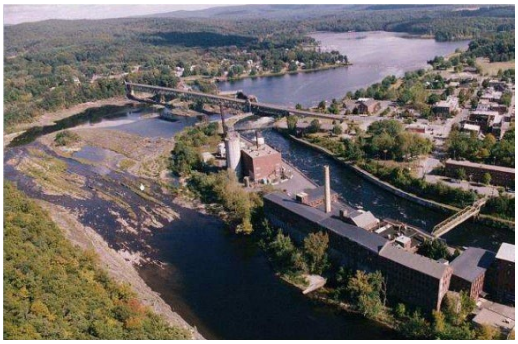
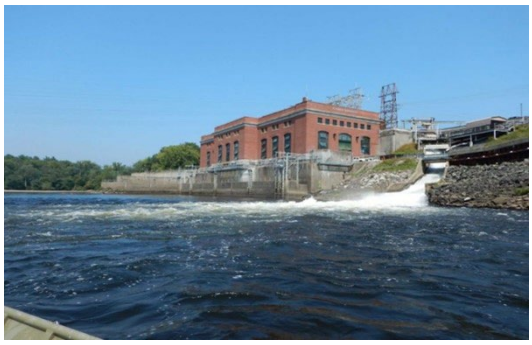
Office of
Energy
Projects
January 2026

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR HYDROPOWER LICENSES

Northfield Mountain Pumped Storage Project; Project No. 2485-071—MA, NH, VT

Turners Falls Hydroelectric Project; Project No. 1889-085—MA, NH, VT



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

January 2026

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FINAL ENVIRONMENTAL IMPACT STATEMENT

FOR HYDROPOWER LICENSES

Northfield Mountain Pumped Storage Project—FERC Project No. 2485-071
Turners Falls Hydroelectric Project—FERC Project No. 1889-085

Massachusetts/New Hampshire/Vermont

Federal Energy Regulatory Commission
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888 First Street, NE
Washington, D.C. 20426

January 2026

FEDERAL ENERGY REGULATORY COMMISSION

WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

To the Agency or Individual Addressed:

Reference: Final Environmental Impact Statement

Attached is the final environmental impact statement (EIS) on applications for new licenses for the Northfield Mountain Pumped Storage Project (Northfield Mountain Project; No. 2485-071) and the Turners Falls Hydroelectric Project (No. 1889-085), both located on the Connecticut River. The Turners Falls and Northfield Mountain projects are located in Franklin County, Massachusetts; Windham County, Vermont; and Cheshire County, New Hampshire. The Turners Falls Project consists of the Turners Falls impoundment, a power canal, two powerhouses, and other associated facilities. The Northfield Mountain Project consists of an upper reservoir, a lower reservoir (the Turners Falls impoundment), a powerhouse, and other associated facilities.

Approximately 20 acres of federally owned land associated with the U.S. Department of the Interior's U.S. Geological Survey (USGS) Silvio Conte Anadromous Fish Laboratory is located within the Turners Falls project boundary. There are no federal lands within the project boundary of the Northfield Mountain Project.

This final EIS documents the view of governmental agencies, non-governmental organizations, affected Indian Tribes, the public, the license applicant, and Federal Energy Regulatory Commission (Commission) staff. It contains staff evaluations of the applicant's proposal and the alternatives for relicensing the Northfield Mountain and Turners Falls projects.

Before the Commission makes a licensing decision, it will take into account all concerns relevant to the public interest. The final EIS will be part of the record from which the Commission will make its decision. The final EIS will be sent to the U.S. Environmental Protection Agency and made available to the public on or about January 30, 2026.

The final EIS may be viewed on the Internet at www.ferc.govc/docs-filing/eLibrary.asp. Please call (202) 502-8222 for assistance.

Attachment: Final EIS

COVER SHEET

a.	Title:	Environmental Impact Statement for Hydropower Licenses: Northfield Mountain Pumped Storage Project, FERC Project No. 2485-071 and the Turners Falls Hydroelectric Project, FERC Project No. 1889-085
b.	Subject:	Final Environmental Impact Statement (final EIS)
c.	Lead Agency:	Federal Energy Regulatory Commission (Commission)
d.	Abstract:	On December 4, 2020, FirstLight Power Services LLC (FirstLight), filed amended applications for new major licenses with the Commission to continue to operate and maintain the 1,166.6-MW Northfield Mountain Pumped Storage Project (on behalf of Northfield Mountain LLC[1]) and the 67.539-MW Turners Falls Hydroelectric Project (on behalf of FirstLight MA Hydro LLC[2]). Both projects are located on the Connecticut River, primarily in Franklin County in Massachusetts. The northern reaches of the shared project boundary encompassing the Turners Falls impoundment extend into Windham County, Vermont; and Cheshire County, New Hampshire. Approximately 20 acres of federally owned land associated with the Silvio Conte Anadromous Fish Laboratory is located within the Turners Falls project boundary. There are no federal lands within the project boundary of the Northfield Mountain Project. Staff's recommendation is to relicense the projects as proposed by the applicant, with certain staff modifications and additional measures recommended by stakeholders and Commission staff.
e.	Contact:	Stephen Kartalia Federal Energy Regulatory Commission Office of Energy Projects 888 First Street, N.E. Washington, D.C. 20426 (202) 502-6131 Stephen.Kartalia@ferc.gov

[1] On December 20, 2018, FirstLight Hydro Generating Company filed an application to transfer the license for the Northfield Mountain Project to Northfield Mountain LLC. The transfer was approved on July 11, 2019.

[2] On December 20, 2018, FirstLight Hydro Generating Company filed an application to transfer the license for the Turners Falls Project to FirstLight MA Hydro LLC. The transfer was approved on July 11, 2019.

		Brandi Welch-Acosta Federal Energy Regulatory Commission Office of Energy Projects 888 First Street, N.E. Washington, D.C. 20426 (202) 502-8964 Brandi.Welch-Acosta@ferc.gov
f.	Transmittal:	This final EIS on the proposed relicensing of the Northfield Mountain Pumped Storage Project and the Turners Falls Hydroelectric Project is being made available for public comment on or about January 30, 2026, as required by the National Environmental Policy Act of 1969[3] and the Commission's Regulations Implementing the National Environmental Policy Act (18 C.F.R., Part 380).

[3] National Environmental Policy Act of 1969, amended (Pub. L. 91-190. 42 U.S.C. §§ 4321–4347, as amended by Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, Pub. L. 97-258, §4(b), September 13, 1982, Pub. L. 118-5, June 3, 2023).

FOREWORD

The Federal Energy Regulatory Commission (Commission), pursuant to the Federal Power Act (FPA)[4] and the U.S. Department of Energy Organization Act[5] is authorized to issue licenses for up to 50 years for the construction and operation of non-federal hydroelectric developments subject to its jurisdiction, on the necessary conditions:

> That the project adopted . . . shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of water-power development, for the adequate protection, mitigation, and enhancement of fish and wildlife (including related spawning grounds and habitat), and for other beneficial public uses, including irrigation, flood control, water supply, and recreational and other purposes referred to in section 4(e).[6]

The Commission may require other conditions consistent with the FPA as may be found necessary to provide for the various public interests to be served by the project.[7] Compliance with such conditions during the licensing period is required. The Commission's Rules of Practice and Procedure allow any person objecting to a licensee's compliance or noncompliance with such conditions to file a complaint noting the basis for such objection for the Commission's consideration.[8]

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[4] 16 U.S.C. § 791(a)-825r, as amended by the Electric Consumers Protection Act of 1986, Pub. L. 99-495 (1986), the Energy Policy Act of 1992, Pub. L. 102-486 (1992), and the Energy Policy Act of 2005, Pub. L. 109-58 (2005).

[5] Public Law 95-91, 91 Stat. 556 (1977).

[6] 16 U.S.C. § 803(a).

[7] *Id.* § 803(g).

[8] 18 C.F.R. § 385.206 (2025).

COMMISSION STAFF PAGE LIMIT AND DEADLINE CERTIFICATIONS

I certify that Commission staff has considered the factors mandated by the National Environmental Policy Act (NEPA) and that this environmental document represents a good-faith effort to disclose the most important considerations required by NEPA within the statutory page limit (42 U.S.C. § 4336a(e)) and the statutory deadline (42 U.S.C. § 4336a(g)). This certification reflects staff's expert judgment that the analysis contained within this environmental document is an accurate representation of the potential environmental effects of the proposed action and the analysis is substantially complete. In staff's judgment, any considerations addressed briefly or left unaddressed would not meaningfully inform the assessment of environmental effects.

Nicholas Jayjack
Director
Division of Hydropower Licensing

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ACRONYMS AND ABBREVIATIONS

Advisory Council	Advisory Council on Historic Preservation
AIR	additional information request
APE	area of potential effects
BMPs	best management practices
B.P.	before present
ºC	degrees Celsius
certification	water quality certification
CFD	computational fluid dynamics
C.F.R.	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
Commission	Federal Energy Regulatory Commission
Conte Fish Lab	Silvio Conte Anadromous Fish Laboratory
Corps	U.S. Army Corps of Engineers
CRMFRC	Connecticut River Migratory Fish Restoration Cooperative
CZMA	Coastal Zone Management Act
DO	dissolved oxygen
E. coli	*Escherichia coli*
EFH	Essential Fish Habitat
EIA	U.S. Energy Information Administration
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ºF	degrees Fahrenheit
FERC	Federal Energy Regulatory Commission
FFPSA	Flows and Fish Passage Settlement Agreement
FirstLight	FirstLight Power Services LLC
Forest Service	U.S. Department of Agriculture, Forest Service
FPA	Federal Power Act
fps	feet per second
FR	Federal Register
FRCOG	Franklin Regional Council of Governments
$ft^3/ft/yr$	cubic feet per foot per year
FWS	U.S. Department of the Interior, Fish and Wildlife Service
GIS	geographic information system
Great River	Great River Hydro, LLC
HPMP	historic properties management plan
Interior	U.S. Department of the Interior
IPaC	(FWS) Information for Planning and Consultation
ISO-NE	Independent System Operator-New England
kVA	kilovolt ampere
kW	kilowatt

LiDAR	light-detecting and ranging
Massachusetts DCR	Massachusetts Department of Conservation and Recreation
Massachusetts DEP	Massachusetts Department of Environmental Protection
Massachusetts DFW	Massachusetts Division of Fisheries and Wildlife
mgd	million gallons per day
mg/L	milligrams per liter
mm	millimeter
MOUIP	Memorandum of Understanding in Principle
MW	megawatt
MWh	megawatt-hour
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NGVD 29	National Geodetic Vertical Datum of 1929
New Hampshire FGD	New Hampshire Fish and Game Department
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NPCC-New England	Northeast Power Coordinating Council's New England region
NRF	Naturally Routed Flow
O&M	operation and maintenance
PA	programmatic agreement
REA	ready for environmental analysis
river right	The right side of the river looking downstream
RM	river mile
RMP	Recreation Management Plan
RoC	rate of temperature change
RTE	rare, threatened, and endangered
SAV	submerged aquatic vegetation
SD1	scoping document 1
SD2	scoping document 2
SHPO	State Historic Preservation Office
TCP	traditional cultural property
TMDL	total maximum daily load
U.S.C.	United States Code
USGS	U.S. Department of the Interior, Geological Survey
Vermont FWD	Vermont Fish and Wildlife Department
WMA	Wildlife Management Area
WSE	water surface elevation

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EXECUTIVE SUMMARY

Proposed Action

On April 29, 2016, FirstLight Hydro Generating Company filed applications for new major licenses with the Commission to continue to operate and maintain the Turners Falls Hydroelectric Project (Turners Falls Project, FERC No. 1889-085) and the Northfield Mountain Pumped Storage Project (Northfield Mountain Project, FERC No. 2485-071), both located in Franklin County, Massachusetts; Windham County, Vermont; and Cheshire County, New Hampshire. Subsequently, amended applications were filed on December 4, 2020, and amendments to the amended applications were filed on March 22, 2024, by FirstLight Power Services LLC (FirstLight), on behalf of FirstLight MA LLC[9] for the Turners Falls Project, and on behalf of Northfield Mountain LLC[10] for the Northfield Mountain Project.

Approximately 20 acres of federally owned lands associated with the Silvio Conte Anadromous Fish Laboratory (Conte Fish Lab) are located within the Turners Falls project boundary. No federal lands are located within the project boundary of the Northfield Mountain Project.

Project Description and Operation

Northfield Mountain Project

The Northfield Mountain Project is a pumped storage peaking project,[11] which pumps water from the Turners Falls impoundment to an upper reservoir during periods of low electrical demand and generates power as water is returned to the impoundment during periods of high demand. The upper reservoir is located atop Northfield Mountain in Erving, Massachusetts, and is contained by a main dam, rockfill dikes and a concrete gravity dam. An intake channel and concrete intake structure conveys water from the upper reservoir to an underground powerhouse that contains four reversible pump-turbine-generator units. Water is conveyed between the powerhouse and the Turners Falls impoundment via underground tunnels and a tailrace at river mile (RM) 127, which is protected by a trashrack with 6-inch clear bar spacing, a boat barrier, and a fish barrier net that is installed seasonally.

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[9] On December 20, 2018, FirstLight Hydro Generating Company filed an application to transfer the license for the Turners Falls Project to FirstLight MA Hydro LLC. The transfer was approved on July 11, 2019.

[10] On December 20, 2018, FirstLight Hydro Generating Company filed an application to transfer the license for the Northfield Mountain Project to Northfield Mountain LLC. The transfer was approved on July 11, 2019.

[11] Under peaking operation, a hydropower project generally only generates for a few hours each day during peak demand periods, when the cost of power is high. The remainder of the time, when the cost of power is low, there is no generation, and the project reservoir refills to meet the next peak demand period.

The upper reservoir typically operates between elevations 1,000.5 feet and 938 feet relative to the National Geodetic Vertical Datum of 1929 (NGVD 29),[12] which provides approximately 12,318 acre-feet of usable storage. The four reversible pump-turbine-generator units operate at gross heads ranging from 753 to 824.5 feet. Each of the four units has an installed capacity of 291.65 megawatts (MW) and hydraulic capacities of 3,800 cubic feet per second (cfs) in pumping mode and 5,000 cfs in generation mode. The project has an installed capacity of 1,166.6 MW.

The project generated an average of about 889,845 megawatt-hours (MWh) annually from 2011 through 2019, while using 1,189,640 MWh annually for pumping operations during the same period. In the summer and winter seasons, the project typically peaks twice per day, in the morning and in late afternoon. During other months, the project may be peaked one to two times per day, depending on electrical demand and/or price. In both cases, water is typically pumped back to the upper reservoir during the night or during low-energy-priced hours.

Turners Falls Project

Turners Falls dam is located on the Connecticut River at approximately RM 122 in the towns of Gill and Montague, Massachusetts. The Turners Falls dam consists of two individual concrete gravity sections, referred to as the Gill and Montague dams, connected by a natural rock island known as Great Island. The Gill dam is approximately 55 feet high and 493 feet long and includes three Tainter gates. The Montague dam is approximately 35 feet high and 630 feet long and includes four bascule gates and a fixed crest section. A 2.1-mile-long power canal extends from the dam to the project's two powerhouses (Station No. 1 and Cabot Station). The canal provides flow to two additional non-project powerhouses and the Conte Fish Lab. Fish passage facilities include a fish ladder at Cabot Station, two fish ladders at Montague dam (one from the bypassed reach to the power canal and the other from the power canal to the Turners Falls impoundment), and a weir/sluice and sampling facility for passing downstream migrating fish. The Turners Falls impoundment extends upstream about 20 miles from the dam and has a surface area of 2,110 acres, a total storage of approximately 20,300 acre-feet, and 12,318 acre-feet of usable storage at the normal full pond elevation of 185.0 feet.

Station No. 1 and Cabot Station have installed capacities of 5.523 MW and 62.016 MW, respectively. Station No. 1 is located at the end of a 700-foot-long branch off the power canal approximately 3,000 feet downstream of Turners Falls dam, and discharges to the bypassed reach. It contains seven Francis turbines, five of which are currently operational. The five operational units have generating capacities ranging from 0.365 to 1.380 MW and hydraulic capacities ranging from 140 to 560 cfs. Cabot Station is located at the downstream end of the power canal and contains six 10.336-MW Francis turbines with a per-unit hydraulic capacity of 2,288 cfs. Adjacent to the powerhouse are eight spillway gates and a log sluice gate. The project (Station No. 1 and Cabot Station together) generated an average of about 332,351 MWh annually from 2011 through 2019.

Cabot Station is generally operated in a peaking mode, using up to 16,150 acre-feet of storage from the Turners Falls impoundment and up to 12,318 acre-feet of additional storage released from the Northfield Mountain Project's upper reservoir when that project is generating.

[12] All elevations described in this EIS are expressed in NGVD 29.

Station No. 1 is operated when flows are too low to operate a single Cabot turbine or when the hydraulic capacity of Cabot is exceeded. During generation, outflows from the powerhouses can vary between the required minimum flow of 1,433 cfs and the project's hydraulic capacity of 15,938 cfs (Station No. 1–2,210 cfs; Cabot Station–13,728 cfs).

Current Environmental Measures

Northfield Mountain Project

- Monitor and remediate streambank erosion within the Turners Falls impoundment through continued implementation of the 1999 Erosion Control Plan (FirstLight, 1999).
- For flood conditions, coordinate operations of the Northfield Mountain and Turners Falls projects in accordance with an agreement with the U.S. Army Corps of Engineers (Corps).
- Deploy a fixed-position guide net to reduce entrainment of Atlantic salmon smolts at the project's intake in the Turners Falls impoundment.[13]
- Manage the Bennett Meadow Wildlife Management Area (WMA) for the compatible use of the land for agricultural and wildlife management purposes.
- Operate and maintain 4 parks and other access areas at the project; facilities include 2 hunting areas, 2 campgrounds with 30 campsites and 1 group camp, 20 trails (32 miles of trail), and a winter sport area.

Turners Falls Project

Current License Requirements

- Monitor and remediate streambank erosion within the Turners Falls impoundment through continued implementation of the 1999 Erosion Control Plan (FirstLight, 1999).
- Coordinate project operations with the Corps in the interest of flood control.
- Maintain the Turners Falls impoundment water surface elevation (WSE) within a range of 176.0 to 185.0 feet.
- Provide a minimum instream flow of 1,433 cfs downstream of Cabot Station.

[13] The Connecticut River Migratory Fish Restoration Cooperative (CRMFRC) has not required installation of the barrier net since the Atlantic salmon restoration program on the Connecticut River was terminated in 2016.

- Provide a continuous minimum instream flow of 200 cfs in the bypassed reach starting on May 1 and increase the minimum flow to 400 cfs when fish passage starts by releasing flow through a bascule gate at the dam, although this may be reduced to 120 cfs.[14]
- Maintain and operate three upstream fish passage facilities (Cabot fishway, the Spillway fishway, and the gatehouse fishway) each with a counting area.
- Provide downstream fish passage at Cabot Station via a broad-crested weir leading to the log sluice from approximately April 1 through November 15.
- Operate and maintain two parks and other access areas at the project; facilities include one canoe portage, one tailwater fishing facility, one trail, two picnic areas, and one interpretive display.

Voluntary Measures

- Grant permissions for non-project uses of project lands through implementation of FirstLight's permitting program and consistent with the standard land use articles of the Turners Falls and Northfield Mountain projects' licenses. These non-project uses include use of project lands for a parking area, the Conte Fish Lab, a fire pond, a privately owned boat club, private camps, landscaping activities, agricultural uses, communications antennae, docks, a National Pollutant Discharge Elimination System discharge, and water withdrawals.

Proposed Facility Modifications

FirstLight does not propose to construct any new project facilities at the Turners Falls or Northfield Mountain projects other than those proposed as environmental measures, described below.

Proposed Project Boundary

Several changes are proposed for the Northfield Mountain project boundary (which includes the Turners Falls impoundment), including the removal of three parcels and the addition of one parcel. A 0.2-acre parcel at 39 Riverview Drive and an 8.1-acre parcel referred to as Fuller Farm, located near 169 Millers Falls Road in Northfield, Massachusetts, would be removed from the project boundary because FirstLight indicates they serve no project purposes. Another 52.3 acres would be removed from the project boundary to exclude a portion of Farley Ledges[15] (a rock climbing area on the eastern side of Northfield Mountain) that FirstLight

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[14] The 400 cfs continuous minimum instream flow is provided through July 15, unless the upstream fish passage season has concluded early, in which case the 400 cfs flow is reduced to 120 cfs to protect shortnose sturgeon. The 120 cfs continuous minimum instream flow is maintained in the bypassed reach from the date the upstream fishways are closed (or by July 16) until the river temperature drops below 7 degrees Celsius (°C), which typically occurs around November 15.

[15] Farley Ledges is a popular informal rock-climbing area partially within the existing Northfield Mountain project boundary south of the upper reservoir.

indicates is not needed for project purposes. FirstLight proposes to add a 135.5-acre parcel of land located south of the Northfield Mountain switching station in the towns of Northfield and Erving to the boundary. The lands to be added would include recreational trails associated with the Northfield Mountain Trail and Tour Center that are currently not enclosed by the project boundary.

Several changes are proposed for the Turners Falls project boundary, including the removal of two parcels that FirstLight indicates are not needed for project purposes and the addition of one parcel. The parcels to be removed include a 0.2-acre parcel at 39 Riverview Drive and a 20.1-acre parcel on which the Conte Fish Lab is located just north of Cabot Station. The 0.2-acre parcel would be removed from the project boundary because FirstLight states that it serves no project purposes. This parcel is located in an area where the Northfield Mountain and Turners Falls project boundaries overlap and would be removed from the project boundary for both projects. The 20.1-acre parcel on which the Conte Fish Lab is located was transferred from the project (at the time licensed to Western Massachusetts Electric Company, FirstLight's predecessor) to the U.S. Department of the Interior (Interior), Fish and Wildlife Service (FWS) in 1987, and then transferred to the U.S. Geologic Survey (USGS) in 1991. FirstLight proposes adding a 0.8-acre parcel at 21 Poplar Street in Montague where it proposes to develop a formal recreational access.

Proposed Project Operation and Environmental Measures

FirstLight proposes the following environmental measures to mitigate or protect environmental resources. Many of the measures proposed in the amended final license application were modified or expanded upon in the Flows and Fish Passage Settlement Agreement (FFPSA) filed by FirstLight on March 31, 2023,[16] and the Recreation Management Plan (RMP) included with the Recreation Settlement Agreement filed by FirstLight on June 12, 2023.[17] The measures proposed by FirstLight for the Turners Falls Project include constraints that would reduce flow fluctuations downstream of the projects most of the time, while allowing peaking operations to occur for a limited number of hours each month.

Measures Proposed for Both Projects

- Implement the Bald Eagle Protection Plans filed with the FFPSA (Articles B300 and A400).
- Implement the following measures to protect northern long-eared bat habitat: (1) avoid cutting trees equal to or greater than 3 inches in diameter at breast height within the project boundaries from April 1 through October 31, unless they pose an immediate threat to human life or property (hazard trees); and (2) where non-hazard trees need to be removed, only remove non-hazard trees between November 1 and March 31 (FFPSA Article B310 and A410).

[16] Accession no. 20230331-5600.

[17] Accession no. 20230612-5219.

- Place undeveloped FirstLight land not used for specific project activities along the Turners Falls impoundment shoreline into a conservation easement to maintain riparian buffers (RMP, Table 6.3-1).
- Conduct a programmatic assessment of existing recreation facilities and buildings to ensure the needs of people with disabilities are considered in the planning and design of each facility and implement applicable improvements (RMP, Table 6.3-1).
- Revisit the RMP once every 10 years to evaluate recreation use and demand (RMP, Table 6.3-1).
- Implement the Historic Properties Management Plans (HPMPs) for the Northfield Mountain and Turners Falls projects, filed on July 8, 2024.

Northfield Mountain Project – Project-Specific Measures

- Continue to operate the Northfield Mountain Project in a store-and-release mode by pumping water from the Turners Falls impoundment during low-load periods when energy costs are low, and then discharging water back into the Turners Falls impoundment during high-load periods when energy costs are high.
- Continue to coordinate operation of the Northfield Mountain and Turners Falls projects in accordance with an existing agreement between FirstLight and the Corps (FFPSA Article B100, part a).
- Operate the Northfield Mountain Project's upper reservoir with a normal maximum WSE of 1,004.5 feet and an 84.5-foot maximum allowable drawdown (i.e., 1,004.5 feet to 920 feet)[18] (FFPSA Article B100, part b).
- Implement the Upper Reservoir Dewatering Protocols filed on June 30, 2017, which include conducting a bathymetric survey of the upper reservoir and intake channel once every two years. If the average sediment depth throughout the middle of the intake channel exceeds 5 feet, review the potential need for sediment removal and conduct annual bathymetric surveys until sediment removal.
- To reduce the entrainment of migratory fish, install and maintain a barrier net across the Northfield Mountain Project tailrace/intake from June 1 to November 15 each year (FFPSA Articles B200 and B230). This operating period may be refined based on consultation among FirstLight, the Massachusetts Division of Fisheries and Wildlife (Massachusetts DFW), the National Marine Fisheries Service (NMFS), and FWS.
- Upon completion of construction of the fish barrier net, operate it for one season (shakedown year), and then conduct effectiveness testing (FFPSA Article B210).

[18] Under existing conditions, the Northfield Mountain upper reservoir elevation may fluctuate between 1,000.5 and 938 feet. The reservoir was designed to allow for fluctuation between 1,004.5 and 920 feet, and FERC has granted six temporary license amendments between 2001 and 2017 that permitted use of this range of storage capacity to support grid reliability.

- Conduct up to three additional rounds of downstream fish passage effectiveness testing and reporting during the first 20 years of the license term, as needed, to meet the Massachusetts DFW, NMFS, and FWS performance goals. If performance goals are not being met, implement one or more of the adaptive management measures listed in FFPSA Article B220. No adaptive management measures other than those specified in the proposed license article would be required for the first 25 years after license issuance unless agreed to by FirstLight, Massachusetts DFW, NMFS, and FWS.
- Develop a fish passage operation and maintenance (O&M) plan for the barrier net in consultation with Massachusetts DFW, NMFS, and FWS to include annual reporting on the status of the barrier net and any needed repairs or equipment replacement (FFPSA Article B240).
- Implement the Northfield Mountain Invasive Plant Species Management Plan filed on March 22, 2024.[19]
- Permanently conserve FirstLight's land within Bennett Meadow WMA that is not already under conservation easement and enhance existing riverfront trails south of Route 10 off the parking lot at Bennett Meadow WMA to include installation of a bench and historical/cultural interpretive signage (RMP measure 6.2.1 and RMP Table 6.3-1).
- Provide a permanent trail easement for the 1.3-mile-long portion of the New England National Scenic Trail that lies inside the Northfield Mountain project boundary on the eastern side of the project's upper reservoir (RMP Table 6.3-1).
- Relocate the boat tour dock from the tailrace to a location upstream of the fish barrier net and provide for an accessible/barrier-free dock layout that supports motorboats, canoes/kayaks, and riverboat tours (RMP measure 6.2.2).
- Construct approximately 5 miles of new trails for mountain biking (RMP measure 6.2.3).
- Construct and maintain a new paddle access campsite in the Barton Cove area (RMP measure 6.2.4).
- Designate Rose Ledges as a project recreation facility to allow climbing, with access to remain free of charge (RMP measure 6.2.5).
- Add the ability to lock canoes and kayaks during the day at Barton Cove (RMP measure 6.2.6).
- Donate used sporting equipment to local youth organizations (RMP Table 6.3-1).

[19] Accession no. 20240322-5086.

Turners Falls Project – Project-Specific Measures

- Based on the Naturally Routed Flow (NRF),[20] discharge the seasonal minimum flows defined in FFPSA Article A110 (Table 2.2.3-1) from the Turners Falls dam or gate located on the power canal just below the dam.
- Based on the NRF, maintain the total minimum flow downstream of Station No. 1 as defined in FFPSA Article A120 (Table 2.2.3-2).
- Based on the NRF, maintain the minimum flow downstream of Cabot Station as defined in FFPSA Article A130 (Table 2.2.3-3).
- Maintain the water level in the Turners Falls impoundment between elevation 176.0 and 185.0 feet and limit the rate of rise to less than 0.9 foot per hour between the hours of 8:00 a.m. and 2:00 p.m. from May 15 to August 15 to protect odonates (dragonflies and damselflies) (FFPSA Article A190).
- Ramp Cabot Station outflows as defined in FFPSA Article A140 (Table 2.2.3-4) except for a limited number of hours in July, August, September, October, and November, as defined in FFPSA Article A160 (Table 2.2.3-5), when flexible operations would be allowed.
- Beginning three years after license issuance, provide flow stabilization downstream of Cabot Station by maintaining ±10% of the NRF in the months of April through November except for the following: (1) a limited number of hours in those months when deviations within ±20% of the NRF would be allowed, as defined in FFPSA Article A160 (Table 2.2.3-6); and (2) a limited number of hours in July, August, September, October, and November, as defined in FFPSA Article A160 (Table 2.2.3-5), when flexible operations would be allowed.
- Based on the NRF, provide variable releases from the Turners Falls dam as defined in FFPSA Article A150 (Table 2.2.3-7) and downstream of Station No. 1, as defined in Article A150 (Table 2.2.3-8), to provide recreational boating opportunities.
- Develop a project operation, monitoring, and reporting plan (FFPSA Article A200) describing how the licensee would document compliance with proposed Articles A110, A120, A130, A140, A150, A160, and A190. The plan would include filing an annual report detailing any allowable deviations and documenting progress toward meeting the flow stabilization measures downstream of Cabot Station (Article A160). Operational requirements may be modified under the conditions listed in Table 2.2.3-10.
- Use the Cabot emergency gates only under the following conditions: (1) in case of a Cabot load rejection; (2) in the case of dam safety issues such as potential canal

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[20] The NRF represents the inflow to the Turners Falls dam. From December 1 through June 30, the NRF is defined as the hourly sum of the discharges from 12 hours previous as reported by: (1) the Vernon Project (FERC No. 1904); (2) the Ashuelot River USGS gage no. 01161000, *Ashuelot River at Hinsdale, NH*; and (3) the Millers River USGS gage no. 01166500, *Millers River at Erving, MA*. From July 1 through November 30, the NRF is defined as the hourly sum of the discharges averaged from 1 to 12 hours previous as reported by these sources.

overtopping or partial breach; and (3) to discharge approximately 500 cfs between April 1 and June 15 for debris management. If flows higher than 500 cfs need to be released through the gates from April 1 to June 15, FirstLight would coordinate with NMFS to minimize potential impact on shortnose sturgeon in the area downstream of Cabot Station (FFPSA Article A180).

- Continue to operate the Turners Falls Project in accordance with the existing agreement with the Corps (FFPSA Article A170).
- In the event of a conflict among the operational requirements of a new license, maintain the operation priority list provided in Table 2.2.3-9.
- Develop a shoreline erosion monitoring plan that includes: (1) conducting an initial shoreline erosion survey within two years of license issuance and additional surveys in Years 10, 20, 30, and 40 of any new license; (2) following completion of each erosion survey, preparing a report summarizing the survey methods, results, and identifying any riverbank segments that require stabilization or repair of existing stabilization measures; and (3) upon approval from Massachusetts DEP and the Commission, completing the stabilization or repair measures identified in the report, if any, within five years.
- Within one year of license issuance, provide the following information year-round on a publicly available website: (1) hourly Turners Falls impoundment water elevations, Turners Falls dam discharge, and Station No. 1 discharge; (2) hourly anticipated Turners Falls dam and Station No. 1 discharge for a 12-hour window into the future; and (3) the anticipated timing of the annual power canal drawdown (FFPSA Article A210).
- Construct and operate the proposed upstream and downstream fish passage facilities described in section 2.2.1.2 (FFPSA Article A300).
- Conduct initial fish passage effectiveness testing per the schedule defined in FFPSA Article A310 (Table 2.2.3-11).
- Conduct up to three additional rounds of upstream and downstream fish passage effectiveness testing and reporting during the first 20 years after license issuance, as needed to meet fishery agency performance goals. If the initial effectiveness testing shows that performance goals are not being met, FirstLight would implement one or more of the adaptive management measures listed in FFPSA Articles A320 for downstream passage and A330 for upstream passage. No adaptive management measures other than those specified in the proposed license article would be required for the first 25 years of the license unless expressly agreed to by FirstLight, Massachusetts DFW, NMFS, and FWS.
- Operate the fishways during the following periods: (1) May 1–November 15 for upstream eel passage; (2) April 4–July 15 for upstream anadromous fish passage; and (3) April 4–November 15 for downstream passage. The operating periods may be refined on an annual or permanent basis based on consultation among FirstLight, Massachusetts DFW, NMFS, and FWS (FFPSA Article A340).
- Develop and implement a fish passage O&M plan in consultation with Massachusetts DFW, NMFS, and FWS (FFPSA Article A350).

- Implement the Turners Falls Invasive Plant Species Management Plan filed on March 22, 2024.[21]
- Install a "pocket park" (e.g., a small park with viewing point and picnic table) at the Pauchaug-Schell Bridge Greenway and signage for historical and cultural interpretation (RMP measure 6.1.1).
- Construct and maintain a new paddle access campsite at Mallory Brook, or another location in the town of Northfield selected in consultation with the Appalachian Mountain Club and the town of Northfield (RMP measure 6.1.2).
- Construct a formal path leading from the Cabot Camp parking area to a put-in on the Millers River, construct a picnic area, and attempt to find a qualified organization to take responsibility for preserving the Cabot Camp historic buildings (RMP measure 6.1.3).
- Construct a new car-top access and put-in at Unity Park, provide a means of storing and locking vessels, install signage to assist paddlers portaging to downstream of the dam, and reconfigure the parking lot to improve vehicle and pedestrian safety (RMP measure 6.1.4).
- Construct a new river access point downstream of Turners Falls dam, including one path designed for rafters to launch upstream of Peskeomskut Island and another path to allow pass-through boaters to portage around the island (RMP measure 6.1.5).
- Construct a viewing platform, picnic area, and signage downstream of Turners Falls dam with the best feasible view of the dam (RMP measure 6.1.6).
- Construct a formal access for fishing and non-motorized boats upstream of the Station No. 1 tailrace (RMP measure 6.1.7).
- Install new stairs and signage at the Cabot Woods fishing area just downstream of Rock dam (RMP measure 6.1.8).
- Construct a portage trail around Rock dam (RMP measure 6.1.9).
- Construct improvements at the Poplar Street put-in and take-out to include stairs with a boat slide railing leading to a landing/concrete abutment, gangway, and floating dock (RMP measure 6.1.10).
- Install interpretive signage at Cabot Woods (Rock dam) and Peskeomskut/Great Falls (Turners Falls dam) (RMP measure 6.1.11).
- Make safety improvements to abandoned water passages in the Turners Falls bypassed reach (RMP Table 6.3-1).
- Establish a boat wake restriction, in coordination with the Massachusetts Department of Conservation and Recreation, from the Turners Falls dam extending upstream approximately 2 miles to where the Turners Falls impoundment narrows, to mitigate the impact of boat waves in the Barton Cove area.

[21] Accession no. 20240322-5086.

Public Involvement

Before filing the license applications, FirstLight conducted pre-filing consultation under the Commission's Integrated Licensing Process. 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 formal filing of the application with the Commission.

As part of the National Environmental Policy Act scoping process for the relicensing of Great River Hydro's (Great River) Wilder Hydroelectric Project (FERC No. 1892), Bellows Falls Hydroelectric Project (FERC No. 1855), Vernon Hydroelectric Project (FERC No. 1904), and FirstLight's Turners Falls and Northfield Mountain projects,[22] Commission staff distributed a scoping document (SD1) to stakeholders and other interested parties on December 12, 2012. Seven scoping meetings were held between January 28 and January 31, 2013, in West Lebanon, New Hampshire; Bellows Falls, Vermont; Brattleboro, Vermont; and Turners Falls, Massachusetts. Environmental site reviews were held in October 2012. Based on comments made during the scoping meetings and written comments filed with the Commission, Commission staff issued a revised scoping document (SD2) on April 15, 2013.

On February 22, 2024, Commission staff issued a notice accepting the applications; stating that the applications were ready for environmental analysis (REA); soliciting motions to intervene; and requesting comments, terms and conditions, recommendations, and prescriptions.

On May 30, 2025, Commission staff issued a draft environmental impact statement (EIS) for public review and comment and held two public comment sessions in Greenfield, Massachusetts, on July 16, 2025, to receive comments on the draft EIS. Written comments on the draft EIS were due by July 29, 2025, which the Commission extended until August 28, 2025, at the request of various stakeholders.

Alternatives Considered

This final environmental impact statement (EIS) for the Northfield Mountain and Turners Falls projects analyzes the effects of continued project operation and recommends conditions for any new licenses that may be issued for the projects. In addition to the applicant's proposal, the final EIS considers three alternatives for each project: (1) no action, meaning the project would continue to be operated as it currently is with no changes; (2) the applicant's proposal with staff modifications (staff alternative); and (3) the staff alternative with all mandatory conditions.

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[22] At the time of scoping, the Commission indicated its intent to prepare a single NEPA document addressing the proposed relicensing for all five of these projects. To meet the current page limits required for EISs by the Fiscal Responsibility Act of 2023 (Pub. L. No. 118-5, 137 Stat. 10 (2023) (amending NEPA to limit most environmental impact statements to 150 pages, except for projects of extraordinary complexity, which may be up to 300 pages) [codified at 42 U.S.C. § 4336a(e)(1)]), Commission staff have prepared separate EISs for the projects owned by each applicant, one for the three projects owned by Great River Hydro, LLC (the Wilder, Bellows Falls, and Vernon projects) and one for the two projects owned by FirstLight Power Services LLC (the Turners Falls and Northfield Mountain).

Under the staff alternative, the Northfield Mountain and Turners Falls projects would be operated: (1) as proposed by FirstLight with the following staff modifications; and (2) pursuant to the fishway prescriptions filed by Interior and NMFS (Appendices O and P), with the exception of installation of the barrier net in Year 7 after license issuance, and conducting the initial and subsequent effectiveness testing in Years 7 and 8, and again in Years 10, 11, 14, and 15; and the water quality certification conditions filed by Massachusetts DEP (Appendix Q).

