundment that is currently part of a conservation agreement; and (4) 5.9 acres of land associated with River Road downstream of the Fife Brook dam.

BSPC additionally proposes to remove approximately 1 acre of land due to minor adjustments to the project boundary line.

Our Analysis

Section 4.41(h)(2) of the Commission's regulations requires the project boundary to enclose only those lands necessary for operation and maintenance of the project and for other project purposes, including recreation, shoreline control, and the protection of environmental resources.

As discussed above, BSPC proposes to remove from the project boundary approximately 161.77 acres of land that is currently protected by a conservation easement. The 161.77 acres were originally placed in a conservation easement comprised of 1,256 acres of land. According to Massachusetts DFW's April 1, 2019 filing, the purpose of the conservation easement was to provide a large, unfragmented forested area for the protection of environmental resources, including sensitive species at the project. The three distinct parcels of land that compose the 161.77 acres are located on the border of the existing conservation easement, and no sensitive species were identified as occurring within these areas. Although removing these lands has the potential to result in the future loss of habitat if these lands were to be developed, the remaining 1,044.23 acres of land within the project boundary would be sufficient to provide environmental protection, by continuing to provide a large unfragmented forested area to protect sensitive species within the project boundary. Therefore, removal of this land from the project boundary would be warranted.

BSPC's proposal to remove 5.9 acres of land associated with River Road downstream of the Fife Brook dam would not have a significant impact on resources at the project. River Road is a publicly-accessible roadway that serves destinations other than the Bear Swamp Project, including the towns of Sunderland and Greenfield, Massachusetts. Removing the 5.9 acres of land associated with River Road downstream of the Fife Brook dam is warranted as River Road is not a project feature and does not serve a project purpose.

BSPC's proposal to remove approximately 1 acre of land and water associated with minor boundary adjustments does not appear to have a significant impact to resources at the project and instead represents only minor corrections to previous surveying errors. Therefore, removal of this land within the project boundary would be warranted.

Cumulative Effects

Based our review of the license application, as well as agency and public comments, we have identified recreation, as a resource that could be cumulatively affected by activities in the Deerfield River Basin. The activities that could potentially affect boating opportunities and recreational access to project waters include the continued operation and maintenance of the project in combination with operation and maintenance of numerous other hydropower projects and activities on the Deerfield River.

Before hydroelectric projects were constructed on the upper Deerfield River in the early 1900s, flows were uncontrolled and impeded only by the remains of abandoned mill dams. Between 1904 and 1927, five hydroelectric projects were constructed upstream of the Bear Swamp Project (Somerset, Searsburg, Harriman, Sherman, and Deerfield Station No. 5), and four hydroelectric projects (Deerfield Station No. 4, Deerfield Station No. 3, Gardners Falls, and Deerfield Station No. 2) were constructed downstream of the project to control Deerfield River flows. However, whitewater recreation was not popular when the hydroelectric projects were constructed, and the flows were not used for recreation. The construction of the Bear Swamp Project in 1974 further controlled flows in the Deerfield River. Around this time, whitewater boating starting to grow in popularity on the Deerfield River. By the early 1990s, whitewater boating demand had increased enough that whitewater proponents helped develop the 1994 Settlement Agreement, which established regular whitewater releases from hydroelectric projects along the Deerfield River for whitewater boating. It was through the 1994 Settlement Agreement that the annual 106 whitewater release days from Fife Brook dam was established.

Currently, whitewater releases occur at the Deerfield Station No. 5 and Fife Brook dams. The Deerfield Station No. 5 dam is owned and operated by Great River Hydro, and is the first dam upstream of Fife Brook dam. Great River Hydro releases 32 whitewater flows each summer, which allows for boating in the Class III-IV "Dryway" bypassed-reach of the Deerfield Station No. 5 power station. This whitewater reach ends in the upper extent of the Fife Brook impoundment. The current license requires BSPC to provide 106 whitewater flow releases, with a minimum of 700 cfs, from the Fife Brook dam into the Deerfield River. The whitewater flow releases can start anytime between 9:30 a.m. and 12:00 p.m., for 50 weekend days, and 56 weekdays from April 1 on October 31 annually. BSPC, Great River Hydro, Trout Unlimited, and the Whitewater Interest group coordinate an annual meeting to develop the whitewater flow release schedule for the coming year's whitewater flow releases.

Other dams along the Deerfield River do not provide whitewater releases. Whitewater boating downstream of the Fife Brook dam is only possible during high flows (American Whitewater, 2019).

Our Analysis

As discussed in section 3.3.4.2, *Land Use, Recreation, and Aesthetics, Environmental Effects,* BSPC operates and maintains several project recreation facilities that provide access to project land and water for non-motorized boating, fishing, tubing, hiking, hunting, biking, whitewater boating, picnicking, and trail running. BSPC is proposing to improve features, access, and amenities at several of the project recreation features.

The 106 annually scheduled whitewater flow releases provided by the project support a variety of popular whitewater recreation activities on the Deerfield River downstream of the Fife Brook dam. In addition to its popularity for whitewater recreation, the Deerfield River downstream of the Fife Brook dam is also considered a world class tailwater trout stream. The fishery attracts all skill level anglers and commercial fishing guides to the project. BSPC provides several project recreation access areas and facilities that provide access to project water for fishermen, commercial fishing guides, whitewater boaters, tubers, rafters, commercial whitewater outfitters, and other recreationists.

BSPC maintains and operates a 900-acre public hunting area that provides public seasonal hunting access around the upper reservoir. Also, the trail system around the upper reservoir offers miles of year-round recreation, including hiking, trail running, biking, bird watching, and cross-country skiing.

BSPC also maintains and operates a visitor center, which provides the public with educational information on the project operation, land, and water around the project, and the recreation opportunities available on project land. BSPC also maintains and operates the Zoar Picnic Area, which is a popular location for picnicking, and also where whitewater recreationists congregate after exiting the Deerfield River.

In addition to these project recreation facilities, there are ten informal undeveloped public access areas that occur downstream of Fife Brook dam. These areas provide access to the river, and are mainly used by anglers.

While access to the lower extent of the Fife Brook impoundment is restricted due to several safety hazards, and there is no boat portage around Fife Brook dam, BSPC's proposed boater egress trail in the upper extent of the Fife Brook impoundment would improve recreation opportunities and safety for boaters that are utilizing whitewater recreation opportunities in the upper extent of the Fife Brook impoundment, including during scheduled flow releases provided by the licensee of the Deerfield Station No. 5

Development during the 32 annual whitewater flow release days from the Deerfield Station No. 5 dam.

Altogether, the proposed project would provide additional recreation opportunities at the Bear Swamp Project and the Deerfield Station No. 5 Development, and there is no indication that the proposed project would add to the cumulative effects of other activities on recreation in the Deerfield River basin that have occurred in the past or that may occur in the future by any new activities in the Deerfield River Basin.

3.3.5 Cultural Resources

3.3.5.1 Affected Environment

Area of Potential Effect

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

By letter dated July 22, 2016, BSPC consulted with the Massachusetts SHPO, the Narragansett Indian Tribe THPO, and the Stockbridge Munsee Community of Wisconsin THPO regarding the APE for the project.[129] In the consultation letter, BSPC defined the APE as:

> lands enclosed by the project's boundary as delineated in the [Pre-Application Document] for the project, and lands or properties outside the project's boundary where project operation or project-related recreational development or other enhancements may cause changes in the character or use of historic properties, if any historic properties exist. The APE for Bear Swamp Project includes those portions of the [Bear Swamp and Hoosac Tunnel Trail] located within the project boundary.

As described in section 2.1.2 of this EA, the existing project boundary covers 1,474 acres. The proposed APE includes 1,474 acres, and consists of the existing project boundary along with land outside of the project boundary where

[129] *See* March 30, 2018 final license application at E-340.

the project may affect historic properties.[130] In a letter dated September 7, 2016, the Massachusetts SHPO concurred with the proposed APE.[131] BSPC did not receive comments from other consulting parties.

Cultural History Overview

Pre-contact Period

Throughout the Northeast, evidence for the earliest period of human occupation in southern Massachusetts and western Massachusetts, the Paleoindian Period, is extremely rare. Most sites of this period have been identified from isolated diagnostic artifact types. Fluted projectile points, the diagnostic artifact type of the period, have been reported from several locations along the Connecticut Valley in western Massachusetts. Based on ethnographic analogy, it is assumed that peoples of this time were seasonally nomadic, following the movement of game with the changing weather conditions of the year. Similarities in artifact forms among Paleoindians across North America argue for a generalized character of adaptation, with few specializations to local conditions evident (Haynes, 1980).

The period following the Paleoindian occupation, but predating the use of pottery and horticulture, has been designated the archaic period by North American archaeologists. The Archaic Period is further divided into at least three sub periods: Early, Middle, and Late.

In the Northeast region, archaeological sites from the Early Archaic period (10,000-8,000 years before present (BP)) are rare. The diagnostic artifacts most closely associated with the Early Archaic period are bifurcate-base projectile points and, less commonly, stemmed or corner-notched points of the Palmer and Kirk types (Braun and Braun, 1994).

During the Middle Archaic Period (8,000-6,000 BP), environmental conditions in the area began to approach those of present day. Archaeological materials from New England provide evidence of significant local populations at this time, indicating that a

[130] BSPC's Cultural Resources Reconnaissance Report filed on April 25, 2017 states that the proposed project APE is 1,496 acres. However, BSPC appears to have incorrectly calculated the acreage. Based on Commission staff's review of Exhibit G of the final license application and the APE maps within the Cultural Resources Reconnaissance Report, the project APE delineated in both documents measure to 1,474 acres.

[131] *See* Massachusetts SHPO's September 7, 2016 letter.

substantial degree of population growth had occurred by the end of this period (Mulholland, 1984).

Late Archaic Period (6,000-3,000 BP) sites in New England are much more numerous than sites in previous periods. Peoples of New England at this time occupied a wide variety of environmental settings (Mulholland, 1984), and a significant diversity in site type and function is documented. Modern environmental conditions were present and the wild resources available were the same as those observed by the early European settlers and explorers.

The Woodland Period in the Northeast is defined by the onset of new technologies, such as ceramics, the bow and arrow, and horticulture involving non-native plants, like corn. Based mainly on technological diversification in pottery use and subsistence strategies, archaeologists have divided the Woodland Period into three stages: Early, Middle, and Late.

The Early Woodland Period (3,000-2,000 BP) has generally been considered a period of population decline following a cultural florescence during the Late Archaic. This millennium witnessed the first widespread use of ceramics across the Northeast.

The Middle Woodland Period (2,000-1,000 BP) is characterized as a continuation of trends of the Early Woodland period. Subsistence trends of the Early Woodland continued, and large, semi-permanent, or perhaps year-round settlements were used by this time. A significant amount of non-local lithic material was utilized in the Middle Woodland Period, which may indicate an expanding trade network (Talmage, 1982).

It is during the Late Woodland Period and the preceding period that the pattern of settlement witnessed by the first European explorers became established. The Late Woodland Period dates from approximately 1,000 BP to European contact. Also during this time, horticulture, including exotic domesticates, such as corn and beans, became a widespread and occasionally important dietary element. More evidence is present of permanent settlements, or at least locations where sites were used for much of the year, especially on the coasts (Carlson, 1986; Yester, 1988). Late Woodland Period sites are more numerous throughout the Northeast than Early and Middle Woodland Period Sites.

Post-contact Period

The APE for the Bear Swamp Project comprises 1,474 acres in the towns of Rowe, Franklin County and Florida, Berkshire County, Massachusetts. At the time of European contact, the upper Deerfield River Basin in Massachusetts was controlled by the Mohican (Grumet, 1995). It has been suggested that the upper Deerfield River Valley appears to have been used for hunting and travel, but was not permanently settled at the time of European contact (Fitzhugh, 1970).

Colonial settlement in the region began after the erection of Fort Pelham in the present-day town of Rowe, Massachusetts. The small, palisaded fort was built circa 1744 and was part of a larger "line of forts" established by the English colony of Massachusetts to rebuff French and Indian attacks in the lower Deerfield and Connecticut River valleys during King George's War. Fort Pelham was occupied by a small garrison from town of Charlemont until it was abandoned in 1754. The initial settlement of the town of Rowe occurred in 1766, more than a decade after the abandonment of Fort Pelham (Grumet 1995; Heitert, 2003; Fitzhugh, 1970).

The steep valley walls, rugged topography, lack of arable floodplains, and dense forests of the upper Deerfield River Basin made settlement difficult (Fitzhugh, 1970). Settlement in the vicinity of the present-day project area intensified during and after construction of the Hoosac Tunnel. The Hoosac Tunnel is a 4.75-mile-long railroad tunnel within the Hoosac Mountains. Constructed between 1854 and 1875, the Hoosac Tunnel was a vital connection that linked Boston and eastern Massachusetts with the Hudson River. The Hoosac Tunnel also connected the remote area around the Bear Swamp Project to nearby communities, including the town of North Adams (Fitzhugh, 1970). The opening of a soapstone, serpentine, and talc mine near the town of Zoar in 1874 and a paper mill in the town of Monroe in 1886 also helped attract new settlers to the region.

Cultural Resources Investigations

In November 2016, BSPC conducted a cultural reconnaissance survey to identify historic architectural and archaeological sites located in the APE. The investigation consisted of background research, development of a sensitivity model for archaeological sites, and a walkover survey.

The background research indicated that there are two historic properties within, and adjacent to, the APE that are listed on the National Register: the Hoosac Tunnel and the Hoosac Tunnel Bridge. The Hoosac Tunnel and the Hoosac Tunnel Bridge were listed on the National Register in 1973. The Hoosac Tunnel Bridge is located within the APE and the Hoosac Tunnel is located adjacent to the APE, on the west bank of the Deerfield River. The construction of the Hoosac Tunnel is considered historically significant because it pioneered engineering techniques including the use of compressed air-powered rock drills, and the use of nitroglycerin explosives. Portions of the APE are historically related to the construction of the Hoosac Tunnel. The Hoosac Tunnel Bridge is an unaltered, 1916 two-span bridge and is the third-oldest of its type in the State of Massachusetts. It is considered historically significant as a rare surviving example of a Warren though truss style bridge (Donta *et al.,* 2017).

BSPC performed a condition assessment of seven prehistoric archaeological sites and three historic architectural resources that were previously identified within the project APE. The reconnaissance survey also identified five new archaeological sites and one late 19^{th} – 20^{th} century cemetery within the project APE.[132] One Late 19^{th} - 20^{th} century cemetery was also identified outside the project boundary, but adjacent to the Zoar Picnic Area.[133] Both cemeteries are inactive and closed to further interments.

Of the resources investigated during the reconnaissance survey, BSPC proposed that the following resources are associated structures to the National Register Eligible Hoosac Tunnel and Hoosac Tunnel Bridge: the remnants of the original timber crib Deerfield Dam and sluiceway/canal, the Hoosac Tunnel compressor building, the Stone Cellar site, and the Railroad Tracks site. The report also recommended that additional cultural resources investigations be conducted on seven archaeological sites to determine the extent of intact cultural deposits.[134] Two archaeological sites and one architectural resource were determined to be previously destroyed. One architectural resource was recommended as Not Eligible for listing on the National Register.

As part of the reconnaissance survey, BSPC also evaluated the eligibility of the project facilities associated with the Bear Swamp PSD and the Fife Brook Development, including the Fife Brook dam and impoundment, the upper reservoir, underground powerhouse, spillway and intake structures, and penstocks. The Bear Swamp PSD and Fife Brook Development were constructed between 1968 and 1974 and were not 50 years old at the time of the evaluation. In the April 7, 2017 Cultural Resources Reconnaissance Report, BSPC states that the Bear Swamp PSD and Fife Brook Development do not meet the standards to be considered eligible for the National Register under Criteria G.

In May 2018, BSPC conducted a Phase I archaeological intensive (locational) survey of three archaeologically-sensitive locations (survey areas) that were identified

---

[132] Cemeteries and burial places traditionally have been regarded as sacred and protected locations; therefore, cemeteries and graves are not typically evaluated for listing on the National Register unless they meet special requirements (Potter and Boland 1992). The two cemeteries were not evaluated for eligibility for listing on the National Register as part of the reconnaissance survey.

[133] The Nelson Cemetery is located outside of the APE, but adjacent to the Zoar Picnic Area, an approved project recreation facility. Even though the cemetery is delineated with a stone wall, there is a possibility that unmarked burials could extend into the APE.

[134] BSPC's April 7, 2017 Cultural Resources Reconnaissance Report (privileged).

during the reconnaissance survey and performed additional investigation on the seven archaeological sites discussed above.[135] In addition, the 2018 survey identified four new archaeological sites.[136]

Of the 11 archaeological sites investigated during the 2018 survey, BSPC identified nine sites as eligible for listing on the National Register, one site as potentially eligible for listing on the National Register, and one site as not eligible for listing on the National Register. The Fife Brook archaeological sites (#1-4) represent a Late Archaic through Early Woodland period use of a discrete location. The April 25, 2019 Archaeological Intensive (Locational) Survey Report identified the sites as eligible for listing on the National Register under Criteria D, as further study of the sites have the potential to aid in the understanding of Native American occupation and settlement within the Deerfield River Valley. The T-1 Terrace site is also a Late Archaic through Early Woodland occupation site in close proximity to the eligible Fife Brook sites. The April 25, 2019 Archaeological Intensive (Locational) Survey Report identified the T-1 Terrace site as potentially eligible for listing on the National Register under Criteria A for its association with the eligible Fife Brook sites and Criteria D as having the potential to aid in the understanding of Native American occupation and settlement within the Deerfield River Valley (Smith *et al.*, 2019). Table 20 includes the full list of sites that BSPC identified as eligible for listing on the National Register.

Table 20. BSPC National Register recommendations from Phase I Report for sites within the project APE.

Site Name/Trinomial	**National Register Eligibility Recommendation**
Fife Brook #1 (19-BK-1)	Eligible
Fife Brook #2 (19-BK-2)	Eligible
Fife Brook #3 (19-BK-3)	Eligible
Fife Brook #4 (19-BK-201)	Eligible
Fife Brook #5 (19-BK-174)	Not Eligible
T1-Terrace 1 Site	Potentially Eligible
Edwin L. Granger Homestead*	Eligible
Granger Native American Site	Eligible
Steam Sawmill Site*	Eligible

[135] The Wampanoag Tribe of Gay Head (Aquinnah) requested to participate in the field study, and a representative from the tribe was present during the reconnaissance survey. *See* March 30, 2018 final license application at E-349.

[136] BSPC's April 25, 2019 Archaeological Intensive (Locational) Survey Report (privileged).

Site Name/Trinomial	National Register Eligibility Recommendation
Deerfield Dam and Sluiceway Canal Site (ROE.HA.21)*	Eligible
Stone Cellar Site (FLO.HA.09)*	Eligible
Hoosac Tunnel Compressor Building (FLO.HA.10)*	Eligible
Railroad Tracks Site (ROE.HA.23)*	Eligible
Hoosac Tunnel Bridge (FLO.903)*	Previously listed on the National Register
Cressey-Peck Family Farm (ROE.HA.21)	Not Assessed
Cressey Family Cemetery	Not Assessed
Hoosac Tunnel and Wilmington Railroad (ROE.HA.22)	Not Assessed

(Source: Smith *et al.,* 2019)

*Denotes contributing resource to the Hoosac Tunnel National Register District

The April 25, 2019 Archaeological Intensive (Locational) Survey Report recommended the creation of a Hoosac Tunnel National Register Historic District. The district is recommended as eligible under Criteria A for its associations with the National Register listed-Hoosac Tunnel and Hoosac Tunnel Bridge, and Criteria D for the information the sites likely contain related to the first use of compressed air-powered drill the United States. Additionally, the archaeological deposits at each of the identified sites retain integrity with the likelihood of intact subsurface archaeological deposits and features. The intact deposits have the potential to aid in the understanding of the people directly involved in the construction of the Hoosac Tunnel.[137] Contributing resources to the district include the Hoosac Tunnel, Hoosac Tunnel Bridge, the original timber crib Deerfield Dam and sluiceway/canal, the Hoosac Tunnel compressor building, the Stone Cellar site, the Steam Sawmill site, the Edwin L. Granger homestead, and the Railroad Tracks site. The Hoosac Tunnel is the only contributing resource that is not within the APE.

[137] Resources eligible for listing on the National Register under criterion A are those that are associated with events that have made a significant contribution to the broad patterns of our history. Resources eligible for listing on the National Register under criterion D have yielded or may be likely to yield, information important in history or prehistory (National Park Service, 2002).

3.3.5.2 Environmental Effects

Based on the Exhibit G filed on April 30, 2018, BSPC proposes a project boundary that encompasses approximately 1,305.3 acres of land and water, which is approximately 168.7 acres[138] less than the existing project boundary.

BSPC's proposed recreational improvements (including additional parking areas, construction of a new boater egress trail, construction of restroom and changing facilities, and installation of additional signage), use of recreational areas, and maintenance activities associated with routine operation of the project have the potential to affect historic resources in the APE. BSPC proposes to develop an HPMP in consultation with the Massachusetts SHPO and federally recognized tribes to address any potential adverse effects on historic properties.

In the final license application, BSPC states that the Stockbridge-Munsee communicated that they do not have concerns with the relicensing unless new construction is proposed that has the potential to disturb cultural resources.[139] In a letter dated February 11, 2019, the Massachusetts SHPO indicates that the proposed construction of recreation facilities may have the potential to effect historic and archaeological resources. In a letter dated May 9, 2019, the Massachusetts SHPO states that the proposed HPMP should take into account the results of previous cultural resources management surveys to assist BSPC in the management of the identified historical and archaeological resources and the archaeologically sensitive areas.

Our Analysis

As proposed in the April 7, 2017 Cultural Resources Reconnaissance Report, the APE would include the existing project boundary, and lands or properties outside the project's boundary where project operation or project-related recreational development or other enhancements may cause changes in the character or use of historic properties, if any historic properties exist. However, as discussed above in section 3.3.4, *Land Use, Recreation, and Aesthetics, Environmental Effects,* BSPC is proposing to reduce the size of the project boundary by 168.7 acres, from 1,474 acres to 1,305.3 acres. BSPC investigated all land proposed to be removed from the existing project boundary and did

---

[138] BSPC's Exhibit G filed on April 30, 2018 states the proposed project boundary includes the removal of 165 acres of land and water and measures 1,309 acres. However, BSPC appears to have incorrectly summed the proposed acreage changes. Based on Commission staff's review of the Exhibit G maps and georeferenced shape files, BSPC is proposing to remove approximately 168.7 acres of land and water from the current project boundary which results in a proposed project boundary measuring 1,305.3 acres.

[139] *See* page E-15 of the final license application.

not identify any historic properties on the 168.7 acres of land that it is proposing to remove from the project boundary. Therefore, no historic properties would be affected by the removal of the 168.7 acres of land from the project boundary. Since the APE must include the geographic area in which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, the definition of the APE should be revised to include only the 1,305.3 acres associated with the proposed project boundary.[140]

Project-related effects on historic properties that are listed on or eligible for listing on the National Register (see Table 20) within the APE could result from: (1) modifications to project facilities or project operation; (2) project-related ground disturbance; (3) construction of project recreation facilities and use of facilities by visitors; or (4) project-induced shoreline erosion.[141]

During the license term, the project facilities associated with the Bear Swamp PSD and the Fife Brook Development will reach 50 years in age and may qualify for listing on the National Register at that time. It is also possible that unknown historic resources may be discovered during project operation or other project-related activities that require ground disturbance, such as BSPC's proposed recreational enhancements within the APE (see section 3.3.4, *Land Use, Recreation, and Aesthetics, Environmental Effects*).

Developing and implementing an HPMP, in consultation with the Massachusetts SHPO and federally recognized tribes, would ensure that measures are in place to protect historic properties in the APE from adverse effects related to the construction, operation, and maintenance of all project facilities, including the project recreation facilities that could otherwise diminish the integrity of the design and materials of historic properties. An HPMP would ensure that any previously undiscovered archaeological resources within the APE are not adversely affected by the project. The HPMP would also provide for re-evaluation of historic properties during the term of the license due to the passage of time (*i.e.,* project facilities reaching 50 years in age) or changes in the property's integrity.

To meet requirements of section 106, the Commission intends to execute a Programmatic Agreement with the Massachusetts SHPO and federally recognized tribes for the proposed project to protect historic properties that could be affected by the

---

[140] *See* 36 C.F.R §800.4(b)(1) (2019).

[141] Project-induced shoreline erosion does not include shoreline erosion attributable to flood flows or phenomena, such as wind-driven wave action, erodible soils, and loss of vegetation due to natural causes.

continued operation and maintenance of the project. The terms of the Programmatic Agreement would require BSPC to develop and implement an HPMP to ensure that continued operation and maintenance of the project would have no adverse effect on historic properties within the APE.

3.3.6 Socioeconomic Resources

3.3.6.1 Affected Environment

As of 2018, the population of Berkshire and Franklin Counties was 126,348 and 70,963, respectively. Towns within a few miles of the project include North Adams (population 12,904), Florida (population 724), and Clarksburg (population 1,650) in Berkshire County; and Charlemont (population 1,245), Rowe (population 394), and Monroe (population 112) in Franklin County. The nearest major urban areas are Pittsfield, MA (population 44,737) and Albany, NY (population 97,856), located approximately 22 and 39 miles from the project, respectively.

According to the U.S. Census Bureau (2018), there were 69,400 housing units in Berkshire County in 2018, 69 percent of which were owner-occupied between 2013 and 2017. In Berkshire County, the median value of owner-occupied housing was $203,300, while median gross rent costs were $802 (U.S. Census Bureau, 2018). City-Data reported that Berkshire County median house or condo value in 2016 was $198,100 (City-Data, 2016). According to the U.S. Census Bureau (2018), there were 34,172 housing units in Franklin County in 2018, 68.9 percent of which were owner-occupied between 2013 and 2017. In Franklin County, the median value of owner-occupied housing was $226,600, while median gross rent costs were $899 (U.S. Census Bureau, 2018). City-Data reported that Franklin County median house or condo value in 2016 was $230,500, compared to a statewide median of $366,900 (City-Data, 2016). Stability in Berkshire and Franklin Counties was high, with 87.7 and 87.8 percent, respectively, living in the same house for more than one year (U.S. Census Bureau 2018).