Staff Alternative—Measures Applicable to Both Northfield Mountain and Turners Falls Projects

Threatened and Endangered Species

- Restrict tree removal or trimming (except for hazard trees that need to be removed to ensure public or project safety) on project lands from April 1 to October 31 to protect roosting northern long-eared and tricolored bats, as well as nesting migratory birds. Within two business days of an unplanned safety/emergency action resulting in tree disturbance in the project boundary, consult with FWS, Vermont Fish and Wildlife Department (Vermont FWD), New Hampshire Fish and Game Department (New Hampshire FGD), and Massachusetts DFW, as appropriate, and file a report with the Commission providing a description of the action and any measures taken to protect bats, and an assessment of potential disturbance to bats.

Recreation

- Revise the proposed RMP to include: (1) procedures to ensure that debris accumulations at the Turners Falls dam boat barrier are removed in a timely manner commensurate with safety protocols, (2) a provision to evaluate the efficacy of the existing methods for communicating flow information to the public should more effective communication methods become available in the future, and (3) a schedule to periodically evaluate and minimize light pollution caused by lighting from project facilities and recreation, as part of the RMP updates, including a description of activities completed, how advancements in lighting technology have been incorporated including the use of outdoor lighting principles, and compliance with any applicable local, state or federal standards for controlling light pollution.
- Develop a navigability monitoring plan to include: (1) a provision to monitor potential navigational constraints at Barton Cove for three years, including, but not limited to, water levels, sediment deposition, and vegetation; (2) a provision to file annual reports with the Commission that describe all monitoring done in the previous year and recommended measures to maintain or improve navigability at Barton Cove, particularly during low water periods; (3) a provision to assess the effects of any potential dredging on cultural resources and, should dredging be proposed, requirements for compliance with section 5.4.1, *Review of Ground Disturbing Activities*, of the Turners Falls HPMP; and (4) a provision to file a final report with the Commission after three years of monitoring that summarizes all monitoring results, measures implemented, and any recommended additional monitoring or measures that may be needed to allow for safe navigation in Barton Cove.

Land Use and Aesthetics

- Develop a shoreline or land use management plan to incorporate the existing permitting program, land use/shoreline classifications, guidelines, and policies to protect project lands and shorelines, and associated recreational, scenic, and environmental values. Also provide a periodic review and update schedule for consultation with agencies and interested parties.

Cultural Resources

- Revise each of the July 8, 2024, HPMPs to include: (1) a revised APE that includes all land enclosed by the project boundary and any land outside the project boundary where project operation or project-related recreational development or any other enhancements may cause changes in the character or use of historic properties, including, but not limited to, the Riverside/Peskeompskut Archaeological District, Turners Falls Historic District, "The Patch" Historic District, Riverside Historic District, the Turners Falls Power & Electric Company Historic District), Hinsdale Historic District, the Cabot Camp Historic District, and the Northfield Farms Agricultural/Residential District (as applicable); (2) a map or maps that clearly show the revised APE in relation to the project boundary; (3) clarification of the number of archaeological sites within the revised APE and inclusion of maps depicting their location in relation to the revised APE; (4) measures to address potential project-related effects associated with illicit artifact removal, and to include text on interpretive signs to explain the damages and legal ramifications of illicit artifact removal; (5) revisions to section 5.4.4 Monitoring Identified Archaeological Resources to include a plan for regular monitoring of eligible or unevaluated archaeological resources located within the APE; (6) revisions to section 5.4.4 Monitoring Identified Archaeological Resources to include the results from the initial shoreline monitoring survey (i.e., locations of identified project-related erosion, areas recommended for stabilization, and stabilization methods); (7) revisions to section 5.4.4 Monitoring Identified Archaeological Resources to include monitoring protocols for archaeological sites within the bypassed reach, particularly during times when the minimum flow is at or below 500 cfs; (8) a description of the Cabot Camp Historic District and Northfield Farms/Agricultural/Residential District, and description of site 19-FR-343 (Cabot Camp archaeological site) and provisions for regular monitoring of the site; (9) requirements to undertake archaeological survey of lands to be acquired for recreational and other future project-related purposes; (10) requirements for additional post-licensing consultation with participating Tribes regarding potential TCPs within the APEs; and (11) updates to *Appendix A: Agency, Tribal, and Interested Party HPMP Consultation Letters* to reflect the complete consultation record for the HPMP, including, but not limited to, the comment letter from the Massachusetts State Historic Preservation Office filed with the Commission on February 17, 2021.

Staff Alternative—Measures Applicable Only to the Northfield Mountain Project

The following recommended modifications of FirstLight's proposal and staff-recommended measures apply only to the Northfield Mountain Project:

Aquatic Resources

- Limit the use of additional storage (FFPSA Article B100, part b) as follows: (1) additional volume of water (3,009 acre-feet) would not be allowed to be used for generating; and (2) additional storage may not be pumped beyond 12,318 acre-feet during Apil 1 – May 31 for the protection of shortnose sturgeon spawning.
- Develop an operations compliance monitoring plan describing how FirstLight would document compliance with the operational requirements of any license issued for the project.
- Modify the proposed schedule for installing the barrier net in front of the Northfield Mountain tailrace/intake (FFPSA Article B200), and conducting the initial (FFPSA Article B210) and subsequent (FFPSA Article B220) effectiveness testing to be the same as the schedule as specified by Massachusetts DEP conditions 20, 21, and 22, respectively (installation in license Year 5 and initial effectiveness testing in license Years 7 and 8 and again in Years 10, 11, 14, and 15).

Terrestrial Resources

- Modify the Northfield Mountain Invasive Plant Species Management Plan to include continued treatment to control or eradicate invasive species in any areas that have been disturbed by project activities and are supporting invasive plant species that are out-competing desirable plant species.

Staff Alternative—Measures Applicable Only to the Turners Falls Project

The following recommended modifications of FirstLight's proposal and staff-recommended additional measures apply only to the Turners Falls Project:

Geology and Soils

- Modify FirstLight's proposed shoreline erosion monitoring plan to be consistent with Massachusetts DEP condition 25 and include the additional provision: expand the shoreline erosion survey to cover the entire Turners Falls impoundment, with the first survey completed within the first 2 years of any license and then every 10 years starting in Year 10.

Aquatic Resources

- Maintain water levels between elevation 178.5 feet and 185.0 feet except under the specified circumstances when the reservoir could be lowered to 177.5 feet and limit the rate of rise to less than 0.9 foot per hour between the hours of 8:00 a.m. and 2:00 p.m. from May 15 to August 15 (consistent with Massachusetts DEP condition 10(a-b)).
- Develop a canal drawdown protection plan, in consultation with FWS, Massachusetts DFW, and the Connecticut River Conservancy that includes, at a minimum: (1) a provision to develop long-term protective measures, such as drawdown rates and time periods for the drawdowns; (2) an evaluation of the feasibility of conducting drawdowns every other year rather than annually; (3) an evaluation of the feasibility of increasing the interconnectedness between pools in the canal and minimizing no water in areas with

hardened substrate; (4) a provision for salvage efforts led by FirstLight during all planned drawdowns; and (5) a provision for filing the results of salvage efforts each year with the Commission.

- Implement the following drawdown protection measures for the first year immediately following issuance of any future project license: (1) conduct the annual canal drawdown no earlier than mid-September; (2) draw down the canal over a one-day period, consistent with the rate of drawdown performed during Study 3.3.18 in 2014; and (3) install cones to identify paths for large machinery to follow while undertaking maintenance work in the canal during the drawdown.

Terrestrial Resources

- Develop a riparian management plan to provide a 75-foot vegetation buffer along the Connecticut River for all FirstLight-owned lands not needed for specific project purposes.
- Modify the Turners Falls Invasive Plant Species Management Plan specified by Massachusetts DEP condition 27 to extend the baseline survey for aquatic invasive plants in the Turners Falls Impoundment to include the area between the state line and Vernon dam.

Threatened and Endangered Species

- Develop a sturgeon stranding management plan, in consultation with NMFS, FWS, and Massachusetts DFW that includes, at a minimum: (1) identification of spill conditions with potential to result in stranding sturgeon in the Turners Falls bypassed reach; (2) a provision to conduct surveys in the Turners Falls bypassed reach after each spill over Turners Falls dam or whitewater release into the bypassed reach that meets the conditions identified for potential sturgeon stranding,, and to relocate any stranded sturgeon to safe areas within the bypassed reach; (3) a provision to file a report with the Commission within 30 days of any stranding event that identifies the date and time that the survey was conducted, the number, condition, and location of stranded sturgeon, a record of the hourly flows that occurred during the spill or whitewater release preceding the survey, any recommended measures to mitigate from future stranding; and (4) a provision to file an annual report with the Commission by March 1 that summarizes the previous year's stranding surveys as well all previous stranding surveys and any recommendations to the Commission, for approval, for changes to the monitoring schedule.

Recreation

- Modify FirstLight's proposal to post the start and end time and date of the annual canal drawdown on its proposed flow information website (FFPSA Article A210) to require notification as soon as possible, but at least 30 days in advance of the annual drawdown, to allow sufficient time for the public to plan, as needed, for the drawdown.

Staff Alternative with Mandatory Conditions

The staff alternative with mandatory conditions for the Northfield Mountain Project includes the staff-recommended measures described above, as well as the mandatory certification conditions and section 18 prescriptions not included in the staff alternative.

The staff alternative with mandatory conditions for the Turners Falls Project includes the staff-recommended measures described above, as well as the mandatory conditions in the Massachusetts DEP certification not included in the staff alternative: quarterly and annual reporting, as specified in Massachusetts DEP condition 12; water quality monitoring, as specified in Massachusetts DEP condition 26; and creation of a canal drawdown advisory team and providing public access to dewatered parts of the power canal, as specified in Massachusetts DEP condition 32.

No-Action Alternative

Under the no-action alternative, FirstLight would continue to operate the Northfield Mountain and Turners Falls projects as they currently do, and no new environmental measures would be implemented.

Environmental Effects of the Staff Alternative

The primary issues associated with licensing the Northfield Mountain and Turners Falls projects are the effects of continued project operation on erosion along the Connecticut River and effects on aquatic and terrestrial resources, threatened and endangered species, recreation, aesthetics, and cultural resources. Below, we briefly discuss the anticipated environmental effects of issuing new licenses for the projects under the staff alternative.

Geology and Soils

Numerous local non-governmental organizations, town governments, local committees, and Tribal organizations contend that water level fluctuations due to operation of the projects is a dominant cause to riverbank erosion and erosion should be controlled by reducing the magnitude of fluctuations in flows and water levels and continuing the existing erosion monitoring and rehabilitation efforts. FirstLight currently manages erosion within the Turners Falls impoundment through application of appropriate erosion control measures, monitoring and evaluation of repaired sites, and preventive measures. FirstLight also conducts a full-river reconnaissance survey every three to five years within the entire Turners Falls project area to document riverbank characteristics, such as steepness, material type, degree of vegetative cover, and severity of erosion. In addition, FirstLight conducts annual transect surveys to identify any changes in riverbank or channel geometry at 22 sites evenly spaced throughout the geographic extent of the Turners Falls impoundment.

Proposed changes in operation would alter the volume of water that can be released from Northfield Mountain's upper reservoir, outflows from the projects, and WSEs in the Turners Falls impoundment. These modifications have the potential to affect erosion and sedimentation rates within and downstream of the Turners Falls impoundment. FirstLight's proposed shoreline erosion monitoring plan, with staff modifications, would enable FirstLight to identify changes in riverbank or channel geometry along the extent of the Turners Falls impoundment and to identify appropriate measures at all locations where project operations contribute to erosion.

FirstLight also proposes to establish conservation easements along the Turners Falls impoundment's shoreline and on river right (looking downstream) downstream of Turners Falls dam to conserve the riparian buffers along the affected project area, ensure the continued operation of the Bennett Meadow WMA, and to conserve the 1.3-mile-long portion of the New England National Scenic Trail located within the Northfield Mountain project boundary, which would prevent construction activities that may contribute to erosion in these areas.

Aquatic Resources

Proposed operations would provide substantial benefits to the aquatic communities in project reaches compared to current operations. By limiting peaking operations during the spring, FirstLight's proposed operations would likely improve the reproductive success of shortnose sturgeon, American shad, sea lamprey, and other fish species while also reducing impacts on eclosing dragonflies and freshwater mussels. The reduced magnitude and rates for ramping would reduce the risk of scour or abandonment of fish nests that can result from increased velocities associated with up-ramping. Similarly, risks of displacement or mortality from stranding of fish eggs, newly emerged fry, and benthic macroinvertebrates would decrease under the proposed operation. Increased food availability would result from more stable benthic macroinvertebrate habitat conditions, the risk of predation for juvenile fish would decrease with more stable flows, and fish would have more time to move to and hold in more favorable habitat locations.

In the Turners Falls bypassed reach, the proposed minimum flows would benefit key species and life stages downstream of Turners Falls dam by increasing aquatic habitat for: (1) spawning and incubation for most species, including American shad, shortnose sturgeon, and walleye; (2) macroinvertebrates; and (3) juvenile and adult life stages of many fish species.

FirstLight performs week-long annual drawdowns of the Turners Falls power canal, typically during late September or early October, to facilitate canal inspection and maintenance. Under normal operating conditions (when the canal is watered), downstream migrants are able to use the Cabot bypass facility; however, as the canal water level is drawn down, the bypass is no longer available. During drawdowns, some isolated shallow pools and exposed substrate areas remain in the lower portion of the canal, and fish (including lamprey ammocoetes), amphibians (e.g., mudpuppies), mussels, and benthic invertebrates are susceptible to desiccation, predation, or other sources of mortality. Developing a canal drawdown protection plan would minimize the effects of future drawdowns on aquatic species in the Turners Falls canal.

The Turners Falls Project currently operates three volitional upstream fish passage facilities that are used by American shad, American eel, and sea lamprey. Although the fish passage facilities operated by FirstLight provide some level of upstream passage, repeated efforts to improve upstream passage effectiveness continue to result in relatively low passage rates. FirstLight proposes to: (1) construct a spillway lift at Turners Falls dam to be operational by no later than April 1 of Year 9 after license issuance; (2) rehabilitate the gatehouse trapping facility (sampling facility) to be operational by no later than April 1 of Year 9 after license issuance; (3) retire, either by removal or retaining in place, the Cabot ladder and the power canal portions of the gatehouse ladder within two years after the spillway lift becomes operational; (4) install and operate interim upstream eel passage in the vicinity of the existing spillway ladder within one year of license issuance and continue operating it until permanent upstream eel passage facilities are operational; and (5) conduct up to two years of eelway siting studies after the

spillway lift becomes operational, using a similar methodology to its American eel upstream passage study for both years.

FirstLight would design and operate the proposed fish lift in consultation with the fish passage agencies. We expect that upstream American shad passage and passage efficiency at the Turners Falls Project would improve. Furthermore, decommissioning the Cabot ladder and lower portions of the gatehouse ladder would result in fewer shad experiencing significant migratory delay in the power canal. We expect the decommissioning of the Cabot ladder and lower portions of the gatehouse ladder coupled with the higher bypassed reach minimum flows would result in more American shad ascending upstream through the bypassed reach toward the proposed fish lift.

FirstLight proposes to install and operate interim eel passage in the vicinity of the spillway ladder. Designing and installing interim or temporary eel passage, in consultation with the fish passage agencies, would likely improve passage at the Turners Falls Project for migrating eels. FirstLight would operate the interim eel passage facilities until permanent upstream eel passage is in place, which would occur after the spillway fish lift is constructed and operating. Conducting eel passage siting surveys would inform the location of permanent upstream eel passage facilities; therefore, likely improving upstream passage through these facilities.

At the Turners Falls Project, fish moving downstream select among downstream passage routes that include the dam spillway, Station 1 turbines, Cabot Station turbines, the log sluice adjacent to Cabot Station, the Cabot Station fishway or spillway fishway when they are operating, the Milton Hilton project, or the Turners Falls Project. FirstLight proposes to replace the existing Cabot Station trashrack structure with a new full-depth trashrack, construct a 3/4-inch clear-spaced bar rack at the entrance to the Station No. 1 branch canal, and deepen the plunge pool beneath Bascule Gate No. 1. We anticipate that with these improvements, downstream passage survival would improve for adult American shad, juvenile American shad, and American eel.

At the Northfield Mountain Project, juvenile American shad and American eel migrating downstream past the tailrace experience entrainment during pumping operations. FirstLight proposes to design and seasonally deploy a small-mesh barrier net at the tailrace. We anticipate that the small-mesh barrier net would reduce entrainment of juvenile American shad and American eel by the Northfield Mountain Project.

Terrestrial Resources

The FFPSA flow regime would reduce the magnitude and duration of inundation at the upper limits of the fluctuation zone, which are typically inundated following peaking operations at Northfield Mountain. At a local scale within the fluctuation zone, there may be conversion between emergent and scrub-shrub wetlands because higher elevations would tend to be drier and lower elevations would tend to be wetter than under existing conditions. Proposed operations would support the regeneration and maintenance of wetland vegetation by providing a more stable water table during the growing season. The reduced frequency of water level fluctuations would also reduce adverse effects on state-listed dragonflies during emergence and eclosure, when they are vulnerable to drowning during increases in water levels. Placing the undeveloped FirstLight land along the Turners Falls impoundment shoreline and downstream of

Cabot Station into conservation easements would protect these areas from potential development or vegetation removal in the future. This measure would maintain the existing health and function of riparian vegetation and bank stability, as well as protect habitat value for wildlife.

FirstLight's proposed Invasive Plant Species Management Plans would limit the potential introduction and spread of invasive plants by training employees, inspecting and washing vehicles and equipment, and educating the public at project boat ramps. Modifying the plans as recommended by staff to include continued treatment to control or eradicate invasive species in any areas that have been disturbed by project activities, annual surveys targeted at high-risk areas for the presence of new invasive aquatic plants within the Turners Falls impoundment and bypassed reach, notification to management agencies to coordinate a treatment response, and annual treatment of water chestnut in Barton Cove would further reduce adverse effects of invasive species in the project area.

Threatened and Endangered Species

FWS's Information for Planning and Consultation website was used to generate an updated list of listed and proposed threatened and endangered species, designated and proposed critical habitats, and candidate species in the project-affected area. The following species were identified as having the potential to occur in or be affected by the projects: (1) the federally endangered northern long-eared bat, (2) the proposed endangered tricolored bat, (3) the proposed threatened monarch butterfly, and (4) the federally endangered northeastern bulrush. The projects are also within the range of the federally threatened Puritan tiger beetle, which is believed to be extirpated in Vermont and New Hampshire but could occur downstream of the projects along the Connecticut River (FirstLight 2020c). Additionally, there have been recent reports of the federally endangered shortnose sturgeon isolated in rock pools directly downstream of Turners Falls dam. FWS has not designated critical habitat for any federally listed species within the project area.

Based on the available information, relicensing the Northfield Mountain and Turners Falls projects, with staff's recommended measures, would have no effect on northeastern bulrush, would not likely adversely affect the northern long-eared bat, and would likely adversely Puritan tiger beetle and shortnose sturgeon. On June 6, 2025, Commission staff issued letters to FWS and NMFS requesting formal consultation on Puritan tiger beetle and shortnose sturgeon, respectively, and concurrence from FWS regarding the above determinations for northern long-eared bat and northeastern bulrush. In its July 24, 2025, letter, NMFS responded that all information required to initiate formal section 7 consultation was provided or otherwise available. NMFS stated that it would provide its Biological Opinion by October 20, 2025, but, to date, has not done so. No responses were received from FWS.

Although proposed species are provided no special protection under the ESA, we nevertheless provide an analysis of the proposed action on the tricolored bat and monarch butterfly in Appendix F, *Biological Assessment*, because they may later be added to the list of federally endangered and threatened species. We conclude that relicensing the project would not likely jeopardize the continued existence of the tricolored bat or the monarch butterfly.

Recreation, Land Use, and Aesthetics

FirstLight proposes to implement its RMP for the Northfield Mountain and Turners Falls projects. The RMP includes construction of new recreation facilities, modifications to existing

recreation facilities, an implementation schedule for enhancements, ongoing management and maintenance measures, monitoring to evaluate recreation use and demand, and a provision to revisit the RMP every 10 years.

The proposed RMP would provide multiple benefits, including: (1) a framework for management recreation at the projects; (2) improvements to put-ins, take-outs, and portage trails around the Turners Falls Project to improve access for boating, fishing, and other recreational uses; (3) construction of new river access points upstream and downstream of Peskeomskut Island and Rock dam to improve access for whitewater boaters to experience the rapids, as well as facilitate portages for boaters that wish to avoid them; and (4) the addition of 5 miles of mountain biking trails at Northfield Mountain and maintenance of climbing opportunities at Rose Ledges, which would allow consistent future management and improvements of these sites in accordance with the RMP during the term of any new license.

Staff's recommended modifications to FirstLight's proposed RMP would improve the efficacy of the existing procedures for communicating flow information to the public. Similarly, including a provision to develop a plan to minimize light pollution from project facilities and recreation sites and update the plan every five years to incorporate advancements in lighting technology and compliance with any applicable local, state, or federal standards for light pollution would minimize adverse effects on opportunities for viewing the night sky. Staff's recommendation to include provisions in the RMP for debris management at the boat barrier would formalize removal practices and ensure that debris accumulations are removed in a safe and timely manner to reduce adverse effects on aesthetics.

Including federally recognized Tribes in consultation for future updates to the RMP, or as part of recreation advisory groups, would ensure that that Tribal interests are captured and Tribes can provide ongoing input into measures to protect areas of cultural importance from adverse effects related to the proposed recreation facility improvements, as well as from project O&M activities.

FirstLight's proposed operating regime would improve boating conditions compared to current conditions. FirstLight's proposal would result in higher flows in the bypassed reach due to increased minimum flows, and variable whitewater releases that are closer to or within the optimal range for whitewater boating downstream. Minimum flow increases and stabilization of the flow regime downstream of Cabot Station would reduce the frequency and magnitude of flow and water level fluctuations in the river and create a more predictable boating experience, specifically for paddlers continuing down the mainstem of the Connecticut River.

Staff's recommended navigability monitoring plan would address navigational concerns within Barton Cove by monitoring potential navigational constraints (such as water levels, sediment deposition, and vegetation) and facilitating the consideration of all potential constraints to help determine whether additional measures to maintain or improve navigability at Barton Cove are warranted (such as dredging).

Cultural Resources

The continued operation and maintenance of the projects would adversely affect archaeological resources that are listed or eligible for listing on the National Register of Historic Places (National Register) or remain unevaluated. Potential effects are likely to result from project-erosion, artifact collection, and recreational access or use. Additionally, any new

construction or modifications to project infrastructure could adversely affect structures that are eligible for listing on the National Register. Finally, while FirstLight's consultation with participating Tribes has not resulted in the formal documentation of any TCPs within the projects' APEs, participating Tribes have recently expressed concern regarding important ceremonial places that may be located within or directly adjacent to the APE. Additional post-licensing consultation with the Tribes would ensure that potential effects on these resources are appropriately addressed.

FirstLight filed proposed HPMPs for the Turners Falls and Northfield Mountain projects on July 8, 2024. Inclusion of staff's recommended measures in revised HPMPs would ensure that properties within the projects' APEs (as redefined in section 3.3.7.1, *Cultural Resources, Areas of Potential Effect*) that are eligible for listing in the National Register are appropriately addressed in accordance with section 106 of the National Historic Preservation Act (NHPA). To meet the requirements of section 106, Commission staff intends to execute a programmatic agreement (PA) for each of the projects with the Advisory Council on Historic Preservation (should it choose to participate), the Massachusetts SHPO, the New Hampshire SHPO, and the Vermont SHPO for each project for the protection of historic properties within the APE that would be affected by project O&M activities. The terms of the PAs would require FirstLight to address all historic properties identified within the Commission's revised project APEs through implementation of revised final HPMPs for each project.

License Conditions

Staff recommendations for conditions for any new licenses that may be issued for the projects are based on the analysis presented in this final EIS. Draft license articles for the Northfield Mountain and Turners Falls projects are attached in Appendix R of this EIS.

Conclusions

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

In Appendix H of this EIS, we estimate the likely cost of alternative power for each of the alternatives identified above.

For the Northfield Mountain Project, our analysis shows that, under the no-action alternative, project power would cost $15,348,628, or about $17.25/MWh, less than the cost of alternative power. Under the proposed action alternative, project power would cost $14,437,796, or about $15.34/MWh, less than the cost of alternative power. Under the staff alternative, project power would cost $14,244,487, or about $15.13/MWh, less than the cost of alternative power. Under the staff alternative with mandatory conditions, project power would cost $14,338,867, or about $15.23/MWh, less than the cost of alternative power.

For the Turners Falls Project, our analysis shows that, under the no-action alternative, project power would cost $353,515, or about $1.06/MWh, less than the cost of alternative power. Under the proposed action alternative, project power would cost $3,812,222, or about $13.09/MWh, more than the cost of alternative power. Under the staff alternative, project power would cost $3,966,432, or about $13.62/MWh, more than the cost of alternative power. Under the staff alternative with mandatory conditions, project power would cost $4,051,281, or about $13.91/MWh, more than the cost of alternative power.

We chose the staff alternatives as the preferred alternative for each project because: (1) the Northfield Mountain and Turners Falls projects would continue to provide a dependable source of electrical energy and ancillary services for the region; (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, recreation, aesthetics, and cultural resources. The overall benefits of the staff alternative would be worth the cost of the proposed and recommended environmental measures.

FINAL ENVIRONMENTAL IMPACT STATEMENT
Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
Washington, D.C.

Northfield Mountain Pumped Storage Project
FERC Project No. 2485-071—Massachusetts/Vermont/New Hampshire

Turners Falls Hydroelectric Project
FERC Project No. 1889-085—Massachusetts/Vermont/New Hampshire

1.0 INTRODUCTION

1.1 APPLICATIONS

1.1.1 Northfield Mountain Pumped Storage Project

On April 29, 2016, FirstLight Hydro Generating Company filed an application for a new major license with the Federal Energy Regulatory Commission (Commission or FERC) to continue to operate and maintain the Northfield Mountain Pumped Storage Project (Northfield Mountain Project, FERC No. 2485-071). Subsequently, FirstLight Hydro Generating Company filed an amended application on December 4, 2020, and amendments to its amended application were filed on March 22, 2024, on behalf of Northfield Mountain LLC.[23] The 1,166.6-megawatt (MW)[24] project is located at river mile (RM) 127.2 on the Connecticut River in Franklin County, Massachusetts; Windham County, Vermont; and Cheshire County, New Hampshire (Figure 1.1.1-1).[25] The project does not occupy federal land.

1.1.2 Turners Falls Hydroelectric Project

On April 29, 2016, FirstLight Hydro Generating Company filed an application for a new major license with the Commission to continue to operate and maintain the Turners Falls Hydroelectric Project (Turners Falls Project, FERC No. 1889-085). On July 11, 2019, the Commission approved the transfer of the license for the Turners Falls Project from FirstLight Hydro Generating Company to FirstLight MA Hydro LLC (FirstLight). Subsequently, FirstLight filed an amended application on December 4, 2020, and amendments to its amended

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[23] On December 20, 2018, FirstLight Hydro Generating Company filed an application to transfer the license for the Northfield Mountain Project to Northfield Mountain LLC. The transfer was approved on July 11, 2019.

[24] Due to rounding of values to the nearest hundred kilowatt (kW), the Commission currently lists the project's authorized installed capacity as 1,166.8 MW, but recomputation of the sum of the lesser of the turbine and generator ratings for each unit to the nearest kW results in an installed capacity of 1,166.6 MW, which would be the authorized installed capacity of any new license issued for the project.

[25] Figures and tables are found in Appendices B and C, respectively.

application were filed on March 22, 2024, on behalf of FirstLight MA LLC.[26] The 67.539-MW[27] project is located at RM 122 on the Connecticut River in Franklin County, Massachusetts; Windham County, Vermont; and Cheshire County, New Hampshire (Figure 1.1.1-1).[28] Approximately 20 acres of federally owned lands associated with the U.S. Department of the Interior's Geological Survey (USGS) Silvio Conte Anadromous Fish Laboratory (Conte Fish Lab) are located within the Turners Falls project boundary.

1.2 PURPOSE OF ACTION AND NEED FOR POWER

1.2.1 Purpose of Action

The purpose of the projects is to provide a source of hydroelectric power and ancillary services to the electrical grid. Therefore, under the provisions of the Federal Power Act (FPA), the Commission must decide whether to issue new licenses to FirstLight for the projects, and what conditions should be placed on any licenses issued. In deciding whether to issue a license for a hydroelectric project, the Commission must determine that the projects 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 recreation opportunities; and (4) the preservation of other aspects of environmental quality.

Issuing new licenses for the Northfield Mountain and Turners Falls projects would allow FirstLight to generate electricity at the projects for the terms of the new licenses, making electrical power from a renewable resource available to the regional grid. The projects provide reserve capacity and fast ramping to help meet peak demand, as well as voltage and frequency regulation and black capability to enhance system reliability in the Independent System Operator-New England (ISO-NE) power system. The Northfield Mountain Project would further support intermittent renewable resources such as wind and solar by using power to pump during periods of excess supply and generating during periods when those resources decline, thereby replacing generation that would otherwise come from carbon-emitting resources.

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[26] On December 20, 2018, FirstLight Hydro Generating Company filed an application to transfer the license for the Turners Falls Project to FirstLight MA Hydro LLC. The transfer was approved on July 11, 2019.

[27] While the Commission cites the authorized installed capacity as 67,589 kW, the sum of the lesser of the turbine and generator ratings for each unit would total 67,539 kW, which would be the authorized installed capacity for a new license.

[28] FirstLight filed a revised Exhibit M for the project on March 18, 2021, to replace the exhibit that was part of the current license. The filing included updated ratings for the turbines and generators for the Station No. 1 and Cabot Station. Based on the lesser of the turbine and generator ratings in kW, the installed capacity is 67,539 kW.

This final environmental impact statement (final EIS) has been prepared in compliance with the National Environmental Policy Act of 1969 (NEPA)[29] and the Commission's implementing regulations,[30] to assess the environmental and economic effects associated with operation and maintenance (O&M) of the projects and alternatives to the proposed projects, and make recommendations to the Commission on whether to issue new licenses for the Northfield Mountain and Turners Falls projects, and if so, to recommend terms and conditions to become a part of any licenses issued.

This final EIS assesses the environmental and economic effects of continuing to operate the projects: (1) as proposed by FirstLight; (2) as proposed, with additional staff-recommended measures; and (3) as proposed with additional staff-recommended measures and any mandatory conditions prescribed by state and federal agencies. We also consider the effects of the no-action alternative. Under the no-action alternative, the projects would continue to operate as they do under the current licenses, and no new environmental protection, mitigation, or enhancement measures would be implemented. The primary issues associated with relicensing the projects are the potential effects of project operation on streambank erosion; the effects of minimum flows and flow fluctuations on aquatic habitat for fish and benthic macroinvertebrates; measures needed to provide effective fish passage; and adequate, safe recreation along the Connecticut River; the protection of threatened and endangered species and cultural resources; and maintaining the flexibility to produce power during periods when the output from other sources of renewable energy is not sufficient to meet demand. Figure 1.1.1-1 provides an overview of the location of the projects, including the locations of other FERC-licensed projects on the Connecticut River.

1.2.2 Need for Power

The projects provide hydroelectric generation to meet part of New England's power requirements, resource diversity, and capacity needs.

The Northfield Mountain Project 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 electrical system. The project has an installed capacity of 1,166.6 MW, generates an average of about 889,845 megawatt-hours (MWh) annually, and consumes an average of about 1,189,640 MWh annually for pumping.

The Turners Falls Project is a conventional hydropower project with an installed capacity of 67.539 MW and an average generation of about 332,351 MWh annually.

The North American Electricity Reliability Corporation (NERC) annually forecasts electrical supply and demand nationally and regionally for a 10-year period. Both projects are located within the Northeast Power Coordinating Council's New England region (NPCC−New England). According to NERC's 2024 forecast, net internal demand in the region is expected to increase from 24,013 MW in 2025 to 27,023 MW in 2034, and resource capacity is expected to

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[29] National Environmental Policy Act of 1969, amended (Pub. L. 91-190. 42 U.S.C. §§ 4321–4347, as amended by Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, Pub. L. 97-258, §4(b), September 13, 1982, Pub. L. 118-5, June 3, 2023).

[30] 18 C.F.R. Part 380.

increase from 28,458 MW in 2025 to 30,077 MW in 2029. The region's reserve margin is expected to increase from 25.0% in 2025 to 26.3% in 2027, followed by a decrease to 14.8% in 2034, while the reference margin decreases from 12.7% in 2025 to 11.3% in 2027 through 2034. Therefore, the NPCC−New England reserve margin is anticipated to remain above the reference margin for the entirety of the forecast period (NERC, 2024).

The Northfield Mountain and Turners Falls projects contribute to a diversified generation mix and provide low-cost power that may displace non-renewable, fossil-fired generation, thereby avoiding some power plant emissions and creating an environmental benefit. In addition, the peaking capability of the projects complements increased integration of solar and wind generation, helping to meet demand when those intermittent sources are reduced or unavailable. They also provide additional services to the grid, such as voltage and frequency regulation and black start capability. Therefore, we conclude that power from the projects could help meet a need for power in the NPCC−New England region in the short and long term.

1.3 STATUTORY AND REGULATORY REQUIREMENTS

Any new licenses that may be issued for the projects would be subject to numerous requirements under the FPA and other applicable statutes. Appendix D describes the major regulatory and statutory requirements.

1.4 PUBLIC REVIEW AND COMMENT

The Commission's regulations [18 Code of Federal Regulations (C.F.R.) §§ 5.1-5.16] 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, the Endangered Species Act (ESA), the National Historic Preservation Act (NHPA), and other federal statutes. Pre-filing consultation must be completed and documented according to the Commission's regulations.

1.4.1 Scoping

Before preparing this final EIS, we conducted scoping to determine what issues and alternatives should be addressed. As part of the NEPA scoping process for the Wilder (FERC No. 1892-030), Bellows Falls (FERC No. 1855-050), Vernon (FERC No. 1904-078), Turners Falls (FERC No. 1889-085), and Northfield Mountain (FERC No. 2485-071) projects,[31] Commission staff distributed a scoping document (SD1) to stakeholders and other interested parties on December 12, 2012. It was noticed in the *Federal Register* (FR) on January 7, 2013

[31] At the time of scoping, the Commission indicated its intent to prepare a single NEPA document addressing the proposed relicensing for all five of these projects. To meet the current page limits required for EISs by the Fiscal Responsibility Act of 2023 (Pub. L. No. 118-5, 137 Stat. 10 (2023) (amending NEPA to limit most environmental impact statements to 150 pages, except for projects of extraordinary complexity, which may be up to 300 pages) [codified at 42 U.S.C. § 4336a(e)(1)]), Commission staff have prepared separate EISs for the projects owned by each applicant, one for the three projects owned by Great River Hydro, LLC (the Wilder, Bellows Falls, and Vernon projects) and one for the two projects owned by FirstLight Power Services LLC (the Turners Falls and Northfield Mountain).

(78 FR 929). Seven scoping meetings were held between January 28 and January 31, 2013, in West Lebanon, New Hampshire; Bellows Falls, Vermont; Brattleboro, Vermont; and Turners Falls, Massachusetts. A court reporter recorded all comments and statements made at the scoping meetings, and these comments and statements are part of the Commission's public record for the project.

An environmental site review (site visit) is typically held in conjunction with the Commission's NEPA scoping meetings. However, Commission staff anticipated that access to some project facilities would be limited by winter weather conditions during the early part of 2013 when scoping for these projects was scheduled. For this reason, and to provide all interested stakeholders an opportunity to view the projects' facilities, the Commission hosted the environmental site reviews in October 2012, before the onset of winter. Public notice of the environmental site reviews was issued on August 3, 2012, and published in eight newspapers in the projects' region. The site visits were widely attended by individuals representing, local, state, and federal government agencies; non-governmental organizations; and members of the public. Based on comments made during the scoping meetings and written comments filed with the Commission, Commission staff issued a revised scoping document (SD2) on April 15, 2013.

In addition to comments provided at the scoping meetings, Table 1.4.1-1 lists the entities that provided written comments for the Turners Falls and Northfield Mountain projects.

1.4.2 Interventions

On February 22, 2024, the Commission issued notices that FirstLight's applications to relicense the Northfield Mountain and Turners Falls projects were accepted and deemed ready for environmental analysis. The notices set April 22, 2024, as the deadline for filing protests and motions to intervene. On April 10, 2024, the Commission extended the deadline for filing protests and motions to intervene to May 22, 2024. A list of entities who filed motions to intervene is provided in Table 1.4.2-1.

1.4.3 Comments on the Applications

On February 22, 2024, the Commission issued notices stating that the applications were ready for environmental analysis and soliciting comments, recommendations, preliminary terms and conditions, and preliminary fishway prescriptions. On April 10, 2024, the Commission extended the deadline for filing comments, recommendations, preliminary terms and conditions, and preliminary fishway prescriptions to May 22, 2024. On November 21, 2024, the Commission filed a notice of a revised schedule for issuance of the EIS and solicited additional comments on alternatives or impacts and on relevant information, studies, or analyses with respect to the proposed action. A list of entities who filed comments on the applications is provided in Table 1.4.3-1.

In addition to the commenting entities listed above for the Northfield Mountain and/or Turners Falls projects, more than 150 comment letters were filed by individuals with no agency or non-governmental organization affiliation. The 10 most frequent comments provided by the public are:

- 41% oppose relicensing the Northfield Mountain project and/or recommend that entrainment impacts be addressed.

- 28% recommend license terms of less than 50 years; most recommend terms of 30 years or less.
- 27% are concerned about project-caused erosion.
- 13% want higher than proposed summer and fall minimum flows.
- 12% want fish passage measures to be implemented sooner than proposed.
- 11% oppose relicensing the Turners Falls Project.
- 10% recommend reducing flow fluctuations.
- 7% recommend conversion of the Northfield Mountain Project to a closed-loop system.
- 6% recommend recreational improvements.
- 6% state that minimum flows are inadequate.

The applicant filed reply comments on July 8, 2024, in response to the comments filed from February 22 to June 4, 2024.

1.4.4 Comments on the Draft Environmental Impact Statement

Commission staff issued the draft EIS for the Northfield Mountain (No. 2485-071) and Turners Falls (No. 1889-085) projects on May 30, 2025. Comments on the draft EIS were due by July 29, 2025. At the request of various stakeholders, the Commission extended the deadline for comments to August 28, 2025. In addition, Commission staff conducted two public comment sessions in Greenfield, Massachusetts, on July 16, 2025. Statements made at the meetings were recorded by a court reporter and incorporated into the Commission's public record for the proceeding.[32] A list of entities who filed comments on the draft EIS is provided in Appendix U.

1.5 TRIBAL CONSULTATION

Consultation with federally recognized Tribes (the Mashpee Wampanoag Tribe, Wampanoag Tribe of Gay Head, Narragansett Indiana Tribe of Rhode Island (Narragansett Tribe), and Stockbridge-Munsee Band of Mohican Indians), as well as interested state-recognized Tribes and Tribal organizations has occurred throughout the relicensing process for the Northfield Mountain and Turners Falls projects and is summarized below. A record of communications with Tribes and Tribal organizations can be found in Appendix C, Table 1.5-1, *Record of Tribal Consultation*.

On November 8, 2012, and November 14, 2012, respectively, Commission staff invited consultation with the Mashpee Wampanoag Tribe and the Wampanoag Tribe of Gay Head to determine whether they had any interests or concerns regarding the relicensing of the Turners Falls and Northfield Mountain projects. On December 6, 2012, and December 28, 2012, Commission staff followed up with phone calls to Wampanoag Gay Head Tribe. No response to this outreach was received. Commission staff also had a phone call with the Mashpee Wampanoag Tribe on December 6, 2012, and spoke with a Tribal representative who requested a copy of the pre-application documents (PADs) for both projects. These documents were emailed

[32] *See* transcripts of the July 16, 2025, draft EIS public comment sessions issued on August 1, 2025, under accession no. 20250801-4000.

to the representative on the same day. Commission staff followed up with the Tribe by phone again on December 28, 2012. No response to this call was received.

In a letter issued on February 5, 2013, Commission staff invited consultation with the Narragansett Tribe. Commission staff met in-person with the Narragansett Tribal Historic Preservation Officer and other Tribal representatives on May 1, 2013, and via telephone on February 27, 2014, March 11, 2014, and August 8, 2015 (this call also included representatives of the Nolumbeka Project[33]) to discuss their involvement in the projects. In an April 11, 2014, letter to the Narragansett Tribe, Commission staff explained the relicensing consultation process. Commission staff also provided the Tribe with consultation information in a January 19, 2016, letter.

In a May 25, 2016, letter to the Commission, the Elnu Abenaki, a state-recognized Tribe in Vermont, expressed interest in the relicensing processes and filed comments. On September 20, 2021, the Elnu Abenaki filed comments regarding the projects and Commission staff responded on April 14, 2022.

On April 26, 2017, the Cowasuck Band-Pennacook-Abenaki People (Cowasuck Band) filed a letter expressing interest in the projects, and in a telephone call on October 11, 2017, Commission staff discussed the status of the projects with the Cowasuck Band and how they might participate in the relicensing processes.

On September 29, 2022, Commission staff invited the Stockbridge-Munsee Community to participate in the relicensing process. The Stockbridge-Munsee Community did not respond to any Commission outreach for the projects.

On August 29, 2025, Commission staff received an email from the Advisory Council on Historic Preservation (Advisory Council) regarding correspondence that the Advisory Council had received from the Nolumbeka Project Tribal Coalition.[34] Commission staff responded to the Advisory Council on September 23, 2025, explaining the opportunities that have been available for public comment and that the Nolumbeka Project's comments had been considered in the preparation of the EIS.

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[33] The Nolumbeka Project describes itself as a "non-profit organization dedicated to the preservation of the history of Native Americans/American Indians of New England through educational programs, art, history, music, heritage seed preservation and cultural events." Nolumbeka Project, *Who We Are*, https://nolumbekaproject.org/who-we-are/ (accessed November 24, 2025).

[34] The Nolumbeka Project Tribal Coalition is a coalition between the Nolumbeka Project, the Elnu Abenaki Tribe, and the Chaubunagungamaug Band of Nipmuck Indians.

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2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 NO-ACTION ALTERNATIVE

Under the no-action alternative, the projects would continue to operate under the terms and conditions of the current licenses, 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, and to compare the benefit and costs of any measures that might be required under any new license.

2.1.1 Current Project Facilities

Figures 2.1.1-1 and 2.1.1-2 show the primary features of the projects, and the following sections provide more details about these facilities.

2.1.1.1 Northfield Mountain Project

The tailrace of the Northfield Mountain Project is located on the Turners Falls impoundment, approximately 5.2 miles upstream of Turners Falls dam in the town of Northfield, Massachusetts. The upper reservoir of the Northfield Mountain Project is located atop Northfield Mountain in Erving, Massachusetts, and consists of a main dam, rockfill dikes, and a concrete gravity dam. An intake channel and concrete intake structure is located on the upper reservoir. The intake structure conveys water to a pressure conduit that splits into two conduits that each split into two penstocks for a total of four penstocks. The penstocks convey water to an underground powerhouse that contains four reversible, pump-turbine-generator units. Water is conveyed from the powerhouse to the Turners Falls impoundment through four underground draft tube tunnels. Each pair of draft tube tunnels connects into two discharge conduits and then connects into a single tailrace tunnel. The tailrace tunnel connects to an intake structure protected by a trashrack with 6-inch clear bar spacing and a tailrace channel leading to the impoundment, protected by a boat barrier.

In addition to the structures listed above, the project includes: (1) two step-up transformers (one for each pair of units); (2) an underground cable leading from the transformers to the switchyard; and (3) appurtenant facilities.

The upper reservoir typically operates between elevations 1,000.5 feet[35] and 938 feet, which equates to a 62.5-foot drawdown. Within this range of fluctuation, the upper reservoir has a surface area of 134 and 286 acres at elevations 938 and 1,000.5 feet, respectively, and approximately 12,318 acre-feet of usable storage. The underground powerhouse contains four reversible pump-turbine-generator units that operate at gross heads ranging from 753 to

[35] All elevations in this document are relative to the National Geodetic Vertical Datum of 1929 (NGVD 29). Any elevation references to mean sea level by FirstLight in its license application are equivalent to elevations in this datum.

824.5 feet. The project has an installed capacity of 1,166.6 MW[36] (each unit is 291.65 MW). The approximate station hydraulic capacity is 15,200 cubic feet per second (cfs) (3,800 cfs per/unit) in pumping mode and 20,000 cfs (5,000 cfs per/unit) in generation mode. The project generated an annual average of 889,845 MWh from 2011 through 2019, with average annual pumping energy used for that period of 1,189,640 MWh.[37] Figure 2.1.1-1 provides a map of the major project facilities for the Northfield Mountain Project.

2.1.1.2 Turners Falls Project

Turners Falls dam is located on the Connecticut River at approximately RM 122 in the towns of Gill and Montague, Massachusetts. The dam consists of two individual concrete gravity dams—Gill and Montague—that are connected by a natural rock island known as Great Island. Gill dam is approximately 55 feet high and 493 feet long, extending from the east bank of the Gill shoreline to Great Island. It includes three 40-foot-wide by 39-foot-high Tainter spillway gates. Montague dam is approximately 35 feet high and 630 feet long, is founded on bedrock, and connects Great Island to the west bank of the Connecticut River. It includes four 120-foot-wide by 13.25-foot-high bascule gates and a fixed crest section that is normally not overflowed.

The Turners Falls impoundment, which also serves as the lower reservoir for the Northfield Mountain Project, is approximately 20 miles long, extending upstream through the Connecticut River valley to the base of Vernon dam (Vernon Hydroelectric Project, FERC No. 1904). The Turners Falls impoundment has a surface area of 2,110 acres, a total storage of approximately 20,300 acre-feet, and 12,318 acre-feet of usable storage at the normal full pond elevation of 185.0 feet (as measured at Turners Falls dam). Most of the Turners Falls impoundment lies in Massachusetts; however, approximately 5.7 miles of the northern portion of the impoundment are in New Hampshire and Vermont. A 2.1-mile-long power canal extends

[36] Due to rounding of values to the nearest hundred kW, the Commission currently lists the Northfield Mountain Project authorized installed capacity as 1,166.8 MW. Recomputation of the sum of the lesser of the turbine and generator ratings for each unit to the nearest kW, however, results in an installed capacity of 1,166.6 MW, which would be the authorized installed capacity of any new license issued for the project.

[37] Note that while we present a 10-year average annual generation for Turners Falls for 2010–2019, the Northfield Mountain Project was out of service from May through part of November 2010, so we only present a nine-year average annual generation average for Northfield Mountain. Also, the values for 2011–2019 are only approximately representative of current conditions because several modifications occurred during that period. Units 2, 3, and 4 underwent efficiency improvements with the replacement of the turbine runners and rewind of the motor-generators between 2011 and 2014, and a rewind of the Unit 1 motor-generator commenced in August 2015, and was completed in February 2016.

from the dam to the project's two powerhouses (Station No. 1 and Cabot Station), as well as non-project hydroelectric and other facilities on the power canal.[38]

The project's two powerhouses, Station No. 1 and Cabot Station, have a combined installed capacity of 67.539 MW[39] that generated an average of 332,351 MWh annually from 2011 to 2019. Station No. 1 is located at the end of a 700-foot-long branch off the power canal, approximately 3,000 feet downstream of Turners Falls dam, and discharges to the bypassed reach. It contains seven Francis turbines, five of which are currently operational. The five operational units have generating capacities of 1.380, 0.365, 1.276, 1.226, and 1.276 MW and hydraulic capacities of 560, 140, 500, 490, and 520 cfs. The total generating and hydraulic capacities of the turbine-generator units at Station No. 1 are 5.523 MW and 2,210 cfs, respectively.

Cabot Station is located at the downstream end of the power canal and contains six 10.336-MW Francis turbines with an approximate per-unit maximum hydraulic capacity of 2,288 cfs. The total generating and hydraulic capacities of the turbine-generator units at Cabot Station are 62.016 MW and 13,728 cfs, respectively. Adjacent to the powerhouse are eight 13-foot-7-inch-wide by 16-foot-8-inch-high spillway gates. In addition, there is a 16-foot-2-inch-wide by 13-foot-1-inch-high log sluice gate located at the downstream end of the forebay.

The project includes an upstream fish passage system that consists of: (1) the Cabot fishway, an approximately 850-foot-long fish ladder providing passage from the Cabot Station tailrace to the downstream end of the power canal through a series of 66 pools over a vertical distance of about 66 feet, with attraction flows provided by two attraction gates; (2) the spillway fishway, an approximately 500-foot-long fish ladder providing passage from the upstream end of the bypassed reach to the upstream end of the power canal through a series of 42 pools over a vertical distance of about 42 feet, with attraction flows provided by two attraction gates; and (3) the gatehouse fishway, an approximately 225-foot-long vertical slot fish ladder providing passage from the upper end of the power canal to the Turners Falls impoundment over a vertical distance of about 12 feet. In addition, downstream fish passage facilities are located at Cabot Station and consist of reduced bar spacing in the upper 11 feet of the intake racks, a broad-crested weir configured to enhance fish passage at the log sluice, the log sluice itself, above-water lighting, and a sampling facility. Figure 2.1.1-2 provides a map of the major project facilities for the Turners Falls Project.

2.1.2 Current Project Boundary

The current project boundaries for the Northfield Mountain and Turners Falls projects each encompass all project features and lands necessary for the safe O&M of the project and other project purposes, such as recreation, shoreline control, and protection of environmental

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[38] Flows from the power canal are also used by Turners Falls Hydro, LLC's Turners Falls Hydroelectric Project (P-2622), a Milton Hilton, LLC project (unlicensed), and the Conte Fish Lab.

[39] While the Commission cites the authorized installed capacity as 67,589 kW, the sum of the lesser of the turbine and generator ratings for each unit would total 67,539 kW, which would be the authorized installed capacity for a new license.

resources. The Northfield Mountain project boundary includes the area around the upper reservoir, the perimeter of the Turners Falls impoundment, and the portion of the mountainside between these areas. The Turners Falls project boundary also includes the perimeter of the Turners Falls impoundment (overlapping with the Northfield Mountain project boundary), as well as Turners Falls dam and an area below the dam down to Cabot Station.

The portion of the project boundary that is shared by the two projects, around the perimeter of the Turners Falls impoundment, is defined by a combination of metes and bounds and elevation contours. Representative elevation contours include: (1) 186.5 to 187.5 feet in the vicinity of Turners Falls dam; (2) 197.1 to 200.0 feet in the vicinity of the Millers River confluence; (3) 201.5 to 202.0 feet in the vicinity of the Northfield Mountain intake/tailrace; (4) 207.6 feet and 207.2 feet at the Massachusetts/Vermont and Massachusetts/New Hampshire borders, respectively; and (5) 211.5 feet immediately downstream of Vernon dam.[40]

Elevations along the portion of the boundary specific to the Northfield Mountain Project are approximately 201.5 feet to 202.0 feet in the vicinity of the intake/tailrace, with the boundary along the slopes surrounding (below) the upper reservoir generally being defined by metes and bounds rather than by elevation contours. The portion of the boundary specific to the Turners Falls Project, from the dam to Cabot Station, is defined almost entirely by metes and bounds.

The combined project boundary for the Turners Falls and Northfield Mountain projects contains a total of 7,246 acres, comprising 2,238 acres of flowed land and 5,008 acres of upland at minimum flow conditions. When the river is at maximum flow (50-year flood) conditions, there are 3,981 acres of flowed land and 3,265 acres of upland.

2.1.3 Project Safety

The Northfield Mountain and Turners Falls projects have been operating for more than 40 years under their current licenses.[41] During this time, Commission staff conducted operational inspections at each project, focusing on the continued safety of the structures, identification of unauthorized modifications, efficiency and safety of operations, compliance with the terms of the licenses, and proper maintenance. In addition, every five years an independent consultant inspects and evaluates the projects and submits a consultant's safety report for Commission review.

As part of the licensing process, Commission staff will evaluate the continued adequacy of the project facilities under any new licenses issued for the projects. Special articles would be included in any new licenses issued, as appropriate. Commission staff would continue to inspect the projects during the terms of any new licenses to ensure continued adherence to Commission-

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[40] To the extent that it is defined by elevation rather than by metes and bounds, the elevation of the boundary is variable, changing along the length of the Turners Falls impoundment and differing from one side of the river to the other at a given location.

[41] The Northfield Mountain Project received an original licensed on May 14, 1968. The Turners Falls Project was originally licensed on January 17, 1944, and received a new license on May 5, 1980.

approved plans and specifications, special license articles relating to construction (if any), O&M, and accepted engineering practices and procedures.

2.1.4 Current Project Operation

2.1.4.1 Northfield Mountain Project

The Northfield Mountain Project is a pumped storage peaking project,[42] with a capability to use 12,318 acre-feet of storage (a 62.5-foot drawdown of its upper reservoir) for generation purposes.[43] During pumping operations, water is pumped from the Turners Falls impoundment to the upper reservoir. In summer and winter, the Northfield Mountain Project typically peaks twice a day—in the morning and in the late afternoon. During other months, commonly called shoulder months, the Northfield Mountain Project may be peaked one to two times a day, depending on electrical demand and/or price. In both cases, water is typically pumped back to the upper reservoir during the night or during low-energy-priced hours. When operating in a pumping mode, the approximate hydraulic capacity of the project is 15,200 cfs. When operating in a generation mode, the approximate hydraulic capacity is 20,000 cfs.

2.1.4.2 Turners Falls Project

Cabot Station is operated as a peaking plant, with an estimated capability to use about 16,150 acre-feet of storage[44] for generation purposes. The current license allows the impoundment to be maintained at elevations between 176.0 and 185.0 feet, as measured at Turners Falls dam.[45] Station No. 1 is operated when flows are too low to operate a single Cabot turbine or when the hydraulic capacity of Cabot is exceeded. During generation, outflows from the project's two powerhouses can vary between the required minimum flow of 1,433 cfs[46] and the project's approximate full hydraulic capacity of 15,938 cfs (Station No. 1–2,210 cfs; Cabot

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[42] Under peaking operation, a hydropower project generally only generates for a few hours each day during peak demand periods, when the cost of power is high. The remainder of the time, when the cost of power is low, there is no generation, and the project reservoir refills to meet the next peak demand period.

[43] Under existing conditions, the Northfield Mountain upper reservoir elevation may fluctuate between 1,000.5 and 938 feet. FERC has granted six temporary license amendments between 2001 and 2017 that permitted use of storage capacity between elevations 1,004.5 and 920 feet to support grid reliability.

[44] We estimate the usable storage capacity of the Turners Falls Project impoundment to be 16,150 acre-feet at a 9-foot drawdown (185.0–176.0 feet). This could be supplemented by up to 12,318 acre-feet of additional storage being released from the Northfield Mountain Project when that project is generating.

[45] FirstLight typically uses a 3.7-foot drawdown for its peaking operations.

[46] Typically, FirstLight maintains the minimum flow requirement through discharges at Cabot Station and/or Station No. 1. Compliance with FirstLight's minimum flow requirement is measured downstream of Cabot Station and is the sum of all project facilities' discharges.

Station–13,728 cfs). During periods of sustained high flows, project generation is continuous, and peaking operations cease.

2.1.5 Current Environmental Measures

2.1.5.1 Northfield Mountain Project

Current License Requirements

- Monitor and remediate streambank erosion within the Turners Falls impoundment through continued implementation of the 1999 Erosion Control Plan (FirstLight, 1999).
- For flood conditions, coordinate operations of the Northfield Mountain and Turners Falls projects in accordance with an agreement with the U.S. Army Corps of Engineers (Corps).
- Deploy a fixed-position guide net to reduce entrainment of Atlantic salmon smolts at the project's intake in the Turners Falls impoundment.[47]
- Manage the Bennett Meadow Wildlife Management Area (WMA) for the compatible use of the land for agricultural and wildlife management purposes.
- Operate and maintain 4 parks and other access areas at the project; facilities include 2 hunting areas, 2 campgrounds with 30 campsites and 1 group camp, 20 trails (32 miles of trail), and a winter sport area.

2.1.5.2 Turners Falls Project

Current License Requirements

- Monitor and remediate streambank erosion within the Turners Falls impoundment through continued implementation of the 1999 Erosion Control Plan (FirstLight, 1999).
- Coordinate project operation with the Corps in the interest of flood control.
- Maintain the Turners Falls impoundment water surface elevation (WSE) within a range of 176.0 to 185.0 feet.
- Provide a minimum instream flow of 1,433 cfs downstream of Cabot Station.

[47] The Connecticut River Migratory Fish Restoration Cooperative (CRMFRC) has not required installation of the barrier net since the Atlantic salmon restoration program on the Connecticut River was terminated in 2016.

- Provide a continuous minimum instream flow of 200 cfs in the bypassed reach starting on May 1 and increase the minimum flow to 400 cfs when fish passage starts by releasing flow through a bascule gate at the dam, although this may be reduced to 120 cfs.[48]
- Maintain and operate three upstream fish passage facilities (Cabot fishway, the Spillway fishway, and the gatehouse fishway), each with a counting area.
- Provide downstream fish passage at Cabot Station via a broad-crested weir leading to the log sluice from approximately April 1 through November 15.
- Operate and maintain two parks and other access areas at the project: facilities include one canoe portage, one tailwater fishing facility, one trail, two picnic areas, and one interpretive display.

Voluntary Measures

- Grant permissions for non-project uses of project lands through implementation of FirstLight's permit program, consistent with the standard land use articles of the Turners Falls and Northfield Mountain projects' licenses. These non-project uses include use of project lands for a parking area, the Conte Fish Lab, a fire pond, a privately owned boat club, private camps, landscaping activities, agricultural uses, communications antennae, docks, a National Pollutant Discharge Elimination System discharge, and water withdrawals.

2.2 APPLICANT'S PROPOSAL

FirstLight proposes the following environmental measures to mitigate or protect environmental resources. Many of the measures proposed in the amended final license application were modified or expanded upon in the Flows and Fish Passage Settlement Agreement (FFPSA) filed by FirstLight on March 31, 2023,[49] and the Recreation Management Plan (RMP) included with the Recreation Settlement Agreement filed by FirstLight on June 12, 2023.[50] The signatories of the FFPSA were FirstLight; U.S. Department of Interior, Fish and Wildlife Service (FWS); the National Marine Fisheries Service (NMFS); Massachusetts Department of Fish and Wildlife (Massachusetts DFW); the Nature Conservancy; American Whitewater; the Appalachian Mountain Club; Crab Apple Whitewater, Inc.; New England FLOW; and Zoar Outdoor. Signatories of the Recreation Settlement Agreement were FirstLight; the National Park Service; Massachusetts Department of Conservation and Recreation (Massachusetts DCR); the towns of Irving, Gill, Montague, and Northfield, American

[48] The 400 cfs continuous minimum instream flow is provided through July 15, unless the upstream fish passage season has concluded early, in which case the 400 cfs flow is reduced to 120 cfs to protect shortnose sturgeon. The 120 cfs continuous minimum instream flow is maintained in the bypassed reach from the date the upstream fishways are closed (or by July 16) until the river temperature drops below 7 degrees Celsius (°C), which typically occurs around November 15.

[49] Accession no. 20230331-5600.

[50] Accession no. 20230612-5219.

Whitewater, the Appalachian Mountain Club, Crab Apple Whitewater, Inc., New England FLOW, Zoar Outdoor, Franklin Regional Council of Governments (FRCOG), and Western Massachusetts Climbers Coalition. The measures proposed by FirstLight for the Turners Falls Project include constraints that would reduce flow fluctuations downstream of the projects most of the time, while allowing peaking operations to occur for a limited number of hours each month.

2.2.1 Proposed Project Facilities

2.2.1.1 Turners Falls Station No. 1 Upgrades

FirstLight proposes to modify the dog-leg feeder canal and/or replace equipment at Station No. 1 within three years of license issuance to enable remote operation of the units and to allow the units to operate over a range of flows. FirstLight would first submit design plans to the Commission and incorporate any required changes. The modifications to each unit would include upgrading the brakes, controls, governors, grounding transformer, protective relaying, excitation system, and turbine rehabilitation. Auto-synchronizing equipment and sensors would also be installed to interface with the existing programmable logic controller (FFPSA Article A100).

2.2.1.2 Turners Falls Upstream and Downstream Fish Passage Facilities

FirstLight proposes to construct or modify various upstream and downstream fish passage facilities at the project (FFPSA Article A300): (1) construct a new spillway lift and plunge pool downstream of Bascule Gate No. 1 of Turners Falls dam; (2) install an interim eelway near the Turners Falls dam, followed by up to two permanent eelways based on up to two years of siting studies; (3) construct a bar rack at the entrance to the Station No. 1 forebay; (4) replace the existing Cabot Station trashrack structure with a new full-depth trashrack with 1-inch clear spacing; (5) rehabilitate the gatehouse trapping facility; (6) retire the Cabot Station fish ladder; and (7) retire the entrance portion of the gatehouse fish ladder.

2.2.1.3 Proposed Recreation Improvements

FirstLight proposes to construct or modify several recreation and public access sites, relocate and reconstruct the boat tour dock in the vicinity of the tailrace of the Northfield Mountain Project, and construct 5 miles of new mountain bike trails, as described in section 2.2.3, *Proposed Project Operation and Environmental Measures*.

2.2.2 Proposed Project Boundary

Several changes are proposed for the Northfield Mountain project boundary, including the removal of three parcels and the addition of one parcel. FirstLight proposes to remove a 0.2-acre parcel at 39 Riverview Drive and an 8.1-acre parcel referred to as Fuller Farm, located near 169 Millers Falls Road in Northfield, Massachusetts, because they serve no project purposes. FirstLight proposes to remove another 52.3 acres to exclude a portion of Farley Ledges that it indicates is not needed for project purposes. FirstLight proposes to add a

135.5-acre parcel[51] of land located south of the Northfield Mountain switching station in the towns of Northfield and Erving to the boundary. The land to be added would include recreational trails associated with the Northfield Mountain Trail and Tour Center that are currently not enclosed by the project boundary.

Several changes are proposed for the Turners Falls project boundary, including the removal of two parcels that FirstLight indicates are not needed for project purposes and the addition of one parcel. The parcels to be removed include a 0.2-acre parcel at 39 Riverview Drive and a 20.1-acre parcel on which the Conte Fish Lab is located just north of Cabot Station. FirstLight states that the 0.2-acre parcel would be removed from the project boundary because it serves no project purposes. This parcel is located in an area where the Northfield Mountain and Turners Falls project boundaries overlap and would be removed from the project boundary for both projects. The 20.1-acre parcel on which the Conte Fish Lab is located was transferred to the U.S. Department of the Interior, FWS in 1987 and then transferred to USGS. FirstLight proposes adding a 0.8-acre parcel at 21 Poplar Street in Montague where it proposes to develop a formal recreational access.

2.2.3 Proposed Project Operation and Environmental Measures

FirstLight proposes the following environmental measures to mitigate or protect environmental resources. Many of the measures proposed in the amended final license application were modified or expanded upon in the FFPSA filed by FirstLight on March 31, 2023,[52] and the RMP included with the Recreation Settlement Agreement filed by FirstLight on June 12, 2023.[53] The measures proposed by FirstLight for the Turners Falls Project include constraints that would reduce flow fluctuations downstream of the projects most of the time, while allowing peaking operations to occur for a limited number of hours each month.

2.2.3.1 Measures Proposed for Both Projects

- Implement the Bald Eagle Protection Plans filed with the FFPSA (Articles B300 and A400).
- Implement the following measures to protect northern long-eared bat habitat: (1) avoid cutting trees equal to or greater than 3 inches in diameter at breast height within the project boundaries from April 1 through October 31, unless they pose an immediate threat to human life or property (hazard trees); and (2) where non-hazard trees need to be removed, only remove non-hazard trees between November 1 and March 31 (FFPSA Article B310 and A410).
- Place undeveloped FirstLight lands not used for specific project activities along the Turners Falls impoundment shoreline into a conservation easement to maintain riparian buffers (Recreation Settlement Agreement).

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[51] Of the 135.5 acres being added, 12.5 acres is owned by FirstLight, while Eversource Energy owns the remaining 122 acres.

[52] FirstLight (2023c)

[53] Accession no. 20230612-5219.

- Conduct a programmatic assessment of existing recreation facilities and buildings to ensure the needs of people with disabilities were considered in the planning and design of each facility and implement applicable improvements (RMP, Table 6.3-1).
- Revisit the RMP once every 10 years to evaluate recreation use and demand (RMP, Table 6.3-1).
- Implement the Historic Properties Management Plans (HPMPs) filed on July 8, 2024.

2.2.3.2 Northfield Mountain Project–Project-Specific Measures

- Continue to operate the Northfield Mountain Project in a store-and-release mode by pumping water from the Turners Falls impoundment during low-load periods when energy costs are low, and then discharging water back into the Turners Falls impoundment during high-load periods when energy costs are high.
- Continue to coordinate operation of the Northfield Mountain and Turners Falls projects in accordance with an existing agreement between FirstLight and the Corps (FFPSA Article B100, part a).
- Operate the Northfield Mountain Project upper reservoir with a normal maximum WSE of 1,004.5 feet and an 84.5-foot maximum allowable drawdown (i.e., 1,004.5 feet to 920 feet)[54] (FFPSA Article B100, part b).
- Implement the Upper Reservoir Dewatering Protocols filed on June 30, 2017, which include conducting a bathymetric survey of the upper reservoir and intake channel once every two years. If the average sediment depth throughout the middle of the intake channel exceeds 5 feet, review the potential need for sediment removal and conduct annual bathymetric surveys until sediment removal.
- To reduce the entrainment of migratory fish, install and maintain a barrier net across the Northfield Mountain Project tailrace/intake from June 1 to November 15 each year (FFPSA Articles B200 and B230). This operating period may be refined based on consultation among FirstLight, Massachusetts DFW, NMFS, and FWS.
- Upon completion of construction of the fish barrier net, operate it for one season (shakedown year), and then conduct effectiveness testing (FFPSA Article B210).
- Conduct up to three additional rounds of downstream fish passage effectiveness testing and reporting during the first 20 years of the license term, as needed, to meet the fishery agency performance goals. If performance goals are not being met, implement one or more of the adaptive management measures listed in FFPSA Article B220. No adaptive management measures other than those specified in the proposed license article would be

[54] Under existing conditions, the Northfield Mountain upper reservoir elevation may fluctuate between 1,000.5 and 938 feet. The reservoir was designed to allow for fluctuation between 1,004.5 and 920 feet, and FERC has granted six temporary license amendments between 2001 and 2017 that permitted use of this range of storage capacity to support grid reliability.

required for the first 25 years after license issuance unless agreed to by FirstLight, Massachusetts DFW, NMFS, and FWS.

- Develop a fish passage operation and maintenance (O&M) plan for the barrier net in consultation with Massachusetts DFW, NMFS, and FWS to include annual reporting on the status of the barrier net and any needed repairs or equipment replacement (FFPSA Article B240).
- Implement the Northfield Mountain Invasive Plant Species Management Plan filed on March 22, 2024.[55]
- Permanently conserve FirstLight's land within the Bennett Meadow WMA that is not already under conservation easement and enhance existing riverfront trails south of Route 10 off the parking lot at Bennett Meadow WMA to include installation of a bench and historical/cultural interpretive signage (RMP measure 6.2.1 and RMP Table 6.3-1).
- Provide a permanent trail easement for the 1.3-mile-long portion of the New England National Scenic Trail that lies inside the Northfield Mountain project boundary on the eastern side of the project's upper reservoir (RMP Table 6.3-1).
- Relocate the boat tour dock from the tailrace to a location upstream of the fish barrier net and provide for an accessible/barrier-free dock layout that supports motorboats, canoes/kayaks, and riverboat tours (RMP measure 6.2.2).
- Construct approximately 5 miles of new trails for mountain biking (RMP measure 6.2.3).
- Construct and maintain a new paddle access campsite in the Barton Cove area (RMP measure 6.2.4).
- Designate Rose Ledges as a project recreation facility to allow climbing, with access to remain free of charge (RMP measure 6.2.5).
- Add the ability to lock canoes and kayaks during the day at Barton Cove (RMP measure 6.2.6).
- Donate used sporting equipment to local youth organizations (RMP Table 6.3-1).

2.2.3.3 Turners Falls Project–Project-Specific Measures

- Based on the Naturally Routed Flow (NRF),[56] discharge from the Turners Falls dam or gate located on the power canal just below the dam, provide the seasonal minimum flows defined in FFPSA Article A110 (Table 2.2.3-1).

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[55] Accession no. 20240322-5086.

[56] The NRF represents the inflow to the Turners Falls dam. From December 1 through June 30, the NRF is defined as the hourly sum of the discharges from 12 hours previous as reported by: (1) the Vernon Project (FERC No. 1904); (2) the Ashuelot River USGS gage no. 01161000, *Ashuelot River at Hinsdale, NH*; and (3) the Millers River USGS gage no. 01166500, *Millers River at Erving, MA*. From July 1 through November 30, the NRF is defined as the hourly sum of the discharges averaged from 1 to 12 hours previous as reported by these sources.

- Based on the NRF, maintain the total minimum flow downstream of Station No. 1 as defined in FFPSA Article A120 (Table 2.2.3-2).
- Based on the NRF, maintain the minimum flow downstream of Cabot Station as defined in FFPSA Article A130 (Table 2.2.3-3).
- Maintain the water level in the Turners Falls impoundment between elevation 176.0 feet and 185.0 feet and limit the rate of rise to less than 0.9 foot per hour between the hours of 8:00 a.m. and 2:00 p.m. from May 15 to August 15 to protect odonates (FFPSA Article A190).
- Ramp Cabot Station outflows as defined in FFPSA Article A140 (Table 2.2.3-4) except for a limited number of hours in July, August, September, October, and November, as defined in FFPSA Article A160 (Table 2.2.3-5), when flexible operations would be allowed.
- Beginning three years after license issuance, provide flow stabilization downstream of Cabot Station by maintaining ±10% of the NRF in the months of April through November except for the following: (1) a limited number of hours in those months when deviations within ±20% of the NRF would be allowed, as defined in FFPSA Article A160 (Table 2.2.3-6); and (2) a limited number of hours in July, August, September, October, and November, as defined in FFPSA Article A160 (Table 2.2.3-5), when flexible operations would be allowed.
- Based on the NRF, provide variable releases from the Turners Falls dam as defined in FFPSA Article A150 (Table 2.2.3-7) and downstream of Station No. 1, as defined in Article A150 (Table 2.2.3-8), to provide recreational boating opportunities.
- Develop a project operation, monitoring, and reporting plan (FFPSA Article A200) describing how the licensee would document compliance with proposed Articles A110, A120, A130, A140, A150, A160, and A190. The plan would include filing an annual report detailing any allowable deviations and documenting progress toward meeting the flow stabilization measures downstream of Cabot Station (Article A160). Operational requirements may be modified under the conditions listed in Table 2.2.3-10.
- Use the Cabot emergency gates only under the following conditions: (1) in case of a Cabot load rejection; (2) in the case of dam safety issues such as potential canal overtopping or partial breach; and (3) to discharge approximately 500 cfs between April 1 and June 15 for debris management. If flows higher than 500 cfs need to be released through the gates from April 1 to June 15, FirstLight would coordinate with NMFS to minimize potential impact on shortnose sturgeon in the area downstream of Cabot Station (FFPSA Article A180).
- Continue to operate the Turners Falls Project in accordance with the existing agreement with the Corps (FFPSA Article A170).
- In the event of a conflict among the operational requirements of the new license, maintain the operation priority list provided in Table 2.2.3-9.
- Develop a shoreline erosion monitoring plan that includes: (1) conducting an initial shoreline erosion survey within two years of license issuance and additional surveys in

Years 10, 20, 30, and 40 of any new license; (2) following completion of each erosion survey, preparing a report summarizing the survey methods, results, and identifying any riverbank segments that require stabilization or repair of existing stabilization measures; and (3) upon approval from Massachusetts DEP and the Commission, completing the stabilization or repair measures identified in the report, if any, within five years (Table 2.2.3-12).

- Within one year of license issuance, provide the following information year-round on a publicly available website: (1) hourly Turners Falls impoundment water elevations, Turners Falls dam discharge, and Station No. 1 discharge; (2) hourly anticipated Turners Falls dam and Station No. 1 discharge for a 12-hour window into the future; and (3) the anticipated timing of the annual power canal drawdown (FFPSA Article A210).
- Construct and operate the proposed upstream and downstream fish passage facilities described in section 2.2.1.2 (FFPSA Article A300).
- Conduct initial fish passage effectiveness testing per the schedule defined in FFPSA Article A310 (Table 2.2.3-11).
- Conduct up to three additional rounds of upstream and downstream fish passage effectiveness testing and reporting during the first 20 years after license issuance, as needed to meet fishery agency performance goals. If the initial effectiveness testing shows that performance goals are not being met, FirstLight would implement one or more of the adaptive management measures listed in FFPSA Articles A320 for downstream passage and A330 for upstream passage. No adaptive management measures other than those specified in the proposed license article would be required for the first 25 years of the license unless expressly agreed to by FirstLight, Massachusetts DFW, NMFS, and FWS.
- Operate the fishways during the following periods: (1) May 1–November 15 for upstream eel passage; (2) April 4–July 15 for upstream anadromous fish passage; and (3) April 4–November 15 for downstream passage. The operating periods may be refined on an annual or permanent basis based on consultation among FirstLight, Massachusetts DFW, NMFS, and FWS (FFPSA Article A340).
- Develop and implement a fish passage O&M plan in consultation with Massachusetts DFW, NMFS, and FWS (FFPSA Article A350).
- Implement the Turners Falls Invasive Plant Species Management Plan filed on March 22, 2024.[57]
- Install a "pocket park" (e.g., a small park with a viewing point and picnic table) at the Pauchaug-Schell Bridge Greenway and signage for historical and cultural interpretation (RMP measure 6.1.1).

[57] Accession no. 20240322-5086.

- Construct and maintain a new paddle access campsite at Mallory Brook, or another location in the town of Northfield selected in consultation with the Appalachian Mountain Club and the town of Northfield (RMP measure 6.1.2).
- Construct a formal path leading from the Cabot Camp parking area to a put-in on the Millers River, construct a picnic area; and attempt to find a qualified organization to take responsibility for preserving the Cabot Camp historic buildings (RMP measure 6.1.3).
- Construct a new car-top access and put-in at Unity Park, provide a means of storing and locking vessels, install signage to assist paddlers portaging to downstream of the dam, and reconfigure the parking lot to improve vehicle and pedestrian safety (RMP measure 6.1.4).
- Construct a new river access point downstream of Turners Falls dam, including one path designed for rafters to launch upstream of Peskeomskut Island and another path to allow pass-through boaters to portage around the island (RMP measure 6.1.5).
- Construct a viewing platform, picnic area, and signage downstream of Turners Falls dam with the best feasible view of the dam (RMP measure 6.1.6).
- Construct a formal access for fishing and non-motorized boats upstream of the Station No. 1 tailrace (RMP measure 6.1.7).
- Install new stairs and signage at the Cabot Woods fishing area just downstream of Rock dam (RMP measure 6.1.8).
- Construct a portage trail around Rock dam (RMP measure 6.1.9).
- Construct improvements at the Poplar Street put-in and take-out to include stairs with a boat slide railing leading to a landing/concrete abutment, gangway, and floating dock (RMP measure 6.1.10).
- Install interpretive signage at Cabot Woods (Rock dam) and Peskeomskut/Great Falls (Turners Falls dam) (RMP measure 6.1.11).
- Make safety improvements to abandoned water passages in the Turners Falls bypassed reach (RMP Table 6.3-1).
- Establish a boat wake restriction, in coordination with the Massachusetts Department of Conservation and Recreation, from the Turners Falls dam extending upstream approximately 2 miles to where the Turners Falls impoundment narrows, to mitigate the impact of boat waves in the Barton Cove area.