In 2016, the median household income for Berkshire and Franklin Counties was $58,418 and $57,106, respectively, which is less than the state median household income of $75,297 (City-Data, 2016). The 2018 unemployment level for Berkshire County (4 percent) and Franklin County (3 percent) was higher than the state level of 2.9 percent (U.S. Bureau of Labor Statistics, 2018). In 2016, 9.8 percent of residents in Berkshire County and 8.7 percent of residents in Franklin County were estimated to be living in poverty, compared to 10.4 percent for the State of Massachusetts (City-Data, 2016).

As of 2016, educational, health, and social services employed 53 percent of workers in Berkshire and Franklin Counties. Retail trade employed 11 percent in Berkshire County and 14 percent in Franklin County (City-Data, 2016). The single largest employers are Berkshire Health Systems and Yankee Candle Company, Inc. in Berkshire and Franklin Counties, respectively. Tourism and recreation opportunities also represent significant economic drivers in Berkshire and Franklin Counties. In 2017, domestic travel expenditures in Berkshire and Franklin Counties were $456.6 million and $60.3 million, respectively. Domestic travel expenditures supported 3,950 jobs in Berkshire County and 390 jobs in Franklin County (MA Office of Travel and Tourism, 2018).

There are three FERC-licensed hydropower projects on the Deerfield River, which consist of a water storage reservoir, nine conventional hydroelectric dam facilities, and a pumped storage development (see Table 1). The Somerset Development of the Deerfield Project operates as a storage reservoir to regulate water in the river basin for the downstream Deerfield Project developments. The Harriman Development of the Deerfield Project is also used to regulate flows on the Deerfield River. These reservoirs retain flow during spring runoff, enhance hydropower peaking operations, and augment summer flows to enhance recreational boating and fishery resources downstream. Developments downstream of the Bear Swamp Project on the Deerfield River include the Deerfield Station No. 4 (RM 20), the Deerfield Station No. 3 (RM 17), the Gardners Falls Project (RM 15.7), and the Deerfield Station No. 2 (RM 13.2). The Gardners Falls Project and the three Deerfield Stations have a combined total capacity of approximately 18 MW.

3.3.6.2 Environmental Effects

Recreation Resources

As discussed in section 3.3.4, *Land Use, Recreation, and Aesthetics*, extensive outdoor recreation opportunities exist in Berkshire and Franklin Counties, including whitewater boating on the Deerfield River. Franklin Regional Government estimates that there are about 120,000 and 150,000 recreation visitors to the region annually (FRCOG, 2014).

BSPC proposes to continue to provide 106 annual whitewater flow releases from the Fife Brook impoundment to the Deerfield River from April 1 through October 31. The whitewater flow releases start times would continue to begin between 9:30 a.m. and 12 p.m., for a minimum duration of 3 hours. BSPC proposes to increase the minimum flow for whitewater flow releases from 700 cfs to 800 cfs.

The Whitewater Interest Group recommends that additional scheduled whitewater flow release days be provided from May to October. The Whitewater Interest Group also recommends that BSPC increase whitewater flow releases on 32 annual whitewater flow release days when flow releases from Deerfield Station No. 5 range from 900 to 1,100 cfs. In contrast, Massachusetts DFW and Trout Unlimited state that the 106 annual whitewater flow releases should continue at a minimum flow of 700 cfs.

Massachusetts DFW recommends a number of changes to the existing flow regime to protect emerging dragonflies under section 10(j), which could affect whitewater flow releases. While, Massachusetts DFW does not provide any ramping rate restrictions on whitewater flow releases from April 1 through May 14 or September 1 through October 31, they recommend the following restrictions on whitewater flow releases between May 15 and August 31:

May	• The 2 weeks of Wednesday through Sunday whitewater flow releases must occur prior to May 15; • Continue to provide 2 weeks of Saturday and Sunday whitewater flow releases; and • Observed Memorial Day may be substituted for a Saturday or Sunday whitewater flow release between May 18 through May 31.
June	• The 2 weeks of Wednesday through Sunday whitewater flow releases must occur after June 14; and • Continue to provide 2 weeks of Saturday and Sunday whitewater flow releases.
July	• The 3 weeks of Wednesday through Sunday whitewater flow releases must occur prior to July 23.
August	• Continue to provide 4 weeks of Thursday through Sunday whitewater flow releases.

Additionally, Massachusetts DFW recommends the following specific ramping rates on days that do not have scheduled flow releases for whitewater recreation:

May 15 through June 30	• Provide releases between 7 a.m. and 4 p.m.; and • Provide an up-ramping rate no greater than 130 cfs per hour, and no greater than 32 cfs per 15 minute period.
July 1 through August 31	• Provide releases between 7 a.m. and 4 p.m.; and • An up-ramping rate no greater than 158 cfs per hour, and no greater than 40 cfs per 15 minute period.

Our Analysis

The whitewater features in the Deerfield River attract visitors from a multi-state area to the project. These features have led to the development of an outdoor recreation industry that has expanded beyond whitewater, into multi-sport recreational opportunities, including fishing, mountain biking, and zip lining. The recreational opportunities boost the local economy through jobs and tourism, including through the purchase of outdoor recreation equipment, food, and lodging.

More than 50,000 whitewater recreation users visited the project in June, July, and August in 2016. The average recreational visitor to the project traveled about 100 miles to access project recreation sites, and spent approximately $176 per visit. These visitors are estimated to produce a net economic benefit to the area of more than $9,000,000 annually.

BSPC's proposal to continue providing 106 whitewater flow releases according to the existing schedule would not result in any added or lost whitewater flow release days, nor cause any losses or gains to the local economy relative to existing conditions. Scheduling additional whitewater flow releases days, as recommended by the Whitewater Interest Group, could attract more whitewater recreationists to the area. The Code of Massachusetts Regulations (CMR)[142] limits commercial whitewater trips on the Deerfield River to 480 users per day.[143] Therefore, each additional whitewater flow release day has the potential to produce a net economic benefit of approximately $84,480 per day[144].

Increasing whitewater flow releases to 900 - 1,100 cfs could attract additional whitewater users, as the results of the 2016 Whitewater Boating Flow Study found that 900 cfs is the optimal whitewater flow release for this reach of the Deerfield River. While whitewater flow releases above 1,000 cfs are desirable for whitewater boaters, this higher flow can pose a safety risk for inexperienced whitewater recreationists or tubers that cannot guide the watercraft away from obstacles. In addition, because the number of commercial whitewater users per day is restricted by the State of Massachusetts, overall commercial use would be similar to use at normal whitewater flow releases of 800 cfs.

Limiting whitewater flow volumes to 700 cfs, as opposed to the 800 cfs BSPC proposes to continue providing at the project, could deter up to 50 percent of whitewater users from visiting the project waters, based on the results of the 2016 Whitewater Boating Flow Study. More than half of participants in that study indicated that they would not return to boat this section of the river if flows of 700 cfs were provided due to unfavorable boating conditions. This recommendation could result in a net economic loss of $42,240 per day[145] for up to 106 days.

---

[142] *See* 323 CMR § 6.04.

[143] *See* 323 CMR § 6.04(6).

[144] Commission staff calculated this number by multiplying $176 per user by the 480 whitewater users that are permitted on this section of the Deerfield River according to Massachusetts state regulations (323 CMR § 6.1).

[145] Commission staff calculated this number by dividing 480 maximum daily commercial whitewater users by 2 to determine the number of whitewater users deterred by lower flow volumes, which equals 240. Then staff multiplied the 240 deterred whitewater users by the $176 per user.

Annual Payment to Charlemont

Interior, Massachusetts DFW, and the Whitewater Interest Group state that BSPC should be required to make annual payments to the town of Charlemont to address public health and safety costs on and around the river incurred by users of project waters. BSPC is not proposing any payments to Charlemont.

Our Analysis

The Zoar Picnic Area (a project facility) and Shunpike Rest Area (a non-project state-owned facility) are both located within the town of Charlemont, and are popular access areas to the Deerfield River that receive capacity or near-capacity usage during weekends in the summer. The associated crowds require police officers and other emergency services from the town of Charlemont for public safety. However, the town has not stated their costs nor requested an annual payment from BSPC. In addition, neither Interior, Massachusetts DFW, nor the Whitewater Interest Group have indicated how much policing the recreation sites cost the town of Charlemont, nor have they clarified what public safety and emergency services would be required. Additionally, the Commission has stated its strong preference for specific measures directed toward a specific project effect and/or purpose.[146] In general, when funds are proposed to be paid to a non-license entity for a measure, staff will analyze the actual measure itself to determine whether the measure addresses an identified project effect or would enhance a resource affected by the project. In the case of public health and safety at the project, Interior, Massachusetts DFW, and the Whitewater Interest Group do not provide specific measures that would address public health and safety. Therefore, staff cannot assess the benefits of these measures on resources at the project.

Hydropower Generation Resources

BSPC proposes to continue to operate the Bear Swamp PSD in a store and release mode by pumping water from the Fife Brook impoundment (*i.e.*, the lower reservoir) during periods of low electricity demand, storing the water until periods of high electricity demand, and then generating electricity by discharging water back into the Fife Brook impoundment during periods of high electricity demand. BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5."

Stakeholders have proposed alternative flow regimes and ramping rates that have the potential to impact the operations of downstream hydropower developments. Massachusetts DFW recommends under section 10(j) that BSPC operate the project in a

[146] *See Policy Statement on Hydropower Licensing Settlement*s, 116 FERC ¶ 61,270 (2006).

"year-round, run-of-release mode." Similarly, Interior recommends under section 10(j) that BSPC operate the Fife Brook Development as a "run-of-release facility, passing inflow it receives from the upstream Deerfield Project's Deerfield [Station] No. 5 development below Fife Brook dam on a near instantaneous basis."

Massachusetts DFW and Interior also recommend up-ramping limitations (*i.e.*, limits to the hourly rate of change in flow releases) under section 10(j). CRC recommends releasing all flows from Fife Brook dam using a staged ramping process, including a 1-hour hold at an intermediate flow that is equivalent to the midpoint of the total scheduled flow. CRC recommends additional intermediate flow release of one hour for "higher flows."

Our Analysis

The Deerfield River is a highly regulated water resource with multiple peaking hydroelectric projects that dictate flows. Any alteration to the operation of the Bear Swamp Project has the potential to impact downstream hydropower facilities.

BSPC does not currently operate the Fife Brook Development in a "run-of-release" mode on an instantaneous basis, but stores inflow from Deerfield Station No. 5 when necessary to comply with the minimum flow release requirement of 125 cfs. While currently not instantaneous, all inflow from Deerfield Station No. 5 is ultimately released from the Fife Brook dam. The proposed ramping rates, minimum flows, and operating modes would not result in a loss of water from the river system. Therefore, any alterations to the flow regime at the Fife Brook Development would not significantly impact the amount of water provided to the downstream developments, including the Deerfield Station No. 4 (RM 20), Deerfield Station No. 3 (RM 17), Gardners Falls Project (RM 15.7), and the Deerfield Station No. 2 (RM 13.2). Thus, any alternative flow regime, including those proposed by BSPC and stakeholders, would not affect the total amount of generation that could be produced at the downstream hydropower developments.

Altering the flow regime could affect the ability of the downstream hydropower developments to refill their reservoirs and produce electricity during peak demand periods when energy prices are relatively high. The proposed "run-of-release" operation and the recommended ramping rates, minimum flows, and operating modes have the potential to alter the time and magnitude of flows that are passed from the Fife Brook Development to the downstream developments relative to existing operation.

Decreasing the ramping rate for flow releases from the Fife Brook Development, as recommended by Massachusetts DFW, Interior, and CRC, would increase the time it takes to pass flows from Deerfield Station No. 5 to the downstream hydropower developments. The ramping limitations recommended by Massachusetts DFW would cause the longest delay. Outflow from the Fife Brook impoundment would be restricted from 7 a.m. to 4 p.m. on non-scheduled whitewater flow release days, such that flows could only increase at a rate of 130 cfs per hour from May 15 through June 30 of each year, and a rate of 158 cfs per hour from July 1 through August 31 of each year. These ramping restrictions would result in a 4- to 6-hour ramping time to increase flows from the 125-cfs minimum flow to generation flows that are greater than 800 cfs. This delay could result in an economic loss to the downstream hydropower developments if it caused the developments to forego generation during a peak demand period. Any lost opportunity cost associated with the ramping rates would depend on: (1) the specific timing of the flow release from the Fife Brook Development relative to the peak demand periods for electricity; and (2) the amount of storage capacity already held in the downstream development that could be used for peaking until additional releases are received from upstream developments. Based on the circumstantial nature of any such lost opportunity cost, staff cannot estimate the costs that could be experienced by any specific hydropower development.

Operating the project in a "run-of-release" mode would result in inflows from Deerfield Station No. 5 being passed downstream from the project to the Deerfield River on a near instantaneous basis, which would ensure that flows to the downstream hydropower developments would not be delayed by water storage at the project. However, an instantaneous "run-of-release" operation has the potential to impact economics of the Bear Swamp PSD. The Bear Swamp Project is subject to different outflow requirements (*i.e.*, minimum flow, whitewater flow release) than the upstream Deerfield Station No. 5. In order to ensure that the project releases the required minimum flows and whitewater flow releases, BSPC stores water in the Fife Brook impoundment to supplement inflow when necessary. Operating the project in "run-of-release" mode would eliminate the licensee's ability to store inflows, and could require the licensee to use part of the 4,600 acre-feet that is reserved for operation of the Bear Swamp PSD. Over time, this operation would reduce the operating capacity of the pumped storage development and result in an economic loss at the project. The economic impact from lost generation at the Bear Swamp PSD could be significant over time if the licensee was not able to replenish storage to 4,600 acre-feet.

4.0 DEVELOPMENTAL ANALYSIS

In this section, we look at the project's use of the Deerfield River for hydropower purposes to see what effects various environmental measures would have on the project's costs and power generation. Under the Commission's approach to evaluating the economics of a hydropower project, as articulated in *Mead Corp*.,[147] the Commission compares the current project cost to an estimate of the cost of obtaining the same amount of energy and capacity using a likely alternative source of power for the region (cost of

---

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

alternative power). In keeping with Commission policy as described in *Mead Corp.*, our economic analysis is based on current electric power cost conditions and does not consider future escalation of fuel prices in valuing the hydropower project's power benefits.

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

4.1 POWER AND ECONOMIC BENEFITS OF THE PROJECT

Table 21 summarizes the assumptions and economic information we use in our analysis for the project. BSPC provided this information in its license application and subsequent submittals, or was estimated by staff. We find that the values provided by BSPC are reasonable for the purposes of our analysis. Cost items common to all alternatives include: (1) insurance costs; (2) estimated future capital investment required to maintain and extend the life of facilities; (3) relicensing costs; (4) normal operation and maintenance costs; and (5) Commission fees.

Table 21. Parameters used for economic analysis of the Bear Swamp Project.

Parameter	Value [a]
Bear Swamp PSD installed capacity [b] (MW)	600
Bear Swamp PSD dependable capacity (MW)	600
Bear Swamp PSD authorized capacity [b] (MW)	666
Bear Swamp PSD average annual generation [c] (MWh)	451,070
Bear Swamp PSD average annual pumping [c] (MWh)	618,293
Bear Swamp PSD projected annual generation [d] (MWh)	500,688
Bear Swamp PSD projected annual pumping [d] (MWh)	686,305
Fife Brook Development installed capacity [e] (MW)	10

Parameter	Value [a]
Fife Brook Development average annual generation (MWh)	32,793
Period of analysis (years)	30
Federal tax rate (%)	21
Local tax rate (%)	8
Relicensing cost [f]	$3,200,000
Capital improvement costs [g]	$4,183,401
Commission fees, $/year [h]	$998,054
Annual operation and maintenance cost [i]	$9,414,080
Property Taxes	$3,879,000
Energy value ($/MWh)	$59.35 [j]
Pumping cost ($/MWh)	$21.42 [k]
Bear Swamp PSD projected capacity and ancillary services [l] value ($/kw-month)	$34,390,020 [m]
Interest rate (%)	7
Discount rate [n] (%)	7
Escalation rate (%)	0
Net book investment	$108,784,000

(Source: BSPC, as modified by staff)

[a] Values provided by BSPC in 2018 dollars. Values not provided in 2018 dollars were converted using the U.S. Department of Labor Consumer Price Index.

[b] The Bear Swamp PSD has an installed generating capacity of 600 MW; however, the Commission authorized the rehabilitation of the existing turbine units to create an additional 66 MW of installed capacity, thereby increasing the total authorized capacity for the Bear Swamp PSD to 666 MW.

[c] The Bear Swamp PSD average annual generation and pumping (MWh) values are based on the current 600-MW configuration and do not account for the authorized increase in capacity.

[d] The Bear Swamp PSD projected annual generation and pumping (MWh) values are based on the authorized 666-MW configuration. Commission staff extrapolated the values from the generation and pumping rates associated with the 600-MW configuration.

[e] The Fife Brook Development operates in response to regulated peaking inflows from Deerfield Station No. 5. Therefore, the dependable capacity is equal to the installed capacity.
[f] Relicensing costs include the administrative, legal/study, and other expenses to date.
[g] Capital improvement costs include the remaining cost to upgrade the Bear Swamp PSD turbines and generators. Commission staff assume the construction period began August 14, 2009 when the license amendment order was issued, and will continue until August 13, 2022, based on the Commission's December 9, 2016 letter that granted an extension of time to BSPC to finish the upgrades.
[h] Commission fees are based on statements of annual charges received from the Commission for administrative charges based on authorized capacity. Commission staff assume an average fee based on the current generation rate and the anticipated generation rate associated with the authorized 666-MW capacity, prorated for the period of analysis.
[i] Existing project operation and maintenance includes operation and maintenance related to environmental measures associated with the current license.
[j] Actual real-time generation costs vary over the course of each day. The values presented represent best average peak pricing from the 2016 operating year, which is representative of typical operating conditions and costs.
[k] Actual real-time pumping costs vary over the course of each day. The values presented represent best average off-peak pricing from the 2016 operating year, which is representative of typical operating conditions and costs.
[l] Ancillary services value includes: (1) operating/forward reserve and Net Commitment-Period Compensation credits; (2) regulation; (3) voltage and reactive support; and (4) uplifts and other charges.
[m] The Bear Swamp PSD projected capacity and ancillary services value is based on the authorized 666-MW configuration. Commission staff extrapolated the value from the capacity and ancillary services value associated with the 600-MW configuration.
[n] Assumed by staff to be the same as interest rate.

4.2 COMPARISON OF ALTERNATIVES

Table 22 summarizes the installed capacity, annual generation, cost of alternative power, estimated total project cost, and difference between the cost of alternative power and total project cost for each of the alternatives considered in this EA: no-action, BSPC's proposal, and the staff alternative.

Table 22. Summary of the annual cost of alternative power and annual project cost for the three alternatives for the Bear Swamp Project.

Parameter	No Action Alternative	BSPC's Proposal	Staff Alternative
Bear Swamp PSD authorized capacity (MW)	666	666	666
Bear Swamp PSD installed capacity (MW)	600	600	600
Bear Swamp PSD dependable capacity (MW)	600	600	600
Bear Swamp PSD projected annual generation (MWh)	500,688	500,688	500,688
Bear Swamp PSD projected annual pumping (MWh)	686,305	686,305	686,305
Fife Brook Development installed capacity (MW)	10	10	10
Fife Brook Development annual generation (MWh)	32,793	32,793	32,793
Total projected project annual generation (MWh)	533,481	533,481	533,481
Annual cost of alternative power ($ and $/MWh)	$64,932,532 121.71	$64,932,532 121.71	$64,932,532 121.71
Annual project cost ($ and $/MWh)	$33,669,545 63.11	$33,713,213 63.19	$33,707,311 63.18
Difference between the cost of alternative power and the project cost ($ and $/MWh)	$31,262,987 58.60	$31,219,319 58.52	$31,225,221 58.53

(Source: staff)

4.2.1 No-Action Alternative

Under the no-action alternative, the project would continue to operate as it does now. The project would have an installed capacity of 676 MW, and generate an average of 533,481 MWh of electricity annually. The average annual cost of alternative power would be $64,932,532, or about $121.71/MWh. The average annual project cost would be $33,669,545, or about $63.11/MWh. Overall, the project would produce power at a cost that is $31,262,987, or about $58.60/MWh, less than the cost of alternative power.

4.2.2 BSPC's Proposal

Table 23 lists all environmental measures, and the estimated cost of each, considered for the Bear Swamp Project. Under BSPC's proposal, the Bear Swamp Project would have an installed capacity of 676 MW, and generate an average of 533,481 MWh of electricity annually. The average annual cost of alternative power would be $64,932,532, or about $121.71/MWh. The average annual project cost would be $33,713,213, or about $63.19/MWh. Overall, the project would produce power at a cost that is $31,219,319, or about $58.52/MWh, less than the cost of alternative power.

4.2.3 Staff Alternative

The staff alternative is based on BSPC's proposal with staff modifications and additional measures. The staff alternative would have an installed capacity of 676 MW and an average annual generation of 533,481 MWh. The average annual cost of alternative power would be $64,932,532, or about $121.71/MWh. The average annual project cost would be $33,707,311, or about $63.18/MWh. Overall, the project would produce power at a cost that is $31,225,221, or about $58.53/MWh, less than the cost of alternative power.

4.3 COST OF ENVIRONMENTAL MEASURES

Table 23 gives the cost of each of the environmental enhancement measures considered in our analysis. We convert all costs to equal annual (levelized) values over a 30-year period of analysis to give a uniform basis for comparing the benefits of a measure to its cost.

Table 23. Cost of environmental mitigation and enhancement measures considered in assessing the effects of operating the Bear Swamp Project.

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
General				
Develop an Operation Compliance Monitoring Plan that describes: (1) the mechanisms and structures that will be used to provide minimum flow releases and whitewater flow releases; (2) periodic maintenance and calibration for any installed measuring devices; and (3) procedures for recording and reporting data to FERC and resource agencies.	BSPC, Massachusetts DFW,[g] Interior,[g] Staff	$5,000	$0	$3,296
Continue to operate the Bear Swamp PSD in a store and release mode.	BSPC, Staff	$0	$0	$0
Continue to operate the Bear Swamp PSD upper reservoir with a normal maximum water level elevation of 1,600 feet NGVD and a 50.0-foot maximum allowable drawdown (*i.e.*, 1,550 to 1,600 feet NGVD).	BSPC, Staff	$0	$0	$0
Continue to operate the Fife Brook impoundment with a normal maximum water level elevation of 870 feet NGVD and a 40.0-foot maximum allowable drawdown (*i.e.*, 830 to 870 feet NGVD).	BSPC, Staff	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Notify all agency representatives on the service list if an amendment or appeal of any fish and wildlife-related license conditions or extension of time is filed with the Commission.	Interior, Massachusetts DFW	$0	$0	$0
Allow Massachusetts DFW and FWS to inspect the project and request pertinent operation records for the purpose of monitoring compliance with the terms and conditions of a new license.	Massachusetts DFW [g]	$0	$0	$0
Aquatic Resources				
Continue to provide a 125-cfs continuous minimum flow release from the Fife Brook dam to protect fish and aquatic resources in the Deerfield River.	BSPC, Staff	$0	$0	$0
Operate the Fife Brook Development in a run-of-release mode such that inflow from Deerfield Station No. 5 matches outflow from the Fife Brook dam.	BSPC, Interior,[g] Massachusetts DFW [g]	$0[c]	$28,000[c]	$22,120[c]

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Provide a continuous minimum flow of 350 cfs downstream of the Fife Brook Development from November 1 through April 15 to protect trout incubating trout eggs; and a continuous minimum flow of 125 cfs from April 16 through October 31.	Interior,[g] Massachusetts DFW,[g] Trout Unlimited, CRC	$0	$216,100[d]	$170,719[d]
Ramp up flow releases from the Fife Brook Development from the 125-cfs minimum flow to generation flows over a one-hour period from March 15 through June 30.	Trout Unlimited	$0[e]	$0[e]	$0[e]
Ramp down generation and whitewater flow releases from the Fife Brook Development to the minimum flow over a one-hour period from March 15 through June 30 to protect emerging trout fry.	Trout Unlimited, Staff	$0[e]	$0[e]	$0[e]
Release flows from Fife Brook dam with a 1-hour hold at an intermediate flow that is equivalent to the midpoint of the total scheduled flow. For higher operational flows, stop at two intermediate levels for one hour each.	CRC	$0	$17,500[f]	$13,825[f]

Enhancement/Mitigation Measures	**Entity**	**Capital Cost**	**Annual cost[a]**	**Levelized annual cost[b]**
Ramp at 0.060 foot per hour or 130 cfs per hour (not to exceed 32 cfs per 15-minute period) between 7 a.m. and 4 p.m. from May 15 through June 30. Ramp at 0.334 foot per hour or 158 cfs per hour (not to exceed 40 cfs per 15-minute period) between 7 a.m. and 4 p.m. from July 1 through August 31.	Massachusetts DFW,[g] Interior[g]	$0	$7,500[f]	$5,925[f]
Conduct an IFIM modeling study to evaluate alternative flow scenarios during relicensing and during the next relicensing proceeding for the Deerfield Project.	CRC, Trout Unlimited	Unknown[h]	Unknown[h]	Unknown[h]
Install a flow gage immediately downstream of Fife Brook dam and provide information to the public in real-time.	Trout Unlimited, CRC	$2,000	$500	$646

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Develop an Invasive Mussel Species Monitoring and Management Plan that includes the following measures to minimize the spread of invasive mussel species at the project, including dreissenid mussels (e.g., zebra mussels and quagga mussels): (1) educational training for project maintenance staff; (2) educational signage; (3) best management practices for minimizing the spread of invasive mussel species during project-related construction and maintenance activities; and (4) rapid notification, coordination, and response with appropriate federal and state resource agencies in the event invasive dreissenid mussel species are detected at the project.	BSPC, Massachusetts DFW,[g, n] Staff	$10,000	$1,000	$2,043
Develop a Dragonfly Flight and Emergence Survey Plan.	Massachusetts DFW[g]	$5,000	Unknown[h]	Unknown[h]
Develop a Special Status Dragonfly Habitat Enhancement Plan.	Massachusetts DFW[g]	$5,000	Unknown[h]	Unknown[h]
Establish a 200-foot, natively vegetated buffer zone on all riverfront lands within and downstream of the project boundary.	Massachusetts DFW[g]	Unknown[h]	Unknown[h]	Unknown[h]