2.2.4 Modifications to Applicant's Proposal—Mandatory Conditions

Fishway Prescriptions

On May 16, 2024, Interior filed preliminary fishway prescriptions for the Northfield Mountain and Turners Falls projects and requested that the Commission include a reservation of authority to prescribe fishways consistent with the terms of the FFPSA. On November 25, 2025, Interior filed a letter affirming that its modified fishway prescriptions for the Northfield Mountain and Turners Falls projects are the same as its preliminary fishway prescriptions. The prescriptions contain 16 conditions; see Appendix O. There are five conditions specifically for

the Northfield Mountain Project, six conditions specifically for the Turners Falls Project, and five conditions for both projects. Conditions 12, 13, and 16 are administrative in nature, and do not address specific resources; therefore, they are not analyzed in this EIS.

On May 21, 2024, NMFS filed preliminary fishway prescriptions for the Northfield Mountain and Turners Falls projects and requested that the Commission include a reservation of authority to prescribe such additional or modified fishways at those locations and at such times as they may subsequently determine are necessary to provide for effective upstream and downstream passage of diadromous fish through the project facilities. On June 7, 2024, NMFS filed corrections to preliminary fishway prescriptions for both projects. The prescriptions contain six conditions for the Northfield Mountain Project and eight conditions for the Turners Falls Project, and are reproduced in Appendix P.

Water Quality Certification Conditions

On April 22, 2025, the Massachusetts Department of Environmental Protection (DEP) issued a single water quality certification for the Northfield Mountain and Turners Falls Projects. The certification contains 17 standard conditions and 34 special conditions, reproduced in Appendix Q. Standard conditions 1–17 are administrative in nature and do not address specific resources; therefore, they are not analyzed in this EIS. Table 2.2.4-1 summarizes differences between the certification conditions and FirstLight's proposal.

2.3 STAFF ALTERNATIVE

Under the staff alternative, the Northfield Mountain and Turners Falls projects would be operated as proposed by FirstLight, including the conditions specified in the fishway prescriptions filed by NMFS and Interior, with the exception of NMFS's preliminary fishway prescription conditions 8.1.1, 8.1.2, and 8.1.3; Interior's fishway prescription conditions 7, 8, and 9; and the conditions specified by Massachusetts DEP, with the exception of conditions 26 and 32. The following modifications of and additions to FirstLight's proposed measures also would be included.

2.3.1 Measures Applicable to Both Projects

Threatened and Endangered Species

- Restrict tree removal or trimming (except for hazard trees that need to be removed to ensure public or project safety) on project lands from April 1 to October 31 to protect roosting northern long-eared and tricolored bats, as well as nesting migratory birds. Within two business days of an unplanned safety/emergency action consult with FWS, Vermont Fish and Wildlife Department (Vermont FWD), New Hampshire Fish and Game Department (New Hampshire FGD), and Massachusetts DFW, as appropriate, and file a report with the Commission providing a description of the action and any measures taken to protect bats, and an assessment of potential disturbance to bats.

Recreation

- Revise the proposed RMP to include: (1) procedures to ensure that debris accumulations at the Turners Falls dam boat barrier are removed in a timely manner commensurate with safety protocols; (2) a provision to evaluate the efficacy of the existing methods for

communicating flow information to the public should more effective communication methods become available in the future; and (3) a schedule to periodically evaluate and minimize light pollution caused by lighting from project facilities and recreation, as part of the RMP updates, including a description of activities completed, how advancements in lighting technology have been incorporated including the use of outdoor lighting principles, and compliance with any applicable local, state, or federal standards for controlling light pollution.

- Develop a navigability monitoring plan to include: (1) a provision to monitor potential navigational constraints at Barton Cove for three years, including, but not limited to, water levels, sediment deposition, and vegetation; (2) a provision to file annual reports with the Commission that describe all monitoring done in the previous year and recommended measures to maintain or improve navigability at Barton Cove, particularly during low water periods; (3) a provision to assess the effects of any potential dredging on cultural resources and, should dredging be proposed, requirements for compliance with section 5.4.1, *Review of Ground Disturbing Activities*, of the Turners Falls HPMP; and (4) a provision to file a final report with the Commission after three years of monitoring that summarizes all monitoring results, measures implemented, and any recommended additional monitoring or measures that may be needed to allow for safe navigation in Barton Cove.

Land Use and Aesthetics

- Develop a shoreline or land use management plan to incorporate the existing permitting program, land use/shoreline classifications, guidelines, and policies to protect project lands and shorelines, and associated recreational, scenic, and environmental values. Also provide a periodic review and update schedule for consultation with agencies and interested parties.

Cultural Resources

- Revise each of the July 8, 2024, HPMPs to include: (1) a revised APE that includes all land enclosed by the project boundary and any land outside the project boundary where project operation or project-related recreational development or any other enhancements may cause changes in the character or use of historic properties, including, but not limited to, the Riverside/Peskeompskut Archaeological District, Turners Falls Historic District, "The Patch" Historic District, Riverside Historic District, the Turners Falls Power & Electric Company Historic District), Hinsdale Historic District, the Cabot Camp Historic District, and the Northfield Farms Agricultural/Residential District (as applicable); (2) a map or maps that clearly show the revised APE in relation to the project boundary; (3) clarification of the number of archaeological sites within the revised APE and inclusion of maps depicting their location in relation to the revised APE; (4) measures to address potential project-related effects associated with illicit artifact removal, and to include text on interpretive signs to explain the damages and legal ramifications of illicit artifact removal; (5) revisions to section 5.4.4 Monitoring Identified Archaeological Resources to include a plan for regular monitoring of eligible or unevaluated archaeological resources located within the APE; (6) revisions to section 5.4.4 Monitoring Identified Archaeological Resources to include the results from the initial

shoreline monitoring survey (i.e., locations of identified project-related erosion, areas recommended for stabilization, and stabilization methods); (7) revisions to section 5.4.4 Monitoring Identified Archaeological Resources to include monitoring protocols for archaeological sites within the bypassed reach, particularly during times when the minimum flow is at or below 500 cfs; (8) a description of the Cabot Camp Historic District and Northfield Farms/Agricultural/Residential District, and description of site 19-FR-343 (Cabot Camp archaeological site) and provisions for regular monitoring of the site; (9) requirements to undertake archaeological survey of lands to be acquired for recreational and other future project-related purposes; (10) requirements for additional post-licensing consultation with participating Tribes regarding potential TCPs within the APEs; and (11) updates to *Appendix A: Agency, Tribal, and Interested Party HPMP Consultation Letters* to reflect the complete consultation record for the HPMP, including, but not limited to, the comment letter from the Massachusetts SHPO filed with the Commission on February 17, 2021.

2.3.2 Measures Applicable Only to the Northfield Mountain Project

The following recommended modifications of FirstLight's proposal and staff-recommended measures apply only to the Northfield Mountain Project:

Aquatic Resources

- Limit the use of additional storage (FFPSA Article B100, part b) as follows: (1) additional volume of water (3,009 acre-feet) would not be allowed to be used for generating; and (2) additional storage may not be pumped beyond 12,318 acre-feet during Apil 1 – May 31 for the protection of shortnose sturgeon spawning.
- Develop an operations compliance monitoring plan describing how the FirstLight would document compliance with the operational requirements of any license issued for the project.
- Modify FirstLight's proposed schedule for installing the barrier net in front of the Northfield Mountain tailrace/intake (FFPSA Article B200), and conducting the initial (FFPSA Article B210) and subsequent (FFPSA Article B220) effectiveness testing to be the same as the schedule as specified by Massachusetts DEP conditions 20, 21, and 22, respectively (installation in license Year 5 and initial effectiveness testing in license Years 7 and 8 and again in Years 10, 11, 14, and 15).

Section 18 Prescription Conditions Not Recommended

- Install the Northfield Mountain tailrace barrier net in Year 7 after license issuance and conduct performance testing in license Years 10 and 11; 14 and 15; and, if needed 17 and 18.

2.3.3 Measures Applicable Only to the Turners Falls Project

The following recommended modifications of FirstLight's proposal and staff-recommended measures apply only to the Turners Falls Project:

Geology and Soils

- Modify FirstLight's proposed shoreline erosion monitoring plan to be consistent with Massachusetts DEP condition 25 and include the additional provision: expand the shoreline erosion survey to cover the entire Turners Falls impoundment, with the first survey completed within the first 2 years of any license and then every 10 years starting in Year 10.

Aquatic Resources

- Maintain water levels between elevation 178.5 feet and 185.0 feet except under the specified circumstances when the reservoir could be lowered to 177.5 feet, and limit the rate of rise to less than 0.9 foot per hour between the hours of 8:00 a.m. and 2:00 p.m. from May 15 to August 15 (consistent with Massachusetts DEP condition 10(a-b)).
- Develop a canal drawdown protection plan, in consultation with FWS, Massachusetts DFW, and Connecticut River Conservancy that includes, at a minimum: (1) a provision to develop long-term protective measures, such as drawdown rates and time periods for the drawdowns; (2) an evaluation of the feasibility of conducting drawdowns every other year rather than annually; (3) an evaluation of the feasibility of increasing the interconnectedness between pools in the canal and minimizing no water in areas with hardened substrate; (4) a provision for salvage efforts led by FirstLight during all planned drawdowns; and (5) a provision for filing the results of salvage efforts each year with the Commission.
- Implement the following drawdown protection measures for the first year immediately following issuance of any future project license: (1) conduct the annual canal drawdown no earlier than mid-September; (2) draw down the canal over a one-day period, consistent with the rate of drawdown performed during Study 3.3.18 in 2014; and (3) install cones to identify paths for large machinery to follow while undertaking maintenance work in the canal during the drawdown.

Terrestrial Resources

- Develop a riparian management plan to provide a 75-foot vegetation buffer along the Connecticut River for all FirstLight-owned lands not needed for specific project purposes.
- Modify the Turners Falls Invasive Plant Species Management Plan specified by Massachusetts DEP condition 27 to extend the baseline survey for aquatic invasive plants in the Turners Falls Impoundment to include the area between the state line and Vernon dam.

Threatened and Endangered Species

- Develop a sturgeon stranding management plan, in consultation with NMFS, FWS, and Massachusetts DFW that includes, at a minimum: (1) identification of spill conditions with potential to result in stranding sturgeon in the Turners Falls bypassed reach; (2) a provision to conduct surveys in the Turners Falls bypassed reach after each spill over Turners Falls dam or whitewater release into the bypassed reach that meets the conditions identified for potential sturgeon stranding, and to relocate any stranded sturgeon to safe

areas within the bypassed reach; (3) a provision to file a report with the Commission within 30 days of any stranding event that identifies the date and time that the survey was conducted, the number, condition, and location of stranded sturgeon, a record of the hourly flows that occurred during the spill or whitewater release preceding the survey, any recommended measures to mitigate from future stranding; and (4) a provision to file an annual report with the Commission by March 1 that summarizes the previous year's stranding surveys as well all previous stranding surveys and any recommendations to the Commission, for approval, for changes to the monitoring schedule.

Recreation

- Modify FirstLight's proposal to post the start and end time and date of the annual canal drawdown on its proposed flow information website (FFPSA Article A210) to require notification as soon as possible, but at least 30 days in advance of the annual drawdown to allow sufficient time for the public to plan as needed for the drawdown.

Water Quality Certificate Conditions Not Recommended

The staff alternative does not include the following certification conditions because, pursuant to sections 4(e) and 10(a) of the FPA, the conditions either are not operationally feasible, do not provide a project-related benefit, or are a conditional future action for which we cannot determine benefits and costs:

- Provide quarterly and annual reports of project operations including continuous hydrographs, weekly and monthly statistics, and a summary of discharges on a daily, weekly, and monthly basis (condition 12(d) and 12(e)).
- Develop a water quality monitoring plan (condition 26).
- Create a temporary canal drawdown team and allow public access to the dewatered portion of the canal for scientific and environmental outreach and education activities (condition 32(b) and 32(c)).

2.4 STAFF ALTERNATIVE WITH MANDATORY CONDITIONS

The Commission is required to include all conditions of Massachusetts DEP water quality certification and NMFS and FWS section 18 fishway prescriptions in any new licenses issued for the projects. Therefore, the staff alternative with mandatory conditions includes the staff-recommended measures discussed above in section 2.3, *Staff Alternative*, as well as all the conditions included in the certification and section 18 prescriptions.

2.5 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

Certain alternatives to the applicant's proposal were considered but eliminated from further analysis because they are not reasonable in these cases. These alternatives are presented in Appendix G.

2.6 CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2)(A) of the FPA, 16 U.S.C. § 803(a)(2)(A), requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. We reviewed 40 comprehensive plans that are applicable to the Northfield Mountain and Turners Falls projects; see Appendix K. No inconsistencies were found.

3.0 ENVIRONMENTAL ANALYSIS

In this section, we present: (1) a general description of the projects' 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.[58] Sections are organized by resource area. The affected environment for each resource area, including the historical and current conditions, is provided first. The existing condition is the baseline against which the environmental effects of the proposed action and alternatives are compared, including an assessment of the effects of proposed mitigation, protection, and enhancement measures, and any potential cumulative effects of the proposed action and alternatives.

Staff conclusions and recommended measures are discussed in section 5.1, *Comprehensive Development and Recommended Alternative*, and in Appendix J.[59]

3.1 GENERAL SETTING

The Connecticut River is the largest and longest river in New England. It originates near the U.S.−Canada border at an elevation of approximately 2,670 feet and flows approximately 410 miles to Long Island Sound. After flowing about 9 miles through New Hampshire, it flows southwestward and forms the border between New Hampshire and Vermont for about 238 miles. It then crosses Massachusetts and Connecticut to empty into the Long Island Sound. The lower 60 miles of the river downstream of Windsor Locks, Connecticut, are tidal. There are 15 mainstem dams and hydropower projects on the Connecticut River (Table 3.1-1), 11 of which are conventional hydropower projects integral with or proximal to the dam; 1 is a pumped storage project (Northfield Mountain) that uses the Turners Falls impoundment as its lower reservoir; and the remaining three are smaller hydropower projects associated with the Holyoke Canal system.

The Connecticut River's drainage basin covers about 11,250 square miles, about 64% of which is upstream of Turners Falls dam. This upper Connecticut River Basin includes parts of north central Massachusetts, eastern Vermont, western New Hampshire, and a small area in Canada (Figure 3.1-1). Generally, the Lake Champlain and Hudson River watersheds are located

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[58] Appendix A, *Glossary of Terms*, includes definitions of selected terms relating to the project, environment, and our analysis.

[59] Unless otherwise indicated, our information is taken from the amended applications for new license filed by FirstLight on December 4, 2020 (FirstLight, 2020c,d; Gomez and Sullivan and Cardno, 2020) and amendments filed on March 22, 2024 (FirstLight, 2024a,b,c,d; Gomez and Sullivan, 2024; Gomez and Sullivan and Kleinschmidt, 2024), including the study reports developed in support of the applications (specific citations for the study reports can be found in the literature cited section of this document), supplemental information filed by FirstLight on March 15, 2021 (FirstLight, 2021c), June 21, 2021 (FirstLight, 2021f), June 23, 2021 (FirstLight, 2021b), July 2, 2021 (FirstLight, 2021g), August 4, 2021 (FirstLight, 2021h), May 11, 2023 (FirstLight, 2023b), December 11, 2023 (FirstLight, 2023d) and November 4, 2024 (FirstLight, 2024i).

to the west, and the Androscoggin, Saco, and the Merrimack River watersheds are located to the east.

Land use in the Connecticut River valley is predominantly rural and undeveloped consisting of agricultural lands (9%), wetlands (7%), and forested lands (77%), with only about 7% developed lands. The headwater areas are sparsely populated with only small towns and limited agricultural areas. The relatively flat land near the Connecticut River, including the floodplain, has substantial agricultural fields. Agriculture lands in the area are used for dairy, vegetable, and hay farming. Downstream, the topography of the Connecticut River valley is mostly level to rolling, with some higher hills including Northfield Mountain, where the upper reservoir of the Northfield Mountain Project is located. Most lands alongside the Connecticut River in the vicinity of the projects are zoned for limited residential use with infrequent commercial and industrial sites. However, much of the land has been preserved by property owners using various conservation easements for agriculture, open space, and habitat protection (New Hampshire DES, 1991). Downstream of the Turners Falls Project, land use transitions to increasing development and densely populated urban areas in Massachusetts and Connecticut (Zimmerman, 2006).

The Connecticut River Basin has warm and humid summers and cold, snowy winters. Average July temperatures range from a daily average maximum of approximately 75 to 80 degrees Fahrenheit (°F) and a daily average minimum of 55° to 60°F. Average January temperatures range from a daily average maximum of 25° to 30°F and a daily average minimum of 8°F. The average annual precipitation of 40 to 50 inches is relatively evenly distributed throughout the year. Snowfall is highly variable from year to year, but the average annual snowfall in the Connecticut River valley ranges from 55 to 65 inches (Dupigny, n.d.).

Seventeen major tributaries enter the Connecticut River, 15 of which are upstream of Turners Falls dam (Table 3.1-2). The economy in the project vicinity is driven by social services such as education and health care, accounting for approximately 30% of total jobs in the area. The next largest industries include retail trade, manufacturing, and construction.

3.2 CUMULATIVE EFFECTS

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

Based on information in the pre-application documents and staff analysis of the written comments submitted from agencies and other stakeholders on the scoping document 1 (SD1) and comments from the January 2013 public scoping meetings, we identified the following resources that may be cumulatively affected by the proposed relicensing of the Northfield Mountain and Turners Falls projects: water quality and quantity (including power generation); fishery resources (including anadromous and catadromous fish and fish passage); floodplain communities; freshwater mussels; sediment movement; recreational uses; and rare, threatened, and endangered species (RTE). In Appendix E, we discuss the geographic and temporal scope and provide our cumulative effects analysis.

3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

In this section, we discuss and analyze the site-specific environmental issues of the proposed project and alternatives on environmental resources. We present our recommendations in section 5.1, *Comprehensive Development and Recommended Alternative.*

3.3.1 Geology and Soils

3.3.1.1 Affected Environment

Geologic and Physiographic Setting

FirstLight's Northfield Mountain and Turners Falls projects lie in the Connecticut River Valley within the New England physiographic province. The geologic history of the valley is complex and was initially shaped by processes along margins of shifting tectonic plates. In the Paleozoic era, colliding continents in the region resulted in the formation of igneous (volcanics and granites), metamorphic, and sedimentary rocks. In the Mesozoic era, the splitting of the Pangea supercontinent (approximately 200 million years ago) caused rift valleys; one of these rift valleys formed the initial drainage of the ancestral Connecticut River Valley (Little, 2016). Sediments transported into the valley resulted in the formation of sandstone, shale, and conglomerate. During uplifting of the land in the Cenozoic era, streams cut into the underlying rock formations.

The surficial geology (i.e., geology relating to the earth's surface) in the area of the projects is largely attributable to glaciation for about two million years during the Pleistocene. Although the position of the Connecticut River Valley was established prior to glaciation, the final advance and retreat of the continental ice mass during the Wisconsin stage (approximately 20,000 years ago) eroded bedrock, realigned drainages, deposited till, and left glacial erosional surfaces. During the retreat of the thick ice sheet, a large lake formed along the river valley (Lake Hitchcock), which at its maximum stretched 250 miles from Rocky Hill, Connecticut, to St. Johnsbury, Vermont, and was 20 miles wide (Little, 2016). Glacial deposits in the region from that period include the following:

- **Glacial till:** The till was laid down by retreating glacier ice and consists of non-sorted, generally non-stratified mixtures of particles ranging in grain size from clay to large boulders in a matrix of predominantly fine sand and silt. Till blankets may vary widely in thickness, ranging from a few inches to several hundred feet.
- **Glacial stratified deposits:** Sediments in meltwater carried into Lake Hitchcock were deposited as stratified and well-sorted gravel, sand, silt, and clay layers. Glacial stratified deposits are the predominant surficial material in the Connecticut River Valley. These deposits generally overlie glacial till; however, in some places till is not present, and the stratified deposits lie directly on bedrock. The principal bottom sediments of the ancient Lake Hitchcock are clay, silt, and fine sand; they are up to approximately 300 feet thick and overlain by a continuous blanket of sand of a few feet to more than 20 feet thick.

Following the draining of Lake Hitchcock approximately 12,600 years ago, the reestablished river cut through the glacial deposits, creating terraces and floodplains that dominate the river valley today (Ridge and Larsen, 1990). Some of these terraces are remnants of Lake Hitchcock's shoreline and lake bottom and are located high above the river. In places

where the Connecticut River did not reoccupy its pre-glacial valley with its wide floodplain, it flowed over bedrock and created waterfalls and rapids (Little, 2016), some of which became the site of hydropower dams.

The two principal post-glacial deposits overlying glacial deposits are floodplain alluvium and aeolian deposits. The grain size distribution of alluvium generally varies over short distances, both vertically and laterally. The aeolian deposits in the region consist of windblown silt and sand that form a discontinuous but widespread blanket up to several feet thick.

The surface geology in the upper reservoir area of the Northfield Mountain Project predominantly consists of thin glacial till and shallow bedrock. Northfield Mountain is the northwest flank of a broad dome structure with a northeast-southwest axis. The rocks comprising the dome consist of hard metasediments of Paleozoic age and are grouped into two geologic formations: the Dry Hill granite gneiss and the Poplar Mountain gneiss.

Consistent with the geology of the region, most of the surficial deposits along the Connecticut River in the Turners Falls project area are glacial tills, glacial stratified deposits, and post-glacial deposits of varying thickness and deposited in terraces. Bedrock is exposed in some locations along the river.

Faulting and Seismicity

Crustal rupture is the principal source of crustal deformation in the northeastern United States, although the spatial and vertical distributions of recorded earthquakes within approximately 100 miles of the projects do not point to a predominant factor responsible for the seismicity. USGS has not mapped any Quaternary faults for New Hampshire, Vermont, or Massachusetts (Peterson et al., 2014), implying that there have been no active faults over at least the last two million years. Ancient inactive faults within the area of the Northfield Mountain Project appear to be limited. The major inactive fault near the area is the "border fault" between the Triassic sandstones of the Connecticut Valley and the metasediments; this fault formed during the breakup of Pangea supercontinent 200 million years ago and extends 130 miles from New Haven, Connecticut, to Keene, New Hampshire. Within the vicinity of the Northfield Mountain Project, the border fault lies west of the Connecticut River and well away from the project facilities.

The projects lie in an area of relatively low seismicity (i.e., earthquake occurrence). Most earthquakes in the vicinity of the projects have been of small magnitude. From 1974 (when the seismic monitoring network was established in the region) through 2020, 148 earthquakes occurred with a magnitude of 2.5 on the Richter scale or greater within 110 miles of Turners Falls dam (USGS, 2021). Humans do not typically feel earthquakes with a Richter scale magnitude of less than 2.5. Earthquakes with a magnitude of 5.0 to 5.9 are considered "moderate" and can cause damage of varying severity to poorly constructed buildings, no to slight damage to all other buildings, and are felt by everyone (USGS, 2012). The only earthquake recorded in Massachusetts to be over 5 on the Richter scale occurred in 1727 at just 5.6 in Newbury (Weston Observatory, 2021).

The amount of direct physical damage from an earthquake depends on several factors, including the earthquake intensity, stability of underlying geologic materials, and construction features of structures exposed to seismic vibration, which vary from site to site. To show probabilistic expectations for damaging shaking from earthquakes, USGS developed seismic

hazard maps that indicate the earthquake motions that have a certain probability of occurring across the entire United States. The hazard map for the vicinity of the projects indicates a peak horizontal ground acceleration[60] of 0.06 to 0.14 g (gravitational force) for a 2% probability of exceedance in 50 years (Petersen et al., 2014).

Soils

The soils for the projects are almost entirely formed from glacial and post-glacial deposits. In general, soils found at the project areas consist of moderately to excessively well-drained sands, silt loams, and sandy loams that are moderately susceptible to erosion. Specific soils near the Turners Falls impoundment vary spatially based on the location along river terraces, floodplains, and upland areas. Soil types within the footprint of the upper reservoir for the Northfield Mountain Project consist primarily of disturbed soil and cut and fill.

Shoreline and Streambank Characterization

The complex glacial and post-glacial history of the Connecticut River Valley resulted in multiple layers of sediment exposed along the riverbank at any given location. Layered sandy soils (including sandy loams with mixtures of silt and clay), whether of glacial or alluvial origin, mostly occur along the shoreline and streambank throughout the project areas.

Bank heights in the mainstem project areas depend largely on the geomorphic surface (e.g., floodplains, terraces, and upland areas) transected by the river. Bank heights are low where the river flows across the modern floodplain and are higher where the river encounters older glacial surfaces (i.e., terraces). Banks along the riverine areas are generally steeper than those along the impoundments where banks are partially inundated. Bank heights of greater than 50 feet are present where the river flows through glacial till.

Bank erosion occurs when the sum of forces (e.g., water flow, wave action, gravity) exceeds the resisting strength of the bank (Parker et al., 2008). Bank composition and bank height, along with riparian vegetation cover, are primary factors affecting the extent of bank erosion within the project areas (Micheli and Kirchner, 2002). Banks with a height of 15 to 30 feet and composed primarily of sand and sandy loam are typically the least stable. Banks higher than 30 feet (i.e., glacial terraces) are more stable because they are often composed of compacted clay, gravel, and bedrock.[61]

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[60] Peak ground acceleration is the maximum ground acceleration that occurs during earthquake shaking at a location. Earthquake shaking generally occurs in all three directions. The horizontal peak ground acceleration component is generally larger than the vertical component and is the most commonly used type of ground acceleration in engineering applications. A horizontal peak ground acceleration of 0.14 g is equal to 4.5 feet/second, resulting in strong perceived shaking but light potential damage (USGS, 2012).

[61] Shoreline and streambank conditions for the Northfield Mountain and Turners Falls projects are taken from FirstLight's 2013 full river reconnaissance survey (Choi, 2014a) and relicensing study on the operational impact on existing erosion and potential bank instability (Choi, 2014b). The three studies document streambank characteristics, such as steepness, material type, degree of vegetative cover, and severity of erosion.

Northfield Mountain—The upper reservoir shoreline of the Northfield Mountain Project is composed of constructed dikes created with fill material from excavation areas during construction. The upper reservoir area also includes steep areas cut into bedrock and gently sloping areas that are alternately exposed and inundated in response to changing water levels. The upper reservoir shoreline is stable with no or little erosion (Choi, 2014b).

Turners Falls—Based on the 2013 survey, streambanks in the Turners Falls impoundment generally consist of an upper bank that is often above water except during high flow conditions, and a lower bank that is frequently submerged (Choi, 2014a). Most (78%) of the upper riverbanks in the impoundment surveyed had moderate or steep slopes, heights greater than 12 feet, consisted of silt and sand, and had heavy vegetation. Most of the lower riverbanks had flat (beach) to moderate slopes, consisted of silt and sand, and had no or sparse vegetation. In terms of erosion (conditions in 2013), the riverbanks of the entire impoundment were generally stable; there was little or no erosion through much of this reach (84.4%), 14.1% of the reach had some erosion, 0.5% had some to extensive erosion, and 0.6% had extensive erosion.

3.3.1.2 Environmental Effects

Construction-Related Erosion

FirstLight does not propose any specific measures related to mitigating construction-related erosion.

Our Analysis

FirstLight's proposal to construct fish passage facilities and improve recreation facilities would include both in-water and onshore construction. Construction of new facilities, modification of existing facilities, or other ground-disturbing activities would require heavy equipment operation; ground-disturbing activities; and dewatering work areas, which have the potential to adversely affect aquatic habitat by increasing soil erosion and fine sediment delivery to project waterways. Fine sediment can adversely affect water quality and associated aquatic habitat by increasing turbidity and total suspended solids. Accumulation of fine sediment in aquatic substrate can adversely affect fish spawning success and limit habitat suitability for many aquatic invertebrates. The Commission typically includes construction-related license articles in any new licenses that include new construction (including recreation facilities, fish passage facilities, or a minimum flow powerhouse) that require development of site-specific erosion and sediment control plans for each construction project. FirstLight's other proposed recreational improvements would be onshore near existing maintained areas with little risk of causing an increase in sedimentation in the Connecticut River.

Effects of Impoundment Fluctuations on Shoreline Erosion

Impoundment drawdowns currently allowed under the existing licenses can affect geology and soil resources by constantly inundating and dewatering riverbanks. FirstLight's proposed changes in operation would alter the volume of water that can be released from Northfield Mountain's upper reservoir, outflows from the projects, and WSEs in the Turners Falls impoundment. These modifications have the potential to affect erosion and sedimentation rates within and downstream of the Turners Falls impoundment.

FirstLight proposes the following impoundment WSEs:

- Maintain the Turners Falls impoundment WSE within a 9-foot range of 176.0 to 185.0 feet but limit the rate of WSE rise to less than 0.9 foot per hour between 8:00 a.m. and 2:00 p.m. from May 15 to August 15 under proposed Article A190.
- Increase the allowable range of WSEs in the Northfield Mountain upper reservoir from between 1,000.5 feet and 938 feet (allowing a 62.5-foot drawdown) to between 1,004.5 and 920 feet (allowing an 84.5-foot drawdown), which would provide an additional 3,009 acre-feet of usable storage under proposed Article B100.

The FFPSA signatories recommend the operational measures proposed by FirstLight relating to the Turners Falls impoundment fluctuations as proposed in FFPSA Article A190 and the Northfield Mountain Project as proposed in FFPSA B100.[62]

In comments on the draft EIS, FRCOG, Connecticut River Conservancy, and American Rivers recommend modifying FFPSA Article A190 to include the following requirements for the Turners Falls impoundment, as measured at the Turners Falls dam:

- Target elevation: hold the Turners Falls impoundment at a target average elevation of 181.5 feet, with "average" defined as the arithmetic average of all hours of a given year.
- Target bandwidth: maintain the Turners Falls impoundment elevation between the following target bandwidths: for 50% of the hours per year, the daily elevation change shall be less than 1.2 feet, for 75% of hours per year the daily elevation change shall be less than 1.5 feet, and for 90% of hours per year, the daily elevation change shall be less than 2.1 feet. Daily elevation change is defined as the maximum elevation minus the minimum elevation of a calendar day.
- For the remaining 10% of hours, maintain WSEs between 179 and 184 feet. These deviations will be necessary only during certain prescribed circumstances, such as during ISO-NE grid emergencies, flood events, disaster declarations, and/or rare instances during which flow management of Cabot Station dictated by the FFPSA requires more flexibility as agreed-to by federal and state resource agencies.

American Rivers recommends limiting the Turners Falls impoundment WSE to no lower than 179 feet and only using the additional storage capacity in Northfield Mountain's upper reservoir during ISO-designated emergency needs.

The Nolumbeka Project Tribal Coalition[63] comments that there is erosion occurring on the east bank in the Wissatinnewag Run (Turners Falls bypassed reach) of the Connecticut River, as well as just below the Conte Fish Lab and near the Cabot Station section of the river.[64] To address this erosion and other unaddressed erosion locations, the Nolumbeka Project Tribal Coalition recommends the development of a shoreline erosion action plan that also includes an action plan for project-induced operational mishaps and severe weather events. Nolumbeka

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[62] FWS (10(j) recommendation TF7 also recommends FFPSA Article A190.

[63] The Nolumbeka Project Tribal Coalition is a coalition between the Nolumbeka Project, the Elnu Abenaki Tribe, and the Chaubunagungamaug Band of Nipmuck Indians.

[64] Nolumbeka Project Tribal Coalition May 22, 2024, letter.

Project Tribal Coalition recommends that the plan include identification of ongoing shoreline erosion challenges, including shoreline ice plate failures.

Massachusetts DEP condition 13 specifies the FFPSA Article B100 Northfield Mountain impoundment WSEs, and condition 10 modifies FFPSA Article A190 for Turners Falls impoundment WSEs. The amendment would maintain Turners Falls impoundment water levels between elevation 178.5 feet and 185 feet except under specified provisions for discretionary events to operate between elevations 178.5 and 177.5 feet for no more than 168 hours per year and 12 hours per event; and provide the ability to draw down to the extent necessary but no lower than 177.5 feet for nondiscretionary events.

Our Analysis

Vulnerability of riverbanks to erosion is determined largely by soil type, inflow velocity, bank height, the amount of riparian vegetation, and the magnitude of fluctuations in WSE elevations. When riverbank erosion occurs along the perimeter of the Turners Falls impoundment, it occurs on upslopes above the shoreline where soil is destabilized due to shear forces on steep banks, in locations with minimal riparian vegetation, and in areas that experience rapid increases and decreases in WSE (Cardno et al., 2015).

To evaluate baseline erosion impacts on riverbanks, FirstLight conducted an initial study to identify existing causes of erosion and associated forces (Choi, 2014a). The study determined bank erosion rates and assessed the causes of erosion at 25 study sites located throughout the Turners Falls impoundment under baseline operating conditions. Due to its engineered shorelines, the Northfield Mountain Project was not included in the final analysis. The study sites spanned the longitudinal extent of the Turners Falls impoundment and represented the riverbank features, characteristics, and erosion conditions found throughout the study reach.[65] FirstLight then conducted a study to evaluate the effects of operations proposed in its 2016 license application with baseline conditions (Choi, 2014b). FirstLight's proposed operations were subsequently modified via the FFPSA. Two supplemental studies (FirstLight, 2023b; 2024c) were conducted to evaluate the effects of the revised operations agreed to in the FFPSA, which reflect FirstLight's current proposal. Both studies used the U.S. Department of Agriculture's Bank Stability and Toe Erosion Model. The analysis presented in this section references the 2024 Bank Stability and Toe Erosion Model supplemental study, as it supersedes the results presented in the 2023 supplemental study.

The 2024 supplemental study defined a significance threshold of riverbank erosion based on the observed mean annual erosion rate found during the baseline monitoring study. If the erosion at a given site was greater than the erosion rate that represents the lowest 5% of all observed rates (0.163 $ft^3/ft/yr$) the site was classified as having measurable or significant rates of bank erosion. Sites included in the study were the same 25 detailed study sites located

[65] The results of the modeling and analyses conducted at each study site were then extrapolated throughout the Turners Falls impoundment such that each riverbank segment identified during the initial 2013 full river reconnaissance study (Choi, 2014a) had a dominant and, in some cases, contributing cause(s) of erosion assigned to it. To be considered "dominant," it needed to be responsible for at least 50% of the bank erosion at a site. To be considered "contributing," it had to contribute greater than 5%, but less than 50%, of the erosion at the site.

throughout the Turners Falls impoundment used in the initial erosion and potential bank instability study. Study site locations were grouped into four primary river reaches, including the upper (Reach 4, just below Vernon dam); middle (Reach 3, beginning 1-2 miles downstream of Vernon dam and extending to about 1 mile upstream of the Northfield Mountain tailrace); Northfield Mountain (Reach 2, area in the immediate area of the Northfield Mountain tailrace); and lower (Reach 1, from just downstream of the Northfield Mountain tailrace to Turners Falls dam).

As Table 3.3.1.2-1 shows, four study sites in the Turners Falls impoundment exhibited increases in erosion rates from the baseline to proposed operations of more than 5%; however, the increase in erosion rate only exceeded 0.163 $ft^3/ft/yr$ in three of those four sites. As part of the supplemental study, FirstLight conducted a hydraulic analysis of the project area to determine velocities and shear stresses in the riverbank environments under various flow conditions.[66]

Results of Bank Stability and Toe Erosion modeling runs for FirstLight's currently proposed operations were used to evaluate the dominant and subdominant causes of erosion. Overall, high flows were the dominant cause of erosion for about 37.1 miles of the shoreline (86% of the entire Turners Falls impoundment), while boat wakes were the dominant cause for the remaining 5.9 miles (14% of the entire Turners Falls impoundment). Moderate flows (i.e., flows between 17,130 and 37,000 cfs) were a contributing cause of erosion at three sites throughout the Turners Falls impoundment (sites 119BL, 87BL, and 75BL), all of which are located within the Northfield Mountain reach. Study results identified proposed operations as a contributing cause of significant erosion[67] at three sites: 18L and 3L in the upper reach and BC-1R in the lower reach (FirstLight, 2024c). Extrapolation of these results indicates proposed operations would increase erosion in a total of about 7.7 miles of shoreline. According to study results, proposed operations would represent a contributing cause of erosion in a 2.8-mile-long reach on river left (on the left side of the river, looking downstream) downstream of Vernon dam, a 0.9-mile-long reach on river right (on the right side of the river, looking downstream) upstream of the Northfield Mountain tailrace, and a 4.1-mile reach between French King Gorge and the exit of Barton Cove (FirstLight, 2024c).

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[66] FirstLight assessed the erosive impact of flows within thresholds established by the hydraulic characteristic of each reach presented in Table 3.3.1.2-1. Modeling resulted in two flow thresholds in the upper reach of the Turners Falls impoundment (Reach 4): (1) less than 17,130 cfs and (2) greater than 17,130 cfs. This threshold value corresponds with the hydraulic capacity of the Vernon Hydroelectric Project and is consistent with the hydraulic characteristics of this more riverine reach. In the remaining three hydraulic reaches (i.e., from just upstream of the NH/MA border to Turners Falls dam), three flow thresholds were established, including: (1) less than 17,130 cfs; (2) 17,130 to 37,000 cfs; and (3) greater than 37,000 cfs. The value 37,000 cfs was chosen as the high-flow threshold as it represents the combined hydraulic capacity of the Vernon and Northfield Mountain projects.

[67] Erosion rates of no more than 0.16 $ft^3/ft/yr$ are considered insignificant and are within survey accuracy.

FirstLight's study results indicate that proposed FFPSA project operations could increase riverbank erosion rates compared to baseline conditions at 13 out of the 25 detailed study sites. However, at most of these locations, riverbank erosion rates would not increase significantly above baseline operating conditions (i.e., less than 0.163 $ft^3/ft/yr$) and would only increase above the study's significance threshold at 3 out of the 25 detailed study sites. Under future FFPSA operating conditions, study results show that seasonal high flows, groundwater seeps, anthropogenic factors (e.g., boat wakes and shoreline land use practices), and debris and ice build-up, would remain the primary causes of riverbank erosion in the project impoundment and downstream of the Turners Falls dam. High flows exceeding 35,000 cfs occur about 3% of the time under normal project operations and would occur at a similar rate under future conditions.

FirstLight estimates that the Turners Falls Project's peaking operations typically draw down the Turners Falls impoundment about 3.7 feet (measured at the dam) with a maximum daily change between 1.2 and 1.6 feet. Our analysis of FirstLight's simulated Turners Falls impoundment WSEs for baseline conditions for days that do not exceed the project's hydraulic capacity (FirstLight, 2021e) indicates that the 10% to 90% exceedance range in daily fluctuations is 0.9 to 3.0 feet near Turners Falls dam and 2.0 to 5.0 feet near Vernon dam in 1962–2003.

Under proposed operations, within three years after license issuance, the frequency and magnitude of Turners Falls peaking operations would be reduced under FFPSA Article 160 by maintaining outflows from Cabot Station within ±10% of the NRF in the months of April through November, except for the following: (1) a limited number[68] of hours in those months when deviations within ±20% of the NRF would be allowed; and (2) a limited number of hours[69] Thein July, August, September, October, and November, when flexible operations would be allowed. Regarding the Nolumbeka Project Tribal Coalition's concerns about premature ice plate failures, this represents a substantial reduction from current operations, in which peaking operations result in daily drawdowns of the Turners Falls impoundment by approximately 3.7 feet.

FirstLight's evaluation of the 2000–2016 hourly data (Gomez and Sullivan and Cardno, 2020) indicates the WSE at Turners Falls dam was typically between about 180 to 183 feet in all months of the year, and the median elevation was 181.3 feet. FirstLight's erosion-related model concurs with this typical operating bandwidth and shows the Turners Falls impoundment elevation at 179 feet or above approximately 96% of the time and at or above 178.8 feet approximately 98% of the time. Additional data provided by FirstLight demonstrate that, between 1975 and 2024, FirstLight and prior owners only operated below 178.5 feet an average of 279 hours per year (i.e., about 3% of the year). FirstLight's proposed modelled scenarios, that include the FFPSA operating conditions, generally do not appear to vary substantially from the

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[68] Deviations within ±20% of the NRF would be allowed for up to 22 hours from 4/1 to 5/15, 18 hours from 5/16 to 5/3, 7 hours from 6/1 to 6/15, 7 hours from 6/16 to 6/30, 55 hours from 7/1 to 8/15, 27 hours from 8/16 to 8/31, 44 hours from 9/1 to 10/31, and 11 hours from 11/1 to 11/30.

[69] Flexible operations would be allowed for up to 20 hours in July, 26 hours in August, 23 hours in September, 20 hours in October, and 28 hours in November, with no more than 7 flexible events per month.

preceding discussion and project an annual operating range of approximately 179 feet to 184.4 feet for the Turners Falls impoundment.

On June 24, 2025, FirstLight notified the Commission of an emergency drawdown of the Turners Falls impoundment to make necessary repairs. On July 8, 2025, the Turners Falls impoundment was drawn down to a level below the minimum license elevation of 176 feet. Visual inspections during the drawdown, recorded as photos in updated comment letters, show exposed sediment actively caving in. Additional visual representation provided by Massachusetts DEP depicts eroding shoreline areas at an elevation of 177.5 feet. Overall, these drawdown events indicate that operating the Turners Falls impoundment in the 176-feet to 179-foot range would expose historically inundated shoreline areas and increase the potential for these areas to dewater and erode. In conjunction with FFPSA Article 160, limiting the operational bandwidth of the Turners Falls impoundment to the elevations specified in Massachusetts DEP condition 10, which amends FFPSA Article A190 for the Turners Falls impoundment WSEs, would further limit water level fluctuations in the Turners Falls impoundment and mitigate the potential for shoreline erosion.

As discussed previously, FirstLight proposes a year-around increase in the allowable range of WSEs in the Northfield Mountain upper reservoir from 1,000.5 feet to 938 feet (allowing a 62.5-foot drawdown) to between 1,004.5 and 920 feet (allowing an 84.5-foot drawdown), providing an additional 3,009 acre-feet of usable storage. Between 2001 and 2017, FERC granted five temporary license amendments that permitted use of this increased range of storage capacity to support grid reliability.[70] Although FERC's 2017 approval of FirstLight's request allowed use of the upper reservoir's additional 3,009 acre-feet of storage during ISO-NE discretionary actions taken during emergency operations, it prohibited generation with more than the currently licensed 12,318 acre-feet of storage on a day-to-day basis. In this 2017 order, FERC concluded that limiting the use of the additional storage for ISO-NE discretion actions taken during emergency operations and NERC reliability standards would minimize the possible impacts to environmental resources while allowing FirstLight to help maintain grid reliability, given the infrequency of such declared emergencies. FERC's 2018 disapproval of a similar FirstLight request for additional Northfield Mountain operational flexibility stated that any future proposal should be restricted to use during ISO-NE discretionary actions taken during emergency operations unless FirstLight can provide sufficient evidence why a broader amendment is appropriate.

Based upon when (i.e., 2001 to 2017) FirstLight requested temporary changes in the Northfield Mountain upper reservoir, the Turners Falls impoundment water level was within the typical operating ranges previously discussed. Although the extent to which this proposed year-around change in the operation of Northfield Mountain would alter flows and WSEs within and downstream of the Turners Falls impoundment is unknown, because the use of this additional storage would depend on market conditions, limiting the Turners Falls impoundment to the operational bandwidth specified in Massachusetts DEP condition 10, would not significantly impact the generation potential of Northfield Mountain as additional flexible generation has

[70] FERC also approved a temporary amendment in 2015 that allowed the upper reservoir to be drawn down to 920 feet on two days in May to enable an inspection and possible repairs in the upper reservoir.

occurred while Turners Falls impoundment elevations were above 179 feet. If the volume of water that is pumped or used during generation is increased, this would cause some increase in the magnitude of changes in flow velocities and water elevations. This effect, however, would be mitigated if FirstLight is restricted in using the additional storage of 3,009 acre-feet for generating purposes and can only use the current 12,318 acre-feet of storage for generation. Overall, the potential impact of using additional storage in the Northfield Mountain upper reservoir would be relatively small compared to the reduction in flow and WSE that would occur due to the proposed constraints on the frequency of peaking operations and reduced maximum variations in outflows from Cabot Station.

Shoreline Erosion

FirstLight currently manages erosion within the Turners Falls impoundment in accordance with Article 19 in the Turners Falls Project existing license and with Article 20 in the Northfield Mountain Project existing license.[71] The existing Erosion Control Plan (FirstLight, 1999), developed to meet the requirements of these articles, includes the following: (1) classification of riverbanks and erosion sites; (2) prioritization of erosion sites; (3) application of appropriate erosion control measures or treatments based on prioritization; (4) monitoring and evaluation of repaired sites; and (5) a preventive measures program. Under the Erosion Control Plan, FirstLight also conducts a full-river reconnaissance survey every three to five years within the entire Turners Falls project area to document riverbank characteristics, such as steepness, material type, degree of vegetative cover, and severity of erosion. In addition, FirstLight conducts annual transect surveys to identify any changes in riverbank or channel geometry at 22 sites evenly spaced throughout the geographic extent of the Turners Falls impoundment (FirstLight, 1999).

FirstLight proposes to develop a shoreline erosion monitoring plan for Turners Falls impoundment reaches within Massachusetts where proposed project operations would represent a contributing cause of erosion.[72] The plan would be developed after consultation with Massachusetts DEP and include: (1) conducting an initial shoreline erosion survey within two

[71] Articles 19 and 20 in the existing project licenses require FirstLight to take reasonable measures to prevent soil erosion within the boundary of each project and minimize soil erosion and siltation on lands adjacent to the stream resulting from construction and operation of the projects. Article 20 also notes that the Commission, upon request, or upon its own motion, may order FirstLight to construct and maintain such preventive works to accomplish this purpose and to revegetate exposed soil surface as the Commission may find to be necessary after notice and opportunity for hearing.

[72] FirstLight's proposed measures to address shoreline erosion were filed with its March 22, 2024, amendment to its license application, in a document titled "FirstLight Streambank Erosion Proposal for the Turners Falls Impoundment."

years of license issuance and additional surveys in Years 10, 20, 30, and 40 of any new license;[73] (2) following completion of each erosion survey, preparing a report summarizing the survey methods, results, and identifying any riverbank segments that require stabilization or repair of existing stabilization measures; and (3) upon approval from Massachusetts DEP and the Commission, completing the stabilization or repair measures identified in the report, if any, within five years. Following completion of remediation activities, FirstLight would file as-built documentation (plans/photos) of the stabilization/repair efforts with Massachusetts DEP and the Commission.

FirstLight also proposes to establish conservation easements along the Turners Falls impoundment's shoreline and on river right (looking downstream) downstream of Turners Falls dam to conserve the riparian buffers along the affected project area, allow for the continued operation of the Bennett Meadows WMA, and to conserve the 1.3-mile-long portion of the New England National Scenic Trail in the Northfield Mountain project boundary. To mitigate the impact of boat wakes in the Barton Cove area, FirstLight would also establish a boat wake restriction, in coordination with the Massachusetts DCR, from Turners Falls dam extending upstream approximately two miles to where the Turners Falls impoundment narrows.

In response to FirstLight's May 2023 Bank Stability and Toe Erosion modeling report for erosion in the Turners Falls impoundment (FirstLight, 2023b), Massachusetts DEP provided its *Technical Memorandum: Review of the BSTEM Modeling and Reporting Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)*, which was filed on June 20, 2024.[74] At Massachusetts DEP's request, this memorandum summarizes the findings of a third-party review. Based upon study outcomes, Massachusetts DEP's third-party reviewer, Interfluve, recommended that FirstLight develop a shoreline monitoring plan in consultation with Massachusetts DEP. The monitoring plan would include: (1) procedures for a comprehensive baseline survey of representative monitoring stations; (2) a framework to conduct periodic re-surveys (e.g., two- to five-year intervals) comparing ongoing conditions with the erosion and vegetative cover conditions established during the initial baseline survey; and (3) procedures for monitoring high-flow events at pre-determined monitoring sites so surveys can be conducted before and immediately after the high-flow event (Massachusetts DEP, 2024c).

Massachusetts DEP condition 25 specifies that the FirstLight repair and stabilize all previously stabilized sites in the Turners Falls impoundment where the 2013 Full River

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[73] Each erosion survey would consist of the following: (1) a reconnaissance survey to characterize the riverbank characteristics and erosion conditions of each riverbank segment where proposed project operations were identified by the Bank Stability and Toe Erosion Model as a contributing cause of erosion; and (2) cross-sectional surveys at existing detailed study sites where proposed project operations were identified by the model as a contributing cause of erosion. If a detailed study site does not currently exist in such a reach (e.g., the reach from the Barton Cove exit to the French King Gorge), FirstLight would establish a representative detailed study site within that reach during the first erosion survey following license issuance. Any newly established detailed study sites would be re-surveyed during subsequent surveys.

[74] Massachusetts DEP (2024c).

Reconnaissance identified erosion, and the sites have not already been repaired since 2014. In addition, FirstLight would implement and complete stabilization or preventive maintenance projects at seven additional sites within the Turners Falls impoundment that were identified during the 2013 Full River Reconnaissance. The condition also specifies that FirstLight develop, in consultation with Massachusetts DEP, and finalize an erosion control monitoring plan that is based on a quality assurance project plan. The condition provides methods and procedures for documenting shoreline erosion and intervals at which erosion monitoring surveys and boat-based inspections would be conducted. The condition also identifies the sites and conditions for which FirstLight would be responsible for any needed shoreline stabilization. The condition specifies that the quality assurance project plan be resubmitted every five years for reapproval by Massachusetts DEP, and FirstLight would submit any significant or substantive changes to the quality assurance project plan as an addendum to the approved plan. Following the completion of each survey, FirstLight would prepare a report summarizing the survey methods and results and hold a 60-day written comment period on the draft report. All survey results would be posted on the website established pursuant to Massachusetts DEP condition 12, with email notices to (at a minimum): the FRCOG; Connecticut River Conservancy; the towns of Northfield, Montague, Erving, and Gill; the Nolumbeka Project; and the Chaubunagungamaug Band of Nipmuck Indians. Within the Barton Cove area, FirstLight would work with the appropriate state and federal agencies to implement a no wake zone from the Turners Falls dam (Station 0+00) to where the Turners Falls impoundment narrows upstream of Barton Cove (Station 110+00) to address the effects of boat waves on shoreline erosion.

Numerous local non-governmental organizations, town governments, local committees, and Tribal organizations contend that water level fluctuations due to operation of the projects are a dominant cause of riverbank erosion upstream and downstream of the projects and warrant controlling erosion by reducing the magnitude of fluctuations in flows and water levels and continuing the existing and additional monitoring and rehabilitation efforts.[75] These entities, in addition to a large contingent of stakeholders including private individuals (e.g., local landowners and farmers), mostly located adjacent to Turners Falls impoundment and riverine areas, recommend that FirstLight: (1) develop a plan to address shoreline erosion; (2) develop a target elevation and WSE bandwidth for the Turners Falls impoundment to create a more stable impoundment environment; (3) conduct frequent shoreline erosion surveys of selected monitoring sites; (4) continue the existing provision for a full river reconnaissance survey; and (5) be responsible for the maintenance and repair of all bank restoration projects.

The FRCOG recommends that FirstLight: (1) continue to take reasonable measures to prevent soil erosion on lands adjacent to streams; (2) develop a target elevation and WSE elevation bandwidth for the Turners Falls impoundment to create a more stable impoundment environment; (3) continue the current practice of conducting annual transect surveys at 22 previously surveyed transects plus 9 new locations established for relicensing studies 3.1.1 (2013 Full River Reconnaissance) and 3.1.2 (Northfield Mountain/Turners Falls Operations Impact on Existing Erosion and Potential Bank Instability); (4) conduct full river reconnaissance

[75] Commentors include the Nolumbeka Project Tribal Coalition, the town of Gill, FRCOG, Connecticut River Conservancy, Massachusetts state legislators, and the Ashuelot River Local Advisory Committee.

surveys on an annual basis and hire an independent third-party to determine the methods of the full river reconnaissance survey; (5) fund annual operational costs to continue the USGS gage (gage level data only) no. 01161280 near the Route 10 bridge; (6) continue to be responsible for maintenance and repair of all bank restoration projects started and/or completed under the current existing license; and (7) develop a plan to address shoreline erosion.

The town of Gill recommends that FirstLight: (1) establish license conditions that reduce the amount of river level fluctuation due to project operations; (2) continue the current license requirement to conduct annual transect surveys; (3) conduct full river reconnaissance surveys on an annual basis, using consistent methodology (such as light-detecting and ranging [LiDAR] surveys) that has been publicly reviewed and with a quality assurance project plan approved by Massachusetts DEP and the U.S. Environmental Protection Agency (EPA); (4) continue the existing license articles that require the minimization of soil erosion and siltation on lands adjacent to the stream resulting from the construction and operation of the project; and (5) develop a plan to address shoreline erosion in accordance with the recommendations filed by FRCOG.

The town of Gill also recommends: (1) the Commission require FirstLight to get a certificate of compliance from the Gill Conservation Commission for the Bank Stabilization Phase III Order of Conditions issued in 2009 (MassDEP File #162-68); (2) require a review and summary of outstanding orders of conditions issued by the four local conservation commissions (Gill, Montague, Erving, and Northfield) prior to any sale, transfer, or restructuring of FirstLight's ownership; (3) provide the opportunity for the four local conservation commissions and the FRCOG to review and comment on any erosion-related monitoring reports submitted by FirstLight to the Commission; and (4) provide for input from the four local conservation commissions, FRCOG, Massachusetts DCR, Massachusetts Environmental Police, and MassDEP on any FirstLight boat wake restriction policies.[76]

To reduce the potential for erosion in the Turners Falls impoundment related to Northfield Mountain Project operations, Connecticut River Conservancy recommends that FirstLight implement a baseline river height from which FirstLight would maintain a "normal operational range." Operating parameters would require impoundment elevations to stay within this range and include specific conditions for any deviances outside of the range.

As discussed above, the Nolumbeka Project Tribal Coalition comments that there is erosion occurring on the east bank in the Wissatinnewag Run (Turners Falls bypassed reach) of the Connecticut River, as well as just below the Conte Fish Lab and near the Cabot Station section of the river. To address this erosion and other unaddressed erosion locations, the Nolumbeka Project Tribal Coalition recommends the development of a shoreline erosion action plan that also includes an action plan for project-induced operational mishaps and severe weather events.[77]

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[76] These recommendations do not relate to the Commission's licensing jurisdiction and are beyond the scope of this EIS.

[77] Nolumbeka Project Tribal Coalition May 22, 2024, letter.

In its reply comments, FirstLight disagrees with comments suggesting that project operations constitute a dominant cause of riverbank erosion.

Our Analysis

Because study results suggest project operations would have a limited impact on the riverbanks, FirstLight does not propose to conduct annual erosion transect surveys or continue full-river reconnaissance surveys throughout the geographic extent of the Turners Falls impoundment. FirstLight's proposal to establish conservation easements along the Turners Falls impoundment riparian corridor, allow for the continued operation of the Bennett Meadow WMA, and to conserve the 1.3-mile-long portion of the New England National Scenic Trail in the Northfield Mountain project boundary would provide beneficial protection to vulnerable bank areas. Similarly, FirstLight's proposal to establish a boat wake restriction, in coordination with the Massachusetts DCR, from Turners Falls dam extending upstream approximately two miles to where the Turners Falls impoundment narrows, would likely benefit bank stability and reduce erosion.

FirstLight's proposed shoreline erosion monitoring plan would effectively monitor erosion and address shoreline erosion in the project areas (26,300 linear feet of shoreline) where the 2024 supplemental study found project operations to be a contributing cause of erosion. However, due to study results showing that project operations could increase shoreline erosion rates at the majority of detailed study locations, the project has the potential to contribute to additional shoreline erosion outside of these identified locations. Consistent with the existing Erosion Control Plan, and aligning with the measures specified in Massachusetts DEP condition 25, modifying FirstLight's proposed shoreline erosion monitoring plan to: (1) conduct a full river reconnaissance survey of the entire Turners Falls impoundment every 10 years with the first survey occurring within 2 years of license issuance and each survey thereafter occurring in Years 10, 20, and30; and (2) align shoreline erosion monitoring efforts with Massachusetts DEP condition 25 for the portion of Turners Falls impoundment in Massachusetts, would support the identification of shoreline erosion impacts over a larger portion of the project area and the specific causes of erosion (e.g., project operation, seasonal high flows, ice build-up).

The existing Full River Reconnaissance shoreline coverage and survey frequency, established as part of the existing Erosion Control Plan resulted in delineation of 228,009 linear feet of shoreline in 2013.Conducting a full river reconnaissance survey of the entire Turners Fall impoundment with a frequency consistent with Massachusetts DEP condition 25 would provide a level of shoreline monitoring consistent with the recommendations provided by local stakeholders and the recommendations presented in Massachusetts DEP's June 2024 technical memorandum. Aligning additional shoreline erosion monitoring efforts, for portions of the Turners Falls impoundment in Massachusetts, with Massachusetts DEP condition 25 would enable FirstLight to identify changes in riverbank or channel geometry at detailed sites along the extent of the Turners Falls impoundment and implement appropriate stabilization measures at all locations where surveys identify project operations as a contributing cause of erosion. Based on Massachusetts DEP condition 25, FirstLight would need to work with Massachusetts DEP to establish the appropriate survey locations in the portion of Turners Falls impoundment within Massachusetts.

Regarding FRCOG's recommendation that FirstLight hire an independent third-party to determine the methods of the full river reconnaissance survey, the existing record indicates that

FirstLight has adequately managed the shoreline erosion monitoring efforts required by the existing Erosion Control Plan. Consistent with FERC's standard practice, FirstLight would be required to provide a draft plan to the agencies for review and comment and, after the agencies have been provided with adequate time to comment, file a revised plan indicating how all agency recommendations have been addressed in the plan. In addition, the plan and all reports required by the plan would be filed on the record, where all stakeholders would have the opportunity to review and provide comments for FERC's consideration.

Regarding Connecticut River Conservancy's recommendation that FirstLight implement a baseline river height from which FirstLight would maintain a "normal operational range" within the Turners Falls impoundment, under proposed operations, WSEs within the Turners Falls impoundment and flows from the project would already be maintained within specific ranges to support other environmental measures.

Sedimentation and Sediment Transport in the Connecticut River

Dams interrupt the downstream continuum of sediment supply and transport, which in turn can affect channel morphology and limit the amount of coarse substrate (i.e., gravel/cobble) available for aquatic habitat. Sediment transport within the Turners Falls project area occurs primarily during seasonal high-flow events, typically at flow levels above the combined hydraulic capacity of the project powerhouses. Sediment deposition and accumulation in the project impoundment and surrounding project areas occur at varying rates, based on flow conditions and project operations.

The Ashuelot River Local Advisory Committee recommends establishment of long-term monitoring and assessment of how sediment will move in the river due to operational changes over the next license.

Our Analysis

The Turners Falls Project impounds a large portion of the Connecticut River that otherwise would be free flowing. Under existing conditions, the Turners Falls impoundment traps large substrate material, and much of the fine sediment is transported downstream during seasonal high-flow events.

FirstLight's proposed operations would allow some changes in the volume of water released from Northfield Mountain's upper reservoir, outflows from the projects, and reservoir elevations. As a result, sediment dynamics could change in localized areas (e.g., in the Turners Falls impoundment just downstream of the Northfield Mountain tailrace and in the Connecticut River immediately downstream of Turners Falls dam) in response to changes in flow magnitude, frequency, and duration. However, any sediment response to these operational changes would likely not be detectable after high-flow events caused by major rain events or snowmelt. Overall, sediment dynamics throughout most of the project areas would likely remain unchanged, and naturally occurring high flows would continue to be the dominant cause of sediment movement. Because proposed operations would likely not have a noticeable effect on sediment dynamics outside of temporary effects in localized areas, the establishment of a long-term monitoring program would provide an undefined benefit to the assessment of how sediment would move in the river due to operational changes.

Sediment Management at the Northfield Mountain Project

Sedimentation in the Northfield Mountain Project upper reservoir and its intake channel[78] results from refill pumping during high-flow periods when the Connecticut River's ability to transport large quantities of suspended sediment is greatest. Water and sediment are transported at a high velocity through the conduit system to the upper reservoir. As the water and sediment combine with water already in the intake channel, the wider and deeper intake channel leads to a deceleration to the sediment-rich pumped water and sediment deposition. The upper reservoir's intake channel experiences lower velocities under generation than it does under pumping; therefore, generation does not result in movement of the sediment deposited in the intake channel back into the Turners Falls impoundment (Alden, 2014).

FirstLight proposes to implement its Upper Reservoir Dewatering Protocols, filed on June 30, 2017, which include measures to avoid or minimize and monitor the release of sediment from the upper reservoir into the Connecticut River during maintenance drawdowns and sediment removal activities. FirstLight would conduct bathymetric surveys of the upper reservoir and intake channel every two years, and if the results of the survey indicate an average sediment depth throughout the middle of the upper reservoir intake channel of 5 feet or greater, FirstLight would evaluate approaches for potential sediment removal, notify the appropriate agencies and inform them of the next steps planned, and perform annual bathymetric surveys until sediment removal occurs.

If the decision to remove sediments is made, FirstLight would notify EPA, Massachusetts DEP, and FERC prior to initiating work. Best management practices and monitoring methods identified in the dewatering protocols would be followed, and these would be updated over time to reflect advances in techniques or technologies and/or to respond to specific conditions anticipated to be encountered during a specific dredging event. If the BMPs are updated, FirstLight would provide the most recent version to EPA, Massachusetts DEP, and FERC for review in advance of future dredging activities. FirstLight would monitor turbidity or suspended sediment concentration levels in the tailrace and mainstem Turners Falls impoundment over the course of the dewatering.

Massachusetts DEP condition 30 specifies that FirstLight file with Massachusetts DEP, a revised sediment management plan incorporating additional information related to monitoring, reporting, and planning of sediment management for the Northfield Mountain Project. The revised plan would include a requirement that following monitoring, FirstLight would generate and submit a report with the collected data, including an evaluation of sedimentation rates that establish a trajectory of potential dredging events, if needed. Based on those identified scenarios and/or thresholds, FirstLight, in consultation Massachusetts DEP, would develop protocols for the movement and management of removed sediment, with proposed locations of potential long-term storage/disposal. Following any dredging event, FirstLight would include details on construction and discharge monitoring. FirstLight would post the sediment management plan on

[78] The channel in the upper reservoir that leads to the penstock is referred to as the intake channel, while the channel leading from the Turners Falls impoundment to the Northfield Mountain penstock is referred to as the tailrace.

the website (established pursuant to condition 12) within two weeks of Massachusetts DEP's approval.

No other entity filed comments or recommendations regarding sedimentation in the Northfield Mountain upper reservoir.

Our Analysis

Prior to initiation of the FERC relicensing process, EPA issued an Administrative Order dated August 4, 2010, which requested a report identifying measures to prevent discharges of sediments associated with draining the Northfield Mountain upper reservoir. Subsequently, by letter dated January 20, 2011, FERC staff requested a plan to avoid or minimize the entrainment of sediment into the project works during upper reservoir maintenance drawdowns. On July 15, 2011, FirstLight filed the Northfield Mountain Pumped Storage Sediment Management Plan (Gomez and Sullivan, 2011) in response to EPA and FERC requests. The plan was developed in consultation with EPA and Massachusetts DEP. The plan contains proposed methods to assess sediment dynamics in the project's upper reservoir and the Turners Falls impoundment from 2011 through 2014. In the plan, FirstLight committed to propose management measures to minimize entrainment of sediment into the project works at the conclusion of the data collection and assessment efforts.

At the request of EPA, FirstLight included the plan in its revised study plan as relicensing Study No. 3.1.3, *Northfield Mountain Project Sediment Management Plan*, which included various field studies, data collection, and modeling efforts which occurred from 2011 to 2016. The results of these efforts were used to inform management measures to minimize entrainment of sediment into the project works and discharge to the Connecticut River during drawdown or dewatering activities. The final report for the study (Gomez and Sullivan, 2016a) was filed with the Commission and EPA in October 2016.

On December 15, 2016, EPA filed comments with the Commission requesting that FirstLight provide greater detail on dewatering protocols, plans, procedures, and schedule for its review and update. EPA also requested FirstLight propose additional monitoring of discharges during a dewatering. FirstLight filed its proposed dewatering protocols (FirstLight, 2017) in June of 2017.

Continued operation of the Northfield Mountain Project would result in the continued deposition of fine sediments in the upper reservoir and its intake channel. The rate of sediment accumulation in the upper reservoir and its intake channel depends on several factors, including the suspended sediment concentration in water pumped, the volume of water pumped, the residence time between pumping and generation, and the rate of generation, which controls velocities in the upper reservoir's intake channel. Conditions between September 29-30, 2012, and October 11-12, 2014, were estimated to result in an average accumulation rate of about 8,000 cubic yards per year in the intake channel (Gomez and Sullivan, 2016a).

FirstLight's proposal would increase the upper reservoir's active storage by about 3,009 acre-feet (i.e., 24%,) has the potential to result in increased pumping of water into the upper reservoir, which would tend to increase the sediment accumulation rate in the reservoir and its intake channel. However, the upper reservoir was designed to allow for operation over this wider range of elevations, and on six occasions between 2001 and 2024, the Commission granted temporary license amendments that permitted use of this storage capacity for months at a

time. Further, FirstLight has noted that there is no certainty whether the increase in upper reservoir storage capacity would result in increased operation of the project, since project operation is a function of the cost of the energy to pump and the value of the energy when generating. Therefore, the overall increase in pumping and accompanying sediment accumulation may be limited.

FirstLight's proposed Upper Reservoir Dewatering Protocols would help to avoid or minimize the entrainment of sediment from the Northfield Mountain upper reservoir into the project works and their release into the Connecticut River during maintenance drawdowns and sediment removal activities. The plan provides appropriate protocols, mechanisms for monitoring the effectiveness of FirstLight's sediment management procedures, and the incorporation of lessons learned from the project's dewatering events and advancements in technology. The plan aligns with the conditions specified by Massachusetts DEP condition 30.

3.3.2 Aquatic Resources

3.3.2.1 Affected Environment

Water Quantity

Turners Falls dam was modified in 1970 to raise the impoundment's WSE and provide additional storage capacity for the Northfield Mountain Project. The Northfield Mountain Project, originally developed to balance output from the Vermont Yankee Nuclear Power Plant (Energyzt, 2020), began commercial operation with a single unit in 1972 and commercial operation of its other three units in 1973; it ceased operation in 2014.

River flows entering the project area are regulated by upstream impoundments, which have more than 400,000 acre-feet of active storage, combined. Table 3.1-1 provides the name, location, and storage capacity of these impoundments. USGS reports flows measured in the Connecticut River at Montague City, Massachusetts (gage no. 01170500; USGS, 2023), which is less than 1 mile downstream of the Turners Falls Project's lowermost powerhouse, Cabot Station. Table 3.3.2.1-1 summarizes frequencies for annual and monthly flows for the 45-year period from 1975 through 2019. Average annual flows ranged from 9,796 to 21,390 cfs. Monthly average flows for this period were highest from March through May, ranging from 21,213 to 37,061 cfs, and lowest from August through September, ranging from 6,843 to 7,768 cfs.

On August 28, 2011, Hurricane Irene made landfall and followed a path from western Long Island through western Connecticut and west of the Connecticut River through Massachusetts and Vermont. In the Connecticut River Basin, about 6 to 11 inches of rainfall occurred during a 12- to 18-hour period, with some totals exceeding a 500-year rainfall frequency, and a maximum flow of 127,000 cfs was recorded at the USGS Montague gage. The Corps (2011) estimates that use of between 35% to 79% of the flood storage in the Corps dams in the Connecticut River Basin reduced the peak flow by about 34,000 cfs.

The Montague gage has a drainage area of 7,860 square miles, 90% of which is upstream of Turners Falls dam.

FirstLight coordinates operations with Great River as required under Article 304 in the existing Turners Falls Project license and a May 28, 2003, hydro operating agreement between

Great River and FirstLight.[79] FirstLight typically operates its projects in a coordinated manner to maximize the efficient use of available water by considering variations in electricity prices and natural flow. Operations for Great River's Wilder, Bellows Falls, and Vernon projects and FirstLight's Northfield Mountain and Turners Falls projects are also coordinated with the Corps to manage flooding in the basin.

FirstLight operates the Northfield Mountain and Turners Falls projects to meet the target impoundment elevations and minimum flows provided in Table 3.3.2.1-2. Typically, it operates the Turners Falls Project (Cabot Station) in peaking mode. It operates the Northfield Mountain Project in pumping mode when energy demands and/or energy costs are low and in generation mode when energy demands and/or energy costs are high. During periods of sustained high flows, the Turners Falls Project generates continuously, and Northfield Mountain is only used to refill the upper reservoir so as to not contribute additional flow as specified in Table 3.3.2.1-3.

The following discussion describes the historical range of inflows, outflows, and impoundment WSEs for each project. For the Turners Falls Project, we summarize FirstLight's evaluation of historical impoundment WSEs for calendar years 2001–2016, and our analysis of the Montague gage historical flow data for calendar years 2001–2015 (Figure 3.3.2.1-1). For the Northfield Mountain Project, we summarize FirstLight's evaluation of 2000–2014 hourly Turners Falls impoundment WSEs at the Northfield Mountain tailrace and conclusions from its hydraulic model study of the Turners Falls impoundment.

Northfield Mountain—The Northfield Mountain Project operates as a pumped-storage facility using up to 12,318 acre-feet of storage. About 5.2 miles upstream of Turners Falls dam, FirstLight pumps water from Turners Falls impoundment to the upper reservoir and generates electricity by releasing the water from the upper reservoir back into Turners Falls impoundment. Each of the project's four reversible pump-turbine-generator units can pump water at a rate of 3,200 to 3,800 cfs and generate electricity with a flow rate of 2,250 to 5,000 cfs/unit (i.e., up to a total pumping flow of 15,200 cfs and generation flow of 20,000 cfs). Historical data for 2000–2014 indicate that WSE in the Turners Falls impoundment at the Northfield Mountain tailrace ranged from about 177 to 195 feet and was between 181 to 185 feet 80% of the time.[80]

Daily WSE fluctuations in the Turners Falls impoundment are influenced by several factors including inflows, which are affected by upstream storage impoundments and Great River's operation of Great River's Vernon Project (P-1904), FirstLight's operation of the Northfield Mountain pumped-storage project, and FirstLight's releases from the Turners Falls Project. Figure 3.3.2.1-2 summarizes Turners Falls impoundment WSEs simulated with FirstLight's HEC-RAS one-dimensional steady-state hydraulic modeling (Gomez and Sullivan, 2014a) for a range of baseline conditions.

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[79] At the time this agreement was reached, the parties were US Gen New England, Inc. (Great River's predecessor) and Northeast Generating Company (FirstLight's predecessor).

[80] From May 5 to September 4, 2010, Northfield Mountain was completely shut down due to a maintenance event and sediment clogging the Northfield Mountain Project's generation station.

These simulations indicate the following conditions for the Turners Falls impoundment WSEs:

- The WSE at Turners Falls dam is the most controlling factor for WSE throughout most of the Turners Falls impoundment, but the French King Gorge is a hydraulic control that affects WSEs in the middle and upper Turners Falls impoundment. The effects of constriction at the gorge are greatest when high flows coincide with the WSE at Turners Falls dam at its lower limit.[81]
- When Vernon is at its maximum generation and the Northfield Mountain Project is idle, the difference in WSE ranges up to 6.7 feet in the Vernon dam tailrace and up to 2.9 feet in the Northfield Mountain tailrace.
- When Vernon is at its maximum generation, the difference in WSE with the Northfield Mountain Project at maximum generation and pumping ranges up to 0.5 feet in the Vernon dam tailrace and up to 7.6 feet in the Northfield Mountain tailrace.
- When Vernon is at its minimum flow, the difference in WSE with the Northfield Mountain Project at maximum generation and idle ranges up to 0.2 feet in the Vernon dam tailrace and up to 3.9 feet in the Northfield Mountain tailrace.

Turners Falls—FirstLight's Turners Falls Project impounds the river for about 15 miles between the Vernon dam and the Northfield Mountain tailrace at RM 127 and another 5 miles downstream to Turners Falls dam. This impoundment, which is also the lower impoundment for the Northfield Mountain Project, receives inflow from 6,266 square miles above the Vernon dam, a cumulative 811 square miles from two primary tributaries (the Ashuelot River at RM 140 and Millers River at RM 126), and 86 square miles from smaller tributary basins and local inflow. The Corps' flood management includes use of a combined storage capacity of 121,180 acre-feet at the Surry Mountain and Otter Brook dams in the Ashuelot River Basin, and the Birch Hill and Tully dams in the Millers River Basin (Corps, 2025a,b,c,d).

The project includes a 2.1-mile-long power canal that supplies water to several entities and terminates at the project's Cabot Station, which discharges into the Connecticut River about 2.5 river miles downstream of the Turners Falls dam. The project can also release water into the project's bypassed reach from the Turners Falls dam and Station No.1, which is located on the Turners Fall power canal 0.9 miles downstream of the dam. Non-project inflows to the Turners Falls bypassed reach include Fall River just below the dam and the Turners Falls Hydro, LLC and Milton Hilton, LLC project tailraces about 0.3 miles and 0.5 miles downstream of Turners Falls dam, respectively.[82] The Turners Falls Hydro, LLC Project (FERC No. 2622) can operate at about 60–289 cfs. Prior to obtaining a new license that became effective on March 1, 2021, Project 2622 was only operated at 289 cfs when flow in the power canal was greater than

[81] The gorge limits the downstream flow of water, resulting in higher WSEs upstream of the gorge than would otherwise occur.

[82] Milton Hilton, LLC and Turners Falls Hydro, LLC have indentured water rights. FirstLight currently has an agreement with each of these entities that provides that the entity will come online when the naturally routed flow in the Connecticut River increases to 15,000 cfs (close to the combined capacity of Cabot Station and Station No. 1).

15,000 cfs, as stipulated in the off-license Water Use Agreement that is currently in place between Turners Falls Hydro and FirstLight. However, the new FERC license (FERC, 2021) allows Project 2622 to be operated any time the flow to the project intake on the Turners Falls power canal is at least 60 cfs. The Milton Hilton, LLC Project is owned by a private developer and has a hydraulic capacity of 113 cfs.

FirstLight's evaluation of the 2000–2016 hourly data (Gomez and Sullivan and Cardno, 2020) indicates the WSE at Turners Falls dam was typically between about 180 to 183 feet in all months of the year. FirstLight estimates that the project's peaking operations typically use a 3.7-foot drawdown. Our analysis of the 2001–2015 Montague gage historical flow data (Figure 3.3.2.1-1) indicates that the Turners Falls Project powerhouse capacity (15,938 cfs for Cabot Station and Station No. 1 combined) was exceeded each year at about the same frequency and seasonal timing as Vernon, and daily fluctuations were at least 8,000 cfs on most days.

Water Quality

The Clean Water Act regulates the quality of waters of the United States by setting and applying water quality standards. The water quality standards consist of designated uses, water quality criteria, antidegradation requirements, and general policies affecting the application and implementation of the water quality standards (EPA, 2014). Individual states develop water quality standards and submit them to EPA for approval, and once approved by EPA, the standards are applicable to federal actions, including issuance of any new licenses for the Northfield Mountain and Turners Falls projects.