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Establish a Rare Dragonfly Species Mitigation Fund.	Massachusetts DFW[g]	Unknown[h]	Unknown[h]	Unknown[h]
Terrestrial Resources				
Develop a State-Listed Rare Plants Management Plan that includes measures to minimize adverse project effects on state-listed rare plants.	BSPC, Massachusetts DFW,[g] Staff	$5,000	$2,000	$2,207
Develop an Invasive Plant Species Monitoring and Management Plan that includes measures to reduce the spread of invasive plant species, including: (1) educating recreational users on ways to reduce the spread of invasive plant species; (2) implementing best management practices, such as identifying invasive plant species that may be introduced by a given project-related activity, identifying critical control points (locations and times), and implementing measures to prevent the spread of invasive plant species during routine project operation and maintenance activities; (3) recording incidental observations of invasive plant species; and (4) using only native seed and plant materials outside of lawn areas.	BSPC, Massachusetts DFW,[g] Staff	$10,000	$1,000	$2,043

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Modify the Invasive Plant Species Monitoring and Management Plan to include a requirement to conduct a comprehensive survey of invasive plants every 5 years to develop site-specific control/management actions to reduce the spread of invasive species at the project.	Massachusetts DFW[g]	Unknown[h]	Unknown[h]	Unknown[h]
Develop a Bald Eagle Protection Plan that includes provisions to: (1) avoid killing, injuring, or harassing bald eagles during tree cutting or thinning operations at the project; and (2) minimize project effects on nesting bald eagles at the project.	BSPC, Massachusetts, DFW,[g] Staff	$5,000	$0	$627
Incorporate the following measures for nesting bald eagles from the FWS's 2007 *National Bald Eagle Management Guidelines* in BSPC's proposed Bald Eagle Protection Plan: (1) keep a distance of at least 330 feet between the activity and the nest (distance buffers); (2) maintain forested (or natural) areas between the activity and around nest trees (landscape buffers); and (3) avoid construction and maintenance activities during the breeding season.	Staff	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Develop a Bat Management Plan that includes provisions to avoid and minimize adverse effects to special status bats that may result from future project-related activities.	BSPC, Interior,[g] Massachusetts, DFW[g]	$5,000	$2,000	$2,207
Avoid cutting trees greater than 3 inches in width at breast height, between June 1 and July 31, to protect NLEB.	Staff	$0	$0	$0
Recreation Resources				
Whitewater Flow Releases				
Continue to provide 106 annual whitewater flow releases from the Fife Brook dam for a minimum duration of 3 hours on 50 weekend days and 56 weekdays from April 1 through October 31.	BSPC, Staff	$0	$0	$0
Increase whitewater flow releases from 700 cfs to 800 cfs.	BSPC, Staff	$0	$0	$0
Release the 106 scheduled whitewater flows from Fife Brook dam between 9:30 a.m. and 12 p.m.	BSPC	$0	$0	$0
Release the 106 scheduled whitewater flows from Fife Brook dam beginning at 10 a.m.	Interior, Trout Unlimited, CRC, Staff	$0	$0[i]	$0[i]

Enhancement/Mitigation Measures	**Entity**	**Capital Cost**	**Annual cost[a]**	**Levelized annual cost[b]**
Release generation flows starting at 10 a.m. on days when whitewater flow releases are not scheduled, from June 16 through Labor Day.	Interior, Whitewater Interest Group	Unknown[h]	Unknown[h]	Unknown[h]
Provide outflow volumes from Fife Brook Development that match the exact inflow volumes provided from the upstream Deerfield Station No. 5 on 32 days of the year, when flow releases from Deerfield Station No. 5 range from 900 to 1,100 cfs for 4 to 5 hours.	Whitewater Interest Group	$0	$0[j]	$0[j]
Provide higher flow releases of 900 – 1,100 cfs during the 106 scheduled flow release days.	Whitewater Interest Group	$0	$0	$0
Provide the 106 annual whitewater flow releases at a minimum flow of 700 cfs.	Massachusetts DFW, Trout Unlimited	$0[e]	$0[e]	$0[e]
Provide an additional 14 whitewater flow release days to the annual schedule, or shift weekday whitewater releases from April and October to weekdays between June 16 and Labor Day.	Whitewater Interest Group	$0[k]	$0[k]	$0[k]

Enhancement/Mitigation Measures	**Entity**	**Capital Cost**	**Annual cost[a]**	**Levelized annual cost[b]**
Maintain the elevation of the Fife Brook impoundment at or below 835 feet NGVD until 3 p.m. on the 32 days of the year when Deerfield Station No. 5 is scheduled to release whitewater flows.	Whitewater Interest Group	$0	$0[l]	$0[l]
Maintain the elevation of the Fife Brook impoundment at or below 835 feet NGVD until 12 p.m. on the 32 days of the year when Deerfield Station No. 5 is scheduled to release whitewater flows.	Staff	$0	$0[m]	$0[m]

Enhancement/Mitigation Measures	**Entity**	**Capital Cost**	**Annual cost[a]**	**Levelized annual cost[b]**
Recreation Facilities				
Develop a Recreation Facilities Management Plan that includes provisions to: (1) continue operating and maintaining the existing project recreation facilities; (2) design and construct a new boater egress trail that begins downstream from the Showtime rapid and extends upstream to the existing vehicle turnaround at Great River Hydro's Dunbar Brook Picnic Area, which is part of Deerfield Station No. 5; (3) enhance overflow parking at the Fife Brook Fishing and Boating Access Area; (4) widen the access trail at the Zoar Whitewater Access Area; (5) install additional seasonal restroom facilities, a stall-type changing facility, and an additional staircase at the Zoar Picnic Area; (6) install handrails on staircases at project recreation areas; and (7) install additional signage to educate recreationists on safety and the Deerfield River flow regime.	BSPC, Staff	$20,000	$5,000	$6,456

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Modify BSPC's proposed Recreation Facilities Management Plan to include measures for operating and maintaining two undeveloped access sites (*i.e.*, the "Carbis Bend" and the "Bridge to Nowhere" access sites), as project recreation sites to ensure safe river access for anglers in the Deerfield River downstream of the Fife Brook dam.	Staff	$0	$500	$395
Modify BSPC's proposed Recreation Facilities Management Plan by adding the following measures to improve boating in the upper reaches of the Fife Brook impoundment: (1) construct and maintain a boater take-out site downstream of the Showtime rapid, along with the new boater egress trail proposed by BSPC; and (2) install signs along the river to guide boaters to the take-out.	Staff	$40,000	$200	$5,171
Improve the Fife Brook Fishing and Boating Access Area by adding more parking spaces.	BSPC, Interior, Massachusetts DFW, Whitewater Interest Group	Unknown[h]	Unknown[h]	Unknown[h]

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Construct a new set of stairs to replace the existing stairs at the Fife Brook Fishing and Boating Access Area.	Interior	$8,000	$100	$1,082
Modify BSPC's proposed Recreation Facilities Management Plan by adding the following measures to improve parking at the Fife Brook Fishing and Boating Access Area: (1) create up to 10 additional spaces at the unpaved, off-site overflow parking area by removing vegetation and placing gravel throughout the parking area; and (2) mark the parking spaces at the overflow parking area to enable the most efficient use of the space.	Staff	$10,000	$500	$1,648
Improve the Fife Brook Fishing and Boating Access Area by establishing a new boat put-in site.	Interior, Massachusetts DFW, Whitewater Interest Group	Unknown[h]	Unknown[h]	Unknown[h]
Provide electric power at the Fife Brook Fishing and Boating Access area for rafters to run air pumps.	Interior, Massachusetts DFW, Whitewater Interest Group	$2,000	$300	$488

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Modify BSPC's proposed Recreation Facilities Management Plan to include measures for installing and maintaining at least two additional seasonal restrooms at the Zoar Picnic Area.	Staff	$0	$6,000	$4,740
Modify BSPC's proposed Recreation Facilities Management Plan to include measures for installing and maintaining a changing facility with at least four changing stalls at the Zoar Picnic Area.	Staff	$10,000	$600	$1,727
Provide seasonal waste receptacles at the Zoar Picnic Area.	Interior, Massachusetts DFW, Whitewater Interest Group	Unknown[h]	Unknown[h]	Unknown[h]
Modify BSPC's proposed Recreation Facilities Management Plan to include measures for installing and maintaining at least six seasonal trash receptacles, with five of them located near picnic tables and one at the exit at the Zoar Picnic Area.	Staff	$400	$400	$366

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Develop a succession plan for the aging trees at the Zoar Picnic Area so that shade is maintained by gradually replacing the trees.	Trout Unlimited, CRC, Deerfield River Watershed Association	$1,000	$0	$125
Modify BSPC's proposed Recreation Facilities Management Plan to include measures that: (1) limit tree cutting at the Zoar Picnic Area to the selective cutting of only hazardous trees to maintain shade at this recreation site; and (2) replace any trees that are removed from the Zoar Picnic Area with new trees at the same site as the removed ones.	Staff	$0	$0	$0
Improve and widen the trail at the Zoar Whitewater Access Area.	Interior, Massachusetts DFW, Whitewater Interest Group	Unknown[h]	Unknown[h]	Unknown[h]
Modify BSPC's proposed Recreation Facilities Management Plan by adding a measure to widen the access trail at the Zoar Whitewater Access Area to a width of 8 feet so that rafts can be carried flat from the road to the river.	Staff	$2,000	$300	$488

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Construct a portage trail around Fife Brook dam.	Whitewater Interest Group	$1,000,000	$12,000	$134,794
Construct a trail between the Visitors Center and the Fife Brook impoundment to provide access to the reservoir.	Whitewater Interest Group	$30,000	$3,000	$6,129
Provide access to the Fife Brook impoundment.	CRC	Unknown[h]	Unknown[h]	Unknown[h]
File regular reports (*i.e.*, every 5 to 10 years) with information on recreation use, shoreline public access, and recreational expenditures.	CRC	$400	$200	$208
Provide free Wi-Fi access at the Fife Brook Fishing and Boating Access Area to improve public safety by providing communications to and from emergency responders.	Interior, Massachusetts DFW, Whitewater Interest Group	$200	$100	$104
Install Wi-Fi or cellular phone coverage in the project area.	CRC	Unknown[h]	Unknown[h]	Unknown[h]

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Modify BSPC's proposed Recreation Facilities Management Plan to improve safety at project recreation sites by installing either an emergency phone or dedicated Wi-Fi access with a limited range to be used for emergency communications at each of the project recreation sites along the Deerfield River downstream of Fife Brook dam.	Staff	$10,000	$500	$1,648
Modify BSPC's proposed Recreation Facilities Management Plan to improve safety at project recreation sites by installing signage at project recreation sites describing the flow releases from Fife Brook dam and the safety warning systems at the sites, including the 15-minute pause at 3 MW.	Staff	$4,000	$100	$580
Improve project safety by installing and maintaining flow release warning systems at project recreation sites and informal access sites downstream of Fife Brook dam.	Trout Unlimited	$12,000	$200	$1,662

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Modify BSPC's proposed Recreation Facilities Management Plan to improve safety at project recreation sites by installing and maintaining warning systems at project recreation facilities downstream of Fife Brook dam to provide warning of water releases from the dam, including auditory and visual warnings.	Staff	$12,000	$200	$1,662
Modify BSPC's proposed Recreation Facilities Management Plan to improve safety at project recreation sites by holding the generator at 3 MW for 15 minutes before increasing outflow to higher levels when increasing outflow from Fife Brook dam.	Staff	$0	$0	$0
Improve project safety by installing flow release warning lights along Zoar Road.	CRC, Trout Unlimited	$10,000	$400	$1,569

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Maintain a public website that provides: (1) the annual schedule for the 106 whitewater flow release days; (2) a 24-hour schedule of the timing and size of flows from the Fife Brook Development to the Deerfield River, to be posted by 5 p.m. on the prior day; (3) current outflow from the Fife Brook dam; (4) updates to the current 24-hour schedule and the current outflow information on a 5-minute basis; and (5) a static map that displays the amount of time it takes for whitewater releases of 800 cfs to flow from Fife Brook dam to each project recreation site.	Staff, CRC	$0	$0	$0
Improve flow information by modifying the Safe Waters website to include information on when current flows began, and updates due to the schedule changes, as well as longer-term schedules.	CRC, Trout Unlimited	$0	$0	$0
Improve the Safe Waters website to include graphs illustrating flows during the previous 24 hours.	CRC	$500	$300	$300

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Provide annual payments to the town of Charlemont to address public health and safety costs.	Interior, Massachusetts DFW, Whitewater Interest Group	Unknown[h]	Unknown[h]	Unknown[h]
Improve the Shunpike Rest Area by constructing and operating a permanent restroom.	Interior, Massachusetts DFW, Franklin Regional Government, town of Charlemont, Whitewater Interest Group, Trout Unlimited, CRC, and Deerfield River Watershed Association	$30,000	$1,200	$4,707

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Conservation Easement				
Renew or make permanent the conservation easement for 1,256 acres of land that is currently protected by a conservation easement, or transfer the land to a conservation organization.	Massachusetts DFW,[g] Whitewater Group, Franklin Regional Government, CRC, Deerfield River Watershed Association	$0	$0	$0
Cultural Resources				
Develop an HPMP to protect historic properties that are eligible for or listed on the National Register.	BSPC, Staff	$15,000	$2,000	$3,460
Project Boundary				
Remove 109.74 acres of land northeast of the upper reservoir that is currently part of a conservation easement.	BSPC, Staff	$0	$0	$0

Enhancement/Mitigation Measures	Entity	Capital Cost	Annual cost[a]	Levelized annual cost[b]
Remove 20.04 acres of land west of the Fife Brook dam that is currently part of a conservation easement.	BSPC, Staff	$0	$0	$0
Remove 31.99 acres of land associated with River Road and land north of Fife Brook impoundment that is currently part of a conservation agreement.	BSPC, Staff	$0	$0	$0
Remove 5.9 acres of land associated with River Road downstream of the Fife Brook dam.	BSPC, Staff	$0	$0	$0
Remove approximately 1.0 acre of land due to minor adjustments to the project boundary line.	BSPC, Staff	$0	$0	$0

(Source: BSPC, staff)

[a] Annual costs typically include operational and maintenance costs and any other costs that occur on a yearly basis.

[b] All capital and annual costs are converted to equal annual costs over a 30-year period to give a uniform basis for comparing all costs.

[c] The Fife Brook turbine-generator is subject to engineering limitations and generally cannot generate at a level less than 3 MW. The outflow corresponding to 3 MW depends on the elevation within the Fife Brook impoundment, which is generally controlled by the Bear Swamp PSD. Therefore, operating in a run-of-release mode may not be possible for certain flow conditions (*i.e.,* between 125 and 650 cfs when the water in the impoundment is at an elevation of 830 feet NGVD) without altering operating procedures for the Fife Brook dam and/or impoundment. For this analysis, Commission staff assumed the tainter gates on the Fife Brook dam could be utilized to pass flows when utilizing flows for generation would not be possible. Annual costs represent generation lost by passing flows through the tainter gates instead of through the Fife Brook powerhouse. Additional capital costs may be needed to modify the tainter gates for this purpose; however, Commission staff does not have sufficient information to evaluate the cost of any capital

improvements. For the period May 2016 through October 2016, inflow from the Deerfield Station No. 5 fell between 125 cfs (minimum flow from the Fife Brook Development) and 650 (flow corresponding to 3 MW output at the Fife Brook powerhouse when the Fife Brook impoundment is at a water level of 830 cfs) approximately 5 percent of the time, which correlates to approximately 467 MWh in lost generation per year.

[d] Based on BSPC's concerns regarding turbine cavitation at low operating ranges, Commission staff assumes the additional 225 cfs needed to meet the 350-cfs minimum flow requirement would not be used for generation. Annual costs represent generation lost by passing flows through the minimum flow release pipes and/or the tainter gates, instead of through the Fife Brook powerhouse. Commission staff assume inflow from Deerfield Station No. 5 is sufficient to meet the 350 cfs minimum flow requirement; however, storing additional water in the Fife Brook impoundment would likely be needed to account for inflow fluctuations, which may impact the Bear Swamp PSD's ability to utilize the full 4,600 acre feet of fluctuation between impoundments. For the period May 2016 through October 2016, 88 percent of outflows from the Fife Brook impoundment were 350 cfs or less. Assuming 88 percent of the additional 225 cfs outflows from the Fife Brook impoundment would need to be passed through the minimum flow release pipes and/or tainter gates equates to approximately 3,640 MWh in lost generation for the period November 1 through April 15.

[e] The recommendation is consistent with current project operation.

[f] Commission staff assumes additional water would need to be maintained within the Fife Brook impoundment to provide the recommended ramping schedule. The annual costs of the recommended measure assume no lost generation at the Fife Brook Development and instead account only for the impact to the Bear Swamp PSD's ability to utilize the full 4,600 acre-feet of fluctuation between impoundments. In estimating this cost, Commission staff assumes the Bear Swamp PSD peaks once daily at the 2 p.m. peak hourly demand for the year.

[g] Section 10(j) recommendation.

[h] The recommendation lacks specificity needed to estimate a cost.

[i] Since the current license already requires whitewater flows to be released between 9:30 a.m. and 12:00 p.m., Commission staff assumes providing whitewater flow releases beginning at 10 a.m. would not cause any additional costs to project operations.

[j] Flows between 900 and 1,100 cfs fall within the hydraulic capacity of the Fife Brook powerhouse. Commission staff assume there would be no lost generation associated with passing exact inflow volumes provided from the upstream Deerfield Station No. 5.

[k] Commission staff assumes shifting the days of whitewater releases or increasing the number of releases falls within BSPC's ability to operate the Bears Swamp PSD and Fife Brook Development without any additional costs to project operations.

[l] Commission staff assumes delaying generation for 1 hour until 3 p.m. would not result in lost generation costs at the Bear Swamp PSD. However, delaying generation at the Bear Swamp PSD after the 2 p.m. peak hourly demand may constrain BSPC's ability to provide generation and ancillary services during the peak demand period, the costs of which are not accounted for here.

[m] Commission staff assumes the Bear Swamp PSD pumps water into the upper reservoir in the early morning (before 6 a.m.) and peaks once daily, beginning at the 2 p.m. peak hourly demand for the year or later.

[n] Massachusetts DFW identifies this plan as an Invasive Wildlife Species Monitoring Plan. However, based on the discussion provided in its section 10(j) recommendation, we interpret this recommendation to apply specifically to invasive mussel species.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

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

Based on our independent review of agency and public comments filed on the project and our review of the environmental and economic effects of the proposed project and project alternatives, we selected the staff alternative as the preferred alternative. We recommend this alternative because: (1) issuing a new license for the project would allow BSPC to continue to operate its project as a dependable source of electrical energy; (2) the public benefits of the staff alternative would exceed those of the no-action alternative; and (3) the staff-recommended measures would protect and enhance fish and wildlife resources, federally threatened species, recreation opportunities, and cultural and historic resources.

In the following section, we make recommendations as to which environmental measures proposed by BSPC or recommended by agencies or other entities should be included in any license issued for the project. In addition to BSPC's proposed environmental measures listed below, we recommend additional environmental measures to be included in any license issued for the project, and we describe these requirements in the draft license articles in Appendix A.

5.1.1 Measures Proposed by BSPC

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

- Continue to provide a 125-cfs continuous minimum flow release from the Fife Brook dam to protect fish and aquatic resources in the Deerfield River;

- Develop an Operation Compliance Monitoring Plan that describes: (1) the mechanisms and structures that will be used to provide minimum flow releases and whitewater flow releases; (2) periodic maintenance and calibration for any installed measuring devices; and (3) procedures for recording and reporting data to FERC and resource agencies;

- Develop an Invasive Mussel Species Monitoring and Management Plan that includes the following measures to minimize the spread of invasive mussel species at the project, including dreissenid mussels (e.g., zebra mussels and quagga mussels): (1) educational training for project maintenance staff; (2) educational signage; (3) best management practices for minimizing the spread of invasive mussel species during project-related construction and maintenance activities; and (4) rapid notification, coordination, and response with appropriate federal and state resource agencies in the event invasive dreissenid mussel species are detected at the project.

- Develop a State-Listed Rare Plants Management Plan that includes measures to minimize adverse project effects on state-listed rare plants;

- Develop an Invasive Plant Species Monitoring and Management Plan that includes measures to reduce the spread of invasive plant species, including: (1) educating recreational users on ways to reduce the spread of invasive plant species; (2) implementing best management practices, such as identifying invasive plant species that may be introduced by a given project-related activity, identifying critical control points (locations and times), and implementing measures to prevent the spread of invasive plant species during routine project operation and maintenance activities; (3) recording incidental observations of invasive plant species; and (4) using only native seed and plant materials outside of lawn areas;

- Develop a Bald Eagle Protection Plan that includes provisions to: (1) avoid killing, injuring, or harassing bald eagles during tree cutting or thinning operations at the project; and (2) minimize project effects on nesting bald eagles at the project;

- Develop a Recreation Facilities Management Plan that includes provisions to: (1) continue operating and maintaining the existing project recreation facilities; (2) design and construct a new boater egress trail that begins downstream from the Showtime rapid and extends upstream to the existing vehicle turnaround at Great River Hydro’s Dunbar Brook Picnic Area, which is part of Deerfield Station No. 5; (3) enhance overflow parking at the Fife Brook Fishing and Boating Access Area; (4) widen the access trail at the Zoar Whitewater Access Area; (5) install additional seasonal restroom facilities, a stall-type changing facility, and an additional staircase at the Zoar Picnic Area; (6) install handrails on staircases at project recreation areas; and (7) install additional signage to educate recreationists on safety and the Deerfield River flow regime;

- Continue to provide 106 annual whitewater flow releases from the Fife Brook dam for a minimum duration of 3 hours on 50 weekend days and 56 weekdays from April 1 through October 31;

- Increase whitewater flow releases from 700 cfs to 800 cfs; and

- Develop an HPMP to protect historic properties that are eligible for or listed on the National Register.

5.1.2 Additional Measures Recommended by Staff

In addition to BSPC's proposed measures noted above, we recommend including the following measures in any license that may be issued for the Bear Swamp Project.

- When decreasing outflow from the Fife Brook dam, ramp down the generation/whitewater flow release to the 125-cfs minimum flow release over a one-hour period from March 15 through June 30 to protect emerging trout fry;

- Incorporate the following measures for nesting bald eagles from the FWS's 2007 *National Bald Eagle Management Guidelines* in BSPC's proposed Bald Eagle Protection Plan: (1) keep a distance of at least 330 feet between the activity and the nest (distance buffers); (2) maintain forested (or natural) areas between the activity and around nest trees (landscape buffers); and (3) avoid construction and maintenance activities during the breeding season;

- Avoid cutting trees greater than 3 inches in width at breast height, between June 1 and July 31, to protect NLEB;

- Modify BSPC's proposed Recreation Facilities Management Plan by adding the following measures to improve boating in the upper reaches of the Fife Brook impoundment: (1) construct and maintain a boater take-out site downstream of the Showtime rapid, along with the new boater egress trail proposed by BSPC; and (2) install signs along the river to guide boaters to the take-out;

- Modify BSPC's proposed Recreation Facilities Management Plan by adding the following measures to improve parking at the Fife Brook Fishing and Boating Access Area: (1) create up to 10 additional spaces at the unpaved, off-site overflow parking area by removing vegetation and placing gravel throughout the parking area; and (2) mark the parking spaces at the overflow parking area to enable the most efficient use of the space;

- Modify BSPC's proposed Recreation Facilities Management Plan by adding a measure to widen the access trail at the Zoar Whitewater Access Area to a width of 8 feet so that rafts can be carried flat from the road to the river;

- Modify BSPC's proposed Recreation Facilities Management Plan to include measures for installing and maintaining the following amenities at the Zoar Picnic Area: (1) at least two additional seasonal restrooms; (2) a changing facility with at least four changing stalls; and (3) at least six seasonal trash receptacles, with five of them located near picnic tables and one at the exit;

- Modify BSPC's proposed Recreation Facilities Management Plan to include measures that: (1) limit tree cutting at the Zoar Picnic Area to the selective cutting of only hazardous trees to maintain shade at this recreation site; and (2) replace any trees that are removed from the Zoar Picnic Area with new trees at the same site as the removed ones;

- Modify BSPC's proposed Recreation Facilities Management Plan to include measures for operating and maintaining two undeveloped access sites (*i.e.*, the "Carbis Bend" and the "Bridge to Nowhere" access sites), as project recreation sites to ensure safe river access for anglers in the Deerfield River downstream of the Fife Brook dam;

- Modify BSPC's proposed Recreation Facilities Management Plan to include the following measures for improving safety at project recreation sites: (1) install and maintain warning systems at project recreation facilities downstream of Fife Brook dam to provide warning of water releases from the dam, including auditory and visual warnings; (2) when increasing outflow from Fife Brook dam, hold the generator at 3 MW for 15 minutes before increasing outflow to higher levels; (3) install signage at project recreation sites describing the flow releases from Fife Brook dam and the safety warning systems at the sites, including the 15-minute pause at 3 MW; and (4) install either an emergency phone or dedicated Wi-Fi access for emergency communications with a limited range at each of the project recreation sites along the Deerfield River downstream of Fife Brook dam;

- Release the 106 scheduled whitewater flows from Fife Brook dam beginning at 10 a.m., instead of between 9:30 a.m. and 12:00 p.m. as proposed by BSPC;

- Maintain a public website that provides: (1) the annual schedule for the 106 whitewater flow release days; (2) a 24-hour schedule of the timing and size of flows from the Fife Brook Development to the Deerfield River, to be posted by

5 p.m. on the prior day; (3) current outflow from the Fife Brook dam; (4) updates to the current 24-hour schedule and the current outflow information on a 5-minute basis; and (5) a static map that displays the amount of time it takes for whitewater releases of 800 cfs to flow from Fife Brook dam to each project recreation site; and

- Maintain the elevation of the Fife Brook impoundment at or below 835 feet NGVD until 12 p.m. on the 32 days of the year when the Deerfield Station No. 5 is scheduled to release whitewater flows to allow for whitewater recreation opportunities in the rapids located in the upper extent of the Fife Brook impoundment.

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

Down Ramping Fife Brook Dam Outflows

Trout Unlimited recommends a 1-hour ramp down period following all flow releases from March 15 through June 30 to protect emerging trout fry. As described in section 3.3.1.2, *Aquatic Resources, Environmental Effects, Additional Flows in the Deerfield River Downstream of Fife Brook Dam*, under the current project operation, flows downstream of Fife Brook dam return to 125 cfs approximately 1 hour after BSPC ceases generation. However, BSPC has no formalized down-ramping procedure and is not proposing to implement one. The current down-ramping rate provides some time for any fish that may have moved into shallow water at generation flows to return to deeper water as flows recede following generation. Based on the benefits to aquatic resources in the downstream reach that are provided by a 1-hour down-ramp, staff recommends implementing this measure. Because this measure is consistent with current project operation, there would be no additional cost associated with it.

Bald Eagle Protection Plan

BSPC proposes to develop a Bald Eagle Protection Plan in consultation with Interior and Massachusetts DFW, including provisions to: (1) avoid killing, injuring, or harassing bald eagles during tree cutting or thinning operations at the project; and (2) avoid/minimize project effects on nesting bald eagles at the project. Incorporating the following specific measures detailed in FWS's 2007 *National Bald Eagle Management Guidelines* would protect nesting bald eagles from disturbance associated with construction and/or maintenance activities: (1) keeping a distance of at least 330 feet between the activity and the nest (distance buffers); (2) maintaining forested (or natural) areas between the activity and around nest trees (landscape buffers); and (3) avoiding construction and maintenance activities during the breeding season. This measure would ensure that bald eagle nesting habitat is protected from project-related activities, at no additional cost to BSPC.

Northern Long-Eared Bat Protection

As discussed in section 3.3.4, *Threatened and Endangered Species*, the federally threatened NLEB is likely present in the project area and maternity roosts could potentially occur in the project boundary and be affected by project maintenance. Specifically, project maintenance activities and proposed recreation site improvements have the potential to disturb bats if tree cutting or thinning were to occur during roosting or other phases in their reproductive life cycle. Trees provide valuable habitat for NLEB during their roosting reproductive phase, which takes place in the summer months, and tree removal during these months may disturb NLEB. Implementing a seasonal clearing restriction for trees greater than 3 inches in width at breast height, between June 1 and July 31, would avoid the time period when NLEB may be occupying nearby roosting trees, at no additional cost to BSPC. This measure would ensure that NLEB is protected from project-related activities, at no additional cost to BSPC.

Recreation Facilities Management Plan

BSPC proposes to develop a Recreation Facilities Management Plan within 12 months of license issuance that includes provisions for operating, maintaining, and improving project recreation facilities. Currently, there is no formal plan for managing project recreation facilities. The Recreation Facilities Management Plan would ensure that project facilities are properly operated and maintained for the term of any new license issued for the project. In addition, the plan includes measures for improving site access, safety, and sanitation at recreation sites in the project boundary, which would improve conditions at recreation sites during periods of high demand for whitewater boating. Because of these benefits to recreation, we recommend the development of the plan and conclude that it is worth the approximate levelized annual cost of $6,456. We address specific components of the plan below in the context of the recreation facilities that would be affected by the proposed measures.

<u>Recreation in the Fife Brook Impoundment</u>

BSPC proposes to design and construct a new boater egress trail that would begin downstream of the Showtime rapid and extend upstream to the existing vehicle turnaround at Great River Hydro's Dunbar Brook Picnic Area.

There are no project recreation facilities that provide access to the Fife Brook impoundment, and there is currently no direct public access to the Fife Brook impoundment. However, boaters that use the Dunbar Brook Picnic Area or Monroe Bridge put-in locations to access the bypassed reach of Deerfield Station No. 5 can boat downstream to the Fife Brook impoundment. Three Class IV rapids (Dragon's Tooth, Labyrinth, and Showtime) occur in the bypassed reach of Deerfield Station No. 5, which overlaps with the upper extent of the Fife Brook impoundment. Boaters who use the Showtime rapid must exit from the Deerfield River and then carry their boats along rocky terrain on the shoreline for up to 1,000 feet to gain access to the upstream takeout. The rough terrain and length of the walk with boating equipment present an egress issue for boaters. Constructing and maintaining a boater take-out site downstream of the Showtime rapid, along with the new trail proposed by BSPC, would allow boaters to exit the river safely after completing the whitewater run through the Showtime rapid. Additionally, installing signs along the river to guide boaters to the take-out would improve the upstream whitewater boating experience by improving egress. Because this trail and take-out would improve access for whitewater boaters, Commission staff recommend it and conclude that it is worth the estimated levelized annual cost of $5,171.

Fife Brook Fishing and Boating Access Area Improvements

BSPC proposes, as part of its Recreation Facilities Management Plan, to address overflow parking at the Fife Brook Fishing and Boating Access Area and/or enhance the existing overflow parking area.

On days when BSPC is scheduled to release flows for whitewater boating during the peak summer season, the parking areas at the Fife Brook Fishing and Boating Access Area are frequently at or over capacity. The facility currently has parking for 8-10 vehicles on-site, and parking for an additional 25 vehicles at the unpaved, overflow area across River Road (about 500 to 1,000 feet from the put-in). During peak demand periods for whitewater boating, BSPC has observed crowding in the parking area and vehicles parked along the road. Increasing parking on-site, or at the overflow area, would reduce the crowding that occurs at the Fife Brook Fishing and Boating Access Area during the peak summer season. It would also reduce the number of vehicles parked along the road. This would make the access area easier and safer to use, especially on peak use days when the site is used at capacity.

Commission staff recommend improving parking at the Fife Brook Fishing and Boating Access Area to improve site access and safety. However, BSPC does not specify what measures they are proposing to implement to improve parking at the Fife Brook Fishing and Boating Access Area. Based on the level of demand at this area, staff recommends the construction of more parking spaces at the Fife Brook Fishing and Boating Access Area, by: (1) creating up to 10 additional spaces at the unpaved, off-site overflow parking area by removing vegetation and placing gravel throughout the parking area; and (2) marking the parking spaces at the overflow parking area to enable the most efficient use of the space. Commission staff concludes that the benefits of these measures for recreation access are worth the estimated levelized annual cost of $1,648.

Zoar Whitewater Access Area

Interior, Massachusetts DFW, and the Whitewater Interest Group state that BSPC should be required to improve and widen the trail at the Zoar Whitewater Access Area that leads to the Deerfield River downstream of Fife Brook dam, so that rafts can be carried flat from the road to the river. BSPC, in its response to comments, proposes to widen the access trail at the Zoar Whitewater Access Area. Neither BSPC nor stakeholders propose an exact width for the trail.

The Zoar Whitewater Access Area provides access to whitewater features in the Deerfield River, including the Class III Zoar Gap rapid. Although there is no information on the exact width of the existing trail, it is apparent from comments that the trail is not currently wide enough to carry a raft flat through the trail. Widening the trail would make it easier for recreationists to travel between the parking area and the river, especially whitewater recreationists that are carrying wide inflatable rafts. A typical inflatable raft used by a whitewater outfitter can be at least 5-feet wide, and as much as 7-feet wide. Widening the trail to be 8 feet wide would allow for most rafts to be carried flat along the trail. Because widening the trail to 8 feet would improve recreation at the project, we recommend this measure and conclude it is worth the estimated levelized annual cost of $488.

Zoar Picnic Area Improvements

BSPC is proposing to increase the number of seasonal restroom facilities, provide a stall-type changing facility at the Zoar Picnic Area. Interior, the Whitewater Interest Group, and Massachusetts DFW state that BSPC should provide seasonal waste receptacles to mitigate dumping along the riverbank and in the woods surrounding the picnic area. Stakeholders also state that BSPC should construct a second set of steps downstream of the existing set of stairs to improve river access at the site. In its response to comments, BSPC proposes to construct a second set of steps at the Zoar Picnic Area. Separately, Trout Unlimited, CRC, and the Deerfield River Watershed Association state that BSPC should be required to prepare a succession plan for the aging trees at the Zoar Picnic Area so that shade is maintained by gradually replacing the trees instead of cutting down all of the trees at the same time.

The Zoar Picnic Area provides a number of recreation opportunities and is heavily used by anglers and boaters, especially during the whitewater recreation season. Visitor use data from the 2016 Recreation User Survey shows that the existing three seasonal restrooms at the Zoar Picnic Area are inadequate to accommodate user demand during the peak summer recreation season and holiday weekends. Additional seasonal restrooms would improve sanitation and reduce wait times for restroom use at the site, which, according to the Deerfield River Watershed Association, are long enough to cause some users to relieve themselves along the river. BSPC does not propose a specific number of additional seasonal restrooms for the site. Given the level of demand at this site during the summer boating season, installing at least two additional porta-potties between the months of April and October would improve sanitation at this site. We conclude that the benefits of installing additional seasonal restrooms outweigh the estimated annual levelized cost of $4,740.

There is no changing facility at the site, and little to no privacy for river users who wish to change into dry clothes. Installing a changing facility at the Zoar Picnic Area, as proposed by BSPC, would increase privacy for recreation users that need to change out of wet clothes associated with water recreation. In addition, installing a changing facility would reduce the use of restrooms for changing clothes, thereby reducing wait times for restrooms. A facility with at least four changing stalls would provide the ability for multiple people to change at once as well as reduce restroom use. We conclude that the benefits of such a facility would be worth the estimated levelized annual cost of $1,727.

Installing and maintaining seasonal trash receptacles between April and October would reduce litter at the site and improve sanitation and aesthetics, provided that they are emptied regularly, numerous enough, and conveniently located to encourage use. Installing at least six receptacles, with one located close to approximately every five picnic tables and another one located by the site exit, would ensure that the trash receptacles are readily available and evenly distributed across the picnic site to encourage use. We conclude that the installation of at least six trash receptacles at the site would improve recreation at the project, and conclude that benefits to sanitation and aesthetics outweighs the estimated levelized annual cost of $366.

Although BSPC is not proposing to remove trees from any project recreation sites at this time, vegetation maintenance at project recreation sites can be necessary for public safety reasons or to protect important infrastructure. At the same time, removing all of the mature trees from the Zoar Picnic Area would have an adverse effect on recreation at the site. This is because the Zoar Picnic Area is the last boat take-out along the Deerfield River at the downstream end of the project boundary, and provides shade for large groups of boaters that have been exposed to the sun for up to several hours during the summer season while boating downstream from the Fife Brook Fishing and Boating Access Area. In its current state, the site can provide shaded conditions for dozens of recreation users on hot summer days that are using the 22 grills and 22 picnic tables at the site.

To ensure that shade continues to be provided at the Zoar Picnic Area, staff recommends limiting tree cutting at the Zoar Picnic Area to the selective cutting of only hazardous trees. To the extent that a hazardous tree needs to be removed from the Zoar Picnic Area during the term of any new license, staff recommends that the tree be replaced by another tree that, upon maturity, would provide the same shade benefits as the tree that is removed. Staff recommends that these measures be included in the Recreation Facilities Management Plan. These measures would ensure that recreation use at the site is not adversely affected by significant changes in the amount of shade, and would only impose minimal costs on the licensee to the extent that a hazardous tree needs to be removed and replaced during the term of any new license. With these measures in place, the succession plan recommended by Trout Unlimited, CRC, and the Deerfield River Watershed Association would not be needed to ensure that an adequate amount of shade continues to be provided at the Zoar Picnic Area.

Additional Recreation Access Areas

There are 10 undeveloped non-project recreation areas that provide access to the Deerfield River downstream of Fife Brook dam. During the course of the relicensing proceeding, it became apparent through stakeholder comments at public meetings and through other studies that these informal sites provide important recreation access for anglers at the project. Specifically, these sites provide access to fishing areas that are not reachable from the project recreation sites. In addition, these sites can provide a quieter and more natural fishing experience than can be found at the developed project recreation sites that receive heavier use by other recreation users, such as rafters and kayakers.

The Carbis Bend and Bridge to Nowhere recreation sites were referenced by stakeholders in correspondence with BSPC that is included in the FLA, and these sites were included in the Angler Wading Study after consultation with the Angler Wading Study Working Group. Operating and maintaining these two undeveloped sites as project recreation facilities would ensure that river access is provided for anglers in the Deerfield River downstream of the dam. Because of the benefits to recreation, Commission staff recommend operating and maintaining these access areas as undeveloped project recreation sites, and conclude that the benefits outweigh the estimated levelized annual cost of $395.

Project-Wide Recreation Safety Improvements

Warning System

The Franklin Regional Government comments that the current measures that are used at the project to warn recreation users of increasing flow releases from the Fife Brook dam is ineffective and provides little warning to downstream anglers of rising waters. Trout Unlimited recommends installing a flow release warning system using light installations at formal and informal recreation areas. In its response to comments, BSPC proposes to work with the Commission's Division of Hydropower Administration and Compliance to ensure that the January 2012 Public Safety Plan sufficiently addresses any safety issues related to the audibility of the downstream warning system. BSPC does not propose any specific revisions to its existing January 2012 Public Safety Plan for the project.

As determined by the warning system effectiveness study, BSPC's existing siren-based downstream warning system does not adequately warn recreation users when higher flows are being released from Fife Brook dam to the Deerfield River. The siren is located at the Fife Brook dam, and is only audible under ideal conditions at the Fife Brook Fishing and Boating Access Area, which is just 0.4 mile downstream of the dam. It is not audible at any of the other downstream recreation sites. Given the abundance of noise sources and the acoustics within the Deerfield River Valley (*e.g.*, traffic, trains, wildlife, recreation users), the lone siren at the Fife Brook dam is not adequate to ensure safety downstream of the project.

Installing warning systems at project recreation sites downstream of Fife Brook dam would provide warning of water releases directly at the sites where anglers and other recreationists would be located. Warning systems that employ both auditory and visible signals, such as horns and flashing red lights, would be more noticeable to people on the river than just a sound or light alone. A warning system could be positioned at each site so as to be most visible and audible to both people entering the water and those already in the river. Such warning systems could be either connected to the existing power line that runs along the road, or could be powered by alternative power sources, such as solar power. Sequential activation of each warning unit could be timed to coincide with the downstream advancement of rising waters, which could provide a more accurate indication of when rising waters would arrive at a site. Installation of such warning systems would be an improvement over the existing warning system, and increase safety for recreationists downstream of the Fife Brook dam. Warning units should be placed at the Fife Brook Fishing and Boating Access Area, the Zoar Whitewater Access Area, the Zoar Picnic Area, and the staff-recommended Carbis Bend and Bridge to Nowhere sites.[148] Because installation of such warning systems would improve project safety over the existing siren at the Fife Brook dam, we conclude that it is worth the estimated levelized annual cost of $1,662 and recommend it.

Generator Ramping

To avoid sudden increases in flow downstream of Fife Brook dam, BSPC currently ramps its generator at the Fife Brook Development to 3 MW, and holds the generator at 3 MW for 15 minutes before increasing generation to higher output levels.[149] BSPC provides the 15-minute pause as an in-water safety measure to alert fishermen to rising water levels from a generation flow release. BSPC proposes to discontinue the 15-

[148] Carbis Bend and the Bridge to Nowhere are currently undeveloped non-project recreation access sites. The staff alternative recommends including these as project recreation sites.

[149] As discussed in section 2.1.4 (*Existing Project Operation*), BSPC does not run the turbine-generator at the Fife Brook Development below an output of approximately 3 MW due to rough operating conditions that are encountered when output reaches this level. A generator output of 3 MW is equivalent to a discharge of between 270 cfs and 650 cfs from the Fife Brook dam, depending on the elevation of the impoundment.

minute pause at 3 MW because it states that the measure has not been effective in providing an adequate signal to alert fisherman to rising water levels.

BSPC's proposal to discontinue its practice of holding the generator at 3 MW for 15 minutes before increasing generation to higher output levels would remove a safety measure for downstream river users. Hydropower generation at the Fife Brook Development increases outflow from the 125-cfs minimum flow to up to maximum hydraulic capacity of 1,540 cfs. An increase in flow from 125 cfs to 900 cfs, for example, results in a corresponding change of 2.62 feet in the depth of the Deerfield River. The current practice of pausing the generator ramp-up for 15 minutes at lower flows provides recreation users in the Deerfield River downstream of Fife Brook dam with a warning that a further increase in generation outflow is imminent, and that they should get out of the river. This increase is evident even if the audible or visual warning systems malfunction. Continuing to hold generation at 3 MW for 15 minutes during the recreation season (April 1 through October 31) would cost $0 because BSPC is already implementing this measure. Staff recommends this measure based on the benefits for public safety.

Communication with Emergency Services

CRC states that BSPC should install Wi-Fi or cellular phone coverage in the project area because a cellular phone signal is not available for emergency calls or access to the river flow information. Interior, the Whitewater Interest Group, and Massachusetts DFW state that BSPC should provide free Wi-Fi access at the Fife Brook Fishing and Boating Access Area to improve public safety by providing communications to and from emergency responders. In its response to comments, BSPC states that it currently provides recreation users at the Fife Brook Fishing and Boating Access Area with a dedicated Wi-Fi connection to the "Safe Waters" website, which provides information regarding real-time flow schedules. BSPC is not proposing improvements to cellular phone or Wi-Fi infrastructure at the project.

There is currently no means of contacting emergency services at many, if not all, of the project recreation sites because of the rural nature of the project and the mountainous topography that blocks what cellular phone service is available. River use, especially whitewater rafting, has inherent danger. An emergency phone line or dedicated Wi-Fi service with a limited range would allow for communications during emergencies at the project, which would improve the timeliness of emergency services for recreation users at the project. We conclude that the public safety benefits of installing either an emergency phone or dedicated Wi-Fi access for emergency communications with a limited range at each of the project recreation sites along the Deerfield River downstream of Fife Brook dam would be worth the estimated annual levelized cost of $1,648, and recommend it.

Signage

BSPC proposes to install additional signage downstream from the Fife Brook dam that will provide information on the flow regime and river safety. The Whitewater Interest Group requests that BSPC install additional signage to educate recreationists on safety and the Deerfield River flow regime.

There are eight signs downstream of Fife Brook dam that warn the public of rising waters. The signs do not provide information on the flow regime, the warning system at the project, or other information on river safety (BSPC, 2009). Installing signs at the project recreation sites downstream of Fife Brook dam would ensure that river users would be informed of potential dangers, safety measures, and river conditions that they could expect to encounter at the project. Information describing flow releases from Fife Brook dam and the safety warning system, including the 15-minute pause at 3 MW, would increase public safety at the project. Based on the improvements to public safety that would be provided by the installation of additional signs at the project recreation sites, we conclude that the additional signs are worth the estimated levelized annual cost of $580, and recommend installing them at the project.

Timing of Whitewater Flow Releases

The current license requires BSPC to begin releasing scheduled whitewater flows between 9:30 a.m. and 12 p.m. on the day of the scheduled release. Interior, CRC, and Trout Unlimited recommend releasing whitewater flows from Fife Brook dam earlier in the day (at or before 10 a.m.) to provide more suitable water temperatures for trout downstream of Fife Brook dam during the summer months.

The Bear Swamp Project is located on a reach of the Deerfield River that is classified as a Class B waterway with a cold water qualifier by the State of Massachusetts. The cold water qualifier is applied to streams capable of supporting a year-round population of cold water-adapted aquatic life, such as trout. The state water quality standards require that the temperature in the waterway not exceed 68°F based on the mean of the daily maximum temperature over a seven-day period in cold water fisheries, unless naturally occurring. Although water temperatures did not exceed 68°F on average at any monitoring locations during the 2016 Water Quality Monitoring Study, water temperatures increased with distance downstream of Fife Brook dam and did exceed 68°F on occasion in the Deerfield River. Water quality data suggests that the observed increase in water temperature downstream of the Fife Brook dam is a natural process unrelated to operation of the project.

As discussed in section 3.3.2, *Environmental Effects*, *Water Temperature*, there is no evidence that releasing water from Fife Brook dam at or before 10 a.m. would provide cooling downstream. Based on an analysis of the timing of flow releases on days when water temperature exceeded 68°F in the Deerfield River during the Water Quality Monitoring Study, it is evident that releases from Fife Brook dam before 10 a.m. still result in water temperatures above 68°F. Therefore, this additional measure would not significantly benefit water temperature or trout.

Despite the lack of benefits associated with water temperate, beginning the whitewater flow release at 10 a.m. could increase survival for dragonflies in the Deerfield River and provide greater predictability on the timing of whitewater flows for recreation users.

As discussed in section 3.3.2, *Environmental Effects*, *Dragonfly Ramping Rates*, the effect of beginning to release whitewater flows at 10 a.m. on dragonflies depends on when the rising water levels associated with whitewater flow releases reach locations where dragonflies are emerging and eclosing [*i.e.*, metamorphosing from larvae to adults]. If BSPC begins the whitewater flow release at 10 a.m., the flow release could adversely affect approximately 25 percent of dragonflies that emerge on a particular day at Site 4 (*i.e.*, the site with the greatest abundance of dragonflies that is located closest to the Fife Brook dam (see Table 10)); however, stable water levels before and after this period would allow dragonflies to complete emergence and survive to adulthood. In addition, whitewater flows would arrive at downstream sites later in the day when a smaller fraction of dragonflies emerge.

Beginning to release whitewater flows at 10 a.m. daily would provide greater predictability to the timing of whitewater flow releases. Although BSPC already provides the timing of the flow release schedule on the Safe Waters website, consistently releasing whitewater flows at 10 a.m. on all scheduled whitewater days would minimize the amount of variability in the flow release schedule, which could benefit commercial outfitters that are scheduling rafting trips in advance of the whitewater flow release day. Beginning to release whitewater flows at 10 a.m. daily would also provide parity with the timing of whitewater flow releases from the Deerfield Station No. 5 that is located immediately upstream of the project. The licensee for Deerfield Station No. 5 is required to provide whitewater flow releases beginning at 10 a.m. on 26 weekend days.

Since the current license already requires whitewater flows to be released between 9:30 a.m. and 12:00 p.m., consistently providing a whitewater flow release beginning at 10 a.m. on the 106 scheduled whitewater days would not be expected to add to the existing cost of providing whitewater flows. Based on the benefits to aquatic resources, including dragonflies and trout, and to recreation users, staff recommends this measure.

Flow Release Information

CRC and Trout Unlimited state that the Safe Waters website, which provides information on flow releases from Fife Brook dam,[150] does not provide information necessary for recreation users to know when flows from the Fife Brook impoundment will reach downstream locations for fishing and boating.

BSPC's Safe Waters website provides a 24-hour schedule of the timing and size of flows from the Fife Brook Development to the Deerfield River. The information provided by the Safe Waters website includes the start and end times for various flows that will be released over the 24-hour period, and the current outflow from the Fife Brook dam. From a review of the information available on the Safe Waters website, it appears that BSPC updates the current flow every 5 minutes.

Requiring BSPC to continue providing flow information on the Safe Waters website, or another public website, would ensure that flow information is available for recreation users to know when BSPC is releasing flows from the Fife Brook dam. Therefore, staff recommends that BSPC continue to maintain a public website that provides: (1) the annual schedule for the 106 whitewater flow release days; (2) a 24-hour schedule of the timing and size of flows from the Fife Brook Development to the Deerfield River, to be posted by 5 p.m. on the prior day; (3) current outflow from the Fife Brook dam; and (4) updates to the current 24-hour schedule and the current outflow information on a 5-minute basis.

Although current outflow information is available for the public via the Safe Waters website, recreation users may not be aware of when outflows from Fife Brook dam would be expected to reach a specific project recreation site downstream of the Deerfield River. Flows that are released from the dam reach project recreation sites at different times, depending on how far downstream of the dam a site is located and the velocity of the flow. Posting a static map on the Safe Waters website and at each project recreation site that displays the amount of time it takes for flows (*e.g.*, whitewater flow releases of 800 cfs) to reach each project recreation site would ensure that recreation users have the information necessary to estimate the approximate time when flows from the Fife Brook impoundment would be expected to reach downstream locations for fishing and boating. The estimated annual levelized cost of providing a static map on the Safe Waters website (or a similar public website) and at each project recreation site would be minimal. Staff concludes that the benefits of posting the map outweigh the costs, and recommends it.

[150] Brookfield Renewable Partners, L.P., *Fife Brook*, available at https://www.safewaters.com/facility/22.

Impoundment Elevation for Whitewater Features

The Whitewater Interest Group recommends that BSPC hold the Fife Brook impoundment at 835 feet NGVD during the 32 scheduled whitewater flow releases that are provided on an annual basis from the Deerfield Station No. 5's dam. The Whitewater Interest Group states that holding the Fife Brook impoundment at 835 feet NGVD would provide more whitewater boating opportunities by exposing whitewater features that are inundated as a result of project operations in the upper reaches of the Fife Brook impoundment.

Three Class IV rapids (Dragon's Tooth, Labyrinth, and Showtime) occur in the upper extent of the Fife Brook impoundment between elevations 834 and 845 feet NGVD. When the Fife Brook impoundment is below 834 feet NGVD, the Class IV rapids are fully exposed and available for whitewater boating. When the elevation of the Fife Brook impoundment increases, a backwater effect occurs that inundates the rapids and reduces the opportunity for whitewater boating.

The upstream Deerfield Station No. 5 is required to provide 32 scheduled whitewater flow releases of 900 cfs to 1,100 cfs between May 1 and October 21 annually, for a duration of 4 to 5 hours until 3 p.m. in the day. Encroachment of the impoundment on the Class IV rapids during a scheduled whitewater release from the upstream Deerfield Station No. 5 dam diminishes the quality of the whitewater boating experience. The operation of the Bear Swamp Project affects the Showtime rapid most often (65 percent of the time) due to the elevation of the rapid at 834 feet NGVD.