Table 3.3.2.1-4 presents the designated beneficial uses, set in the water quality standards, for the Connecticut River, and Table 3.3.2.1-5 presents each state's water quality criteria for selected constituents. The most recent section 305(b) reports and the current EPA-approved 303(d) lists are summarized in Tables 3.3.2.1-6 to 3.3.2.1-8. Once EPA approves the 303(d) lists, they are applicable to federal actions, including licensing the projects evaluated in this EIS.[83] Some impairments and sources identified in the latter tables are non-project related (e.g., particularly New Hampshire mercury impairment from atmospheric deposition and a tritium impairment from the nuclear plant in Vermont). In Vermont, impairments include fluctuating flows associated with hydropower production. Similarly, in Massachusetts, fish and aquatic life beneficial uses are listed as non-supporting because of identified impairments that include flow regime modification from hydrostructure flow regulation/modification and alteration in stream-side or littoral vegetative cover from streambank modifications/destabilization.

As noted above, non-project related impairments have been identified in the project areas. Impairments for both project areas include mercury deposition from atmospheric deposition and tritium from the Vermont Yankee Project, and impairment in Turners Falls project area by *Escherichia coli* (*E. coli*) from combined sewer overflows. A combination of legislation that targeted acid deposition and EPA's Acid Rain Program have significantly reduced emissions from primary contributors of sulfur dioxide and nitrogen oxides from fossil fuel-fired power

[83] EPA approved the Massachusetts' 2018–2020 303(d) list and partially approved its 2022 303(d) list, approved New Hampshire's 2020–2022 303(d) list, and approved Vermont's 2020 303(d) list.

plants across the United States, including substantial reductions in the Northeast (EPA, 2023c). In addition, EPA approved the 2007 Northeast Regional Mercury Total Maximum Daily Load (TMDL) (Connecticut DEP et al., 2007) on December 20, 2007. Sources considered by the states in the development of this TMDL include regional atmospheric mercury deposition, municipal wastewater treatment plants, non-municipal wastewater discharges, and stormwater. Massachusetts DEP (2024a,b) prepared a TMDL that addresses the *E. coli* 303(d) listings and released it in March 2024 for public review and comment. Massachusetts DEP has not provided expected completion dates for the TMDLs needed to address total suspended solids or polychlorinated biphenyls. Although TMDLs are not required for several of the impairments because they are not pollutants, these impairments are being addressed through other means. Vermont Department of Environmental Conservation and Massachusetts DEP indicate that they expect the FERC licensing process to address impairments caused by hydropower facilities altering flow regimes and WSEs.

FirstLight's goal for its water quality study was to determine potential effects of the projects on water temperature and dissolved oxygen (DO). Sites monitored are within the Turners Falls impoundment, project tailraces, the Turners Falls bypassed reach, and the Connecticut River between Cabot Station and Holyoke dam. Historical data were used to evaluate suspended sediment resulting from a Northfield Mountain Project maintenance event.

Temperature

FirstLight monitored water temperature at 18 locations in 2015 (Figures 3.3.2.1-3 and 3.3.2.1-4) and reported results of this monitoring and other water quality monitoring in its water quality study report (Gomez and Sullivan, 2016b). Figure 3.3.2.1-5 displays seasonal and temporal trends in temperatures at the Turners Falls impoundment based on semi-monthly vertical profiles at three locations in the impoundment.[84] The seasonal pattern showed gradual warming throughout the spring and summer with the highest temperatures at the three profile locations in August and early September. The difference in temperature between the surface and bottom of the profiles among all three sample locations ranged from 0.0 to 0.9°C.

FirstLight conducted continuous water temperature monitoring at 15-minute intervals from April through mid-November 2015 at 16 sites.[85] Monthly average temperatures were similar among all locations. Temperatures at most sites increased from about 5°C in April to 16°C in May, were highest at about 25°C in August, were about 23°C in July and September, and decreased to 13°C by October. The maximum instantaneous temperature observed across all sites was 28.1°C, which is less than the 28.3°C Massachusetts criterion for Class B warm water fisheries.

Evaluation of the 2015 water temperature, operations, and weather data indicate:

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[84] Ice cover prevented access to the boat barrier site on April 3, and high flows prevented access to the deepest area of the impoundment on June 25 and to the boat barrier site on April 30 and June 25.

[85] Some sites do not have a complete data set for the entire period because the initial deployment of equipment in 2015 was postponed by ice cover. Additional data gaps were caused by logging errors, equipment malfunction, and dewatering of equipment.

- The temperature of Northfield Mountain discharges influences the thermal regime of the Turners Falls impoundment by various amounts throughout the year. Based on a comparison of temperatures during generation versus non-generation in 2015, the Northfield Mountain Project reduces temperatures in its tailrace (Site 4) by as much as 2.7°C in early May and 1.5°C in late May, has negligible effects in late August and September, and increases temperature by as much as 2.4°C in early October (Gomez and Sullivan, 2016b; Figures 3.3.2.1-6 and 3.3.2.1-7). At site 5, about 0.6 miles downstream from the tailrace, the effects of Northfield Mountain discharges are about half the magnitude at its tailrace in early and late May and remain nearly the same as at the tailrace in early October. These effects are further reduced with distance from the Northfield Mountain tailrace.
- In spring, the temperature in the Turners Falls bypassed reach generally tended to be nearly the same as in the impoundment at the boat barrier, regardless of operations of Station No. 1 and Cabot Station and use of the dam's spillway. However, the bypassed reach experienced larger diel fluctuations than the impoundment during non-spill periods.
- In late August to late September 2015, there were periods when the bypassed reach upstream of Station No. 1 was as much as 2.5°C cooler than in the impoundment at the boat barrier (Figure 3.3.2.1-8), which may be due to localized precipitation and runoff from Fall River based on corresponding precipitation data (NOAA, 2021).
- The power canal temperatures were similar to those in the impoundment at the boat barrier and remained fairly constant throughout the day, despite changes in canal flow. Daily temperature ranges were slightly higher when flow in the power canal was relatively low.
- Downstream of Cabot Station, monthly average temperatures at the eight in-river sites were within 1.0°C of one another. Figures 3.3.2.1-9 through 3.3.2.1-12 show temperatures and the hourly rate of temperature change at these eight sites for two 7-day low-flow, warm-temperature periods with Cabot Station operating in both peaking and stable flows.

Dissolved Oxygen

FirstLight sampled DO and other water quality constituents in 2015 for its water quality study (Gomez and Sullivan, 2016b). FirstLight's sampling included continuous DO monitoring to characterize conditions in the Turners Falls impoundment, bypassed reach, power canal, and the Connecticut River below Cabot Station. This study also included monitoring DO in vertical profiles throughout the water column at three locations in the Turners Falls impoundment.

The three monitoring locations in the Turners Falls impoundment were continuously well mixed, with minimal differences in DO and temperature between the surface and bottom. DO remained between 7 and 8 milligrams per liter (mg/L) during July and August at the deepest area in Turners Falls impoundment (108.3 and 111.5 feet, respectively). Continuous DO and temperature data collected throughout the 2015 study period indicated that DO in the Turners Falls impoundment, bypassed reach, power canal, and below Cabot Station remained above the Massachusetts 5.0-mg/L criterion for Class B warm water fisheries. Minimum DO was 5.8 mg/L below Cabot Station (at Site 11).

Suspended Sediment

Evaluation of the relationship between suspended sediment concentrations and discharges from the Vernon Project shows that suspended sediment concentrations increase in the Northfield Mountain forebay with increasing flow; however, the variability is significant (Figure 3.3.2.1-13). Northfield Mountain pumping of high-suspended sediment concentrations water during high river flows and discharge of lower-suspended sediment concentrations water is a result of sediment deposition in the upper reservoir. Comparison of multibeam bathymetric surveys indicates that a net total of 16,077 cubic yards of sediment accumulated in the upper reservoir intake channel between the 2012 and 2014 surveys at an average accumulation rate of about 8,000 cubic yards per year (Gomez and Sullivan, 2016a).[86]

A May 2010 Northfield Mountain maintenance event, which included draining the upper impoundment, resulted in silt/sediment being drafted into the project's tunnels to the powerhouse and causing the project to completely shut down from May 5 to September 4, 2010. The event also discharged silt/sediment into the Turners Falls impoundment and deposited 20,000 to 50,000 cubic yards of silt/sediment in Turners Falls impoundment below the high-water mark for about 800 feet downstream of the Northfield Mountain tailrace (Massachusetts DEP, 2010). Massachusetts DEP deemed these conditions violations of the Massachusetts Clean Water Act and the antidegradation regulations and issued a consent order for FirstLight to develop and implement a restoration plan to remove the deposited silt and sediment (Massachusetts DEP, 2010). Massachusetts DFW found that activities related to the restoration would result in adverse effects to the actual Resource Area Habitat (310 Code of Massachusetts Regulations 10.59) and "take" (321 Code of Massachusetts Regulations 10.00) of arrow clubtail (*Styhtrus spiniceps*, threatened), cobra clubtail (*Gomphus vastus*, special concern), spine-crowned clubtail (*Gomphus abbreviatus*, endangered), Stygian shadowdragon (*Neurocordulia yamaskanensis*, special concern), and riverine clubtail (*Stylurus annticola*, endangered). In response, FirstLight developed a restoration plan, removed the silt/sediment, and filed its Sediment Management Plan (Gomez and Sullivan, 2011) with FERC.

Oil

An oil spill occurred at Turners Falls dam each winter in 2021–2023. On December 20, 2021, about 4 gallons seeped through a minor leak from the main hydraulic lines that supply oil to Bascule Gate No. 1. On February 23, 2022, about 418 gallons of oil leaked from pistons 7 and 8 at Bascule Gate No. 4 (Tighe and Bond, 2022a).[87] On March 9, 2023, about 1 gallon leaked out of pistons 3 and 5, which operate Bascule gate Nos. 2 and 3; oil from these leaks remained fairly contained in stagnant pools of water at the base of the dam until it slowly dissipated. Following each spill, FirstLight worked with Clean Harbors Environmental Services to follow Massachusetts DEP-directed cleanup procedures, which included deployment and recovery of

[86] The net accumulation was determined as the difference between the bathymetric surveys conducted on September 29–30, 2012, and October 11–12, 2014.

[87] Additional assessment of the dam's hydraulic system indicates it to be approximate, with a site glass and a tape measure to determine oil reservoir volume. Maintenance records indicate FirstLight personnel added approximately 418 gallons to the hydraulic reservoir, with the majority added between February 20, 2022, and April 12, 2022.

absorbent pads. However, in 2022, cold temperatures and ice accumulation delayed deployment of the pads until March 15, 2022.[88] FirstLight has: (1) patched the main hydraulic lines to Bascule Gate No. 1 (Tighe and Bond, 2022b); (2) replaced packing filling and cylinder head O-rings on pistons 7 and 8; and (3) repaired chrome pitting, replaced packing and cylinder O-rings for pistons 1 through 6, placed new absorbents in piston pits 1 through 8 and placed new absorbent socks around cylinders of pistons 1 through 8 to prevent future leaks (Tighe and Bond, 2023). In the short term, observations were documented through July 5, 2023. In addition, FirstLight has begun to fully replace each hydraulic cylinder as a long-term solution.

On June 3, 2025, a sudden failure in the hydraulic system that supports the pistons below Bascule Gate No. 2 resulted in an oil spill estimated to be no more than 445 gallons (FirstLight, 2025a). FirstLight (2025b) immediately began emergency response action and notified Massachusetts DEP of the situation. This spill resulted in an emergency drawdown of Turners Falls impoundment to investigate and make repairs to Bascule Gate No. 2. After drawing down the impoundment on July 8, FirstLight and its contractors investigated the issue, implemented repairs, and completed testing to ensure the hydraulic system and gate were functioning properly. Then, FirstLight began refilling the impoundment.

Fisheries Resources

Aquatic Habitat

Impoundments—The Connecticut River in the vicinity of the Northfield Mountain and Turners Falls projects is generally narrow, with areas of floodplain and terraces of silt, sand, and gravel. The Turners Falls impoundment includes both lentic (lake-like) and lotic (riverine) habitats. The upstream portion of the impoundment from the Vernon dam tailrace to the Northfield Mountain tailrace is lotic, generally shallow, contains rocky shoreline, and is uniform relative to the mainstem of the impoundment between the Northfield Mountain tailrace and Turners Falls dam. A few narrow islands in this reach are composed of gravel, cobble, and fines with a few deep pools downstream of the bridge piers that have been scoured over time. The downstream portion of the impoundment, from the Northfield Mountain tailrace to Turners Falls dam, is geomorphically dominated by bedrock and more lentic relative to the upstream portion of the impoundment (Kleinschmidt and Gomez and Sullivan, 2014). This lower portion of the impoundment includes a mix of embayments, points, coves, islands, and a wide range of substrates; it features shallow lacustrine littoral habitat with a deeply incised thalweg. Within the French King Gorge is a narrow but deep (deeper than 100 feet) area of river with sheer rock faces. Cobble and gravel were most common above the French King Gorge area. In some reaches of the impoundment, the littoral zone is absent because of vertical bedrock cliffs. In other areas, there are broad horizontal shoals composed of gravel, sand, or other fines, particularly in embayed sections. Table 3.3.2.1-9 shows the relative abundance of littoral habitat substrate in the Turners Falls impoundment.

[88] Observations from a site walk on February 24, 2022, indicate the oil was confined at the time within the rock islands below the dam before absorbent and containment booms could be installed.

In 2015, FirstLight surveyed the aquatic habitat of the Turners Falls impoundment to identify littoral zone fish spawning locations and potential spawning habitat (Kleinschmidt and Gomez and Sullivan, 2015a). FirstLight identified 17 spawning locations for walleye, yellow perch, and pickerel spp. during the early spring (May 4 through May 6) surveys and 15 spawning locations for sunfish spp., largemouth bass, and lamprey or sucker species during the late spring (June 11 through June 13) surveys. Table 3.3.2.1-10 summarizes spawning information used by FirstLight during the surveys. Early spring spawning sites were distributed throughout the upper, middle, and lower sections of the impoundment and consisted of unguarded egg extrusions, redds, or submerged suitable habitat where no evidence of spawning could be conclusively determined. Late spring spawning was concentrated in the upper and lower extremes of the impoundment and was dominated by dug centrarchid nests with adult males present. A few isolated nests occurred in tributaries, most notably lamprey redds in riffles in Millers River.

FirstLight mapped 490.1 acres of submerged aquatic vegetation (SAV) beds in littoral habitats of the Turners Falls impoundment (Kleinschmidt and Gomez and Sullivan, 2016l). SAV provides valuable cover, food, and oxygen for fish. The greatest area of SAV was dense (51 to 100% cover of dominant species), with the largest beds located near Barton Cove and the Turners Falls dam. In most cases, dense SAV stands were dominated by exotic species, primarily viable leaf and Eurasian milfoil. No SAV beds were mapped within the bypassed reach, and the Montague to Sunderland bridge reach contained only medium (26–50% cover) and sparse (0–25% cover) beds of SAV.

Power Canal—The first 1.4 miles of the Turners Falls power canal downstream of the gatehouse is rectangular with canal walls varying from masonry to concrete to cut-rock faces. The remaining section of the power canal is a 50-acre pond. Substrate in this area of the canal ranges from large areas of silt deposits to areas of exposed bedrock and areas with coarse and fine grain sediments.

Bypassed Reaches—FirstLight surveyed the aquatic habitat within the upper (Turners Falls dam to Station No. 1), lower (Station No. 1 to Rawson Island), and tailrace (Rawson Island to the Montague USGS gage) sections of the project's bypassed reach in 2016 (Table 3.3.2.1-11). The 2.5-mile-long bypassed reach runs from the base of Turners Falls dam to the Cabot Station tailrace and contains mostly bedrock, boulder, cobble, and gravel substrates. It is composed primarily of pool mesohabitat, followed by riffle and backwater types. The bypassed reach from the Station No. 1 tailrace to Rawson Island contains a ledge drop and natural barrier known as Rock dam. The tailrace section includes primarily riffle-run habitat, with some backwater pool-like habitat present from Cabot Station upstream to Rock dam.

Riverine Reaches—FirstLight also surveyed aquatic habitat characteristics within riverine reaches downstream from the Montague USGS gage to the Dinosaur Footprints Reservation in 2016 (Table 3.3.2.1-11). The Connecticut River in this section is a low-gradient reach forming a wide floodplain with alluvial-dominated substrates and a meandering channel in many places. The reach from the Route 116 bridge crossing near Sunderland, Massachusetts, to the Dinosaur Footprints Reservation is influenced by operations of the Holyoke Hydroelectric Project (FERC No. 2004).

Resident Fish

The Connecticut River in the vicinity of the Northfield Mountain and Turners Falls projects provides habitat for a diverse assemblage of fishes ranging from cold- to warmwater species, both resident and migratory (diadromous and potadromous), with minnows, suckers, sunfishes, and perches being the most abundant groups. FirstLight surveyed the Turners Falls impoundment and bypassed reach downstream to Rock dam to determine the existing fish assemblage in the study area (Table 3.3.2.1-12; Kleinschmidt and Gomez and Sullivan, 2016e). In 2015, biologists collected 28 species from the Turners Falls impoundment with spottail shiner, smallmouth bass, and yellow perch being the species most frequently collected. Species that tended to be more dominant in the upper reaches of the impoundment included American eel, mimic shiner, fallfish, smallmouth bass, rock bass, and tessellated darter. Conversely, species such as white sucker, banded killifish, largemouth bass, bluegill, pumpkinseed, and yellow perch were more abundant in the lower reaches of the impoundment. Biologists collected 16 species from the Turners Falls bypassed reach, with smallmouth bass representing nearly 63% of fish collected, American eels representing approximately 10%, and bluegill representing 8% of fish collected. Species diversity was greatest at Rock dam pool, followed by the plunge pool below Turners Falls dam, although the total number of fish captured was greater in the Turners Falls dam plunge pool.

Diadromous Fish

Diadromous, or migratory, fish species that use the Northfield Mountain and Turners Falls project areas to complete their life cycles include the catadromous American eel, anadromous American shad, sea lamprey, blueback herring, striped bass, Atlantic salmon, and shortnose sturgeon. Fish migrating upstream at the Turners Falls Project can use the Cabot fish ladder adjacent to Cabot Station or the spillway fish ladder located at the Turners Falls dam to enter the power canal, then the gatehouse fish ladder at the upstream end of the power canal to ascend into the Turners Falls impoundment. Fish emigrating downstream through the Turners Falls Project either pass over the bascule gates or beneath the Tainter gates at the Turners Falls dam and into the bypassed reach, or through the gatehouse into the power canal. Migrants in the power canal can pass into the downstream reach through the Station No. 1 turbines, the Cabot Station turbines, a log sluice adjacent to the Cabot Station, the Milton Hilton Project, or the Turners Falls Hydro Project.

American Eel—The American eel is a catadromous fish species that typically spends most of its life cycle in fresh and brackish water and returns to the sea to spawn. Following spawning in the Sargasso Sea, larvae are transported to the Eastern Seaboard by ocean currents (Boschung and Mayden, 2004). Larvae typically reach New England coastal waters and the mouth of the Connecticut River from March through June and continue their upstream migration through October. American eels may spend between 3 and 40 years in freshwater, and sexual maturing occurs in late summer or fall. Once maturation begins, eels start to move downstream, returning to the Sargasso Sea to spawn.

Downstream migration of American eels is influenced by environmental factors such as water temperature, flow, and the lunar phase. In the project area, this emigration is sporadic from mid- to late-summer through mid-autumn but usually occurs at night during rain events (Kleinschmidt, and Gomez and Sullivan, 2017c). In the Connecticut River Basin, emigrating eels that are present upstream of the projects must pass over dams, spillways, through turbines,

or via downstream fish passage facilities to complete their journey to the Sargasso Sea to spawn. Recent estimates suggest that 2,382 and 2,273 eels passed downstream through the project in 2015 and 2016, respectively (Kleinschmidt and Gomez and Sullivan, 2017c), peaking in early August during 2015 and mid-October in 2016.

Juvenile eel surveys conducted by FirstLight in 2014 found that, of the 6,263 juveniles observed, 94% congregated at the base of the project's Turners Falls spillway fishway compared to other wetted structures/areas surveyed, including Cabot Station discharge area and fishway, Station No. 1 discharge area, various canal discharge areas throughout the bypassed reach, and Turners Falls dam (Kleinschmidt and Gomez and Sullivan, 2016b). In 2015, FirstLight conducted a follow-up juvenile eel trapping study, which also documented that nearly 88% of the juvenile eels migrating upstream in the project area attempt to ascend past the project dam at the Turners Falls spillway fishway (Kleinschmidt and Gomez and Sullivan, 2016b) with July having the greatest numbers captured.

American Shad—The iteroparous[89] American shad are anadromous, living most of their lives in the ocean and spawning in freshwater. Typically, adult American shad migrate into the lower Connecticut River during late-March or April, reaching Cabot Station in late-April or early to mid- May. Most upstream migrating adult American shad pass the Turners Falls Project between April and mid-June. American shad typically spawn in areas dominated by runs and glides from 3 to 18 feet deep and over a variety of substrates, but prefer sand and gravel bottom (Stier and Crance, 1985). The downstream reach of Cabot Station provides this preferred habitat.

Based on a comparison of passage counts since 2012, more than 60% of adult American shad that migrate upstream through the Turners Falls Project continue upstream past Vernon dam. Annual passage counts between 1980 and 2023 for the Turners Falls Project fish ladders (Tables 3.3.2.1-13 through 3.3.2.1-15) ranged from 224 to 94,046 at the Cabot fish ladder, 5 to 41,835 at the Spillway fish ladder, and 11 to 60,089 at the Gatehouse fish ladder. Between 2016 and 2023,[90] American shad annual passage counts into the Turners Falls impoundment ranged from 7% to 16% and averaged 11% of the corresponding counts for upstream passage at Holyoke dam.

FirstLight surveyed the Turners Falls impoundment, bypassed reach, power canal, and downstream reach during May and June 2015 for shad spawning activity (Kleinschmidt and Gomez and Sullivan, 2016c). FirstLight observed 22 unique spawning events in the downstream reach from the Deerfield River confluence (RM 118.6) downstream to just above Third Island (RM 114.4), 7 unique spawning events in the impoundment at the downstream end of Stebbins Island, and 1 spawning event in the power canal and bypassed reach at the downstream end of Rawson Island.

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[89] Iteroparous species are those that can undergo multiple spawning cycles over the course of their lifetime.

[90] In 2015, the Holyoke Hadley Falls station spillway fish lift entrance was modified.

Young-of-the-year shad remain in the project area throughout the summer before emigrating seaward from September through October. Juvenile shad migrate to areas in the North Atlantic and remain at sea for four to six years before returning to spawn.

Sea Lamprey—The anadromous sea lamprey spawns in many Atlantic coastal rivers from Florida to Labrador Canada, including in the Connecticut River and its tributaries. Having the largest documented spawning runs along the Atlantic Coast, sea lamprey that enter the Connecticut River actively migrate upstream and spawn from early April through July (Kynard and Horgan, 2019). In areas of suitable spawning habitat, which includes shallow areas of moderate current with gravel, and rubble substrate, male sea lamprey construct gravel bottom nests. When a female arrives, they spawn and subsequently die. After hatching, the larvae remain in the substrate for several days before emerging and drifting downstream. The larvae settle in depositional areas with soft substrate and transform into ammocoetes that burrow into soft sediments and exist as filter feeders, emerging from the sediment surface to feed. This stage lasts up to seven years; the ammocoetes then undergo a transformation into the parasitic adult phase and migrate to sea.

Downstream migration occurs primarily in spring, but also during the fall. Downstream fish passage of sea lamprey is facilitated by their lack of a swim bladder. In most situations, they can pass through a turbine without suffering decompression damage (Colotelo et al., 2012).

In the Turners Falls project area, lamprey spawning sites were located in areas dominated by cobble or gravel substrate with shallow, flowing water where water velocities increased due to riverine physical characteristics (e.g., shifts in depth contours, channel meanders, or islands). Three sites were located in tributaries along the Connecticut River (Ashuelot River, Millers River and the Fall River). Two sites were located along the mainstem of the Connecticut River around Stebbins Island and at the Hatfield S Curve along a cobble/gravel bar (Kleinschmidt and Gomez and Sullivan, 2016g).

Annual passage counts between 1980 and 2023 at the Turners Falls Project fish ladders (Tables 3.3.2.1-13 through 3.3.2.1-15) range from 187 to 14,709 at the Cabot fish ladder, 0 to 13,689 at the Spillway fish ladder, and 66 to 32,035 at the Gatehouse fish ladder. These data indicate that, since operation of the fish passage facilities at the project commenced in 1980, sea lamprey passage is highly variable but shows a general temporal increase. In addition, the average annual passage of sea lamprey into the project impoundment is approximately 6,000 individuals; the lowest recorded passage of 66 occurred in 1980, and the greatest recorded passage of 32,035 occurred in 2008. Between 2020 and 2023, sea lamprey annual passage counts at the Turners Falls gatehouse ranged from 41% to 93% and averaged 60% of the corresponding counts for upstream passage at Holyoke dam.

Blueback Herring—Pre-spawning blueback herring enter the mouth of the Connecticut River at about the same time as American shad and broadcast spawn on hard substrate in swift-flowing tributaries to the lower Connecticut River. Annual passage counts between 1980 and 2023 for the Turners Falls Project fish ladders (Tables 3.3.2.1-13 through 3.3.2.1-15) ranged from 0 to 7,091 at the Cabot fish ladder, 0 to 6,248 at the Spillway fish ladder, and 0 to 9,578 at the Gatehouse fish ladder. Few blueback herring have been recorded in the Turners Falls project area since the late 1990s. Since the peak of 9,578 individuals passed into Turners Falls impoundment in 1986, counts into the impoundment declined to fewer than 100 individuals in 1994, and fewer than 10 from 1998 to 2023. This trend is also seen at the downstream Holyoke

dam. Offshore bycatch, habitat degradation, habitat fragmentation, and predation by striped bass are thought to be the cause of the decline in returns (Hare et al., 2021).

Striped Bass—Striped bass are native to Atlantic coastal waters from the St. Lawrence River in Canada to the St. Johns River in Florida and move into freshwater to spawn and feed. Adult and juvenile striped bass in freshwater are piscivorous, feeding on river herring (a term referring to the conspecific blueback herring and alewife), American shad, and American eel. Annual passage counts between 1980 and 2023 for the Turners Falls Project fish ladders (Tables 3.3.2.1-13 through 3.3.2.1-15) ranged from 0 to 198 at the Cabot fish ladder, 0 to 153 at the Spillway fish ladder, and 0 to 46 at the Gatehouse fish ladder. Typically, striped bass were rarely observed ascending the Turners Falls upstream passage facilities and have not been documented to spawn in the project area. Over the past decade, striped bass have become more abundant in the river with more than 5,700 striped bass passing the Holyoke dam since 2000. However, annual passage counts for each of the Turners Falls fish ladders was no more than 11 except for in 2006. The 2006 upstream passage counts totaled 351 into the power canal and 46 into the impoundment.

Atlantic Salmon—Atlantic salmon fry and smolts were stocked in tributaries throughout the Connecticut River Basin from 1968 to 2013, with a stocking goal of 10 million fry per year. This stocking was done as part of joint effort between FWS and the four Connecticut River states (Vermont, New Hampshire, Massachusetts, and Connecticut) to restore Atlantic salmon to the Connecticut River Basin, an effort that has since been canceled. However, the State of Connecticut subsequently developed and currently operates the "Salmon Legacy Program" that continues to stock salmon in some Connecticut River tributaries in the state.

Since the fish passage facilities at the Turners Falls Project began operation in 1980, annual passage counts never exceeded 16 individuals passing upstream into the impoundment prior to or since the termination of the restoration program (Tables 3.3.2.1-13 through 3.3.2.1-15). Use of the project's passage facilities by Atlantic salmon has always been low, because most were collected at the Holyoke fish lift for broodstock to support the stocking program.

Shortnose Sturgeon—Shortnose sturgeon are a federally listed endangered species. The affected environment for this species is described in Appendix F, *Biological Assessment*.

Mussels

Freshwater mussel surveys performed by FirstLight indicate eastern elliptio, alewife floater, eastern lampmussel, eastern floater, and triangle floater are present in the Northfield Mountain and Turners Falls project areas (Biodrawversity, 2012). Of these five species, the eastern elliptio is the most ubiquitous and dominant abundant mussel species present in the project areas forming expansive beds in the impoundment and downstream areas. For instance, the eastern elliptio was found at 96.2% of the 52 sites sampled and was 100 to 1,000 times more abundant than other species. Over 400 alewife floaters were found, with the highest densities in the upstream, riverine area of the impoundment. The few eastern lampmussel found were in the impoundment, but none were found in the bypassed reach or power canal. Eight eastern floaters were found in the impoundment and in the power canal. One triangle floater was found near the mouth of the Deerfield River. In its surveys, FirstLight also observed a single shell of the yellow lampmussel, a Massachusetts state-listed endangered species, approximately 8 river miles

downstream of Cabot Station, but no live individuals were collected. In 2007, a single, relic yellow lampmussel shell was also reported in the bypassed reach near Rock dam; however, no shells were observed in the same area during the FirstLight's relicensing studies.

3.3.2.2 Environmental Effects

Coordination of Project Operations

FirstLight currently coordinates operation of the Northfield Mountain and Turners Falls projects pursuant to Article 45 of the Northfield Mountain license and Article 40 of the Turners Falls license. Operations are also coordinated through agreements with the Corps for flood control and navigation, both between the FirstLight projects and with the Corps' storage projects. These flood control and navigation operations are, in effect, also coordinated with Great River Hydro by means of similar agreements between Great River and the Corps.[91]

In addition, there is an agreement in place between FirstLight and Great River under which Great River provides Turners Falls operators with the estimated total daily discharge from the Vernon Project by 10:00 a.m. and the hourly schedule typically by mid-afternoon. Furthermore, Turners Falls operators monitor real-time discharge at the Vernon Project via supervisory control and data acquisition systems and can also monitor the operation of projects upstream of the Vernon Project in near real-time through Great River's web-based flow information, allowing adjustments at Turners Falls as needed.

FirstLight proposes to continue coordination between Turners Falls and Northfield Mountain operations for power generation and with the Corps in the interest of flood control and navigation on the Connecticut River (FFPSA proposed Articles A170 and B100). Massachusetts DEP conditions 8 and 13 specify these proposed Articles.

FirstLight also recommends that FERC require Great River to provide the following information to FirstLight river operations personnel on a daily basis:

1. Day-ahead hourly projections of total Vernon Project outflow (generation flows and spillage) provided by 8:00 a.m. each day to FirstLight river operations personnel. FirstLight river operations personnel would use this information to schedule river operations within the constraints of the license and hourly inflow from Vernon. FirstLight would take appropriate steps to ensure that the Vernon outflow information provided to its river operations personnel is not communicated to individuals involved in marketing operations on behalf of FirstLight or any of its affiliates.
2. Day-ahead hourly total Vernon Project outflow projections would be updated once the day-ahead power bidding market closes and ISO-NE issues the day-ahead schedule.

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[91] This coordination is required under Article 32 in the current Wilder, Bellows Falls, Vernon, and Turners Falls project licenses, and Article 43 in the current Northfield Mountain license.

3. If ISO-NE updates the day-ahead hourly total Vernon Project outflow schedule, then that schedule would be provided to FirstLight within two hours of Great River receiving an update from ISO-NE.

4. In same-day operations, Great River would supply FirstLight with deviations in the total Vernon Project outflow schedule in real-time as well as an updated hourly projection for the remainder of the day. Great River would provide this information each time its outflow deviates from the last hourly projection.

The Connecticut River Watershed Farmers Alliance recommends, in its comments on Great River's Wilder (FERC No. 1892), Bellows Falls (FERC No. 1855), and Vernon (FERC No. 1904) relicensing proceedings, coordination of river flow and resource use along the entirety of the Connecticut River.

Six Massachusetts state legislators recommend that FERC evaluate options for the two FirstLight projects and the three Great River projects (Wilder, Bellows Falls, and Vernon) to collaboratively operate to minimize the risk of flooding considering recent flooding that resulted in millions of dollars of crop damage and the increasing risk of disaster due to climate change.

Our Analysis

Continued coordination of operations by FirstLight between the Northfield Mountain and Turners Falls projects would help to ensure the efficient use of water resources for power generation on the Connecticut River. FirstLight's proposal to require Great River to provide FirstLight with hourly total outflow projections from its upstream Vernon Project prior to the market closing deadline set by ISO-NE is opposed by Great River, which asserts that the information is commercially sensitive and not needed for FirstLight to operate its projects efficiently. Great River's assertion regarding the sensitivity of the data is reasonable, and the current agreement between FirstLight and Great River, in combination with the other available monitoring data for flow and WSE, appear sufficient for FirstLight's purposes. Furthermore, Great River's proposed operation for a new license for its Vernon Project would be more predictable and less variable than it has been in the past, so FirstLight should be able to improve coordination of operation of its own projects with the upstream Connecticut River projects.

Although FirstLight and Great River do not coordinate their flood control and navigation operations directly with each other, each coordinates these operations with the Corps through separate agreements with the Corps, required in their respective licenses. Therefore, the operations of all five projects for flood control and navigation, as well as those of the Corps' storage projects, are currently coordinated through the Corps and would continue to be as long as those agreements remain in place.

Streamflow and Impoundment Level Compliance Monitoring

Monitoring of flows and WSE is necessary to determine whether the projects are operating in compliance with any WSE and flow requirements of any license issued, which helps to ensure that environmental resources are protected.

FirstLight maintains gaging stations to determine the stage and flow of the Connecticut River, the amount of water held in and withdrawn from storage, and the effective head on the turbines in accordance with Article 23 in the Northfield Mountain Project existing license and

Article 8 in the Turners Falls Project existing license. FirstLight also maintains records of these data and reports any deviations from project operation requirements to FERC.

Under the FFPSA, FirstLight proposes and the FFPSA parties, including FWS and NMFS (10(j) recommendation TF4), support two measures relating to compliance monitoring for the Turners Falls Project: (1) develop a project operation, monitoring, and reporting plan that would be filed within one year of license issuance (FFPSA Article A200); and (2) provide information on project operation on a publicly available website within one year of license issuance (FFPSA Article A210).[92]

Under proposed Article A200, FirstLight would develop a project operation, monitoring, and reporting plan for the Turners Falls Project after consultation with Massachusetts DEP, Massachusetts DFW, NMFS, and FWS. The plan would include:

- A description of how the licensee would comply with its proposed project operation requirements.[93]
- A provision to file with the Commission, after consultation with the Massachusetts DEP, Massachusetts DFW, NMFS, and FWS, a minimum flow and operation compliance report detailing implementation of the plan, including any allowable deviations that occurred during the reporting period. A monthly compliance report would be filed with the Commission for April, May, and June on June 1, July 1, and August 1, respectively; and a compliance report for the remainder of the calendar year would be filed by March 1 of the following year. The proposed compliance reports would identify and categorize,[94] on an hourly basis, allowable deviations from restrictions on the Cabot Station ramping rate and flow stabilization downstream of Cabot Station. For April 1 to November 30, a spreadsheet would be used to report daily deviations, the reason for the deviation, the number of hours, and scope.

Under proposed Article A210, FirstLight would provide:

- Measured Turners Falls impoundment WSE at the Turners Falls dam, the Turners Falls dam total discharge, and the Station No. 1 discharge on an hourly basis.
- Anticipated Turners Falls dam total discharge and Station No. 1 discharge for a 12-hour window into the future on an hourly basis.
- Starting and ending time/date of the annual power canal drawdown within one month.

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[92] FFPSA proposed Articles A200 and A210 are also consistent with NMFS 10(j) recommendations TF4 and TF5) and Interior's 10(a) recommendations.

[93] FirstLight states that this would consist of minimum flows (Article A110, A120, and A130), Cabot Station ramping rates (Article A140), variable releases from Turners Falls dam and variable flow below Station No. 1 (Article A150), flow stabilization below Cabot Station (Article A160), and Turners Falls impoundment water level management (Article A190).

[94] Each event would be categorized as one of the following: when an allowable deviation is identified it would be categorized as regulatory, NRF allowance, or discretionary.

Massachusetts DEP condition 11 specifies proposed Article 200, and condition 12 specifies proposed Article A210 with amendments to include quarterly reports and annual summary reports.

FRCOG, Connecticut River Conservancy, and American Rivers recommend modifying proposed measure A200 to include specific Turners Falls impoundment statistics[95] as measured at Turners Falls dam and the USGS gage site in Northfield in the annual compliance reports until the end of any new license. FRCOG, the town of Gill, Connecticut River Conservancy, and American Rivers recommend that FirstLight fund annual operational costs to continue monitoring and real-time reporting of gage level data at USGS gage no. 01161280 near the Route 10 bridge across the Turners Falls impoundment for the duration of any new license.

Three United States legislators express sensitivity to community stakeholder priorities, including the availability of public data to ensure future regulatory compliance, reliability, and environmental stewardship. Six Massachusetts state legislators support FirstLight's proposal (A210) for year-round hourly information on flows out of Turners Falls dam and recommend additional, publicly available data and analyses, including real-time data on the flows pumped by the Northfield Mountain Project and released from the Northfield Mountain and Turners Falls hydropower facilities.

Our Analysis

FirstLight proposes and stakeholders recommend changes in operation for both projects. Developing an operations compliance monitoring plan for each project following FirstLight's general strategy for the Turners Falls Project under FFPSA proposed Article A200, after consultation with Massachusetts DEP, Massachusetts DFW, NMFS, FWS, and the Corps, would allow FirstLight to address and resolve differences in viewpoints of each agency proactively, prior to filing the plan with the Commission for approval. Such plans would minimize misunderstandings about operational compliance by specifying how compliance with the operational requirements of any licenses issued would be measured, documented, and reported. Such a plan for the Turners Falls Project should include provisions to: (1) describe the type of manual and automatic operation of the project; (2) describe how the project would be operated under the entire range of conditions; (3) provide a log for documenting outflows, impoundment elevations, and minimum flows; (4) describe the mechanisms and structures of all flow and impoundment elevation monitoring equipment and gauges; (5) provide rating curves and calculations for all methods of releasing flow downstream of the projects; (6) provide procedures for collecting, recording, and maintaining continuous data on inflow; (7) document flow releases from the project's turbines, spillage, and bypassed reach flows, and impoundment levels; and (8) identify a protocol for providing data to Massachusetts DEP, Massachusetts DFW, NMFS, FWS, and the Corps. The Northfield Mountain operations compliance monitoring plan should include items 1, 2, 4–8 listed above, and a log for documenting pumped flows, outflows, and elevations for the upper reservoir and Turners Falls impoundment.