The Whitewater Interest Group's recommendation to hold the Fife Brook impoundment at 835 feet NGVD during the 32 scheduled whitewater releases from Deerfield Station No. 5 would reduce encroachment on the rapids during the whitewater releases, and thereby increase whitewater recreation opportunities in the upper extent of the Fife Brook impoundment.

Holding the elevation of the Fife Brook impoundment at or below 835 feet would place a constraint on hydropower production at the Bear Swamp PSD on the 32 release days. Specifically, the licensee would not be able to generate electricity at the Bear Swamp PSD until after 3 p.m. on the day of a whitewater flow release from the Deerfield Station No. 5 dam because generation flows from the upper reservoir would rapidly increase the elevation of the Fife Brook impoundment.[151] Although electricity could still be produced at the Bear Swamp PSD after the whitewater flow release ends at 3 p.m., the

[151] Operating the Bear Swamp PSD at the maximum hydraulic capacity of 10,860 cfs would increase the elevation of the Fife Brook impoundment from 830 feet NGVD to 835 NGVD in approximately 30 minutes.

Whitewater Interest Group's recommendation could render the Bear Swamp PSD unavailable for providing capacity, generation, and ancillary services during periods of peak energy demand.

The highest peak demand periods of the year in the New England region have historically occurred as early as 2 p.m.,[152] and the Bear Swamp PSD could be needed for generation and ancillary services in the hours preceding or following the 2 p.m. hour. To ensure that the Bear Swamp PSD is available to help meet the New England region's power requirements and capacity needs during periods of peak energy demand, while also reducing encroachment on the rapids during the whitewater releases, we recommend maintaining the elevation of the impoundment at or below 835 feet NGVD until 12 p.m. on the 32 days when the Deerfield Station No. 5 is scheduled to release whitewater flows.

5.1.3 Measures Not Recommended

Some of the measures proposed by BSPC and recommended by other interested parties would not contribute to the best comprehensive use of Deerfield River water resources, do not exhibit sufficient nexus to the project environmental effects, or would not result in benefits to non-power resources that would be worth their cost. The following discussion includes the basis for staff's conclusion not to recommend such measures.

Run-of-Release Operation

BSPC proposes to continue operating the Fife Brook Development in a "run-of-release mode reacting to, and passing inflows from [Deerfield] Station No. 5." BSPC also proposes to continue releasing a minimum flow of 125 cfs from the Fife Brook dam to protect aquatic habitat in the Deerfield River. During unplanned generator outages, BSPC proposes to release water from storage in the Fife Brook impoundment, if necessary, "as quickly as is reasonable to ensure that the minimum flow of 125 cfs is met to the extent practicable." BSPC proposes to temporarily modify the minimum flow if required by operating emergencies beyond its control, or for short periods upon agreement with Massachusetts DFW. If the flow is so modified, BSPC states that it

[152] According to data provided by the Independent System Operator of New England, the peak hourly demand for the year occurred at 2 p.m. in 12 of the last 18 years. *See* ISO New England Inc., *FCM Annual System Peak Day, Hour, and Load* (May 14, 2019), *available at* https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/ann-sys-peak-day-hr-load.

would notify the Commission as soon as possible, but not later than ten days after each such incident.

Massachusetts DFW recommends under section 10(j) that BSPC operate the project in a "year-round, run-of-release mode." Similarly, Interior recommends under section 10(j) that BSPC operate the Fife Brook Development as a "run-of-release facility, passing inflow it receives from the upstream Deerfield Project's Deerfield [Station] No. 5 development below Fife Brook dam on a near instantaneous basis."

As discussed in section 3.3.1.2, *Aquatic Resources, Environmental Effects, Water Quantity*, a "run-of-release" operation at the project would not provide stability to the aquatic habitat in the Deerfield River downstream of the Fife Brook dam. The Fife Brook impoundment receives the vast majority of its inflow from the Deerfield Station No. 5 powerhouse, which operates in a store and release (peaking) mode. Flows from Deerfield Station No. 5 can oscillate between the required minimum flow of 73 cfs to the maximum hydraulic capacity of 1,250 cfs, and there are no limitations to generator ramping at Deerfield Station No. 5. In a "run-of-release" mode, water levels could fluctuate by as much as 3.42 feet downstream of Fife Brook dam as outflow increases from the 125-cfs minimum flow to the combined total outflow from Deerfield Station No. 5 (*i.e.*, 1,323 cfs). Based on the potential for rapid fluctuations in flows from Deerfield Station No. 5, operating the Fife Brook Development in a "run-of-release" mode as proposed by BSPC and recommended by Massachusetts DFW and Interior would provide no benefit to aquatic habitat in the Deerfield River downstream of Fife Brook dam compared with current operation.

BSPC does not currently operate the Fife Brook Development in a "run-of-release" mode on an instantaneous basis and deviates from such an operation on a daily basis to store inflow to meet the 125-cfs minimum flow requirement and to replenish water lost through evaporation. BSPC stores inflow because the 125-cfs minimum flow requirement from the Fife Brook Development is greater than the 73-cfs release requirement from Deerfield Station No. 5 that is being provided to the Fife Brook Development. Because of this disparity between minimum inflow and minimum outflow, BSPC has historically stored inflows on a regular basis during normal operating conditions.

Operating in an instantaneous run-of-release mode would require inflows from Deerfield Station No. 5 to be released to the Deerfield River downstream of Fife Brook dam on an instantaneous basis, such that the licensee for the Bear Swamp Project would not be able to store flows from Deerfield Station No. 5. If inflow from Deerfield Station No. 5 dropped below 125 cfs (which occurred approximately 78.5 percent of the time from May 1 to October 28, 2016),[153] the licensee for the Bear Swamp Project would need to begin using the 4,600 acre-feet of storage that is dedicated to the Bear Swamp PSD to meet the 125-cfs minimum flow. Over time, the use of the 4,600 acre-feet of stored water and the inability to replenish that water under a run-of-release operation could deplete useable storage and adversely affect the operation of the pumped storage development. If the elevation of the impoundment were allowed to continue to decrease without the allowance of storage, the elevation would eventually drop below the 817.5-foot NGVD intake for the minimum flow release pipe, such that the licensee could no longer release minimum flows from the project to meet the 125-cfs minimum flow requirement that is being proposed by BSPC and recommended by staff.

As discussed in section 3.3.2, *Environmental Effects, Aquatic Habitat, Minimum Flows,* a continuous minimum flow of 125-cfs provides sufficient habitat to support all life stages of trout and aquatic resources downstream of Fife Brook dam. Any interruptions in providing a continuous minimum flow could negatively affect these resources by reducing the fitness and viability of the fish population. In the winter, the loss of a continuous minimum flow of 125 cfs could completely dewater trout nests, which could reduce the sustainability of the reproducing trout population.

Requiring the Fife Brook impoundment to continue to be operated with a minimum elevation limit of 830 feet NGVD and a maximum elevation limit of 870 feet NGVD would limit the useable storage capacity of the project for the pumped storage hydropower operation and the conventional hydropower operation, while also providing operational flexibility for the licensee to release the 125-cfs minimum flows and 800-cfs whitewater flows that are recommended by staff. Minimum and maximum impoundment elevations of 830 and 870 feet NGVD, respectively, would provide a useable storage capacity of 4,900 acre-feet, of which 4,600 acre-feet would be used to operate the Bear Swamp PSD consistent with current operation and 300 acre-feet would be used to meet the 125-cfs minimum flow release and 800-cfs whitewater flow release.

Based on the lack of benefits associated with a run-of-release operation, the operational constraints that a run-of-release operation would impose on generation, minimum flow, and whitewater recreation releases, and the limited storage capacity that is available between the recommended minimum and maximum impoundment elevations of 830 and 870 feet NGVD outside of the 4,600 acre-feet that is used for the pumped storage operation, we do not recommend requiring a run-of-release operation at the project.

---

[153] *See* October 9, 2019 Memo between Commission staff and BSPC discussing the data request for the Bear Swamp Project No. 2669, available at http://elibrary.ferc.gov:0/idmws/doc_info.asp?document_id=14804773.

Higher Minimum Flows

Interior and Massachusetts DFW recommend under section 10(j) that BSPC release a continuous minimum flow of 350 cfs from November 1 through April 15 from Fife Brook dam for the protection of fish and aquatic habitat. Trout Unlimited and CRC recommend the same measure as Interior and Massachusetts DFW for the protection of spawning trout, incubating eggs, and emerging fry.

The Deerfield River downstream of Fife Brook dam fluctuates regularly from hydropower peaking flows and from whitewater flow releases. However, the existing operation of the Fife Brook Development does not appear to prevent trout from spawning in the Deerfield River. Results from the 2017 Trout Spawning Study that was conducted by Trout Unlimited found a total of 101 redds in the Deerfield River upstream of Charlemont, 98 of which were fully constructed, and 37 of which contained eggs.

Regular changes in water levels from hydropower peaking flow releases can dewater redds as flows decrease from generation/whitewater flow releases (800 cfs and up) to minimum flows at 125 cfs. Increasing the minimum flow to 350 cfs could potentially increase the reproductive success of trout in the Deerfield River and reduce the number of fish that need to be stocked annually in the Deerfield River. However, a minimum flow of 350 cfs would not significantly decrease the amount of trout redd dewatering because the wetted width and depth of the Deerfield River does not significantly increase from 125 cfs to 350 cfs.

As discussed in section 3.3.2, *Environmental Effects*, *Minimum Flows*, increasing the minimum flow from 125 to 328 cfs provides relatively minor increases in wetted width and depth. The mean width of the 14 transects that were studied as part of the Instream Flow Assessment Study was approximately 167 feet. In 57 percent of the transects that were studied, wetted width increased by less than two feet from 125 cfs to 328 cfs. Besides a change of 14 feet that can be attributed to a backwatering effect in one of the transects, the greatest change in wetted width was 3.5 feet. Similarly, increasing flows from 125 cfs to 328 cfs increased the water depth in the Deerfield River by less than 0.4 foot, on average across the transects. Increases in wetted width and depth would not be expected to significantly increase wetted width or depth relative to a flow of 328 cfs.

As discussed in section 3.3.2, *Environmental Effects*, *Effects on Trout Spawning Habitat and Egg Development*, a flow of 350 cfs would enhance depth suitability for all life stages of rainbow trout and brown trout compared to a minimum flow of 125 cfs. For brook trout and longnose sucker, a depth of 350 cfs would provide similar depth suitability as the minimum flow. However, increasing the minimum flow to 350 cfs increases the velocity in the river, which decreases habitat suitability compared to the existing 125-cfs minimum flow. Brook trout, a native species, would be most affected by a flow of 350 cfs. A flow of 350 cfs reduces the amount of suitable velocity habitat for brook trout by 28.6 percent when compared to the existing 125-cfs minimum flow. Over time, the trout population in the Deerfield River could shift to more non-native species, as there would be more suitable habitat for brown trout and rainbow trout than brook trout. Reducing the abundance of brook trout could negatively affect fishing, as anglers would have less opportunity to catch native trout species. We estimate that the annual levelized cost of providing a minimum flow of 350 cfs would be $170,719. Because the benefits of a 350-cfs minimum flow would be relatively minor for trout species compared with the existing 125-cfs minimum flow, we conclude that the benefits of the measure do not outweigh the cost, and therefore do not recommend a 350-cfs minimum flow.

Generator Ramping

When generating under existing conditions, BSPC increases outflow from the 125-cfs minimum flow to 3 MW, whereupon it pauses for 15 minutes before increasing flows to higher levels. Although BSPC proposes to discontinue the 15-minute pause at 3 MW, staff recommends that the measure continue to be implemented from April 1 through October 31 to provide recreation users in the Deerfield River with a warning that a further increase in generation outflow is imminent. Using the 3-MW ramping procedure, it takes approximately 1.1 hours to ramp from 125 cfs to 900 cfs.

Rapidly fluctuating water levels and flow velocities have the potential to adversely affect fish in a river system because fish have to expend energy to relocate to areas with suitable cover and habitat when water levels and flow velocities change. Rapid increases in water velocity can also affect aquatic habitat by scouring sediment near the dam and transporting fine sediments downstream, which can fill in the spaces in the substrate used by benthic macroinvertebrates and fish. Dragonflies that are shedding their larval exoskeleton are vulnerable to being washed away when water levels are rising rapidly in the Deerfield River. Based on the dragonfly survey and flow attenuation study that BSPC conducted, the current project operation causes the water level in the Deerfield River downstream of Fife Brook dam to rise to a height that exceeds the vertical climbing distance of most of the observed dragonfly species and to rise at a rate that exceeds the climbing rate of the observed species, including the state-listed *Boyeria grafiana* and *Ophiogomphus carolus*.

CRC states that changes in flows from Fife Brook dam should come at a slower pace for ecological habitat and recreation safety reasons. CRC recommends releasing all flows from Fife Brook dam using a staged ramping process for increasing flows, which would include a 1-hour hold at an intermediate flow that is equivalent to the midpoint of the total scheduled flow. CRC recommends two intermediate flow releases of one hour for unspecified “higher flows.” Lastly, CRC recommends a down-ramping hold period of 30 minutes.

To protect state-listed dragonflies, Massachusetts DFW recommends under section 10(j) that BSPC restrict flow releases from Fife Brook dam by limiting the ramping rate of the flows between the hours of 7 a.m. to 4 p.m. to 0.060 foot per hour from May 15 through June 30 and 0.334 foot per hour from July 1 through August 31. Massachusetts also recommends moving whitewater flow release days in May, June, and July to before May 15, after June 14, and before July 23. Interior supports Massachusetts DFW's recommendation. Separately, Trout Unlimited recommends a 1-hour ramp up from March 15 through June 30 when newly-emerged trout fry are most vulnerable.

Trout Unlimited's recommendation is consistent with current project operation and would not provide additional benefits to aquatic resources.

The recommendations submitted by Massachusetts DFW and CRC would attenuate water level fluctuations downstream of Fife Brook dam more consistently than BSPC's existing and proposed modes of operation. The recommendations would reduce the effects of rapidly-changing water levels on aquatic habitat downstream and provide additional warning to river users when water levels are rising. In addition, the recommendations would provide resident fish more time to respond to increasing water levels and seek cover than what is currently available under existing operation. Over time, operating the Fife Brook Development with either of these recommendations in place could benefit fish by increasing the overall fitness of resident fish populations.

As described in section 3.3.1.2, *Aquatic Resources, Environmental Effects, Dragonfly Ramping Rates*, Massachusetts DFW's and CRC's recommended ramping measures would provide additional protection for state-listed dragonflies compared to BSPC's current and proposed operation. For instance, Massachusetts DFW's recommendation would reduce the risk of state-listed dragonflies being washed away during emergence and eclosure [*i.e.*, metamorphosis from larval to adult form] from 90 percent to 20 percent for *O. carolus* and from 90 percent to 54 percent for *B. grafiana*. The proportion of emerging and eclosing dragonflies that would be protected by CRC's recommendation would depend on when the hour of stable flow occurred relative to the time of peak emergence shown in Figure 14. Regardless, Massachusetts DFW's and CRC's recommendations would increase the number of state-listed dragonflies that survive to adulthood, which could increase the reproductive success of those species and allow the population to grow.

Although Massachusetts DFW's and CRC's recommendations would provide benefits to fish and benthic macroinvertebrates populations in the Deerfield River, study results show that a diverse variety of fish and benthic macroinvertebrates species occur downstream of Fife Brook dam under current conditions. As documented in the Fish Assemblage Study, fish species include sunfishes, carps, minnows, catfishes, perches, sculpins, American eel, and suckers, including the Massachusetts Species of Special Concern longnose sucker. Gamefish species such as trout are successfully reproducing in the mainstem of the Deerfield River, as evidenced by the age classes of fish reported in the Fish Assemblage Study. Based on survey data collected by Massachusetts DEP in 2014, the benthic macroinvertebrate community in the Deerfield River is also diverse, and includes mayflies, stoneflies, and caddisflies. In addition, the Dragonfly Survey documented eight dragonfly species, including the two state-listed species. The abundance of state-listed dragonflies that BSPC found are comparable to the abundance of five out of the six non-listed species that BSPC found (Table 10). In all, the population of benthic macroinvertebrates appears to provide a good food source for fish, as evidenced by a high fitness level of trout and reproducing numbers of trout species in the Deerfield River downstream of Fife Brook dam.

Massachusetts DFW's recommendation would significantly affect the operation of the Bear Swamp and Fife Brook Developments. Outflow from the Fife Brook impoundment would be restricted from 7 a.m. to 4 p.m. on non-scheduled whitewater flow release days, such that flows could only increase at a rate of 130 cfs per hour from May 15 through June 30 of each year, and a rate of 158 cfs per hour from July 1 through August 31 of each year. These ramping restrictions would result in a 4- to 6-hour ramping time to increase flows from the 125-cfs minimum flow to generation flows that are greater than 800 cfs, which would reduce the flexibility of the project to provide capacity, generation, and ancillary services at the Fife Brook Development during peak demand periods that occur between 7 a.m. and 4 p.m.[154] Constraining project operation in this way would limit the ability of the Fife Brook Development to help meet the New England region's power requirements and capacity needs. In addition, the reduced generation would cause the inflow provided by Deerfield Station No. 5 to accumulate in the Fife Brook impoundment and reduce the storage volume of the impoundment, which, in turn, would reduce generation by the Bear Swamp PSD. This lost generation would cost approximately $7,500 per year.

CRC's recommendation would also reduce generation at the project by requiring the licensee to operate the Fife Brook Development at half of the total scheduled flows for 1 hour and reducing the storage capacity of the Fife Brook impoundment for generation flows from the Bear Swamp PSD. The cost of this lost generation would be approximately $13,825 per year.

As discussed in section 3.3.6.2, *Socioeconomic Resources, Environmental Effects, Hydropower Generation Resources*, the ramping rates recommended by Massachusetts

---

[154] According to data provided by the Independent System Operator of New England, the peak hourly demand for the year occurred at 2 p.m. in 12 of the last 18 years. *See* ISO New England Inc., *FCM Annual System Peak Day, Hour, and Load* (May 14, 2019), *available at* https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/ann-sys-peak-day-hr-load.

DFW would delay generation flows to downstream hydropower developments, which could result in an economic loss if it caused the developments to forego generation during a peak demand period. Any lost opportunity cost for the downstream developments associated with the ramping rates would depend on: (1) the specific timing of the flow release from the Fife Brook Development relative to the peak demand periods for electricity; and (2) the amount of storage capacity already held in the downstream development that could be used for peaking until additional releases are received from upstream developments.[155]

As discussed in section 3.3.4.2, *Land Use, Recreation, and Aesthetics, Environmental Effects, Whitewater Flow Releases and Schedule*, Massachusetts DFW's recommendation would also restrict the dates of whitewater flow releases from Fife Brook dam, which would adversely affect whitewater recreation opportunities at the project. Specifically, Massachusetts DFW's recommendation would eliminate scheduled whitewater flow releases on Wednesdays, Thursdays, and Fridays from mid-May through mid-June and also at the end of July. Depending on which day of the week the first of the month occurs, there could be a loss of approximately five mid-week whitewater flow release days between May and August.

Based on the effects of the recommended ramping schedules on the ability of the Fife Brook Development to help meet the New England region's power requirements and capacity needs during periods of peak energy demand, the cost of lost generation associated with the recommendations, and the potential effects of Massachusetts DFW's recommendation on scheduled recreation days and downstream hydropower developments, we conclude that the benefits of Massachusetts DFW's and CRC's recommendations do not outweigh the costs.

Dragonfly Flight and Emergence Survey Plan

Massachusetts DFW recommends that BSPC develop, in consultation with Massachusetts DFW and FWS, a Dragonfly Flight and Emergence Survey Plan to be implemented every three years to assess state-listed dragonfly populations and ensure that state-listed dragonfly habitat utilization along the river remains stable or increases.

As described in section 3.3.1.2, *Aquatic Resources, Environmental Effects, Dragonfly Ramping Rates*, dragonfly abundance and survival are affected by a combination of factors over a number of years, including project operation and environmental conditions. Operation of the project causes rapidly rising water levels

---

[155] Based on the circumstantial nature of any such lost opportunity cost, staff cannot estimate the costs that could be experienced by any specific hydropower development downstream of Fife Brook dam.

downstream of Fife Brook dam that can wash away and drown emerging and eclosing state-listed and non-state-listed dragonflies. In addition, dragonfly abundance and survival are affected by environmental conditions unrelated to project operation (*e.g.*, high flow events resulting from storms, variability in the abundance of predator of dragonfly larvae and adults, and high precipitation or wind events during eclosure). Because the larval development time is unknown for the two state-listed species that occur at the project, and could be as long as 4 years for *B. grafiana*, the number of larvae that begin the emergence and eclosure represents the combined effects of variability in environmental conditions on survival during a relatively long larval development period in addition to project effects during emergence and eclosure.

While a regularly-scheduled dragonfly abundance and distribution survey could be used by a state resource agency with a mandate to manage the state-listed dragonfly species, the Commission has no such mandate. Further, the recommended study is not specifically tied to any performance measure that would be used to quantify changes in the population and reduce the effects of the project on state-listed dragonflies, and therefore, would not serve any licensed, project-related purpose. For these reasons, we have no justification for recommending that the population surveys be required as a condition of any new license issued for the project.

Special Status Dragonfly Habitat Enhancement Plan and Mitigation Fund

Massachusetts DFW recommends under section 10(j) that BSPC develop a plan to increase the population of state-listed dragonflies on project lands and lands over which conservation easements are established or re-established. Massachusetts DFW states that the plan must include a list of species to be enhanced and identification of suitable habitat sites for site-specific enhancement measures. Massachusetts DFW states that enhancement measures may include removal of flow restrictions in the watershed, restoring native vegetation to riparian corridors and floodplains, measures to retain large woody debris within the Deerfield River, mid-channel emergence habitat enhancements to raise substrate above spring flood levels, and other conservation measures to benefit state-listed dragonflies directly.

Massachusetts DFW also recommends under section 10(j) that BSPC create a Rare Species Mitigation Fund to "fund survey, conservation, and enhancement actions for Special Status odonates [i.e., dragonflies] in the Deerfield Watershed." Massachusetts DFW states that the fund would be administered by BSPC and Massachusetts DFW and that a "proposed project must have a clear benefit to Special Status odonates and must be located within the Deerfield River Basin; or in other major river basins in Massachusetts only if the project directly benefits *O. carolus* and/or *B. grafiana*."

As described in section 3.3.1.2 *Aquatic Resources, Environmental Effects, Dragonfly Ramping Rates*, while current operation can inundate and wash away emerging and eclosing dragonflies, there is no evidence in the record that suggests that a lack of larval, emerging, foraging, or mating habitat limits the populations of *B. grafiana* and *O. carolus* in the Deerfield River downstream of Fife Brook dam. Given that these species emerge and eclose relatively close to the water's surface, there is no indication that providing additional emergence habitat would increase the species population size. In addition, we are recommending that BSPC provide scheduled whitewater releases at 10 a.m., which would provide additional time for dragonflies to complete emergence and eclosure at locations 6 to 8 miles downstream of Fife Brook dam compared to current operation. Therefore, there is no justification for providing funding for or implementing off-site enhancements. Lastly, removal of non-project-related structures throughout the watershed would not have a nexus to the project, and therefore, a license requirement for removing the non-project structures would not serve a project-related purpose. For these reasons, we do not recommend the Special Status Dragonfly Habitat Management Enhancement Plan or a Rare Species Mitigation Fund as conditions of any license issued for the project.

200-foot Vegetated Riparian Buffer Zone

To protect fish and wildlife resources and allow for habitat management, Massachusetts DFW recommends under section 10(j) that BSPC establish a 200-foot, natively vegetated buffer zone on all riverfront land within the project boundary and acquire permanent easements on non-project lands within 200 feet of the Deerfield River as measured from the top of the banks. Massachusetts DFW states that permanent conservation easements along the primary tributaries upstream of the town of Shelburne Falls (approximately 20.8 miles downstream of Fife Brook dam) would also be protective. Massachusetts DFW recommends that BSPC establish a fund for this purpose.

As described in the relevant part of section 3.3.1.2, *Aquatic Resources, Environmental Effects*, permanent conservation easements exist for 201 acres in the riparian zone within the project boundary downstream of Fife Brook dam. In order to protect a 200-foot riparian buffer zone along both banks of the Deerfield River, BSPC would have to purchase or acquire conservation easements for approximately 129 acres of additional land along the river to the downstream edge of the project boundary and more than 678 acres of land downstream of the project boundary to Shelburne Falls. We recommend a number of measures that are designed to protect fish and wildlife resources located on project lands and waters, including BSPC's proposed 125-cfs minimum flow and retaining 201 acres in the project boundary downstream of Fife Brook dam that would be protected in perpetuity by conservation easements. We find that these measures would adequately protect fish and wildlife resources located at the project such that there is no need to require additional mitigation on lands that are currently non-project lands. Nothing in the record indicates any potential future development plans along the riparian area within the project boundary, and Massachusetts DFW did not describe how the additional riparian buffer on nearly 800 acres of non-project lands would mitigate for specific project effects, or how making these lands project lands would otherwise be in the public interest by serving a project-related purpose. For these reasons, we do not recommend a 200-foot riparian buffer along both banks of the Deerfield River.

Instream Flow Study

CRC recommends that BSPC conduct an IFIM modeling study now and when the Deerfield Project begins relicensing in 2032. CRC states that an IFIM is needed to evaluate alternative flow scenarios during relicensing and during the next relicensing proceeding for the Deerfield Project in order to balance project operation with habitat and recreation interests. Similarly, Trout Unlimited states that an IFIM study is needed to evaluate the effects of hydropower peaking operation and minimum flow releases on trout redds downstream of Fife Brook dam.