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[95] Specific statistics for each month are the Turners Falls impoundment's highest, lowest, and average elevation as measured at Turners Falls dam, and the average daily elevation change (maximum minus the minimum daily elevation, averaged over the month).

Development and implementation of proposed Article 210 would enhance the ability of recreationists to determine when lake and river conditions are likely safe and aid in planning their activities on and near waters affected by the projects. The addition of the condition 12 amendment would provide the public with visual records of conditions and aid in their observation of general patterns that could aid their planning for future seasonal recreation in the area. In addition, the quarterly and annual reports would demonstrate how often the Turners Falls Project is operated in compliance with any new license and conditions that resulted in any non-compliance, should that occur.

Water Quality Management and Compliance

Existing water quality data indicate that both the Northfield Mountain and Turners Falls projects have the potential to affect water temperature, DO, suspended sediments, and oil in the Connecticut River. Any degradation of these parameters could impact the designated uses of the Connecticut River in the vicinity of the two projects. The following water quality conditions have been documented for the projects (Gomez and Sullivan, 2016b; Tighe and Bond, 2022a; Massachusetts DEP, 2010):

- Turners Falls impoundment was continuously well mixed.
- The temperature of Northfield Mountain discharges influences the thermal regime of the Turners Falls impoundment by various amounts throughout the year.
- In spring, the bypassed reach experienced larger diel fluctuations than the impoundment during non-spill periods.
- In late August to late September, localized precipitation and runoff from Fall River may have been the cause for the bypassed reach upstream of Station No. 1 to be as much as 2.5°C cooler than in the impoundment at the boat barrier.
- The power canal's daily temperature ranges were slightly higher when its flow was relatively low.
- At the eight in-river sites downstream of Cabot Station,[96] monthly average temperatures were within 1.0°C of one another.
- The Massachusetts 5.0-mg/L DO criterion for Class B warmwater fisheries were met in the Turners Falls impoundment, bypassed reach, power canal, and site just below Cabot Station.
- Maintenance of the Northfield Mountain upper reservoir resulted in elevated suspended sediment concentrations and deposition of sediment in Turners Falls impoundment in 2010.
- Oil spills of between about 1 gallon and 418 gallons at the Turners Falls dam bascule gates in the winters of 2021-2023.

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[96] These monitoring sites are located within a reach extending from about 0.7 miles downstream of Cabot Station to Mitch's Island located about 7.8 miles upstream of Holyoke dam.

- A 445-gallon oil spill occurred at the Turners Falls dam bascule gate no. 2 in June 2025.

In comments on the draft EIS, Massachusetts DEP states that the pooling of water in Turners Falls impoundment fosters a reduction in DO and increased sediment deposition, which along with certain nutrients, creates an environment that promotes eutrophication.

Operation of the projects as proposed by FirstLight (described in section 2.2.3, *Proposed Project Operation and Environmental Measures*) has the potential to alter water quality from existing conditions. Even if water quality conditions remain unchanged, continuation of any negative water quality effects has the potential to adversely affect beneficial uses related to aquatic biota; wildlife and aquatic habitat; fish and shellfish consumption; aesthetics; public water supply; irrigation of crops and other agricultural uses; swimming and other primary contact recreation; and boating, fishing, and other recreational uses. FirstLight states that its water quality study (Gomez and Sullivan, 2016b) shows that the Northfield Mountain and Turners Falls projects met water quality criteria under existing operations, and it concludes that its proposed changes in operation would likely improve water quality. Therefore, FirstLight (2024f) does not propose future water quality monitoring.

American Rivers recommends limiting FirstLight's use of the proposed additional 2,000 acre-feet of upper reservoir storage to only ISO-designated emergency needs and that the lower reservoir minimum elevation be no lower than 179 feet. These recommendations were made to mitigate the adverse effects of operation of the projects on the designated use of secondary contact recreation (boating).[97]

Connecticut River Conservancy contends that FirstLight's water quality study does not comprise a complete and accurate data set for DO and water temperature in the Turners Falls impoundment and portions of the bypassed reach.[98] Connecticut River Conservancy recommends that FERC require FirstLight to collect data that accurately depict the DO and water temperature by moving the loggers from where they were for FirstLight's study and by putting more water in the bypassed reach which was completely dewatered at some locations in the summer. Connecticut River Conservancy also recommends that any new project license mandate protocols to avoid oil spills and ensure that measures are implemented quickly to address any spills that do occur. The protocols would outline how the oil needs to be dealt with

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[97] American Rivers states that, on June 12-13, 2021, FirstLight lowered the Turners Falls impoundment to a water level of 177.5 feet, which stranded boats at the marina located at Barton Cove impacting a designated and existing use of recreation. It states that pumping to a level below 179 feet has not occurred often under the current license, but it is likely to occur more frequently over the coming license term.

[98] Connecticut River Conservancy points out that: (1) inconsistent deployment depths for loggers in the Turners Falls impoundment make it difficult to compare data across sites, (2) the depth of loggers in the impoundment does not allow evaluation of surface water warming, (3) FirstLight's analysis of the data limits understanding of differences that occur at different times of the year, and (4) sections of the bypassed reach where loggers were not placed because there was not sufficient water may violate the temperature standards during some parts of the summer due to partial or complete dewatering.

and in what time frame, include guidelines for how to solve the oil-spill issue, and incorporate BMPs for response to oil spills.

Ms. Svetka recommends that FirstLight monitor and minimize adverse effects from the temperature of water released from the Northfield Mountain Project on the river and aquatic life therein. Ms. Svetka recommends that FirstLight control the Turners Falls Project in a manner to minimize exposure of the bypassed reach's riverbed to limit project effects on water temperature and changes in the ecology of the river.

In comments on the draft EIS, Mr. Szal requests consideration of the cost for FirstLight to fund monitoring and real-time reporting at USGS gage no. 01161280 near the Route 10 bridge. Reporting would include gage height, mean water velocity, discharge, water temperature, DO, and turbidity to assist those involved in understanding the complex interactions among erosion, flow, Northfield Mountain Project discharge and intake cycles, the changes in flow direction caused by those cycles, and certain aspects of water quality.

Massachusetts DEP condition 26 specifies that FirstLight develop, in consultation with Massachusetts DEP, and finalize, a water quality monitoring plan that is based on a quality assurance project plan. The condition provides water quality constituents and intervals to be monitored at locations identified, but states that the sampling locations identified may change during development and review of the quality assurance project plan and thereafter, if determined necessary by Massachusetts DEP. The quality assurance project plan would outline the procedures and methods for collecting, analyzing, and managing the water quality data; and include details on sampling methods, equipment calibration, data management, and quality control procedures. The condition specifies that the quality assurance project plan be resubmitted every five years for reapproval by Massachusetts DEP. FirstLight would submit any significant or substantive changes to the quality assurance project plan as an addendum to the approved plan. The condition also specifies that FirstLight provide Massachusetts DEP with reports summarizing the previous findings along with the raw data. After five years of monitoring, FirstLight may request that required monitoring be performed every two years instead of annually, and Massachusetts DEP would decide whether to deny or allow such a request. Within two weeks of becoming final, the water quality monitoring plan (and quality assurance project plan), all required reports (and data), and all updated quality assurance project plans would be posted on the website established pursuant to condition 12, with email notices to: FRCOG; Connecticut River Conservancy; the towns of Northfield, Montague, Erving, and Gill; the Nolumbeka Project; and the Chaubunagungamaug Band of Nipmuck Indians.

Our Analysis

FirstLight's water quality study (Gomez and Sullivan, 2016b) followed a study plan that was developed in consultation with Massachusetts DEP and other stakeholders, including Connecticut River Conservancy, and was approved by FERC. Consistent with the plan, each logger was deployed at a depth of about 25% of the depth of the sampling location.[99] Although monitoring at these depths does not allow evaluation of near-surface warming in the impoundment, the biweekly vertical profiles indicate virtually no thermal stratification between

[99] Rather than at a specific depth as Connecticut River Conservancy prefers.

the surface and bottom of the impoundment (Figure 3.3.2.1-5).[100] We acknowledge that the study experienced data gaps for vertical profiles in April and late June caused by high flows and ice, and that the continuous data experienced data gaps for unknown reasons. However, our evaluation of each of these gaps and surrounding data does not indicate that the water temperature or DO during these periods did not meet water quality standards. Therefore, we conclude that results of FirstLight's water quality study accurately represent baseline conditions.

Changes in operation of the Northfield Mountain Project could influence water temperature and DO in the Turners Falls impoundment. FirstLight's proposed expansion of the current license's allowable range of upper reservoir WSEs would provide an additional 3,009 acre-feet of useable storage with no limits on when it could be used. Between 2001 and 2024, five license amendments were temporarily granted to allow an increase in the authorized storage capacity in the Northfield Mountain upper reservoir for ISO-NE emergencies, including one in 2017 that included restrictions to maintain the upper reservoir between elevations of 1,004.5 and 947 feet during normal operations; and allow for the use of the additional storage, between 947 and 920 feet, in response to ISO-NE discretionary actions taken during emergency operations. Implementation of FirstLight's proposed unconditional use of an additional 3,009 acre-feet of storage in the upper reservoir could increase the operation of the Northfield Mountain Project and prolong the Northfield Mountain project's current cooling effect in spring (Figure 3.3.2.1-6) and/or warming effect in fall (Figure 3.3.2.1-7) in the Turners Falls impoundment. We expect water temperature to remain in compliance with the 28.3°C maximum criterion and DO to remain in compliance with the corresponding water quality standards, but it is not evident whether the maximum allowable temperature increase of 2.8°C would be met. However, implementing the 2017 temporary amendment restrictions on use of the upper reservoir's additional 3,009 acre-feet of storage would have virtually no effect on the thermal regime in Turners Falls impoundment than under the current license.

Turners Falls Project operations proposed by FirstLight, specified in the Massachusetts DEP certification, and recommended by other stakeholders would increase the consistency of flow through the impoundment and downstream of the project. This would reduce short-term effects of the Turners Falls Project on water temperature and DO within the impoundment and downstream of the dam. As a result, water temperature and DO are generally expected to remain in compliance with the corresponding water quality standards.

The proposed and recommended increases in flow released into the bypassed reach would provide a more stable thermal regime throughout the reach. The increased volume of water released from the dam would increase the continuity of water temperature and DO conditions between the impoundment and just downstream of the dam. The increased proportion of water from the dam would reduce the effect that other inflows have on water temperature and DO within the bypassed reach (e.g., cooling effect of Fall River, which provides inflow about 850 feet downstream of the dam that occurred as a result of a precipitation event in late August 2015). Increasing releases from the dam during summer would also reduce the warming effect

[100] The maximum temperature variation within a profile was 0.9°C, which occurred just upstream of the dam on May 29, 2015. The temperature variation within each of the other profiles was less than 0.5°C.

of water flowing over the bedrock which is within 0.5 miles of the dam. Increased discharge from Station No. 1 would further reduce temperature changes in the bypassed reach.

Minimum flow increases and stabilization of the flow downstream of Cabot Station would also reduce the variability in flow down the river and reduce the magnitude of short-term temperature fluctuations downstream of the project. Although the higher minimum flows recommended by some stakeholders would provide some additional reduction in temperature fluctuations in the bypassed reach and downstream of Cabot Station, we expect that the water temperature standard would continue to be met under the flow regime proposed by FirstLight and specified by the Massachusetts DEP certification.

As discussed in section 3.3.2.1, *Dissolved Oxygen*, the DO standards are met under existing operation of the projects. Dam releases into the bypassed reach would continue to be well oxygenated. Any increase in minimum flow in the bypassed reach would increase stream velocities along the shoreline and would reduce the potential for water to stagnate in pockets of the bedrock streambed and result in low DO concentrations in these areas. Therefore, DO in the bypassed reach is expected to continue to meet the applicable water quality standards. Accordingly, there would be little benefit in continued monitoring of temperature and DO in the bypassed reach.

Monitoring water quality without the results affecting operation or management decisions would serve no direct benefit to water quality or the designated beneficial uses. Adding adaptive measures to Mr. Szal's requested funding for water-quality monitoring at the Route 10 bridge could potentially provide some benefit, but it would be extremely difficult, if not impossible, to determine the extent of the Northfield Mountain Project's effects on water quality at the bridge, which is about 5.7 miles upstream from the project. Developing and implementing a water quality monitoring plan that facilitates adaptive measures to ensure the projects meet water quality standards could be more beneficial. Because the effects of proposed Northfield Mountain operation with additional active storage on water temperatures near the project's tailrace are unknown, it would be beneficial to continuously monitor water temperature in the Northfield Mountain tailrace, 2.15 and 0.5 miles upstream from the tailrace, and 0.61 miles downstream from the tailrace as specified in Massachusetts DEP condition 26. We anticipate that continuous temperature monitoring at these four sites during May–October in three years would determine whether operation of Northfield Mountain Project under a new license causes exceedance of the temperature increase limit (a rise in temperature from a discharge may not exceed 2.8°C) and identify any need for the project to adapt operation to meet the water quality standards.

As discussed above, our analysis of project effects indicates that operating the two projects under new licenses would have negligible adverse effects on water quality. In addition, Massachusetts DEP provides no insight into how results would guide changes in operation or measures implemented. Therefore, we expect that the other water quality monitoring specified in condition 26 would serve virtually no direct benefit to water quality or designated uses. However, we note that it may be worthwhile to evaluate whether water quality monitoring could improve the effectiveness of other measures. For example, development of management plans for invasive plants (refer to section 3.3.3.2, *Invasive Plants*) could include consultation on the

potential to use DO monitoring to evaluate whether implemented management actions cause adverse effects, and if so, guide selection of future management actions.[101]

Continued operation of the projects would require use of petroleum products and measures to limit their potential to spill into waterbodies and adversely affect several designated beneficial uses, including fish and aquatic biota, wildlife, recreation, and aesthetics. Under the existing license, oil spills occurred at the Turners Falls dam bascule gates in the winters of 2021–2023 and in June 2025. In its response to comments, FirstLight reported that it immediately applied absorbent and containment materials, monitored the release area for recurrence of the sheen, and repaired minor leaks identified in pistons that control bascule gates. In January 2024, FirstLight filed a Permanent Solution with No Conditions Statement with Massachusetts DEP documenting actions taken and concluding that the surface water had been returned to pre-release conditions and necessary repairs had been made.

FirstLight has concluded that the eight hydraulic cylinders controlling the bascule gates at the Turners Falls dam are experiencing hydraulic fluid leakage due to the age of the equipment and wear of the chrome surfacing of the piston rods. As a result, FirstLight has begun a phased process to fully replace each hydraulic cylinder to deliver a long-term solution for the system.[102] In July 2024, the ongoing process was in the engineering phase, and the replacement of the cylinders on one gate with two new cylinders was expected to occur in 2025. The removed cylinders will be refurbished and installed in the next gate, and this process will be repeated for the remaining two gates. Upon completion of repairs to the first gate, FirstLight will estimate the timing for repairs to the remaining three gates. FirstLight's continuation of notifying Massachusetts DEP and the National Response Center of any oil spills; and coordinating the removal, refurbishment, and installation of cylinders on each bascule gate with Massachusetts DEP, would provide a reasonable level of protection from future oil spills at Turners Falls dam. The June 2025 445-gallon oil spill and subsequent repair of Bascule Gate No. 2 demonstrate the need for expediency in completing this phased program.

Effects of Impoundment Fluctuations on Aquatic Resources

Impoundment drawdowns currently allowed under the existing licenses can affect aquatic resources by dewatering littoral habitat used by invertebrates and by fish for cover, foraging, and spawning. Water level fluctuations during fish spawning periods can adversely affect spawning and reproduction by disrupting nest site selection and spawning, dewatering nests and desiccating eggs, and causing the guardian male to abandon the nest or fry. In addition, impoundment drawdowns can reduce the abundance and affect the species composition of the macroinvertebrate community occupying the littoral zone. Seasonal impoundment drawdowns can also prevent the establishment of submerged aquatic vegetation.

FirstLight proposes and the FFPSA signatories recommend WSEs for the Turners Falls impoundment and Northfield Mountain upper reservoir provided in FFPSA Articles A190 and

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[101] Some aquatic plant control methods can lower DO and adversely affect fish and other aquatic organisms (Massachusetts DEP, 2004; Wong and Langley, 2019).

[102] FirstLight does not link continuation of this remediation with relicensing of the projects.

B100, respectively. To summarize, FirstLight proposes Turners Falls impoundment WSEs between 176.0 to 185.0 feet and upper reservoir WSEs between 1,004.5 and 920 feet. We present additional details on these proposals in section 3.3.1.2, *Environmental Effects, Effects of Impoundment Fluctuations on Shoreline Erosion*.

In comments on the draft EIS, FRCOG, Connecticut River Conservancy, and American Rivers recommend modifying FFPSA Article A190 to include Turners Falls impoundment target elevations, target bandwidth, and deviations allowable during certain prescribed circumstances, as discussed in section 3.3.1.2, *Environmental Effects, Effects of Impoundment Fluctuations on Shoreline Erosion*. American Rivers also recommends limiting the Turners Falls impoundment WSE to no lower than 179 feet and only using the additional storage capacity in Northfield Mountain's upper reservoir during ISO-designated emergency needs.

Massachusetts DEP condition 13 specifies the FFPSA Article B100 Northfield Mountain impoundment WSEs, and condition 10 amends FFPSA Article A190 for Turners Falls impoundment WSEs. The condition 10 amendment would maintain Turners Falls impoundment water levels between elevation 178.5 feet and 185 feet except under specified provisions for discretionary events to operate between elevations 178.5 and 177.5 feet for no more than 168 hours per year and 12 hours per event; and provide the ability to draw down to the extent necessary but no lower than 177.5 feet for nondiscretionary events.

Our Analysis

FirstLight conducted spawning surveys in the Turners Falls impoundment during May through June of 2015 to assess effects of project-related water level fluctuations on resident fish in project impoundments and riverine reaches downstream of project dams (Gomez and Sullivan and Kleinschmidt, 2016). Results of the study indicate that the spawning success of most resident fish species can be adversely affected by reservoir fluctuations. The results of the study indicate that spawning sites for most late spring spawning nests are suitably submerged about 85-100% of the time, but that spawning sites for early spring spawners (such as yellow perch) were suitably submerged for shorter durations (Gomez and Sullivan and Kleinschmidt, 2016).

The proposed range of WSEs that would be allowed in the Turners Falls impoundment are the same as the range allowed in the current Turners Falls Project license. However, the frequency of WSE fluctuations would be reduced by constraints on the frequency of Turners Falls peaking operation that would be required under FFPSA Article A160, which would take effect in Year 4 of any new license issued for the Turners Falls Project. Article A160 would maintain outflows from Cabot Station within ±10% of the NRF in the months of April through November except for the following: (1) a limited number[103] of hours in those months when deviations within ±20% of the NRF would be allowed; and (2) a limited number of hours[104] in

[103] Deviations within ±20% of the NRF would be allowed for up to 22 hours from 4/1-5/15, 18 hours from 5/16-5/3, 7 hours from 6/1-06/15, 7 hours from 6/16-6/30, 55 hours from 7/01-8/15, 27 hours from 8/16-8/31, 44 hours from 9/1-10/31, and 11 hours from 11/1-11/30.

[104] Flexible operations would be allowed for up to 20 hours in July, 26 hours in August, 23 hours in September, 20 hours in October, and 28 hours in November, with no more than 7 flexible events per month.

July, August, September, October, and November, when flexible operations would be allowed. This represents a substantial reduction from the effects of current Turners Falls project peaking operations on daily drawdowns of the Turners Falls impoundment.

The minimum WSE of 179 feet recommended by American Rivers and 177.5 feet recommended by Massachusetts DEP (condition 13), would decrease the magnitude of WSE fluctuations at the Turners Falls impoundment by 1.5 to 3.0 feet. More stable WSEs would improve spawning success for fish species and conditions for aquatic vegetation. Fluctuations would be further reduced when combined with the proposed constraints on Turners Falls peaking events.

The proposed expansion of the current license's allowable range of WSEs in the Northfield Mountain upper reservoir would provide an additional 3,009 acre-feet of usable storage. In the past 25 years, there have been five temporary amendments to increase upper reservoir storage by the same amount.[105] However, to protect fish spawning, use of the upper reservoir's additional 3,009 acre-feet of storage has not been allowed in April or May since 2001, and the most recent temporary amendment in 2017 limited use of the upper reservoir's additional 3,009 acre-feet of storage to ISO-NE discretionary actions taken during emergency operations. In contrast, FirstLight's proposal (FFPSA Article B100) provides no limits on when the additional 3,009 acre-feet could be used. Therefore, implementation of FFPSA Article B100 could result in substantial increases in the frequency and duration of the project pumping and generating, and thereby substantially increase the magnitude and temporal period of Turners Falls impoundment WSE fluctuations. However, implementing the 2017 temporary amendment restrictions on use of the upper reservoir's additional 3,009 acre-feet of storage would result in virtually the same allowable Northfield Mountain operations and effects on Turners Falls impoundment WSEs as under the current license. In FERC's 2018 denial of a similar request for additional upper reservoir storage, FERC concluded that "any future proposal should be restricted to use during ISO-NE discretionary actions taken during emergency operations, for the reasons outlined in the January 2017 and December 2015 amendment orders, unless FirstLight can provide sufficient evidence why a broader amendment is appropriate.[106]

Overall, proposed operations would improve conditions for aquatic species in project impoundments compared to current operations. By reducing the magnitude and frequency of impoundment level fluctuations, operations would better support the reproductive success for fish and the macroinvertebrate community occupying the littoral zone, as well as improve conditions for aquatic vegetation, which provides valuable rearing habitat for fish and macroinvertebrates. For analysis of effects of project operations on odonates, see section 3.3.3.2, *State-listed Terrestrial Wildlife, Dragonflies and Damselflies*.

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[105] Each of the five temporary license amendments, which were approved in 2001, 2005, 2006, 2015, and 2017, approved expanding the Northfield Mountain upper reservoir storage capacity by 3,009 acre-feet. The accession nos. for these orders are 20010604-0156, 20051130-3050, 20060607-3011, 20141126-3029, 20150501-3021, and 20170106-3019, respectively.

[106] Such as during energy emergency conditions (see 162 FERC ¶ 61,049, Order Denying Temporary Amendment).

Effects of Minimum Flows on Aquatic Resources

Minimum flows affect the quantity, quality, and persistence of habitat for fish and invertebrates in aquatic habitats. FirstLight proposes to increase minimum flows within three segments of the Connecticut River: (1) downstream of Turners Falls dam, (2) downstream of Station No. 1, and (3) downstream of Cabot Station. Under the current license, minimum flows for the Turners Falls Project are only defined for two locations: (1) in the bypassed reach which extends from the Turners Falls dam downstream to Cabot Station, where the current minimum flow ranges from 0 cfs to 400 cfs depending on the season; and (2) downstream of Cabot Station where the current minimum flow is 1,433 cfs year-round. FirstLight proposes to increase minimum flows throughout the year in each reach compared to the current minimum flows as summarized below.

- Downstream of Turners Falls, the minimum flows would be increased from the current range of 0 cfs to 400 cfs to range from approximately 400 cfs up to 4,290 cfs with the lowest flows in the winter and the highest flows in the spring (Table 2.2.3-1).
- Downstream of Station No. 1, the minimum flows would be increased from the current range of 0 cfs to 400 cfs to range from approximately 400 cfs up to 6,500 cfs with the lowest flows in the winter and the highest flows in the spring (Table 2.2.3-2).
- Downstream of Cabot Station, the minimum flows would be increased from the current year-round flow of 1,433 cfs to range from approximately 1,500 cfs up to 8,000 cfs with the lowest flows in the winter and the highest flows in the spring. Beginning in license Year 4, the minimum flows downstream of Cabot Station would be further increased most of the time under FFPSA Article A160, which would maintain outflows from Cabot Station within ±10% of the NRF in the months of April through November except for: (1) a limited number of hours in those months when deviations within ±20% of the NRF would be allowed; and (2) a limited number of hours in July, August, September, October, and November, when flexible operations would be allowed.

NMFS (10(j) recommendation TF1) and FWS (10(j) recommendations TF1, TF2, and TF3) recommend, and Massachusetts DEP conditions 2, 3, and 4 specify, the same minimum flows as specified in FFPSA Articles A110, A120, and A130. American Rivers, Connecticut River Conservancy, and six Massachusetts state legislators recommend FirstLight provide flows of 1,400 cfs between July 1 and November 15 from Turners Falls dam to meet the needs of benthic macroinvertebrates and fluvial resident fish species. The Nolumbeka Project Tribal Coalition recommends a minimum year-round release rate of 2,000 cfs from Turners Falls dam to protection of cultural resources in the bypassed reach. Numerous private individuals also recommend higher flows downstream of Turners Falls dam, some of which agree with the 1,400 cfs minimum flow recommendation.

Our Analysis

Proposed operations aim to provide environmental protection through increasing minimum flows in the upper and lower sections of the bypassed reach downstream of Turners Falls dam and downstream of Cabot Station. Minimum flows would be higher than what is specified in the current license requirements at all times of the year with substantially higher flows during the spring and early summer to maximize spawning habitat for key fish species.

FirstLight conducted an instream flow study to assess the effects of current project operations on aquatic resources and habitats in the Connecticut River between Turners Falls dam and Cabot Station (i.e., the bypassed reach) and below Cabot Station downstream to the vicinity of Dinosaur Footprints Reservation (Gomez and Sullivan and Kleinschmidt, 2016). Depth, velocity, and substrate were evaluated across a range of flows representing low, medium, and high-flow conditions to compute a habitat index versus flow relationship for 22 aquatic species/life stages along with four generalized habitat criteria. Area-weighted suitability values were calculated over a range of flows for five study reaches from Turners Falls dam extending downstream approximately 36 miles; however, the lower 22 miles focused on conditions for state and federally listed mussels. Results of the study concluded that project operations did not appear to affect distribution and abundance of mussels in the lower 22-mile segment (Gomez and Sullivan and Kleinschmidt, 2016, 2018).

For the upper bypassed reach (from Turners Falls dam downstream to Station No. 1), results of the study indicate that the proposed minimum flow releases during the summer through winter (i.e., July 1 through March 30) would lead to increased habitat for adult and juvenile life stages of most fish species as well as habitat for macroinvertebrates compared to current conditions, while habitat would decrease for the juvenile life stage of walleye. In the upper segment (right channel) of this reach, suitable habitat is maximized[107] for most life stages of fish species present during the summer through winter at flows of 560 cfs (Table 3.3.2.2-1). However, in the lower segment of the upper bypassed reach (Transects 10 and 11), suitable habitat is maximized for life stages of fish species present during the summer and winter is achieved at flows ranging from approximately 1,400 to 3,000 cfs depending on whether Station No. 1 is operating at full hydraulic capacity or not (Tables 3.3.2.2-2 and 3.3.2.2-3). When Station No. 1 is not operating, suitable habitat is maximized for most life stages of fish at flows between 1,400 and 3,000 cfs, and when Station No. 1 is operating at full hydraulic capacity, suitable habitat is maximized at 400 cfs for white sucker adult and juveniles, as well as the shallow slow guild and the deep slow guild (Table 3.3.2.2-3). During the early and late spring (i.e., April through June 30) proposed minimum flows would increase spawning and incubation habitat for most species including American shad, shortnose sturgeon, and walleye as well as habitat for macroinvertebrates compared to current minimum flows. However, spawning habitat would decrease for sea lamprey (Tables 3.3.2.2-1 through 3.3.2.2-3).

For the lower bypassed reach (from Station No. 1 downstream to Cabot Station), results of the study indicate that the proposed minimum flow releases during the summer through winter (i.e., July 1 through March 30) would increase habitat for adult and juvenile life stages of most fish species as well as habitat for macroinvertebrates compared to current conditions. However, suitable habitat is maximized for most life stages of fish species that are present during the summer through winter period occurs at flows ranging from 1,200 cfs to 3,000 cfs (Table 3.3.2.2-4). The proposed minimum flow releases during the early and late spring (i.e., April through June 30) would increase spawning and incubation habitat for most species including American shad, shortnose sturgeon, and walleye as well as habitat for macroinvertebrates in all reaches compared to current minimum flows (Table 3.3.2.2-4).

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[107] The study uses the metric "weighted useable area" to quantify suitable habitat.

For the reach from Cabot Station downstream to the Route 116 Sunderland Bridge, results of the study indicate that the proposed minimum flow releases during the summer through winter (i.e., July 1 through March 30) would increase habitat for adult and juvenile life stages of most fish species as well as habitat for macroinvertebrates compared to current conditions. However, the proposed minimum flows would decrease habitat for juvenile and adult life stages of walleye. During the early and late spring, spawning habitat would decrease for fallfish, sea lamprey, and white sucker under the proposed minimum flows (Tables 3.3.2.2-5 through 3.3.2.2-8). Additional analysis was conducted for sea lamprey spawning using different habitat suitability criteria, but habitat remained limited for sea lamprey downstream of Cabot Station (Gomez and Sullivan and Kleinschmidt, 2019a,b).

The higher seasonal (July 1 to November 15) minimum flow releases from Turners Falls dam recommended by American Rivers, Connecticut River Conservancy, and Massachusetts state legislators, and the higher year-round minimum flows recommended by the Nolumbeka Project Tribal Coalition, would affect fish and macroinvertebrates, water quality, sensitive plants, recreation, and cultural resources. Increasing the minimum flow released from Turners Falls dam from the proposed 500 cfs to 1,400 cfs seasonally would increase the amount of habitat for macroinvertebrates and nearly all life stages of fish species that use the bypassed reach during the summer and winter periods. A small section of the upper bypassed reach provides the maximum amount of suitable habitat at flows of 560 cfs for most life stages of fish species that use this section during the summer and winter periods (Table 3.3.2.2-1); however, in most of the bypassed reach, suitable habitat is maximized at flows ranging from approximately 1,200 cfs to 3,000 cfs (Tables 3.3.2.2-2 through 3.3.2.2-4). The proposed minimum flows would increase substantially, with the highest minimum flows proposed during the peak fish spawning and incubation period (April through June), when minimum flows would increase from the current minimum flow of 400 cfs to roughly 4,000 cfs in April and 2,000 cfs in June. Minimum flows during July 1 to November 15 would increase from the current 120 cfs to 500 cfs. The proposed minimum flows would result in a substantial increase in suitable habitat for fish and macroinvertebrates compared to current conditions with the peak minimum flows proposed during the spring period to maximize suitable habitat for critical fish life stage needs, such as spawning and macroinvertebrate production.

In summary, the proposed minimum flows would increase aquatic habitat for many key species and life stages downstream of Turners Falls dam, including substantial increases in spawning and incubation habitat for American shad, shortnose sturgeon, and walleye, habitat for macroinvertebrates, and habitat for juvenile and adult life stages of many fish species. During some of the higher flows proposed, suitable spawning habitat would decrease for sea lamprey, fallfish, and white sucker, as well as habitat for juvenile and adult walleye.

Effects of Flow Fluctuations on Aquatic Resources in Riverine Reaches

Sudden increases in flow associated with generation (up-ramping) can adversely affect fish spawning and reproduction, displace fish eggs and fry, juvenile and adult fish, and benthic macroinvertebrates downstream. Rapid decreases in flow (down-ramping) when generation ceases can strand fish and aquatic organisms. These effects are particularly relevant for eggs, which are immobile, and fry, which are poor swimmers. Sea lamprey may be especially vulnerable to water level fluctuations due to their preference to spawn in shallow fast water in gravel and cobble substrates which exist throughout areas of each riverine reach, tributary

mouths, and within tributaries near the upstream extent of project-influenced reaches where stream gradients begin to increase. Macroinvertebrates such as mussels may become dislodged during high flows that lead to bed scour while odonates may drown during their emergence phase due to rapidly rising waters.

During the first three years of any new license, FirstLight proposes to operate Cabot Station to maintain up-ramping and down-ramping rates of 2,300 cfs/hour from April 1–June 30, and ramping rates would be limited to 2,300 cfs/hour during the hours from 8:00 a.m. to 2:00 p.m. from July 1 through August 15, as described in FFPSA Article A140 (Table 2.2.3-4). Beginning in license Year 4, the frequency and magnitude of flow fluctuations downstream of Cabot Station would be further reduced most of the time under FFPSA Article A160, which would maintain outflows from Cabot Station within ±10% of the NRF in the months of April through November except for: (1) a limited number of hours in those months when deviations within ±20% of the NRF would be allowed; and (2) a limited number of hours in July, August, September, October, and November, when flexible operations would be allowed. When FFPSA Article A160 takes effect, the restriction on up-ramping rates from July 1 through August 15 would cease.

The FFPSA signatories, NMFS (10(j) recommendation TF2) and FWS (10(j) recommendations TF4, T5, and TF6) recommend, and Massachusetts DEP conditions 5, 6, and 7 specify, the operational measures proposed by FirstLight relating to flow fluctuations as specified in FFPSA Articles A140, A150, and A160.

American Rivers recommends limiting the Turners Falls impoundment WSE to no lower than 179 feet and only using the additional storage capacity in Northfield Mountain's upper reservoir during ISO-designated emergency needs.

Six Massachusetts state legislators recommend FirstLight perform regular monitoring and provide publicly available data for populations of macroinvertebrate populations in the Turners Falls bypassed reach, downstream of Cabot Station, and in the Turners Falls impoundment.

Our Analysis

Proposed operations would limit the deviation of outflows from Cabot Station to ±10% of the NRF most of the time with a limited number of hours when greater deviations would be allowed. In addition, FirstLight defines NRF as the hourly sum of inflows to the Turners Falls impoundment averaged from the previous 1 to 12 hours, which would help to dampen the effects of load-following releases from the upstream Vernon Project.

Habitat persistence during up-ramping was evaluated downstream of Cabot Station as part of the instream flow study (Gomez and Sullivan and Kleinschmidt, 2016) using dual-flow analysis. Dual-flow analysis provides information on potential project effects due to daily flow fluctuations between base or minimum flow and generation flows. Results of the dual-flow analysis indicate that species with narrower ranges of habitat suitability (e.g., most spawning life stages such as sea lamprey, fallfish, walleye, and white sucker along with some fry life stages such as fallfish and walleye) show the greatest decline in habitat due to flow fluctuations under current operations, while species with broad ranges of habitat suitability (e.g., macroinvertebrates, shortnose sturgeon fry, white sucker fry, and spawning life stage of American shad) show the least decline in persistent habitat.

FirstLight's proposed operations would reduce the frequency and magnitude of flow fluctuations downstream of Cabot Station. Under proposed operations, most peaking operations would occur during the summer and fall when aquatic species are less sensitive to flow fluctuations while limited peaking operations would occur during the spring when aquatic species are most sensitive to flow fluctuations. By limiting peaking operations during the spring, FirstLight's proposed operations would likely improve the reproductive success of shortnose sturgeon, American shad, sea lamprey, and other fish species while also reducing impacts to emerging dragonflies and freshwater mussels.

FirstLight's proposal to increase the allowable range of WSEs in the Northfield Mountain Project's upper reservoir would provide an additional 3,009 acre-feet of usable storage. As discussed above, the frequency at which this extra storage capacity would be used is unknown. If the volume of water that is pumped or used during generation increases, this could increase the magnitude of flow fluctuations downstream of the Northfield Mountain tailrace and Cabot Station. However, the effect of these fluctuations on conditions downstream of Cabot Station would be relatively small due to the proposed constraints on the frequency of peaking operations and maximum variations in outflows from Cabot Station.

Proposed operations would provide substantial benefits to the aquatic communities in project reaches compared to current operations. The reduced magnitude, duration, and frequency of flow fluctuations under proposed operations would result in a more stable riverine environment. More stable conditions would extend the nest building period for sea lamprey and fallfish and improve reproductive success for other fish species. Reduced magnitude and rates for up-ramping would reduce the risk of nest scour or abandonment that can result from increased velocities associated with up-ramping. Similarly, risks of displacement or mortality from stranding of fish eggs, newly emerged fry, and benthic macroinvertebrates would decrease under the proposed operations. Increased food availability would result from more stable benthic macroinvertebrate habitat conditions, and the risk of predation for juvenile fish would decrease with more stable flows because fish would have more time to move to and hold in more favorable habitat locations.

The increase in habitat persistence and wetted area would likely result in improved macroinvertebrate populations in all affected reaches under proposed operations. The proposed minimum flows increase habitat for macroinvertebrates, which would likely result in improved populations in all affected reaches under proposed operations. Therefore, the potential benefits of macroinvertebrate monitoring are unclear.

American Rivers' recommendation to limit use of the additional storage capacity in Northfield Mountain's upper reservoir to meet ISO-designated emergency needs would provide some minor ecological benefits by reducing flow and WSE fluctuations within and downstream of the Turners Falls impoundment in non-emergency situations. The Commission has granted six temporary license amendments since 2001 that permitted use of this increased range of storage capacity to support grid reliability. Four of these amendments limited the use to ISO-designated emergencies, while the other two did not restrict FirstLight's use of the additional storage. However, the increase in available storage is proposed in conjunction with other operational changes discussed above, which, taken as a whole, would provide substantial ecological benefits. Furthermore, the recommended restriction would reduce the benefits that the Northfield Mountain Project provides to the grid during periods when the demand for electricity exceeds the supply available from other sources of electrical generation.

Power Canal Drawdowns

FirstLight performs week-long annual drawdowns of the Turners Falls power canal typically during late September or early October, to facilitate canal inspection and maintenance. Under normal operating conditions (when the canal is watered), downstream migrants are able to use the Cabot bypass facility; however, as the canal water level is drawn down, the bypass is no longer available. During drawdowns, some isolated shallow pools and exposed substrate areas remain in the lower portion of the canal, and fish (including lamprey ammocoetes), amphibians (e.g., mudpuppies), mussels, and benthic invertebrates are susceptible to desiccation, predation, or other sources of mortality.