As discussed in section 3.3.1.2, *Environmental Effects*, *Water Quantity*, this EA assesses the relationship between aquatic habitat and flow in the reach of the Deerfield River downstream of Fife Brook at the existing 125-cfs minimum flow and additional flow releases of 239 cfs and 328 cfs. BSPC's Instream Flow Assessment Study incorporated existing biological information, including Habitat Suitability Index model data from FWS, to determine the suitability of velocities, depths, and substrates along 14 flow transects for spawning, juvenile, and adult life stages of brown trout, brook trout, rainbow trout, and longnose sucker. The results of the Instream Flow Assessment Study were sufficient to determine the benefits of the proposed/recommended minimum flows on aquatic habitat and, therefore, there is no need to include a license condition requiring an IFIM study.

CRC's recommendation to complete an IFIM study of the Deerfield River when the Deerfield Project begins relicensing in the future would relate to a future licensing decision, not the one before us now. Therefore, we have no justification for including the recommended future flow study as a condition of any new license.

Bat Management Plan

BSPC proposes to develop and implement a Bat Management Plan to identify and implement measures to avoid and minimize adverse effects to special status bat species that may result from future project-related construction or land clearing activities. Interior and Massachusetts DFW recommend BSPC's proposed Bat Management Plan under section 10(j).

Neither BSPC nor the agencies provided any specific measures to be included in the plan and they do not identify what additional project-related construction or land-clearing activities other than the ones identified in this EA would be covered by the plan.

As discussed in section 5.1.2, staff recommends implementing a seasonal clearing restriction for trees greater than 3 inches in width at breast height, between June 1 and July 31, to avoid the time period when NLEB may be occupying nearby roosting trees. Because Interior and Massachusetts DFW have not specified any additional measures that would be included in the Bat Management Plan and additional measures do not appear to be needed to protect NLEB or other special status bat species at the project, we do not recommend the development of a Bat Management Plan.

Invasive Plants

Massachusetts DFW recommends an Invasive Plant Species Monitoring and Management Plan under section 10(j). As part of the plan, Massachusetts DFW recommends that the licensee conduct a comprehensive survey of invasive plants every 5 years to develop site-specific control/management actions to reduce the spread of invasive species at the project.

More than 30 acres of discrete stands of invasive species were found during 2015 and 2016 survey efforts, including existing populations of Japanese knotweed, purple loosestrife, reed canary grass, and other invasive plants along the shorelines of the Deerfield River downstream of the Fife Brook dam. The majority of existing, mapped invasive species populations are located along several miles of discontinuous portions of the shoreline downstream of Fife Brook dam. Given the distribution of invasive plant populations throughout the project boundary and along the Deerfield River, attempting to reduce the prevalence of these species and replanting these areas within the project boundary may not be technically feasible. Further, there is no indication that comprehensive monitoring and/or site-specific control/management actions, as proposed by Massachusetts DFW, are needed to protect fish and wildlife resources at this time. Therefore, we do not recommend including this measure in any license issued for the project.

Recreation in the Fife Brook Impoundment

The Whitewater Interest Group states that BSPC should be required to construct a portage trail around the Fife Brook dam and construct a trail between the Visitors Center and the Fife Brook impoundment to provide public access to the impoundment. CRC comments that access should be provided to the Fife Brook impoundment.

The access facilities recommended by the Whitewater Interest Group and CRC would be located in the lower extent of the Fife Brook impoundment. As discussed in section 3.3.4.2, *Land Use, Recreation, and Aesthetics, Environmental Effects, Recreation in the Fife Brook Impoundment*, there are several safety hazards in the lower extent of the impoundment that limit the ability to provide safe access for public recreation, including daily fluctuations of up to 40 feet and strong currents associated with the Bear Swamp

PSD. Safety and directional signage is installed in the upper extent of the Fife Brook impoundment to warn of the dam ahead and guide boaters out of the river and away from the lower extent of the Fife Brook impoundment downstream of the Deerfield Station No. 5 powerhouse. Because of these safety concerns, we do not recommend the installation of a portage around the Fife Brook dam, the opening of the Fife Brook impoundment to recreation, or the construction of an access trail to the lower extent of the Fife Brook impoundment.

Fife Brook Fishing and Boating Access Area Improvements

Interior, Massachusetts DFW, and the Whitewater Interest Group recommend that BSPC improve the Fife Brook Fishing and Boating Access Area by: (1) establishing a new boat put-in site; and (2) providing electric power for rafters to run air pumps. Interior further comments that BSPC should construct a new set of stairs to replace the existing stairs at the access.

The amenities at the Fife Brook Fishing and Boating Access Area are at capacity during the peak whitewater boating season, including the two existing boat put-in areas. While adding a third boat put-in site would decrease the congestion and wait time for river access, there is no information indicating that users are prevented access the river at the Fife Brook Fishing and Boating Access Area. Also, while a new rafting put-in site at the Fife Brook Fishing and Boating Access Area would decrease crowding at the two existing put-ins, a third put-in site could result in more people entering the river at the same time along a short stretch of shoreline, which could result in overcrowding and dangerous boating conditions in the Deerfield River immediately around the Fife Brook Fishing and Boating Access Area. For these reasons, we do not recommend the construction of a third put-in site.

Interior did not describe why the existing stairs at the Fife Brook Fishing and Boating Access Area need to be replaced, such as existing safety or access issues involving the stairways. BSPC proposes to maintain the existing project recreation facilities, including the existing amenities provided at the Fife Brook Fishing and Boating Access Area. Periodic maintenance of the existing stairways would ensure that the stairs continue to provide safe access to the river during the term of any new license for the project. We estimate that the annual levelized cost of constructing a new set of stairs would be $1,082. Based on the lack of benefits associated with the construction of a new set of stairs, we do not recommend it.

None of the stakeholders indicate that project-related recreation opportunities are insufficient due to the lack of electric power at the Fife Brook Fishing and Boating Access Area. BSPC proposes to continue providing access to the river for whitewater boating at the Fife Brook Fishing and Boating Access Area and at the Zoar Whitewater Access Area, which provide sufficient recreation opportunities to meet the demand for whitewater recreation in this stretch of the Deerfield River. While electric power could make it easier to inflate rafts at the site as a general matter, whitewater boaters have historically used battery- and generator-powered pumps to inflate rafts and tubes at this site. None of the stakeholders have presented information regarding why whitewater boaters cannot continue to do so during the term of any new license or explained what project-related, greater public benefit would be served by having the project provide electric power to inflate privately owned rafts. We therefore have no justification for requiring the project to provide electric power for inflating rafts.

Shunpike Rest Area Improvements

Interior, Massachusetts DFW, Franklin Regional Government, town of Charlemont, the Whitewater Interest Group, Trout Unlimited, CRC, and Deerfield River Watershed Association state that BSPC should be required to fund the construction and maintenance of a restroom facility and trash receptacle at the Shunpike Rest Area. Trout Unlimited specifies that the sanitary facilities should be seasonal, and CRC and the Deerfield River Watershed Association recommend portable restrooms.

The Shunpike Rest Area is not a project recreation site, and is owned and maintained by the Massachusetts Department of Transportation. The Shunpike Rest Area is a popular take-out and put-in location for boaters and rafters making use of project flows in the Deerfield River. There are no trash receptacles or restroom facilities at the site for recreation users.

Because of the heavy public use and lack of restroom facilities, river users exiting at this site are known to frequently relieve themselves along the river. This creates unsanitary conditions at the Shunpike Rest Area. However, the unsanitary conditions at the Shunpike Rest Area do not appear to be the result of inadequate facilities at the Bear Swamp Project.

The project provides recreation opportunities on the Deerfield River between the Fife Brook Fishing and Boating Access Area and the Zoar Picnic Area. Multiple restroom and trash disposal facilities are available for public use in the project boundary, including at the Zoar Picnic Area which is located about 1.8 miles upstream from the downstream extent of the project boundary. BSPC has proposed to increase the availability of sanitary facilities at the Zoar Picnic Area, as discussed above. The existing and proposed sanitation facilities at the project recreation sites are available for use by any members of the public and are adequate for providing sanitary conditions at the project.

The project boundary ends approximately 1.5 miles upstream of the Massachusetts Department of Transportation's Shunpike Rest Area. Boaters that choose to continue downstream past the project boundary to use the Shunpike Rest Area are participating in non-project recreation use on the Deerfield River. None of the proposals or recommendations discussed herein would significantly increase the unsanitary conditions at the Shunpike Rest Area.

Based on the adequacy of the existing and proposed sanitation facilities at the project recreation sites and the fact that the unsanitary conditions are occurring downstream of the project at an area that is not directly associated with project recreation use, we have no project-related justification for and do not recommend that a new license require the construction and maintenance of a restroom facility and trash receptacle at the non-project, Shunpike Rest Area.

Whitewater Releases

BSPC proposes to continue providing 106 annual whitewater releases from April 1 through October 31 to maintain the existing recreational opportunities for whitewater boating in the Deerfield River downstream of Fife Brook dam. BSPC proposes to continue to provide whitewater flow releases between 9:30 a.m. and 12 p.m., for a minimum duration of 3 hours. BSPC also proposes to provide whitewater flow releases of 800 cfs to support safe and enjoyable whitewater recreation in the Deerfield River downstream of the Fife Brook dam.

The Whitewater Interest Group recommends that additional whitewater flow release days be provided beyond the 106 scheduled days during the peak boating season. Specifically, the Whitewater Interest Group recommends either: (1) adding 14 additional whitewater flow release days; or (2) reallocating whitewater flow release days from April and October to between June 16 and Labor Day, each year. Interior and the Whitewater Interest Group also state that hydropower generation between June 16 and Labor Day should begin at 10 a.m. on days when scheduled whitewater releases are not already being provided (*i.e.*, on "non-scheduled days"). The Whitewater Interest Group and commercial whitewater outfitters recommend higher whitewater flow releases of 900 cfs to 1,100 cfs, with a longer duration. The Whitewater Interest Group also recommends that BSPC provide outflow volumes that match the exact inflow volumes provided from the upstream Deerfield Station No. 5 on 32 days of the year, when flow releases from Deerfield Station No. 5 range from 900 to 1,100 cfs for 4 to 5 hours. In contrast to these recommendations, Massachusetts DFW and Trout Unlimited state that the 106 annual whitewater flow releases should continue at a minimum flow of 700 cfs instead of being increased to 800 cfs, as proposed by BSPC.

The Whitewater Interest Group has not provided any specific information regarding why additional whitewater recreation opportunities need to be provided at the project, including why BSPC's proposal to continue providing 106 scheduled whitewater flow releases is insufficient to ensure adequate recreation opportunities. As discussed in section 3.3.4.2, *Land Use, Recreation, and Aesthetics, Environmental Effects, Whitewater Flow Releases*, the 106 scheduled whitewater flow releases occur for 7 months of the year, account for nearly every weekend of the recreation season, and ensure that whitewater flow releases occur on approximately 50 percent of the days between April 1 and October 31. The scheduled flow releases provide an abundance of whitewater recreation opportunities at the project during the recreation season, and ensure predictable flow releases for recreation users to plan outings on the Deerfield River. As discussed in section 5.1.1, Commission staff recommends that these 106 scheduled whitewater flow releases continue to be provided. Although congestion occurs at some recreation facilities during the peak summer season, BSPC proposes and Commission staff recommends several improvements to reduce congestion and ensure adequate access to the Deerfield River, including: (1) improving parking at the Fife Brook Fishing and Boating Access Area; (2) widening the access trail at the Zoar Whitewater Access Area; and (3) installing additional restrooms, changing facilities, and a staircase at the Zoar Picnic Area. Based on the abundance of whitewater recreation opportunities that would continue to be provided by the staff-recommended whitewater flow releases and site improvements, and the lack of evidence that additional whitewater flow releases are needed to ensure adequate recreation opportunities at the project, Commission staff does not recommend adding whitewater flow releases or reallocating whitewater flow release days from April and October to between June 16 and Labor Day.

Requiring hydropower generation to begin at 10 a.m. between June 16 and Labor Day on non-scheduled days, as recommended by Interior and the Whitewater Interest Group, would severely constrain the project's ability to provide power during periods of peak energy demand.[156] As discussed above, staff's recommendation to continue providing 106 scheduled whitewater flow releases on an annual basis already ensures adequate whitewater recreation opportunities at the project. In addition, BSPC's Safe Waters website provides a 24-hour schedule of the timing and volume of flows to inform recreation users of potential, additional whitewater recreation opportunities on the following day. Based on the abundant whitewater recreation opportunities that would be available through the 106 scheduled whitewater flow releases, Commission staff does not recommend requiring generation to begin at 10 a.m. on non-scheduled days.

With regard to the recommendations to release flows other than 800 cfs for whitewater recreation (*i.e.*, 700 cfs or 900 – 1,100 cfs), BSPC conducted an Operations Model Study and a Whitewater Boating Flow Study to determine ideal flows for whitewater recreation. As discussed in section 3.3.4.2, the results of the Operations Model Study indicate that an increase of scheduled whitewater flow release days or an

---

[156] According to data provided by the regional electricity grid operator in New England, the Independent System Operator of New England, the annual peak demand from 2002 - 2017 occurred in the months of June, July, and August between the hours of 2 p.m. and 5 p.m. *See* ISO New England Inc., *FCM Annual System Peak Day, Hour, and Load* (May 14, 2019), *available at* https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/ann-sys-peak-day-hr-load.

increase in volume of whitewater flow releases would result in volumetric shortfalls, when either the minimum flow or whitewater flow releases could not be met, over the duration of any new license term. Any volumetric shortfalls would result in loss of BSPC's ability to generate, loss of whitewater flow release volume, or whitewater flow release days. As discussed in section 3.3.4.2, the Whitewater Boating Flow Study results indicate that the 700-cfs whitewater flow release that is required by the current license does not provide a quality or safe boating experience. A majority of the study participants identified 800 cfs as the lowest flow considered acceptable for both a quality and safe whitewater experience. A whitewater boating outfitter and guide that participated in the study noted that 50,000 – 100,000 people currently run the Deerfield River at 800 cfs each year without incident, but that safety incidents have occurred at flows below 800 cfs.[157] On the other hand, whitewater flows above 1,000 cfs pose safety and navigability concerns for inexperienced whitewater recreationists or tubers that cannot guide the watercraft away from obstacles in the river. Accordingly, Commission staff recommends BSPC's proposed 800-cfs flows, as discussed in section 5.1.1, and does not recommend higher whitewater flow releases of 900 cfs to 1,100 cfs, as recommended by the whitewater groups, or lower flow releases of 700, as recommended by Massachusetts DFW and Trout Unlimited.

Flow Release Information

CRC states that BSPC's Safe Waters website (www.safewaters.com) should include a graph of the flows in the Deerfield River downstream of Fife Brook dam over the previous 24 hours of operation. CRC and Trout Unlimited recommend the installation of a flow gage immediately downstream of Fife Brook dam to monitor flow releases to ensure compliance with minimum flows and whitewater flow releases. CRC and Trout Unlimited also state that information from the gage should be made available to the public on a real-time basis.

The licensee provides up-to-date information on scheduled and current flows in the Deerfield River downstream of the Fife Brook dam. The whitewater release schedule is posted publicly on or before April 1 of the current year. The schedule is physically posted at the Bear Swamp Project and is available online at BSPC's Safe Waters website.[158] BSPC's Safe Waters website also provides a 24-hour schedule of the timing and size of flows from the Fife Brook Development to the Deerfield River. The information provided by the Safe Waters website includes the start and end times for various flows that will be released over the 24-hour period, and the current outflow from the Fife Brook dam. Information on current flows is also available through the Safe

---

[157] *See* March 31, 2017 Whitewater Boating Flow Study Report at 21.

[158] Brookfield Renewable Partners, L.P., *Fife Brook*, available at https://www.safewaters.com/facility/22.

Waters' toll-free phone line (1-844-430-3569). From a review of the information available on the Safe Waters website, it appears that BSPC updates the current flow every 5 minutes. With all of the information that is already available on scheduled and current flow, it is not clear how posting a graph of flows on the Safe Waters website showing the previous 24 hours of operation would be useful for project recreation or other public purposes. Commission staff estimates that the levelized annual cost of including a regularly-updated graph illustrating flows during the previous 24 hours would be $300. Based on the lack of benefits associated with the measure, staff does not recommend it.

Installation of a flow gage at the project would provide exact, instantaneous flow information for the Deerfield River downstream of the Fife Brook dam. However, as discussed, BSPC posts whitewater schedules, 24-hour flow release schedules, and current flow information on the Safe Waters website, and provides access to flow information via Safe Waters' toll-free phone line (1-844-430-3569). In addition, the USGS gage at Charlemont, 12 miles downstream of the project, provides instantaneous flow information about the Deerfield River. There is also no evidence that BSPC is unable to comply with the minimum flow requirements and whitewater flow release requirements of the current license, as the minimum flow pipes at the Fife Brook dam have a capacity equal to the 125-cfs minimum flow and BSPC uses its turbine-discharge rating curve to release the appropriate amount of whitewater flows. We estimate that the annual levelized cost of installing a flow gage downstream of Fife Brook dam and providing information to the public in real-time would be $646. We conclude that installing a flow gage would not likely benefit recreation or environmental resources at the project, and therefore, do not recommend it.

Recreational Reporting

CRC states that BSPC should file regular reports (*i.e.*, every 5 to 10 years) with information on recreation use, shoreline public access, and recreational expenditures because the Form 80 requirement has been eliminated by FERC. BSPC is not proposing any recreation reporting, but states in its response to comments that if the Commission requires reporting that BSPC should provide reports equivalent to the Form 80 at 10-year intervals.

The Commission no longer requires the filing of FERC Form 80. Filing regular reports on recreation use, shoreline public access, and recreational expenditures would provide the Commission and the public with information on recreation at the Bear Swamp Project, but it is not clear what purpose this information would serve as the Commission has determined that regular reporting is no longer necessary. Any problems with recreation access at the Bear Swamp Project can be reported to the Commission's Division of Hydropower Administration and Compliance, which investigates problems that arise at projects during their license terms. We estimate that the annual levelized cost of filing regular recreation reports would be $208. We conclude that filing regular recreation reports would not likely benefit recreation, and therefore, do not recommend it.

Safety and Warning Systems

The CRC and Deerfield River Watershed Association comment that a new warning system is needed, and suggest warning lights along Zoar Road.

Warning lights along Zoar Road may not be visible to anglers and other individuals who are recreating on or near the river. To provide an adequate warning system for recreation users downstream of Fife Brook dam, staff is recommending the installation of auditory and visible signals at project recreation sites and recommending that generation be held at 3 MW for 15 minutes before additional ramping to higher outputs. We estimate that the annual levelized cost of installing warning lights along Zoar Road would be $1,569. We conclude that installing auditory and visible signals at project recreation sites and holding generation at 3 MW for 15 minutes would provide an adequate warning system for recreation users downstream of Fife Brook dam, and therefore, do not recommend installing warning lights along Zoar Road.

Annual Payment to Charlemont

Interior, Massachusetts DFW, and the Whitewater Interest Group state that BSPC should be required to make annual payments to the town of Charlemont to address public health and safety costs on and around the river incurred by users of project waters. BSPC is not proposing any payments to Charlemont.

The Zoar Picnic Area (a project facility) and Shunpike Put-In and Take-Out Area (a non-project state-owned facility) are both located within the town of Charlemont, and are popular access areas to the Deerfield River that receive capacity or near-capacity usage during weekends in the summer. The associated crowds require police officers and other emergency services from the town of Charlemont for public safety. However, the town has not stated their costs nor requested an annual payment from BSPC. In addition, neither Interior, Massachusetts DFW, nor the Whitewater Interest Group have indicated how much policing the recreation sites cost the town of Charlemont, nor have they clarified what public safety and emergency services would be required.

Additionally, local jurisdiction and taxing authorities are responsible for providing police and emergency services, and for collecting the funds for them. Including payments in any project license for government services that are normally funded by taxes is an issue beyond the scope of this licensing process.

For these reasons, staff does not recommend requiring the licensee to make annual payments to the town of Charlemont to address public health and safety costs.

Conservation Easement

In July 2001, the licensee established a conservation easement on 1,457 acres of land that is located at or near the project. A total of 1,407 acres of the land is located within the project boundary. Approximately 1,206 acres of the protected land occurs near the project's upper and lower reservoirs, and 201 acres occur along the river corridor downstream of the Fife Brook dam. The 201 acres of river corridor are subject to in-perpetuity conservation easements, while the 1,206 acres near the project's upper and lower reservoirs are subject to conservation easements that expire with the current license on April 1, 2020.

BSPC is not proposing to renew the conservation easement for 1,256 acres of land that is located near the upper reservoir and Fife Brook impoundment, 50 acres of which is located outside of the project boundary. BSPC is also proposing to remove 161.77 acres of land from the project boundary that are part of the current conservation easement.

Massachusetts DFW recommends under section 10(j), and the Whitewater Interest Group and Franklin Regional Government request that the 1,256 acres of land be placed under a permanent conservation easement. Massachusetts DFW states that the 1,256 acres of land are part of a larger ecosystem that must remain unfragmented to maintain its long-term integrity, and that portions of the land contain state-listed species. Interior, CRC, and the Deerfield River Watershed Association state that the entire 1,256 acres of land should be placed under a permanent conservation easement or another conservation easement for the term of any new license. Interior, CRC, and the Deerfield River Watershed Association recommend that BSPC transfer the land it wishes to remove from the project boundary to a qualified conservation organization. Massachusetts DFW recommends that all of the conservation easement be transferred to a qualified conservation organization if BSPC does not want to renew its conservation easement.

The existing conservation easement restricts land use on 1,457 acres of land to agricultural, forestry, educational, non-commercial recreation, open space, and electric transmission and hydroelectric generation purposes. The majority of land held under the conservation easement is forested. Electric transmission and hydroelectric generation is the second biggest land use.

The licensee established the conservation easements in response to the Commission's April 4, 1997 order, which required the licensee to participate in a conservation easement program for the protection of 1,056 acres of land around the upper and lower reservoirs.[159] The licensee entered into a conservation easement that protected an additional 200 acres around the upper and lower reservoirs, including 50 acres that were not within the project boundary. BSPC is now proposing to retain 1,044.23 acres

[159] *See New England Power Company*, 79 FERC ¶ 61,009 (1997).

around the upper and lower reservoirs, which is approximately 12 acres less than what was required by the Commission's April 4, 1997 order. In section 5.1.1 of the EA, Commission staff recommend that the 1,044.23 acres of land be included in the project boundary.

BSPC is not proposing to develop any of the land that is held under the conservation easement at this time. Much of the acreage that is currently held under the conservation easement is steep and would be difficult to develop. However, if BSPC were to pursue the development of any of land within the project boundary during the term of the license, it would have to obtain Commission approval to do so. The Commission's standard terms and conditions for a hydropower license require land within the project boundary to be retained in substantial conformity with the maps, plans, and other specifications that are designated as exhibits and approved by the Commission in the license order, unless changes are approved by the Commission during the license term. For these reasons, the 1,044.23 acres of land that BSPC is proposing to retain in the project boundary would continue to be used in substantially the same way that it is used under the current license (*i.e.*, for agricultural, forestry, educational, non-commercial recreation, open space, and electric transmission and hydroelectric generation purposes), unless otherwise approved by the Commission.

Any land that is currently held under the conservation easement and that is not included within the project boundary by a new license, such as the 161.77 acres that BSPC proposes to remove and the additional 50 acres that are not within the current project boundary, could be developed during the term of any new license without prior Commission approval. As discussed in section 3.3.4.2, *Land Use, Recreation, and Aesthetics, Environmental Effects, Modification of the Project Boundary*, the three distinct parcels of land that compose the 161.77 acres are located on the border of the existing conservation easement, and no sensitive species were identified as occurring within these areas. Although removing these lands has the potential to result in the future loss of habitat if the lands were to be developed, Commission staff concludes that the remaining 1,044.23 acres of land within the project boundary would be sufficient to provide environmental protection, by continuing to provide a large unfragmented forested area to protect sensitive species within the project boundary. Therefore, Commission staff concludes that removal of the 161.77 acres of land from the project boundary would be warranted.[160] Based on the protections that would be in place under the standard terms and conditions of a new license for the 1,044.23 acres of land that Commission staff recommends including in the project boundary, and Commission staff's recommendation to remove 161.77 acres of land from the project boundary, Commission

[160] No recommendations have been submitted for, or evidence show as to why, the 50 acres of land that is currently outside of the project boundary is needed for project purposes. Therefore, Commission staff has not evaluated this alternative in the EA.

staff does not recommend establishing a new conservation easement for the 1,256 acres of land or transferring the 1,256 acres of land to a conservation organization.

Site Access and Notification of Future Amendments to Project

Massachusetts DFW recommends under section 10(j) that the licensee allow Massachusetts DFW and FWS to inspect the project and obtain operation records for the purpose of monitoring compliance with the terms and conditions of any new license issued by the Commission. Interior and Massachusetts DFW recommend that BSPC be required to notify all representatives of their agencies on the service list if an amendment or appeal of any fish and wildlife-related license conditions or extension of time is filed with the Commission.

As discussed in section 5.1.1, Commission staff recommends the development of an Operation Compliance Monitoring Plan to ensure proper documentation of BSPC's compliance with the operational conditions of any new license. With the development of an Operation Compliance Monitoring Plan, there would not be a substantial environmental benefit associated with an inspection of the project by Massachusetts DFW. However, the Commission's standard terms and conditions for a hydropower license require the licensee to provide employees of the U.S. Government access to project land and works in performance of their official duties. This standard article would apply to site access for FWS employees and its designated representatives. For these reasons, staff does not recommend a separate license condition that requires the licensee to allow Massachusetts DFW and the FWS to inspect the project operation and obtain operation records for the purpose of monitoring compliance with the terms and conditions of a new license.

For significant amendments related to fish and wildlife resources, the Commission's regulations require a licensee to consult with the agencies while preparing the amendment application. For other amendments, appeals, and requests for extensions of time, any entity can receive notification of any filings and issuances through the Commission's eSubscription service. Because existing Commission regulations and services allow Interior and Massachusetts DFW to be informed of amendments, appeals, and requests for extensions of time, we do not recommend this measure be included in any license that is issued for this project.

5.1.4 Conclusion

Based on our review of the agency and public comments filed on the project and our independent analysis pursuant to sections 4(e), 10(a)(1), and 10(a)(2) of the FPA, we conclude that licensing the Bear Swamp Project, as proposed by BSPC with the additional staff-recommended measures, would be best adapted to a plan for improving the Deerfield River Basin.

5.2 UNAVOIDABLE ADVERSE IMPACTS

Fife Brook dam would continue to adversely affect the upstream eel migration by blocking passage of eels that are able to make it past the lower four dams on the Deerfield River and that are unable to scale the dam. Some entrainment mortality is likely unavoidable for fish in the Fife Brook impoundment. For resident fish species, most large fish could avoid involuntary entrainment, but entrainment of some small fish could still occur. In addition, the project would continue to pass peaking flows from Deerfield Station No. 5, and sudden increases in flow from the Fife Brook impoundment could displace some fish and disrupt fish spawning behavior in the Deerfield River downstream of Fife Brook dam. State-listed dragonflies downstream of Fife Brook dam would also continue to be washed away by rising water levels during emergence and eclosure, and the 40-foot changes in water surface elevation in the Fife Brook impoundment would continue to prevent dragonflies from emerging and eclosing within the impoundment.

5.3 FISH AND WILDLIFE AGENCY RECOMMENDATIONS

Under the provisions of section 10(j) of the FPA, each hydroelectric license issued by the Commission shall include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project.

Section 10(j) of the FPA states that whenever the Commission finds that any fish and wildlife agency recommendation is inconsistent with the purposes and the requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of the agency.

In response to our January 30, 2019 notice accepting the application to relicense the project and soliciting motions to intervene, protests, comments, recommendations, preliminary terms and conditions, and preliminary fishway prescriptions, Interior filed six section 10(j) recommendations on March 27, 2019, and Massachusetts DFW filed 16 section 10(j) recommendations on April 1, 2019. Table 24 lists the recommendations filed pursuant to section 10(j), and indicates whether the recommendations are adopted under the staff alternative, as well as the basis for our preliminary determinations concerning measures that we consider inconsistent with section 10(j). Environmental recommendations that we consider outside the scope of 10(j) have been considered under section 10(a) of the FPA and are addressed in the specific resource sections of this document.

Table 24. Analysis of fish and wildlife agency recommendations for the Bear Swamp Project.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Operate the Fife Brook Development in a run-of-release mode such that inflow received from the Deerfield Station No. 5 matches outflow from the Fife Brook dam.	Interior, Massachusetts DFW	Yes.	$22,120	No. Measure is inconsistent with section 10(a) of the FPA because it would conflict with the 125-cfs minimum flow release and would not benefit aquatic resources downstream of Fife Brook dam.
Provide a continuous minimum flow of 125 cfs downstream of the Fife Brook Development from April 16 through October 31.	Interior, Massachusetts DFW	Yes.	$0	Yes. Staff recommends a year-round flow release of 125 cfs to protect fish and aquatic habitat that is inclusive of the recommended period.
Provide a continuous minimum flow of 350 cfs downstream of the Fife Brook Development from November 1 through April 15 to protect trout incubating trout eggs.	Interior, Massachusetts DFW	Yes.	$170,719	No. Measure is inconsistent with section 10(a) of the FPA. The benefits of a 350-cfs minimum flow do not outweigh

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
				the costs. The recommended flow release would not significantly decrease trout redd dewatering and would adversely affect native brook trout. Staff recommends releasing a continuous minimum flow of 125 cfs to protect trout redds.
To protect state-listed dragonflies, release flows from Fife Brook dam between 7 a.m. and 4 p.m. from May 15 through June 30 with an up-ramping rate that is not greater than either: (1) 0.060 foot per hour; or (2) 130 cfs per hour (not to exceed 32 cfs per 15-minute period). Release flows from Fife Brook dam between 7 a.m. and 4 p.m. from July 1 through August 31 with an up-ramping rate that is not greater than either: (1) 0.334 foot per hour; or (2) 158 cfs per	Interior, Massachusetts DFW	Yes.	$5,925	No. Measure is inconsistent with section 10(a) of the FPA. The benefits of the measure do not outweigh the costs associated with lost generation and lost whitewater flow releases.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
hour (not to exceed 40 cfs per 15-minute period). Exceptions to the ramping rates are allowed for purposes of providing 106 scheduled flow releases from the Fife Brook dam for whitewater recreation, as long as certain schedule adjustments are implemented from May through August.				
Develop an Operation Compliance Monitoring Plan for maintaining and monitoring flow releases, including procedures for recording and reporting data to FERC and resource agencies.	Interior, Massachusetts DFW	Yes.	$3,296	Yes.
Develop a Dragonfly Flight and Emergence Survey Plan.	Massachusetts DFW	No.[a]	$627	No. Measure is inconsistent with section 10(a) of the FPA. Staff is not recommending Massachusetts DFW's ramping rate limitations; and the survey would not likely be able to attribute with certainty any

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
				observed changes in the dragonfly population to changes in project operation.
Develop a Special Status Dragonfly Habitat Enhancement Plan.	Massachusetts DFW	No.[b, c]	Unknown – the recommendation lacks specificity needed to estimate a cost.	No.
Establish a 200-foot, natively vegetated buffer zone on all riverfront lands within and downstream of the project boundary.	Massachusetts DFW	No.[c]	Unknown – the recommendation lacks specificity needed to estimate a cost.	No.
Provide a Rare Dragonfly Species Mitigation Fund.	Massachusetts DFW	No.[d]	Unknown – the recommendation lacks specificity needed to estimate a cost.	No.
Develop an Invasive Mussel Species Monitoring and Management Plan.[e]	Massachusetts DFW	Yes.	$2,043	Yes.
Develop a Bat Management Plan.	Interior, Massachusetts DFW	No.[b]	$2,207	No. Staff recommends implementing a seasonal clearing restriction for trees

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
				greater than 3 inches in width at breast height, between June 1 and July 31, to avoid the time period when NLEB may be occupying nearby roosting trees.
Develop a Special Status Plant Management Plan.	Massachusetts DFW	No.[f]	$2,207	Yes.
Develop an Invasive Plant Species Monitoring and Management Plan that includes the following measures: (1) educate recreational users on ways to reduce the spread of invasive plant species; (2) implement "best management practices," such as identifying invasive plant species that may be introduced by a given project-related activity, identifying critical control points (locations and times), and implementing measures to prevent the spread of invasive plant species during routine project operation and maintenance activities; (3) record incidental observations of invasive plant	Massachusetts DFW	Yes.	$1,253	Yes.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
species; and (4) use only seed and plant materials outside of lawn areas to those found to be native to the county in the then-current Vascular Plants of Massachusetts.				
Include the following additional measures in the Invasive Plant Species Monitoring and Management Plan: (1) a comprehensive survey of invasive plants every 5 years that would be used to develop site-specific control/management actions to reduce the spread of invasive species at the project; and (2) plant and seed areas after implementing invasive species control techniques.		No.[b]		No.
Develop a Bald Eagle Protection Plan.	Massachusetts DFW	Yes.	$627	Yes.
Renew the existing conservation easement on 1,264 acres of land, or transfer lands to a qualified conservation entity for perpetual conservation.	Massachusetts DFW	No.[c]	Unknown – the recommendation lacks specificity needed to estimate a cost.	No.

Recommendation	Agency	Within scope of section 10(j)?	Levelized Annual Cost	Recommend Adopting?
Allow Massachusetts DFW and FWS to inspect the project and request pertinent records for the purpose of monitoring compliance with the terms and conditions of a new license.	Massachusetts DFW	No.[b]	$0	No. Staff recommends an Operational Compliance Monitoring Plan to ensure proper documentation of compliance with the conditions of a new license.

[a] The recommended study is not specifically designed to either provide project-related protection, mitigation, or enhancement of fish and wildlife resources, or to measure compliance with or the success of a specific project-related protection, mitigation, or enhancement measure for fish and wildlife resources.

[b] This is not a specific fish and wildlife measure. The provisions of this measure are generic and uncertain.

[c] There is no nexus between a project effect on fish and wildlife and the recommended measure.

[d] The set-aside of money for the development of a fish and wildlife enhancement fund is outside the scope of section 10(j).

[e] Massachusetts DFW identifies this plan as an Invasive Wildlife Species Monitoring Plan. However, based on the discussion provided in its section 10(j) recommendation, we interpret this recommendation to apply specifically to invasive mussel species.

[f] There is no indication that the state-listed rare plants referred to in the recommendation provide habitat for fish or wildlife.

.

5.4 CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2) of the FPA, 16 U.S.C., § 803(a)(2)(A), requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. We reviewed the following 12 comprehensive plans that are applicable to the Bear Swamp Project. No inconsistencies were found.

Atlantic States Marine Fisheries Commission. 2000. Interstate Fishery Management Plan for American eel (*Anguilla rostrata*). (Report No. 36). April 2000.

Atlantic States Marine Fisheries Commission. 2008. Amendment 2 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. October 2008.

Atlantic States Marine Fisheries Commission. 2013. Amendment 3 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. August 2013.

Atlantic States Marine Fisheries Commission. 2014. Amendment 4 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. October 2014.

Franklin County Planning Department. 1990. Deerfield River comprehensive management plan. Greenfield, Massachusetts. June 1990.

Massachusetts Department of Environmental Management. n.d. Commonwealth connections: A greenway vision for Massachusetts. Boston, Massachusetts.

Massachusetts Department of Environmental Quality Engineering. 1983. Connecticut River Basin water quality management plan. Westborough, Massachusetts. June 1983.

Massachusetts Department of Fish and Game. 2006. Comprehensive wildlife conservation strategy. West Boylston, Massachusetts. September 2006.

Massachusetts Executive Office of Energy and Environmental Affairs. Statewide Comprehensive Outdoor Recreation Plan (SCORP): Massachusetts Outdoor 2006. Boston, Massachusetts.

National Park Service. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.

Technical Committee for Fisheries Management of the Connecticut River. 1981. Connecticut River Basin fish passage, flow, and habitat alteration considerations in relation to anadromous fish restoration. Hadley, Massachusetts. October 1981.

U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.

6.0 FINDING OF NO SIGNIFICANT IMPACT

If the Bear Swamp Project is issued a new license as proposed with the additional staff-recommended measures, the project would continue to operate as it does today, while providing enhancements to aquatic and terrestrial resources, protection of threatened and endangered species, improvements to recreation facilities, and protection of cultural and historic resources in the project area.

The staff-recommended measures include minor land-disturbing and land-clearing activities associated the development and improvement of recreation facilities. In addition, the expiration of certain conservation easements on land that staff is proposing to remove from the project boundary would open the land to development. However, there are no current proposals to develop any of the land at issue, and the likelihood of development on this land is low due to the steep topography in the area.

Based on our independent analysis, we find that the issuance of a license for the Bear Swamp Project, with additional staff-recommended environmental measures, would not constitute a major federal action significantly affecting the quality of the human environment.

7.0 LITERATURE CITED

Almodovar, A., and Graciela, G. (1999). Effects of a Small Hydropower Station Upon Brown Trout *Salma Trutta* in the River Hoz Seca (Tagus Basin, Spain) One Year After Regulation. Regul. Rivers: Res. Mgmt. 15**:** 477 – 484.

American Whitewater. 2019. Massachusetts, US River List. Available at https://www.americanwhitewater.org/content/River/state-summary/?state=MA. Accessed October 15, 2019.

Bear Swamp Power Company. 2009. Public Safety Plan: FERC Project Number 2669.

______. 2016a. Aquatic Mesohabitat Assessment and Mapping Study Report. October 2016. FERC Project Number 2669.

______. 2016b Fife Brook Flow Attenuation Study. October 2016. FERC Project Number 2669.

______. 2016c. Right-of-Way Vegetation Management Plan. Available at https://www.mass.gov/files/documents/2018/03/22/Bear-swamp-VMP-2016-2020.pdf. Accessed August 23, 2019.

______. 2017a. Water Quality Study Report. March 2017. FERC Project Number 2669.

______. 2017b. Fish Assemblage Assessment Study Report. March 2017. FERC Project Number 2669.

______. 2017c. Instream Flow Assessment Study Report. March 2017. FERC Project Number 2669.

______. 2017d. State-listed odonates survey (privileged). March 2017. FERC Project Number 2669.

______. 2018. Instream Flow Assessment Additional Habitat Analyses. June 2018. FERC Project Number 2669.

Bell, Milo. C. 1991. Fisheries handbook of engineering requirements and biological criteria.

Berkshire Regional Planning Commission. 2014. Sustainable Berkshires, Land Use; An Element of *Sustainable Berkshires*, Long Range Plan for Berkshire County. Available at http://berkshireplanning.org/images/uploads/documents/Sustainable_Berkshires-Land_Use-20140320.pdf. Accessed July 30, 2019.

Blair, N, Ryan, J. L, and Burne, M. R. 2003. A field guide to the dragonflies and damselflies of Massachusetts.

Boschung, H.T. and R.L. Mayden. 2004. Fishes of Alabama Smithsonian Institution, Washington, D.C.

Braun and Braun 1994. First Peoples of the Northeast. Lincoln Historic Society, Lincoln, Massachusetts.

Brookfield Renewable. 2018. Safe Waters. Available at https://www.safewaters.com/home. Accessed August 23, 2019.

Čada, G.F., C.C. Coutant, and R.R. Whitney. 1997. Development of biological criteria for the design of advanced hydropower turbines. Report 10578. U.S. Department of Energy, Idaho Operations Office, Idaho Falls, Idaho. 97 pp.

Canadian Wildlife Federation. 2019. American eel. Available online at http://cwf-fcf.org/en/resources/encyclopedias/fauna/fish/eel.html. Accessed on October 1, 2019.

Carlson, C.C. 1986. Archival and Archaeological Research Report on the Configuration of the Seven Original 17th Century Praying Indian Towns of the Massachusetts Bay Colony. University of Massachusetts Archaeological Services, Amherst. Report on file with the Massachusetts Historical Commission, Office of the Secretary of State, Boston.

City-Data. 2016. Berkshire and Franklin Counties Data. Available online at http://www.city-data.com. Accessed on August 30, 2019.

Code of Massachusetts Regulations. 314 C.M.R. Available online at https://www.mass.gov/law-library/314-cmr. Accessed October 29, 2019.

Code of Massachusetts Regulations. 321 C.M.R. Available online at https://www.mass.gov/law-library/321-cmr. October 29, 2019.

Code of Massachusetts Regulations. 323 C.M.R. Available online at https://www.mass.gov/law-library/323-cmr. October 29, 2019.

Cole, Michael B. 2017 Deerfield River Watershed Trout Spawning Surveys Available online at https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=15200138. Accessed August 22, 2019.

Coutant, Charles C. and Whitney, Richard R. 2000 Fish Behavior in Relation to Passage through Hydropower Turbines: A Review. Transactions of the American Fisheries Society, 129:2, 351-380.

Donta, Christopher L., Kimberly Smith and Nathan Scholl 2017. Cultural Resources Reconnaissance for the Bear Swamp Power Company, LLC, Bear Swamp Project, Towns of Rowe, Florida, and Charlemont, Berkshire and Franklin Counties, Massachusetts.

Franke, G.F., D.R Webb, R.K. Fisher, Jr., D. Mathur, P.N. Hopping, P.A. March, M.R. Headrick, I.T. Laczo, Y. Ventikso, and F. Sotiropoulos. 1997. Development of environmentally advanced hydropower turbine system design concepts. Report 2677-0141. U.S. Department of Energy, Idaho Falls, Idaho. 456 pp.

FWS (U.S. Fish and Wildlife Service). 2007a. Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States from the List of Endangered and Threatened Wildlife. 72 Fed. Reg., 37345-37372 (July 9, 2007).

_____. 2007b. National Bald Eagle Management Guidelines. Available online at https://www.fws.gov/southdakotafieldoffice/NationalBaldEagleManagementGuidelines.pdf. Accessed October 1, 2019.

_____. 2016a. Endangered and Threatened Wildlife and Plants; 4(d) Rule for the Northern Long-Eared Bat. 81 Fed. Reg. 9,1900-1922 (January 14, 2016).

_____. 2016b. Programmatic biological opinion on final 4(d) rule for the northern long-eared bat and activities excepted from take prohibitions. U.S. Fish and Wildlife Service, Midwest Regional Office.

_____. 2019. The Exotic Zebra Mussel. U.S. Fish and Wildlife Service, Midwest Regional Office. Available online at https://www.fws.gov/midwest/endangered/clams/zebra.html. Accessed October 1, 2019.

FirstLight (FirstLight Hydro Generating Company). 2016. Relicensing study 3.3.10: assess operational impacts on emergence of state-listed odonates in the Connecticut River, 2014-2016 study report. December 2016. FERC Project Numbers 1889 and 2485.

Fischer, R.A., C.O. Martin, and J.C. Fischenich. 2000. Improving riparian buffer strips and corridors for water quality and wildlife. International Conference on Riparian Ecology and Management in Multi-land Use Watersheds. American Water Resources Association. August, 2000.

Fitzhugh, William W. 1970. Archaeological Surveys and Excavations at Fife Brook on the Upper Deerfield River. MHC report 25-824. Report on file with Massachusetts Historical Commission, Boston.

Flodmark, L.E.W., Forseth, T, L'Abee-Lund, J.H., Vollestad, L.A.,2006. Behaviour and Growth of Juvenile Brown Trout Exposed to Fluctuating Flow. Ecology of Freshwater Fish. 15(1):57 – 65.

GMCME (Gulf of Maine Council on the Marine Environment). 2007. American Eels: restoring a vanishing resource in the Gulf of Maine. 12 pages. Available at http://www.gulfofmaine.org/council/publications/american_eel_high-res.pdf. Accessed August 30, 2019.

Griffith, G.E., Omernik, J.M., Bryce, S.A., Royte, J., Hoar, W.D., Homer, J., Keirstead, D., Metzler, K.J., and Hellyer, G. 2009. Ecoregions of New England (color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia, U.S. NPA Geological Survey (map scale 1:1,325,000).

Grumet, Robert S. 1995. Historic Contact Indian People and Colonists in Today's Northeastern United States in the Sixteenth through Eighteenth Centuries.

Gunning, G.E. and C.R. Shoop. 1962. Restricted movements of the American eel, Anguilla rostrata (Leseur), in freshwater streams with comments on growth rate. Tulane Stu. Zool. 9(5):265-272.

Hartel, K.E., D.B. Halliwell, and A.E. Launer. Inland Fishes of Massachusetts. Massachusetts Audubon Society, 2002.

Haynes, C.V. 1980. The Clovis Culture. Canadian Journal of Anthropology 1:115–121.

Heitert, Kristen 2003. Archaeological Reconnaissance Survey and Archaeological Resources Management Plan, Yankee Nuclear Power Station, Rowe and Monroe, Massachusetts. MHC report 25-2503. Report on file with Massachusetts Historical Commission, Boston.

Jenkins, R.E., and N.M. Burkhead. 1993. Freshwater fishes of Virginia. American Fisheries Society, Bethesda, Maryland.

Jensen, A.J. and Johnsen, B.O. 1999. The functional relationship between peak spring floods and survival and growth of juvenile Atlantic Salmon (Salmo salar) and Brown Trout (Salmo trutta) Functional Ecology 1999 13, 778–785.

Katopodis, C. and Gervais, R. 2016. Fish Swimming Performance Database and Analyses. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/002. vi + 550 p.

Kjaerstad, G, Arnekleiv, J.V., Speed, J.D. and Herland, A.K. 2018. Effects of hydropeaking on Benthic Invertebrate Community Composition in Two Central Norwegian Rivers. River Research and Applications. Vol. 34. No. 3: 218-231.

Korman, J., and Campana, S. 2009. Effects of Hydropeaking on Nearshore Habitat Use and Growth of Age 0 Rainbow Trout in a Large Regulated River. Transactions of the American Fisheries Society. 138(1):76-87.

Massachusetts Division of Fisheries and Wildlife. 2019. Longnose sucker *Catostomous catostomous* fact sheet available online at https://www.mass.gov/files/documents/2016/08/qg/catostomus-catostomus.pdf. Accessed August 30, 2019.

MEOEEA (Massachusetts Executive Office of Energy and Environmental Affairs). 2004. Deerfield River Five Year Watershed Action Plan - Final Massachusetts. Available at http://ma-ri-tu-council.org/CouncilEC/articles/Deerfield%20Action%20Plan%20Final%20Draft04-08.pdf. Accessed October 15, 2019.

MEOEEA (Massachusetts Executive Office of Energy and Environmental Affairs). 2017. Massachusetts Statewide Comprehensive Outdoor Recreation Plan 2017. Available at https://www.mass.gov/files/massachusetts-scorp-2017-for-submission.pdf. Accessed July 8, 2019.

Massachusetts DFW (Division of Fisheries and Wildlife). 2015a. Ocellated darner fact sheet. Available at https://www.mass.gov/files/documents/2016/08/qd/boyeria-grafiana.pdf. Accessed September 4, 2019.

Massachusetts DFW (Division of Fisheries and Wildlife). 2015b. Riffle snaketail fact sheet. Available at https://www.mass.gov/files/documents/2016/08/qi/ophiogomphus-carolus.pdf. Accessed September 4, 2019.

Massachusetts Office of Coastal Zone Management. 2011. Policy Guide. Available at https://www.mass.gov/files/documents/2016/08/qc/czm-policy-guide-october2011.pdf. Accessed August 27, 2019.

Massachusetts Office of Travel and Tourism. 2018. The Economic Impact of Travel on Massachusetts Counties 2017. Available at https://www.massvacation.com/wp-content/uploads/2016/11/MA-2017-Report-2-Dec.-31-2018.pdf. Accessed on August 30, 2019.

Mitchell, P. 2009. Deerfield River Watershed 2005 Benthic Macroinvertebrate Assessment. Technical Memorandum TM-33-7. Massachusetts Department of Environmental Protection, Watershed Planning Program, Worcester, MA

National Park Service, 2002. National Register Bulletin: How to Apply the National Register Criteria for Evaluation. Available at https://www.nps.gov/nr/publications/bulletins/nrb15/nrb15_2.htm. Accessed June 25, 2019.

New York Power Authority, 2017. Final License Application for the Blenheim Gilboa Project FERC No. 268.

Nistor, C.E., Pagu, B.I., Magdici, E., Pasarin, B. 2014. Study of Some Morphological Characters of Three Trout Breed Farmed in Salmonid Exploitations from Moldova. Animal Science and Biotechnologies, 2014, 47 (1).

North American Electric Reliability Corporation (NERC). 2018. 2018 Long-Term Reliability Assessment. Available at https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_LTRA_2018_12202018.pdf. Accessed December 2018.

Person, E.; Bieri, M.; Peter, A.; Schleiss, A.J. 2012. Mitigation measures for fish habitat improvement in Alpine rivers affected by hydropower operations. Ecohydrology 2014, 7, 580–599.

Potter, Elisabeth W. and Beth M. Boland. 1992. Guidelines for Evaluating and Registering Cemeteries and Burial Places bulletin. National Register Bulletin 41. U.S. Department of Interior.

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

Ross. R.T, Brenneman. W.M., Slack. W.T., O'Connell. M.T., and Peterson. T.L. 2001. Inland Fishes of Mississippi, Mississippi Department of Wildlife, Fisheries, and Parks. 624 pages.

Sear, D.A., Pattison, I., Collins, A.L., Newson, M.D., Jones, J.I., Naden, P.S., and Carliong, P.A. 2014. Factors Controlling the Temporal Variability in Dissolved Oxygen Regime of Salmon Spawning Gravels. Hydrol. Process. 28, 86–103.

Scruton, D.A., R.S. McKinley, R.K. Booth, S.J. Peake, and R.F. Goosney. 1998. Evaluation of Swimming Capability and Potential Velocity Barrier Problems for Fish Part A. Swimming Performance of Selected Warm and Cold Water Fish Species Relative to Fish Passage and Fishway Design. CEA Project 9236 G 1014, Montreal, Quebec. xiv + 62 pp., 2 appendices.

Smith, Kimberly M., Rose, Charles, Nathan Scholl. 2019. Archaeological Intensive (Locational) Survey for the Bear Swamp Power Company, LLC, Bear Swamp Project, Towns of Rowe, Franklin County and Florida, Berkshire County, Massachusetts.

Talmage, Valerie. 1982. Prehistoric Overview in Historic and Archaeological Resources of Southeast Massachusetts, Massachusetts Historical Commission, Boston.

Trout Unlimited. 2016. Deerfield River Watershed TU Study Request: Trout Spawning Survey in the Deerfield River from Fife Dam to the Number 4 Dam. Submitted to the Federal Energy Regulatory Commission, Washington, D.C.

U.S. Bureau of Labor Statistics. 2018. Local Area Unemployment Statistics. December 2018. Available at https://www.bls.gov/web/laus/laumstrk.htm. Accessed on August 30, 2019.

U.S. Census Bureau. 2018. On-line Data. Available at https://www.census.gov/data.html. Accessed on August 30, 2019.

U.S. Department of Agriculture. 2008. Brown trout (*Salmo trutta*) Species and Conservation Assessment. Prepared for the Grand Mesa, Uncompahgre, and Gunnison National Forests. December 2008. 28 pages.

Wenger, S. 1999. A review of the scientific literature on riparian buffer width, extent, and vegetation. Office of Public Service and Outreach, Institute of Ecology, University of Georgia. 60 pages.

Whitewater to Bluewater. 2019. Brook Trout (*Salvelinus fontinalis*) Life History and Habitat Needs. Available at https://easternbrooktrout.org/groups/whitewater-to-bluewater/species-spotlight/brook-trout-salvelinus-fontinalis. Accessed August 30, 2019.

Winchell, F., Amaral, S., and Dixon, D. 2000. Hydroelectric Turbine Survival Database: An Alternative to Field Studies. Hydrovision 2000 Conference Proceedings.

Yester, D.R. 1988. Subsistence and Diet in North-Temperate Coastal Hunter-Gatherers: Evidence from the Moshier Island Burial Site, Southwestern Maine. In Diet and Subsistence: Current Archaeological Perspectives, edited by B.V. Kennedy and G.M. LeMoine, pp. 207–226. Proceedings of the 18th Annual Chacmool Conference, Department of Archaeology, University of Calgary.

Young, P., J.J. Cech, and L.C. Thompson. 2011. Hydropower-related pulsed-flow impacts on stream fishes: a brief review, conceptual model, knowledge gaps, and research needs. Reviews in Fish Biology and Fisheries. DOI: 10.1007/s11160-011-9211-0.

8.0 LIST OF PREPARERS

Amy Chang – Coordinator, Terrestrial Resources, Wetlands, ESA (Wildlife Biologist, B.S. Biology, M.S. Environmental Science and Policy).

John Baummer – Aquatic Resources (Fish Biologist; B.S. Biology, M.S. Environmental Science).

William Connelly – Aquatic Resources (Fish Biologist; B.S, Forestry and Wildlife Science; M.S., Marine Science; Ph.D., Marine, Estuarine, and Environmental Science).

Patrick Crile – Need for Power, Developmental Resources (Environmental Engineer; B.S. Geology, M.S. Environmental Science and Engineering).

Amanda Gill – Cultural Resources (Archaeologist; B.S., Archaeological Sciences; M.A., Applied Archaeology).

Erin Kimsey – Recreation, Land Use, and Aesthetics (Outdoor Recreation Planner; B.L.A. Landscape Architecture).

Nicholas Palso – Recreation, Land Use, and Aesthetics; (Environmental Protection Specialist; B.S., Wildlife Biology; M.P.A, Masters of Public Administration; Ph.D., Recreation, Park, and Tourism Management).

APPENDIX A

LICENSE CONDITIONS RECOMMENDED BY STAFF

In this section, we present draft license articles for staff-recommended measures:

Draft Article 3XX. *Project Modification Resulting from Environmental Requirements*. If environmental requirements under this license require modification that may affect the project works or operations, the licensee must consult with the Commission's Division of Dam Safety and Inspections – New York Regional Engineer. Consultation must allow sufficient review time for the Commission to ensure that the proposed work does not adversely affect the project works, dam safety, or project operation.

Draft Article 4XX. *Reservation of Authority to Prescribe Fishways*. Authority is reserved to the Commission to require the licensee to construct and maintain, or to provide for the construction, operation, and maintenance of, such fishways as may be prescribed by the Secretary of the Interior, pursuant to section 18 of the Federal Power Act.

Draft Article 4XX. *Project Operation*. The licensee must operate the project as follows:

(1) maintain the Fife Brook impoundment between the elevations of 830 and 870 feet National Geodetic Vertical Datum (NGVD), except as noted below in item (2);

(2) maintain the Fife Brook impoundment between the elevations of 830 and 835 feet NGVD during the hours of 10 a.m. to 12 p.m. on the 32 days of the year when the licensee for the Deerfield Project No. 2323 is scheduled to release whitewater flows from the dam of the Deerfield Station No. 5;

(3) maintain the upper reservoir of the Bear Swamp Pumped Storage Development between the elevations of 1,550 and 1,600 feet NGVD;

(4) release a continuous minimum flow of 125 cubic feet per second (cfs) from the Fife Brook dam into the Deerfield River as measured below the dam;

(5) when increasing outflow from the Fife Brook dam from the 125-cfs minimum flow to higher flows associated with either generation or whitewater recreation, hold the generator at 3 MW for 15 minutes before increasing outflow to higher levels; and

(6) when decreasing outflow from the Fife Brook dam from a generation/whitewater flow to the minimum flow of 125 cfs, ramp down the

generation/whitewater flow release over a one-hour period from March 15 through June 30.

The impoundment water level elevations and minimum flow requirements may be temporarily modified as follows:

Planned Deviations

Impoundment water levels and minimum flow requirements may be temporarily modified for short periods, of up to 3 weeks, after mutual agreement among the licensee and U.S. Department of Interior and Massachusetts Division of Fisheries and Wildlife (collectively, resource agencies). After concurrence from the resource agencies, the licensee must notify the Commission within 14 days and file a report with the Secretary of the Commission as soon as possible, but no later than 30 days after the onset of the planned deviation. Each report must include: (1) the reasons for the deviation and how project operations were modified, (2) the duration and magnitude of the deviation, (3) any observed or reported environmental effects, and (4) documentation of consultation with the resource agencies. For planned deviations exceeding 3 weeks, the licensee must file an application for a temporary amendment of the operational requirements of this license, and receive Commission approval prior to implementation.

Unplanned Deviations

Impoundment water levels and minimum flow requirements may be temporarily modified if required by operating emergencies beyond the control of the licensee (*i.e.*, unplanned deviations). For any unplanned deviation from impoundment water levels or minimum flow requirements that lasts longer than 3 hours or results in visible environmental effects such as a fish kill, the licensee must notify the resource agencies within 24 hours, and the Commission within 14 days, and file a report as soon as possible, but no later than 30 days after each such incident. The report must include: (1) the cause of the deviation; (2) the duration and magnitude of the deviation; (3) any pertinent operational and/or monitoring data; (4) a timeline of the incident and the licensee's response; (5) any comments or correspondence received from the resource agencies, or confirmation that no comments were received from the resource agencies; (6) documentation of any observed or reported environmental effects; and (7) a description of measures implemented to prevent similar deviations in the future.

For unplanned deviations from impoundment water levels or minimum flow requirements lasting 3 hours or less that do not result in visible environmental effects, the licensee must include in the annual operation compliance monitoring report required by Draft Article 4XX (Operation Compliance Monitoring Plan), a description of each incident that occurred during the prior January 1 through December 31 time period. The report must include for each 3 hours or less deviation: (1) the cause of the deviation;

(2) the duration and magnitude of the deviation; (3) any pertinent operational and/or monitoring data; (4) a timeline of the incident and the licensee's response to each deviation; (5) any comments or correspondence received from the resource agencies, or confirmation that no comments were received from the resource agencies; and (6) a description of measures implemented to prevent similar deviations in the future.

Draft Article 4XX. *Operation Compliance Monitoring Plan*. Within 6 months of license issuance, the licensee must file with the Commission, for approval, an Operation Compliance Monitoring Plan that includes, but is not necessarily limited to:

(1) a detailed description of the mechanisms and structures that will be used to operate the project to comply with the requirements specified in Draft Article 4XX (Project Operation) and Draft Article 4XX (Whitewater Flow Releases);

(2) a description of the gages and other measuring devices that will be used to monitor compliance with license requirements, including the locations of the measuring devices;

(3) a description of the procedures for operating, maintaining, and calibrating monitoring equipment;

(4) standard operating procedures to be implemented outside of normal operating conditions, including during: (a) scheduled facility shutdowns and maintenance; and (b) emergency conditions, including those that require unscheduled facility shutdowns and maintenance;

(5) the methods and frequency for reporting monitoring data to the Commission, U.S. Department of the Interior, and the Massachusetts Division of Fisheries and Wildlife; and

(6) a schedule for installing any monitoring equipment needed to document compliance with the operational requirements of the license.

The licensee must prepare the plan after consultation with U.S. Department of the Interior and the Massachusetts Division of Fisheries and Wildlife. The licensee must include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how agency comments are accommodated by the plan. The licensee must allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Draft Article 4XX. *Invasive Mussel Species Monitoring and Management Plan*. Within six months of license issuance, the licensee must file, with the Commission for approval, an Invasive Mussel Species Monitoring and Management Plan that includes the following measures to minimize the spread of invasive mussel species at the project, including dreissenid mussels: (1) educate project maintenance staff on ways to identify invasive mussels at key maintenance areas (*e.g.*, trashracks, minimum flow pipes); (2) post informational signs describing the identification of invasive mussel species and procedures to notify resource agencies of the presence of invasive mussel species; (3) implement best management practices, such as identifying invasive mussel species that may be introduced by a given project-related activity, identifying critical control points (locations and times), and measures to prevent the spread of invasive mussel species during routine project operation and maintenance activities; (4) notify U.S. Department of the Interior (Interior) and Massachusetts Division of Fisheries and Wildlife (Massachusetts DFW) if any invasive mussel species are observed in project waters; and (5) implement control measures in coordination with Interior and Massachusetts DFW in the event invasive mussel species are observed at the project.

The licensee must prepare the plan after consultation with Interior and Massachusetts DFW. The licensee must include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how agency comments are accommodated by the plan. The licensee must allow a minimum of 30 days for agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Draft Article 4XX. *Rare Plants Plan*. Within six months of license issuance, the licensee must file, with the Commission for approval, a Rare Plants Plan that includes measures for the protection of state-listed and special status plants within the project boundary, including specific measures to avoid or minimize adverse project effects on state-listed and special status plants, including effects associated with project-related construction, vegetation alteration, recreational enhancements or maintenance, and land-clearing activities.

The licensee must prepare the plan after consultation with the Massachusetts Division of Fisheries and Wildlife. The licensee must include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how agency comments are accommodated by the plan. The licensee must allow a minimum of 30 days for Division of Fisheries and Wildlife to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Draft Article 4XX. *Invasive Plant Species Monitoring and Management Plan*. Within six months of license issuance, the licensee must file, with the Commission for approval, an Invasive Plant Species Monitoring and Management Plan that includes the following measures to reduce the spread of invasive plant species at the project: (1) educate recreational users on ways to reduce the spread of invasive plant species; (2) implement best management practices, such as identifying invasive plant species that may be introduced by a given project-related activity, identifying critical control points (locations and times), and implementing measures to prevent the spread of invasive plant species during routine project operation and maintenance activities; (3) record incidental observations of invasive plant species; and (4) use only seed and plant materials outside of lawn areas to those found to be native to the county in the then-current Vascular Plants of Massachusetts.

The licensee must prepare the plan after consultation with the U.S. Department of the Interior and Massachusetts Division of Fisheries and Wildlife. The licensee must include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how agency comments are accommodated by the plan. The licensee must allow a minimum of 30 days for agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Draft Article 4XX. *Bald Eagle Protection Plan*. Within six months of license issuance, the licensee must file, with the Commission for approval, a Bald Eagle Protection Plan that includes measures for the protection of bald eagles within the project boundary, including measures to avoid killing, injuring, or harassing bald eagles during tree cutting or thinning operations. The plan must also incorporate the following measures from the U.S. Fish and Wildlife Service's 2007 *National Bald Eagle Management Guidelines*, to avoid disturbances to nesting eagles: (1) keeping a distance of at least 330 feet between the activity and the nest (distance buffers); (2) maintaining forested (or natural) areas between the activity and around nest trees (landscape buffers); and (3) avoiding construction and maintenance activities during the breeding season.

The licensee must prepare the plan after consultation with U.S. Department of the Interior and Massachusetts Division of Fisheries and Wildlife. The licensee must include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how agency comments are accommodated by the plan. The licensee must allow a minimum of 30 days for agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Draft Article 4XX. *Northern Long-Eared Bat Protection Measures*. The licensee must implement the following measures to protect northern long-eared bat habitat: (1) avoid cutting trees equal to or greater than 3 inches in diameter within the project boundary from June 1 through July 31, unless they pose an immediate threat to human life or property; and (2) where trees need to be removed, only remove trees between August 1 and May 31.

Draft Article 4XX. *Recreation Facilities Management Plan*. Within one year of the effective date of this license, the licensee must file a Recreation Facilities Management Plan for Commission approval that includes the following provisions:

(1) A description of the acreage and amenities provided at the following existing project recreation sites: (a) Bear Swamp Visitor Center, (b) Fife Brook Fishing and Boating Access Area, (c) Zoar Whitewater Access Area, (d) Zoar Picnic Area, (e) Bear Swamp Public Hunting Area, and (f) Bear Swamp and Hoosac Tunnel Trail.

(2) A description of the acreage and amenities provided at the following new project recreation facilities: (a) Fife Brook impoundment take-out site and boater egress trail; (b) Carbis Bend; and (c) Bridge to Nowhere.

(3) Provisions for the operation and maintenance of the nine project recreation sites, including: (a) hours of operation (if applicable); (b) signage at each project recreation site; (c) provisions for managing trash and its removal at each project recreation site; and (d) a description of soil erosion and sediment control measures to be used where ground-disturbing activities are proposed.

(4) A map identifying the nine project recreation sites in relation to the project boundary, as licensed herein.

The plan must incorporate the requirements specified in Draft Article 4XX (Recreation Facilities Site Improvements), Draft Article 4XX (Recreation Safety), and Draft Article 4XX (Whitewater Flow Releases). The plan must also include a provisions to: (a) limit tree cutting at the Zoar Picnic Area to the selective cutting of only hazardous trees; and (b) replace any tree that is removed from the Zoar Picnic Area with another tree that, upon maturity, would provide the same shade benefits as the tree that is removed.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

<u>Draft Article 4XX</u>. *Recreation Facilities Site Improvements*. Within one year of the effective date of this license, the licensee must construct the following recreation improvements:

(1) At the Fife Brook Impoundment: (a) construct and maintain a boater take-out site downstream of the Showtime rapid; (b) construct a new boater egress trail that begins at the formal takeout downstream from the Showtime rapid and extends upstream to the existing vehicle turnaround at Great River Hydro's Dunbar Brook Picnic Area; and (c) install signs along the river to guide boaters to the take-out.

(2) At the Fife Brook Fishing and Boating Access Area: (a) create up to 10 additional parking spaces at the unpaved, off-site overflow parking area by removing vegetation and placing gravel throughout the parking area; (b) mark the parking spaces at the overflow parking area to enable the most efficient use of the space; and (c) install handrails at the existing staircases.

(3) At the Zoar Whitewater Access, widen the access trail to a width of 8 feet.

(4) At the Zoar Picnic Area, install and maintain: (a) at least two additional seasonal restrooms; (b) a changing facility with at least four changing stalls; (c) install and maintain at least six seasonal trash receptacles, with five of them located near picnic tables and one at the exit; (d) install a second staircase; and (e) install handrails at the staircases.

Within 90 days of completing construction of the site improvements discussed above, the licensee must file with the Commission a report documenting each completed recreation site. The documentation must show each completed recreation site including all constructed facilities. The documentation may include photographs, aerial photographs, drawings that reflect the as-built condition, or other methods, provided that the documentation clearly demonstrates that each recreation site has been constructed in substantial conformity as approved. The report must also include confirmation that the approved recreation sites are located inside the project boundary. In the event that approved recreation sites are not located inside the project boundary, the licensee must propose a schedule to file, for Commission approval, revised Exhibit G (project boundary) drawings that incorporate the approved recreation sites inside the project boundary.

Draft Article 4XX. *Recreation Safety*. Within one year of the effective date of this license, the licensee must make the following improvements for the safety of recreation users at the project:

(1) Install and maintain flow release warning systems at the Fife Brook Fishing and Boating Access Area, the Zoar Whitewater Access Area, the Zoar Picnic Area, Carbis Bend, and Bridge to Nowhere project recreation sites. These warning systems must utilize both audible and visual warnings, and must be positioned on the bank of the river near the end of the access trail at each site, so as to be most visible and audible to both people entering the water and those already in the river.

(2) Install and maintain signage at each warning system or located nearby at the project recreation site, in order to describe: (a) the flow releases from Fife Brook dam; (b) the safety warning system at the site, including the 15-minute pause in flow increases at 3 MW; and (c) how to react to the warning signals. Sequential activation of each warning unit should be timed to coincide with the downstream advancement of rising waters to provide a more accurate indication of when rising waters would arrive at a site. The licensee must also post a static map at each project recreation site that displays the amount of time it takes for flows (*e.g.*, whitewater flow releases of 800 cfs) to reach each project recreation site downstream of the Fife Brook dam.

(3) Install and maintain either an emergency phone or dedicated Wi-Fi access for emergency communications with a limited range at the Fife Brook Fishing and Boating Access Area, Zoar Whitewater Access Area, Zoar Picnic Area, Carbis Bend, and Bridge to Nowhere project recreation sites.

In addition to the site improvements, the licensee must maintain a public website that provides: (a) the annual schedule for the 106 whitewater flow release days; (b) a 24-hour schedule of the timing and size of flows from the Fife Brook Development to the Deerfield River, to be posted by 5 p.m. on the prior day; (c) current outflow from the Fife Brook dam; (d) updates to the current 24-hour schedule and the current outflow information on a 5-minute basis; and (e) a static map that displays the amount of time it takes for whitewater releases of 800 cfs to flow from Fife Brook dam to each project recreation site.

No later than 6 months prior to making the aforementioned improvements, the licensee must file with the Commission, for review and approval, a conceptual plan identifying the safety improvements at each of the five recreation sites. This plan must be developed in consultation with Interior, the Massachusetts Division of Fisheries and Wildlife, the Whitewater Interest Group, the Connecticut River Conservancy, Trout Unlimited, and the Deerfield River Watershed Association. The licensee must include with the conceptual plan documentation of consultation, copies of comments and recommendations on the plan after it has been prepared and provided to the agencies and resource groups, and specific descriptions of how agency and resource group comments are accommodated by the plan. The licensee must allow a minimum of 30 days for agencies and resource groups to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Within 90 days of installing the safety improvements discussed above, the licensee must file with the Commission a report documenting each completed recreation site. The documentation must show each completed recreation site including all installed facilities (*e.g.*, flow release warning systems, signage, and emergency communications). The documentation may include photographs or other methods, provided that the documentation clearly demonstrates that each recreation site conforms with the requirements herein.

<u>Draft Article 4XX</u>. *Whitewater Flow Releases.*

Beginning in the calendar year following issuance of the license, the licensee must provide at least 106 annual whitewater flow releases of 800 cfs from the Fife Brook dam for a minimum duration of 3 hours beginning at 10 a.m. on 50 weekend days and 56 weekdays from April 1 through October 31.

The licensee must schedule the annual whitewater flow release days after consultation with the licensee for the Deerfield River Project No. 2323, Massachusetts Division of Fisheries and Wildlife, the U.S. Fish and Wildlife Service, and whitewater interest groups. The schedule must be filed with the Commission for approval and once approved, issued for publication by January 31 of each year, including by posting the schedule at each project recreation site downstream of the Fife Brook dam, and posting the schedule on the public website discussed in Draft Article 4XX (Recreation Safety).

The scheduled whitewater flow releases may be temporarily modified if required by operating emergencies beyond the control of the licensee (*e.g.*, electrical demand emergencies, flood control operations, droughts). If the whitewater flow releases are so modified, the licensee must update the published flow release schedule at least 24 hours prior to the release day that will be affected. However, if the operating emergency occurs within 24 hours of the scheduled whitewater release, the update must be published as soon as possible. The licensee must notify the Commission of the deviation as soon as possible, but no later than 10 days after each such incident.

The Commission reserves the right to require changes to the whitewater flow release schedule.

Draft Article 4XX. *Programmatic Agreement and Historic Properties Management Plan*. The licensee must implement the "Programmatic Agreement between the Federal Energy Regulatory Commission and the Massachusetts State Historic Preservation Officer for Managing Historic Properties that May be Affected by Issuance of a License to Bear Swamp Power Company, LLC for the Continued Operation of the Bear Swamp Project in Berkshire and Franklin Counties, Massachusetts (FERC No. 2669-089)," executed on (DATE), and including but not limited to the Historic Properties Management Plan (HPMP) for the project. Pursuant to the requirements of this Programmatic Agreement, the licensee must file, for Commission approval, an HPMP within one year of issuance of this order. When filing the HPMP for Commission approval, the licensee must include documentation of consultation with the Massachusetts State Historic Preservation Officer (SHPO) and federally recognized tribes during the development of the HPMP.

The Commission reserves the authority to require changes to the HPMP at any time during the term of the license. If the Programmatic Agreement is terminated prior to Commission approval of the HPMP, the licensee must obtain approval from the Commission and the Massachusetts SHPO before engaging in any ground-disturbing activities or taking any other action that may affect any historic properties within the project's area of potential effects.

Draft Article 4XX. *Use and Occupancy.* (a) In accordance with the provisions of this article, the licensee has the authority to grant permission for certain types of use and occupancy of project lands and waters and to convey certain interests in project lands and waters for certain types of use and occupancy, without prior Commission approval. The licensee may exercise the authority only if the proposed use and occupancy is consistent with the purposes of protecting and enhancing the scenic, recreational, and other environmental values of the project. For those purposes, the licensee has the continuing responsibility to supervise and control the use and occupancies for which it grants permission, and to monitor the use of, and ensure compliance with the covenants of the instrument of conveyance for, any interests that it has conveyed, under this article. If a permitted use and occupancy violates any condition of this article or any other condition imposed by the licensee for protection and enhancement of the project's scenic, recreational, or other environmental values, or if a covenant of a conveyance made under the authority of this article is violated, the licensee must take any lawful action necessary to correct the violation. For a permitted use or occupancy, that action includes, if necessary, canceling the permission to use and occupy the project lands and waters and requiring the removal of any non-complying structures and facilities.

(b) The types of use and occupancy of project lands and waters for which the licensee may grant permission without prior Commission approval are: (1) landscape plantings; (2) non-commercial piers, landings, boat docks, or similar structures and facilities that can accommodate no more than 10 water craft at a time and where said facility is intended to serve single-family type dwellings; (3) embankments, bulkheads, retaining walls, or similar structures for erosion control to protect the existing shoreline; and (4) food plots and other wildlife enhancement. To the extent feasible and desirable to protect and enhance the project's scenic, recreational, and other environmental values, the licensee shall require multiple use and occupancy of facilities for access to project lands or waters. The licensee must also ensure, to the satisfaction of the Commission's authorized representative, that the use and occupancies for which it grants permission are maintained in good repair and comply with applicable state and local health and safety requirements. Before granting permission for construction of bulkheads or retaining walls, the licensee must: (1) inspect the site of the proposed construction, (2) consider whether the planting of vegetation or the use of riprap would be adequate to control erosion at the site, and (3) determine that the proposed construction is needed and would not change the basic contour of the impoundment shoreline. To implement this paragraph (b), the licensee may, among other things, establish a program for issuing permits for the specified types of use and occupancy of project lands and waters, which may be subject to the payment of a reasonable fee to cover the licensee's costs of administering the permit program. The Commission reserves the right to require the licensee to file a description of its standards, guidelines, and procedures for implementing this paragraph (b) and to require modification of those standards, guidelines, or procedures.

(c) The licensee may convey easements or rights-of-way across, or leases of project lands for: (1) replacement, expansion, realignment, or maintenance of bridges or roads where all necessary state and federal approvals have been obtained; (2) storm drains and water mains; (3) sewers that do not discharge into project waters; (4) minor access roads; (5) telephone, gas, and electric utility distribution lines; (6) non-project overhead electric transmission lines that do not require erection of support structures within the project boundary; (7) submarine, overhead, or underground major telephone distribution cables or major electric distribution lines (69-kV or less); and (8) water intake or pumping facilities that do not extract more than one million gallons per day from a project impoundment. No later than January 31 of each year, the licensee must file with the Commission a report briefly describing for each conveyance made under this paragraph (c) during the prior calendar year, the type of interest conveyed, the location of the lands subject to the conveyance, and the nature of the use for which the interest was conveyed. No report filing is required if no conveyances were made under paragraph (c) during the previous calendar year.

(d) The licensee may convey fee title to, easements or rights-of-way across, or leases of project lands for: (1) construction of new bridges or roads for which all necessary state and federal approvals have been obtained; (2) sewer or effluent lines that discharge into project waters, for which all necessary federal and state water quality certification or permits have been obtained; (3) other pipelines that cross project lands or waters but do not discharge into project waters; (4) non-project overhead electric transmission lines that require erection of support structures within the project boundary, for which all necessary federal and state approvals have been obtained; (5) private or public marinas that can accommodate no more than 10 water craft at a time and are located at least one-half mile (measured over project waters) from any other private or public marina; (6) recreational development consistent with an approved report on recreational resources of an Exhibit E; and (7) other uses, if: (i) the amount of land conveyed for a particular use is five acres or less; (ii) all of the land conveyed is located at least 75 feet, measured horizontally, from project waters at normal surface elevation; and (iii) no more than 50 total acres of project lands for each project development are conveyed under this clause (d)(7) in any calendar year. At least 60 days before conveying any interest in project lands under this paragraph (d), the licensee must file a letter with the Commission, stating its intent to convey the interest and briefly describing the type of interest and location of the lands to be conveyed (a marked Exhibit G map may be used), the nature of the proposed use, the identity of any federal or state agency official consulted, and any federal or state approvals required for the proposed use. Unless the Commission's authorized representative, within 45 days from the filing date, requires the licensee to file an application for prior approval, the licensee may convey the intended interest at the end of that period.

(e) The following additional conditions apply to any intended conveyance under paragraph (c) or (d) of this article:

(1) Before conveying the interest, the licensee must consult with federal and state fish and wildlife or recreation agencies, as appropriate, and the State Historic Preservation Officer.

(2) Before conveying the interest, the licensee must determine that the proposed use of the lands to be conveyed is not inconsistent with any approved report on recreational resources of an Exhibit E; or, if the project does not have an approved report on recreational resources, that the lands to be conveyed do not have recreational value.

(3) The instrument of conveyance must include the following covenants running with the land: (i) the use of the lands conveyed must not endanger health, create a nuisance, or otherwise be incompatible with overall project recreational use; (ii) the grantee must take all reasonable precautions to ensure that the construction, operation, and maintenance of structures or facilities on the conveyed lands will occur in a manner that will protect the scenic, recreational, and environmental values of the project; and (iii) the grantee must not unduly restrict public access to project lands or waters.

(4) The Commission reserves the right to require the licensee to take reasonable remedial action to correct any violation of the terms and conditions of this article, for the protection and enhancement of the project's scenic, recreational, and other environmental values.

(f) The conveyance of an interest in project lands under this article does not in itself change the project boundaries. The project boundaries may be changed to exclude land conveyed under this article only upon approval of revised Exhibit G drawings (project boundary maps) reflecting exclusion of that land. Lands conveyed under this article will be excluded from the project only upon a determination that the lands are not necessary for project purposes, such as operation and maintenance, flowage, recreation, public access, protection of environmental resources, and shoreline control, including shoreline aesthetic values. Absent extraordinary circumstances, proposals to exclude lands conveyed under this article from the project shall be consolidated for consideration when revised Exhibit G drawings would be filed for approval for other purposes.

(g) The authority granted to the licensee under this article shall not apply to any part of the public lands and reservations of the United States included within the project boundary.