FWS recommends (10(j) recommendation TF10) that FirstLight develop a Turners Falls canal drawdown aquatic organism protection plan in consultation with FWS and Massachusetts DFW within 9 months of any license issued. At a minimum, FWS recommends that the plan contain the following provisions: (1) immediate implementation of protection measures identified in its canal drawdown study report (Kleinschmidt and Gomez and Sullivan, 2016h); including: (a) conducting the annual canal drawdown no earlier than mid-September; (b) drawing down the canal at the rate used in 2014 until the FWS-recommended canal drawdown team (provision 2) identifies a permanent rate that sufficiently protects aquatic resources in the canal; and (c) installing cones to identify paths for large machinery to follow while undertaking maintenance work in the canal during the drawdown; (2) creation of a canal drawdown team[108] comprised of FirstLight, FWS, Massachusetts DFW, and Connecticut River Conservancy; and (3) until and unless the measures implemented pursuant to item (2) conflict, FirstLight would continue to allow public access to the dewatered portion of the canal for scientific and environmental outreach and education activities such as Connecticut River Conservancy's fish rescue effort; and FirstLight would maintain communication and coordination with FWS.

Massachusetts DFW's (10(j) recommendation 4) is identical to FWS's 10(j) recommendation with the exception that the plan would be developing within one year of any license issued instead of 9 months. Connecticut River Conservancy supports FWS's recommended plan with the following additions: (1) the plan should articulate a "slow" drawdown rate described as a measure of distance or vertical height per hour; (2) the plan should seek to increase the interconnectedness of the remaining pools during a drawdown and minimize no water conditions in areas of the canal where the substrate does not allow for burrowing; and (3) the plan should evaluate the feasibility of conducting drawdowns every other year or reduce the number of days the canal is drawn down each year. Connecticut River Conservancy further recommends that FirstLight provide in-kind support or financial assistance to support rescue

[108] The purpose of the team would be to identify additional measures to minimize stranded and/or dewatered organisms during the drawdowns. The team would meet quarterly to discuss information needs, develop studies, evaluate potential measures. Once the team identifies protective measures, they would be submitted to the Commission for approval. Upon approval by the Commission, FirstLight would implement the supplemental measures, and the team may be disbanded.

teams during fish salvage events and that FirstLight make the results of fish salvage events publicly available.

Massachusetts DEP condition 32 specifies that FirstLight file, for Commission approval, a Turners Falls canal drawdown aquatic organism protection plan, describing measures it would implement to minimize impacts on aquatic organisms during the annual canal drawdown. This plan would be developed in consultation with FWS, Massachusetts DFW, Connecticut River Conservancy, and Massachusetts DEP and would be posted on the website established pursuant to condition 12. This plan should include: (1) procedures for the canal drawdown; (2) creation of a temporary canal drawdown team comprising FirstLight, FWS, Massachusetts DFW, Connecticut River Conservancy, and Massachusetts DEP for the purpose of identifying additional measures beyond those listed in the condition to minimize stranded and/or dewatered organisms during the canal water level drawdown; and (3) a provision for continued public access to the dewatered portion of the canal for scientific and environmental outreach and educational activities and to maintain communication and coordination with the FWS Connecticut River Coordinator.

Six Massachusetts state legislators recommend that FirstLight should perform monitoring of, and publicize data on, populations and passage through the Turners Falls impoundment and its shore banks of non-fish species that provide important ecosystem services, including native mussels and riparian species.

Our Analysis

During the 2014 drawdown, FirstLight performed surveys in the lower portion of the canal to better understand the potential effects of the annual drawdowns on aquatic species (Kleinschmidt and Gomez and Sullivan, 2016h). The upper portion of the canal was not surveyed because it remains wet for the duration of the drawdowns. Electrofishing and seining surveys were performed in pools greater than 6 inches deep; hand-searching in 1 square meter quadrants in soft sediment areas was also performed to account for burrowing species (i.e., mussels, young sea lamprey, and mudpuppies). Twenty-two fishes and 1 amphibian (mudpuppy) were collected across 14 pools sampled; the most abundant species were spottail shiner, tessellated darter, and juvenile American shad. No endangered, threatened, rare, or species of special concern were observed. From the soft sediment sampling, eastern elliptio (n=534), alewife floater (n=1), sea lamprey ammocoetes (n=11 + 1 transformer[109]), and mudpuppy (n=3) were observed across 64 quadrant samples. All fishes and mudpuppies collected from pools were alive at the time of collection, however mortality did subsequently occur for several fishes during processing of the samples (Table 3.3.2.2-9). All specimens collected from quadrant samples were alive except for 2 mudpuppies on day 1.

Observed stranding during the drawdown included about 766 fish across 16 locations in the lower canal and primarily consisted of American shad (n=266), sunfish species (n=124), shiner species (n=74), and unidentified species (n=266). Six sea lamprey were also stranded. Stranding was typically in depressed areas east of the hydrologically connected pools. The rate of drawdown during the 2014 study allowed for many individuals to seek refuge in pools, and

[109] "Transformer" refers to a sea lamprey transitioning from its ammocoete larval life stage to its juvenile life stage.

the stranding events that did occur suggest fish were aggregated in shallow water depressions that dried out within the first few hours of the study. Large-scale strandings of migratory species or isolated individual strandings were not found during sampling events.

Many relic eastern elliptio shells were observed in the lower portion of the dewatered canal but none contained mussel tissue, which indicates that they died prior to the drawdown. No fresh dead mussels were observed during the quadrant sampling. Given their burrowing nature and ability to move laterally, typically toward deeper water, mussels in the canal likely move to suitable habitat during the annual drawdowns.

While some aquatic organisms may be at risk of stranding during future annual drawdowns, several refuge opportunities are available. The upper portion of the canal, upstream of Copley Tunnel remains wetted during the annual drawdowns and can provide suitable habitat. Additionally, Keith Tunnel, located in the upper quarter of the canal, typically remains open for the duration of the drawdowns with flows being passed through and allows egress for fish. During the 2014 drawdown, 11 of the 14 sampled pools were hydrologically connected (pools 1-3, 6-8, and 10-14) and allowed fish to move downstream toward a larger pool upstream of the Cabot Station intake, which persisted for the duration of the drawdown.

Nonetheless, developing a canal drawdown protection plan as recommended by FWS, Massachusetts DFW and Connecticut River Conservancy would minimize the effects of future drawdowns on aquatic species in the Turners Falls canal. Developing such a plan in consultation with FWS, Massachusetts DFW, and Connecticut River Conservancy and within one year of issuance of any new license for the Turners Falls Project would allow sufficient time for FirstLight and the resource agencies to develop long-term protective measures such as drawdown rates and time periods for the drawdowns. The plan could also include an evaluation of the feasibility of conducting drawdowns every other year rather than annually as well as increasing the interconnectedness between pools in the canal and minimizing no water in areas with hardened substrate. The plan could also contain a provision for salvage efforts led by FirstLight during all planned drawdowns. Filing the results of salvage efforts each year with the Commission would assist the Commission in determining compliance with the requirements of any future license. Finally, implementing the protection measures recommended in its canal drawdown study report (Kleinschmidt and Gomez and Sullivan, 2016h) immediately following issuance of any new license would protect aquatic species in the canal while a formal plan is being developed.

Turners Falls Upstream Fish Passage

The Turners Falls Project currently operates three volitional upstream fish passage facilities, as described in section 2.1.1, *Current Project Facilities*, principally designed to pass Atlantic salmon native runs that have been extirpated from the basin. At present, the migratory species that use the existing passage facilities include American shad, American eel, and sea lamprey; American shad is the primary species targeted for enhanced upstream passage. Although FirstLight's fish passage facilities provide some level of upstream passage, repeated efforts to improve upstream passage effectiveness continue to result in relatively low passage rates. Overall, low passage rates can be attributed to delayed and poor attraction, entry rates, and internal ladder residency.

As described in FFPSA Article A300, FirstLight proposes to: (1) construct a spillway lift at Turners Falls dam to be operational no later than April 1 of Year 9 after license issuance; (2) rehabilitate the gatehouse trapping facility (sampling facility) to be operational no later than April 1 of Year 9 after license issuance; (3) retire, either by removal or retaining in place, the Cabot ladder and the power canal portions of the gatehouse ladder within two years after the spillway lift becomes operational; (4) install and operate interim upstream eel passage in the vicinity of the existing spillway ladder within one year of license issuance and continue operating it until permanent upstream eel passage facilities are operational; and (5) conduct up to two years of eelway siting studies after the spillway lift becomes operational, using a similar methodology to its American eel upstream passage study for both years.

FirstLight would consult with the fish passage agencies during the design of the spillway fish lift, gatehouse trapping facility, and interim eel passage. Implementation of the design plans would not begin until the Commission notifies the licensee that the design plans are approved. Further, based on the eel passage siting survey results, FirstLight would design, construct, operate, and maintain up to two permanent upstream eel passage facilities at the Turners Falls Project no later than three years after completing the final siting survey. FirstLight would consult NMFS, FWS and Massachusetts DFW (fish passage agencies) on the location of the two permanent upstream eel passage facilities. The final eelway siting would take into account the ability to maintain the eelway(s) in light of spillage conditions at the Turners Falls Project.

As described in FFPSA Article 330, following the first round of effectiveness testing, FirstLight proposes to consult with the fish passage agencies and if performance criteria were not met, identify adaptive management measures to implement to improve performance. Potential adaptive measures are included in the FFPSA. Potential measures to improve upstream passage include modifying flows into the bypassed reach during the migration season, modifications to fish lift attraction flows and plunge pool outlet flows, or installation of behavioral barriers. Following implementation of adaptive management measures, FirstLight would conduct additional effectiveness testing in Years 13 through 19, depending on which measures are implemented.

NMFS's and Interior's fishway prescriptions require, and Massachusetts DEP conditions 14 and 17 specify, the same measures as proposed in the FFPSA.

Our Analysis

American Shad Upstream Passage—Upstream passage of American shad through the Turners Falls project area is complex and has been extensively studied by FirstLight and others (Kleinschmidt and Gomez and Sullivan, 2016a, 2017a, 2019; FirstLight, 2019a, 2020a; Sullivan, 2004; Castro-Santos and Letcher, 2010; Castro-Santos and Haro, 2010; Castro-Santos and Haro, 2011; and Castro-Santos and Haro, 2012). As a part of Kleinschmidt and Gomez and Sullivan (2017a), FirstLight compiled the passage efficiencies through the Cabot, spillway, and gatehouse ladders as well as the power canal, estimated from the studies listed above. Table 3.3.2.2-10 presents the passage efficiency estimates reported in those studies. Overall, the passage efficiency estimates from these studies indicate that American shad passage efficiency through the Cabot ladder, power canal, spillway, and gatehouse ladders have been consistently low, never exceeding 60% through the Cabot ladder, power canal, and spillway ladder and rarely exceeding 90% at the gatehouse ladder. When considering passage of the 433 fish tagged and released by

FirstLight at Holyoke dam in 2015, only 22.6% attempted and passed successfully into the Turners Falls impoundment (Kleinschmidt and Gomez and Sullivan, 2017a).

Table 3.3.2.2-10 also presents the median travel time it took tagged American shad to pass through each facility, as estimated by Sullivan (2004) and Kleinschmidt and Gomez and Sullivan (2017a). These data suggest the power canal presents a significant passage delay. Based on the most recent study conducted by FirstLight, American shad that use the power canal to pass upstream have a median travel time of approximately 165 hours. Although not presented in the meta-analysis, FirstLight also determined the median travel time for American shad to pass from the Cabot tailrace through the bypassed reach to the spillway ladder to be 19.8 hours. Therefore, the median travel time for American shad is likely shorter through the bypassed reach, spillway and gatehouse ladders (35.3 hours) than through the Cabot ladder, power canal, and gatehouse ladder (173.2 hours).

Existing performance standards for fish passage facilities located at hydroelectric projects in the Connecticut River Basin dictate the facility must pass upstream migrating adult American shad at a rate of 75% based on those fish that approach within 1 kilometer downstream of the project and pass in less than 48 hours (CRMFRC, 2022). Median travel time data presented in Table 3.3.2.2-10 and provided by FirstLight suggest that those fish that approach the Turners Falls Project could pass in less than 48 hours if ascending upstream through the bypassed reach, but passage through the Cabot ladder and power canal route do not meet performance standards. Thus, the overall passage efficiency, regardless of the route, does not meet passage efficiency standards.

In acknowledgment of the low passage efficiency and, particularly, the long migratory delay within the power canal, FirstLight analyzed the telemetry data to assess American shad movement into and through the bypassed reach to the spillway ladder in relation to bypassed reach flow and Cabot Station discharge (FirstLight, 2020a). To do this, FirstLight fit a series of Cox Proportional Hazard regression models to time dependent covariates to understand what factors increased the likelihood that a tagged shad would migrate to the spillway from the entrance of the project (FirstLight, 2020a).[110,111] The best model, based on the lowest Akaike Information Criterion,[112] determined that passage into and through the bypassed reach from the Cabot tailrace was greatest when the ratio of Cabot Station to bypassed reach discharge was less than 2.5 (Figure 3.3.2.2-1; FirstLight, 2020a). In other words, as Cabot Station discharges exceeds bypassed reach discharges by more than 2.5 times, shad will be less likely to move into the bypassed reach. Once fish move into the bypassed reach, fish prefer to move upstream when flows are stable and greater than 4,000 cfs (Figure 3.3.2.2-2). The effect of higher bypassed

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[110] Entrance into the Turners Falls Project for is considered the telemetry receiver installed at the Montague Wastewater Treatment Plant.

[111] Cox proportional hazard regression models are popular mathematical models used for analyzing survival data or, in fish passage parlance, time-to event data (e.g., time-to-pass).

[112] Akaike Information Criterion summarizes the information in a model, accounting for both sample size and number of predictor variables such that smaller values indicate better, more parsimonious models. Generally, the model with the smallest Akaike Information Criterion value is considered the "best" model (Quinn and Keogh, 2002).

reach flows increasing upstream passage into the bypassed reach is also shown by a comparison of arrival rates at the spillway ladder over a range of bypassed reach flows from 400 cfs to 6,500 cfs (Figure 3.3.2.2-3). Figure 3.3.2.2-3 also shows that at higher bypassed reach flows, shad arrived at the spillway ladder in less time. Therefore, we expect that American shad passage into and through the bypassed reach would increase with FirstLight's proposed bypassed reach minimum flow increase, which would range from 3,500 to 6,500 cfs during the spring upstream migration period.

Although more American shad would likely arrive at the Turners Falls spillway ladder under FirstLight's proposed bypassed reach minimum flow regime, passage efficiency would still be under 60% at the existing spillway ladder. Therefore, without improvements that would enhance internal ladder efficiency, passage efficiency at the project would not meet the current passage goals specified in CRMFRC (2022). However, rather than making improvements to the spillway ladder, FirstLight's proposal to design, in consultation with the fish passage agencies, construct, and operate a fish lift at Turners Falls dam, as proposed in the FFPSA, required by NMFS's and Interior's fishway prescriptions, and specified by Massachusetts DEP condition 14, would provide an alternative means of providing upstream passage. Although we do not know the efficacy of the proposed fish lift in attaining the fish passage performance goals specified by CRMFRC (2022) at this time, because FirstLight would design and operate the proposed fish lift in consultation with the fish passage agencies, we expect that upstream American shad passage and passage efficiency at the Turners Falls Project would improve. Furthermore, decommissioning the Cabot ladder and a portion of the gatehouse ladder, as proposed in the FFPSA, required by NMFS's and Interior's fishway prescriptions, and specified in Massachusetts DEP condition 14, would result in fewer shad experiencing significant migratory delay in the power canal. We expect the decommissioning of the Cabot ladder and lower portions of the gatehouse ladder would result in more American shad ascending upstream through the bypassed reach toward the proposed fish lift.

For its American shad passage studies, FirstLight relied on fish trapped at the downstream Holyoke Project (P-2004) and at the Cabot ladder fish trap. Given that FirstLight proposed in its FFPSA to decommission the Cabot ladder when the proposed fish lift becomes operational, another means to trap fish to support future effectiveness studies would be needed. At present, the gatehouse ladder also has a fish trap but it is in need of repairs. Therefore, rehabilitation of the gatehouse ladder trapping facility, as required by NMFS's and Interior's fishway prescriptions and specified by Massachusetts DEP condition 14, would ensure the trap is safe for fish and can provide a source of American shad for future effectiveness studies.

American Eel Upstream Passage—In 2014, FirstLight conducted night-time visual surveys to identify areas where juvenile American eels congregate or attempt to ascend wetted structures to move upstream of the Turners Falls Project (Kleinschmidt and Gomez and Sullivan, 2016b). The results of the visual surveys indicate that 94% of observed juvenile eels gather at Turners Falls spillway fishway. In 2015, FirstLight installed temporary eel ramp-type traps within the Turners Falls dam spillway fishway, Cabot fishway, and at the Cabot Station emergency spillway to determine whether eels could be passed and where permanent upstream eel passage should be installed to pass the most eels upstream (Kleinschmidt and Gomez and Sullivan, 2016b). Two Medusa-style traps were also installed within the Station No. 1 tailrace. FirstLight monitored the traps from July into early-November. The results of the 2015 trapping effort indicated of the 5,792 eels collected, 88% were trapped within the spillway ladder.

Because there are no dedicated upstream eel passage facilities at the Turners Falls Project, juvenile American eel must negotiate and climb over or around the Turners Falls Project, such as at the spillway fishway, to access rearing habitats upstream. While climbing vertical, wetted surfaces is a documented behavior for juvenile eels, their ability to climb such surfaces decreases as they grow larger (GMCME, 2007). Installing and operating an upstream eel passage facility that is designed to be consistent with the criteria in the FWS Fish Passage Engineering Design Criteria manual have been shown to provide effective upstream eel passage and would improve passage conditions for all sizes of juvenile eels and provide access to habitat upstream of the project (FWS, 2019).

FirstLight proposes in the FFPSA, NMFS's and Interior's fishway prescriptions require, and Massachusetts DEP condition 14 specify, installing and operating interim eel passage in the vicinity of the spillway ladder. Designing and installing interim or temporary eel passage, in consultation with the fish passage agencies and following FWS (2019), would likely improve passage at the Turners Falls Project for migrating eels. FirstLight would operate the interim eel passage facilities until permanent upstream eel passage is in place, which would occur after the spillway fish lift is constructed and operating. Because there is no information describing where eels might congregate after the spillway fish lift is constructed and becomes operational, conducting eel passage siting surveys, as proposed in the FFPSA, required by NMFS's and Interior's fishway prescriptions, and specified by Massachusetts DEP condition 14, would inform the location of permanent upstream eel passage facilities. Because the FFPSA, fishway prescriptions, and Massachusetts DEP condition 14 would require FirstLight to consult with the fish passage agencies regarding the siting survey results and eel passage design, we expect the prescribed permanent upstream eel passage would improve passage.

Adaptive Management Measures—Pending the outcome of the fish passage facility effectiveness testing discussed in *Turners Falls Fish Passage Facility Effectiveness Testing and Performance Goals*, FirstLight may implement Tier 1 and Tier 2 adaptive management measures to improve upstream passage efficacy, principally for American shad, such that the project facilities meet fish passage performance goals stated in the FFPSA. Tier 1 measures include: (1) increasing the bypass minimum flow from 4,500 to 6,500, as measured downstream of Station No. 1 until 90% pass via the lift; (2) shift the minimum flow requirement measured downstream of Station No. 1 to downstream of Turners Falls dam (compliance point shift) from April 1 to June 30 or until 90% have passed by the lift; or (3) make changes to the spillway lift. Tier 2 measures include: (1) install a behavioral deterrent at Cabot Station to encourage upstream movement through the bypassed reach; (2) construct a zone of passage channel at Rawson Island, if shad are entering the river right channel at Rawson Island; (3) install a behavioral deterrent at Station No. 1; and (4) make structural modifications to improve hydraulics at the dam.

We note the results of fish passage effectiveness studies discussed below in *Turners Falls Fish Passage Facility Effectiveness Testing and Performance Goals* would provide information for these measures. Therefore, at present, we have little basis to assess the environmental effect of the adaptive management measures enhancing upstream fish passage. However, as previously discussed, increasing the bypassed reach minimum flow appears to attract fish to enter and pass upstream to the spillway ladder. Should increasing the bypassed reach minimum flow not result in increased passage into the bypassed reach, the proposed adaptive management measure of installing a behavioral deterrent at Cabot Station or Station No. 1 may do so. For instance,

results from FirstLight study of an ultrasound array installed within the Cabot Station tailrace indicated the array effectively encouraged shad to move upstream into the bypassed reach (FirstLight, 2020a). In addition, increasing the bypassed reach minimum flow may create zones of passage that promote passage, or alternatively velocity barriers that preclude passage, as may be the case around Rawson Island (Kleinschmidt and Gomez and Sullivan, 2019), which could be mitigated through the construction of a zone of passage channel. If passage effectiveness appears to be limited by the fish lift, modification to the lift may result in the desired efficacy. Nonetheless, because selection of the adaptive management measures would be based on the results from the effectiveness testing and would occur in consultation with the fish passage agencies, as proposed in the FFPSA, required by NMFS's and Interior's fishway prescriptions, and specified by Massachusetts DEP condition 17, we expect the adaptive management measures would improve overall upstream passage effectiveness at the Turners Falls Project.

Turners Falls Downstream Fish Passage

At hydroelectric projects where diadromous fish are present, out-migrating fish must negotiate and select among different downstream passage routes, such as over dam spillways, via bypasses or sluiceways, or through hydroelectric turbines, to fulfill their life cycle. At the Turners Falls Project, fish must select among downstream passage routes that include the dam spillway, Station No. 1 turbines, Cabot Station turbines, the log sluice adjacent to Cabot Station, or the Cabot Station fishway or spillway fishway, when they are operating. Migratory delay and mortality may occur from negotiating and selecting among these downstream passage routes. To reduce delay and passage mortality, downstream fish passage facilities are often constructed and operated. At the Turners Falls Project, the only downstream fish passage facility is located at the terminus of the power canal adjacent to Cabot Station, which consists of reduced bar spacing on the upper 11 feet of the Cabot Station intake trashrack and a uniform acceleration weir to facilitate passage into the existing log sluice. FirstLight operates the downstream fish passage facility at Cabot Station from April 7 through November 15 to provide downstream passage for post-spawn adult American shad, juvenile American shad, and American eel. Despite the availability of this downstream passage facility, American shad and American eel could also pass downstream via the other downstream passage routes and thus be subjected to delay, injury, and/or mortality.

As described in FFPSA Article A300, FirstLight proposes to replace the existing Cabot Station trashrack structure with a new full-depth trashrack and construct a three-quarter-inch clear-spaced bar rack at the entrance to the Station No. 1 branch canal within four years of license issuance. The new Cabot Station trashrack would have 1-inch clear spacing and would have multiple openings for fish passage, including openings on the top and bottom of the water column. Additionally, FirstLight proposes to construct a plunge pool downstream of Bascule Gate No. 1 as part of the construction of the spillway lift, to be operational no later than April 1 of Year 9 after license issuance.

The new Cabot Station trashrack would have multiple surface entrances including: (1) between Cabot units 2 and 3; (2) between Cabot units 4 and 5; and (3) at the right wall of the intake (looking downstream) at Cabot unit 6. The openings would be 3-feet-wide by 2-feet-tall and would connect to the existing trash trough located behind the racks. Each opening at the top of the trashrack would have an approximate hydraulic capacity of 24 cfs, and the existing trash trough would convey a total hydraulic capacity of approximately 72 cfs from these openings.

The new trashrack would have an additional entrance near the bottom at the left wall of the intake (looking downstream) at unit 1. This entrance would be approximately 3-feet-wide by 3-feet-tall and would connect to a vertical pipe to safely convey fish to the existing trash trough or log sluice. This entrance would be sized to provide a velocity that attracts fish to the bypass relative to the turbine intakes (approximately 5 feet per second [fps]). In addition to the entrances integral to the new trashrack structure, fish would be conveyed via a new uniform acceleration weir and log sluice. FirstLight would resurface the log sluice to limit turbulence and injury to migrants. FirstLight would provide a steel panel (or equivalent) below the weir to exclude migrants from being delayed in the space below the weir. Total flow from all downstream passage components at Cabot Station would be 5% (685 cfs) of maximum hydraulic station capacity (13,728 cfs). The proposed plunge pool would have a minimum depth of 23 feet and consist of two concrete walls that create 110-foot-wide and 65-foot-long box, such that the long wall would be perpendicular to flow, and the short wall will be parallel to flow between Bascule Gate Nos. 1 and 2. Conceptual design drawings of the plunge pool suggest the long and short walls would have a top elevation of 143 and 145 feet, respectively.

FirstLight would consult with the fish passage agencies during the design of the Cabot Station trashrack, Station No. 1 bar rack, and Turners Falls dam plunge pool. Implementation of the design plans would not begin until the Commission notifies the licensee that the design plans are approved.

As described in FFPSA Article 320, following the first round of effectiveness testing, FirstLight proposes to consult with the fish passage agencies and if success criteria were not met, identify adaptive management measures to implement to improve performance. Potential adaptive measures are included in the FFPSA. Potential measures to improve downstream passage include modifying settings that control flows, installation of behavior barriers, design modifications, or modifying flow convergence zones. Following implementation of adaptive management measures, FirstLight would conduct additional effectiveness testing in YEARs 13 through 19, depending on which measures are implemented.

NMFS's and Interior's fishway prescriptions, and Massachusetts DEP condition 14, specify the same measures as proposed in the FFPSA.

Our Analysis

Post-Spawn American Shad Downstream Passage and Survival—After spawning in the Turners Falls impoundment, post-spawn American shad can either remain in the impoundment, emigrate out of the project area via the spillway, or pass downstream into the power canal. In 2015, FirstLight tracked 68 post-spawn American shad out-migrating through the Turners Falls impoundment using radio-telemetry to determine downstream passage route selection and migratory delay through the Turners Falls Project (Kleinschmidt and Gomez and Sullivan, 2016a). Of the 68 fish, 39 (57.4%), 12 (17.6%), and 17 (25.0%), passed into the power canal, via spill into the bypassed reach, or did not pass, respectively (Kleinschmidt and Gomez and Sullivan, 2017a). For the fish that moved from the impoundment into the power canal, they did so with a median passage time of 0.53 days, while those that passed downstream via spill did so with a median passage time of 3.31 days (Kleinschmidt and Gomez and Sullivan, 2017a). To determine what factors affect downstream route selection, FirstLight analyzed fish movement data in relation to time of day, canal flow, and spill flow (Kleinschmidt and Gomez and Sullivan, 2017a). The result of this analysis indicates only canal flow and spill flow affect route selection

(Table 3.3.2.2-11). When canal or spillway flow increases by 1,000 cfs, the number of fish that pass downstream via that route increases by 1.10 and 1.17 times, respectively. In short, post-spawn American shad appear to select the downstream passage route that has the higher flow (Kleinschmidt and Gomez and Sullivan, 2017a).

Once in the power canal, there are three primary downstream passage routes: through the Station No. 1 powerhouse, through the Cabot Station powerhouse, or the Cabot Station bypass. Alternatively, fish may remain in the power canal and not pass downstream. In 2015, FirstLight also assessed downstream movement for those fish that remained in the power canal during their upstream migration or entered the power canal from the impoundment via the gatehouse. Of the 83 fish present in the power canal, 30 (36.1%), 41 (49.4%), 4 (4.8%), and 8 (9.6%) passed downstream through the Cabot Station powerhouse, Cabot Station bypass, remained in the power canal, or passed downstream via an unknown route, respectively (Kleinschmidt and Gomez and Sullivan, 2017a). No fish emigrated out of the power canal through the Station No. 1 powerhouse. The shad that passed downstream through the powerhouse and bypass did so with a median travel time of 0.32 and 0.42 days, respectively, but some fish remained in the power canal for nearly a month before passing (Kleinschmidt and Gomez and Sullivan, 2017a). Like with selecting to pass via the spillway or into the power canal, flow appears to be the driving environmental covariate that determines whether a fish passes downstream of the project via the Cabot Station powerhouse or bypass (Table 3.3.2.2-12). Fish that pass downstream through the powerhouse tend to do so when Cabot Station discharge and power canal flow increases by 1,000 cfs, fish are less likely to pass downstream through the bypass when Cabot Station operations change.

In 2019, FirstLight tagged, released, and tracked 198 adult American shad using radio-telemetry to better understand route selection and passage survival once fish pass from the impoundment into the power canal. In total, 58 fish (29.3%) experienced mortality prior to passing downstream, possibly from handling and tagging effects, whereas 76 (54.3%), 38 (27.1%), and 26 (18.6%) of the remaining available alive fish passed downstream through the Cabot Station powerhouse, bypass, or went undetected after their release, respectively. Table 3.3.2.2-13 presents survival estimates provided in Kleinschmidt and Gomez and Sullivan (2017a) for those fish that passed downstream through the Cabot Station powerhouse, bypass, and the whole project. Collectively, these data indicate that survival is greatest through the bypass, but overall project survival is affected by low survival through the powerhouse. Overall, we estimate the cumulative downstream passage survival for post-spawn American shad to be approximately 65%. We note that FirstLight did not provide a meaningful estimate of passage survival through the spillway because mobile tracking was not conducted in the bypassed reach and a survival estimate was not provided for Station No. 1 because no tagged fish passed through the Station No. 1 powerhouse. Nonetheless, given the turbine configuration at Station No. 1, turbine passage is likely not 100% and some mortality likely occurs from passing through the spillway, overall project downstream passage survival would be less than 65%.

Existing fish passage performance standards for downstream passage at hydroelectric projects in the Connecticut River Basin dictate the project must pass post- spawn adult American shad that arrive within 1 kilometer of the project dam within 24 hours, and with a minimum, survival rate of 95% (CRMFRC, 2022). Our analysis of FirstLight's study results suggest that most of the post-spawn American shad emigrate out of the project area through the power canal

and then through the Cabot Station powerhouse or bypass. Furthermore, we estimate the median travel time needed for a post-spawn American shad to emigrate from the project area is likely around 0.85 days (20.4 hours) but can be much greater. Survival can be relatively high for those individuals that select to pass downstream via the Cabot Station bypass, but overall downstream passage survival would likely be less than 65% under existing conditions and not meet or exceed the performance standards recommended in CRMFRC (2022).

Juvenile American Shad Downstream Passage and Survival—FirstLight conducted several studies to determine downstream migration timing, passage routing, rate of movement, and survival of juvenile American shad at the Turners Falls Project through a combination of hydroacoustic, radio-telemetry, and HI-Z (balloon tag) methods (Kleinschmidt, Gomez and Sullivan, and Aquacoustics, 2016; Kleinschmidt and Gomez and Sullivan, 2017b). Based on the results of a hydroacoustic evaluation, FirstLight determined juvenile shad actively pass downstream through the Turners Falls Project from August 1 through November 14, with three distinct pulses in mid-August, late September and late October/early November (Kleinschmidt, Gomez and Sullivan, and Aquacoustics, 2016). Results of the hydroacoustic study also suggest approximately 2.9 million juvenile shad were passed downstream at Cabot Station with 43% passing downstream through the bypass and the remaining 57% through the turbines, with increased rates of entrainment related to increased turbine discharge (Kleinschmidt, Gomez and Sullivan, and Aquacoustics, 2016).

Like post-spawning adult shad, juvenile shad may emigrate from the project area over the spillway, or via the power canal then through either the Station No. 1 powerhouse, Cabot Station powerhouse or the downstream fish bypass at Cabot Station. To evaluate route selection and rate of movement, FirstLight externally radio-tagged a total of 218 individuals, released them upstream (n=201)[113] of the Turners Falls Dam and within the power canal (n=17), and monitored their downstream movement rate and route selection. FirstLight, also conducted a handling and tagging effect experiment, which demonstrated tagged fish swam irregularly, and experience high rates of tag loss and mortality. Therefore, no meaningful inference regarding passage route selection or rate of movement can be drawn.

To estimate turbine passage survival, FirstLight tagged a total of 371 juvenile shad with balloon tags and released 120 into Cabot Station unit 2/4, 90 into Station No. 1 Unit 2/3, 90 into Station No. 1 Unit 1, and 71 fish directly into the tailraces of the powerhouses in the plunge pool to serve as the experimental control.[114] FirstLight subsequently recaptured individuals within the tailrace, recorded the number of individuals captured alive or dead, and calculated 1-hr post turbine passage survival based on the number of treatment and control fish released and recaptured alive. Overall, FirstLight estimated the 1-hr survival to be 95.0% (90% C.I. +/- 3.3%) through Cabot Station unit 2, 68.7% (90% C.I. +/- 8.2%) through Station No. 1 Unit 2/3, and 76.6% (90% C.I. +/- 7.9%) through Station No. 1 Unit 1 (Kleinschmidt, Gomez and Sullivan,

[113] Includes 18 individuals with tag identification numbers identical to tagged American eel as part of another study.

[114] Control fish are those that are tagged and handled in the same way as other fish that are tagged and handled but released into the tailrace rather than the turbines.

and Aquacoustics, 2016). These data indicate survival is higher through the larger and slower revolving units at Cabot Station than the smaller faster revolving units at Station No. 1.

In addition, FirstLight also tagged with balloon tags and released 182 and 180 juvenile shad through Bascule Gate No. 1 and Bascule Gate No. 4, along with 75 directly into their respective plunge pools as control at three flow releases: 1,500 cfs, 2,500 cfs, and 5,000 cfs. FirstLight then estimated combined 1-hr survival of juvenile shad passage through Bascule Gate No. 1 to be 63.0% (90% C.I. +/- 6.7%), and through Bascule Gate No. 4 to be 64.8% (90% C.I. +/- 6.7%) (Kleinschmidt, Gomez and Sullivan, and Aquacoustics, 2016).

No licensing study determined the survival rate of juvenile shad passing downstream through the downstream fish bypass at Cabot Station. However, previous work conducted by RMC (1995) reported 1-hr survival of 98 to 100% of balloon tagged juvenile shad that were passed downstream through the Cabot Station downstream fish bypass. RMC (1995) also reported little injury and attributed the high survival and low injury rate to the gradual slope of the bypass, sufficient water depth, and absence of boulders at its outfall.

As previously discussed, 95% of downstream migrating shad must survive passing through the project and do so within 24 hours of arriving within 1 kilometer of the project dam, to meet performance criteria. At this time, the travel time juvenile shad exhibit as they move downstream through the project is unknown, therefore, we cannot discern whether juvenile shad would benefit from a passage measure that would reduce downstream migratory delay. However, existing turbine passage survival is relatively high and near the 95% passage performance standard level at Cabot Station, but well below the standard at Station No. 1 and at the spillway. We discuss FirstLight's proposals to improve downstream juvenile shad passage survival in *Station No. 1 Trashrack*, *Cabot Station Trash Rack and Bypass*, and *Plunge Pool Beneath Bascule Gate No. 1,* below.

*American Eel Downstream Passage and Survi*val—In 2015 and 2016, FirstLight monitored downstream American eel passage in the Turners Falls power canal using dual frequency identification sonar to define downstream migratory timing through the project area (Kleinschmidt and Gomez and Sullivan, 2017c). Results of the monitoring suggest silver-phase American eel emigrate through the project area between August and mid-November. Over two years of monitoring, FirstLight estimates approximately 2,400 and 2,300 silver-phase American eel emigrated downstream through the power canal in 2015 and 2016, respectively.

In 2015, FirstLight employed radio-telemetry techniques to evaluate route selection and the rate of movement of out-migrating silver-phase American eel as they passed through the Turners Falls project area. In total, 257 eels were tagged and released upstream of the project,[115] of which, 127 approached Turners Falls dam and entered the power canal (69%) or passed

[115] Of the 257 tagged eels, 132 were tagged and released by FirstLight, while 165 were tagged and released by Great River, the owner and operator of the upstream Vernon, Bellows Falls, and Wilder Hydroelectric projects (Kleinschmidt and Gomez and Sullivan, 2017c). The eels tagged by FirstLight were released approximately 3 kilometers upstream of the Turners Falls (n=60) and 5 kilometers upstream of the Northfield Mountain tailrace (n=72). All eels tagged by Great River were released upstream of its Vernon (n=50), Bellows Falls (n=65), and Wilder (n=50) projects.

downstream over the spillway (10%) (Kleinschmidt and Gomez and Sullivan, 2017c). Of those that passed into the canal, 72 passed downstream through the Cabot Station powerhouse, 7 via the fish bypass, 3 through the Station No. 1 powerhouse, and 5 via an unknown route. Once in the power canal, the median travel time to pass downstream ranged from 96.4 to 169.0 hours (Kleinschmidt and Gomez and Sullivan, 2017c).

To understand what environmental factors influence downstream passage once eels enter the power canal, FirstLight fit the data to a series of Cox Proportional Hazard regression models. At least for those fish passing downstream through the Cabot Station powerhouse, the models indicate eels tend to pass downstream at night when Cabot Station discharges are high (hazard ratio = 1.26, $p<0.001$).[116] However, there were no factors that significantly influenced downstream passage via the other possible routes, including the downstream fish bypass (Kleinschmidt and Gomez and Sullivan, 2017c).

To estimate survival from passing downstream through either the Cabot Station powerhouse, Cabot Station downstream fish bypass, Station No. 1 powerhouse, or the spillway, FirstLight balloon tagged eels, and released them into the above routes (Kleinschmidt and Gomez and Sullivan, 2017c). Table 3.3.2.2-14 presents the number of eels tagged and released and their respective 1-hour and 48-hour survival estimates. These data indicate turbine passage survival is greater than 90% when eels pass through Cabot Station or the larger turbine with slow revolutions at Station No. 1 (Unit 1). When eels pass over the spillway through either Bascule Gate No. 1 or 4, combined survival ranges between approximately 83% and 88%, respectively (Kleinschmidt and Gomez and Sullivan, 2017c).

In summary, the downstream eel passage data provided in Kleinschmidt and Gomez and Sullivan (2017c) demonstrate most out-migrating American eels pass into the power canal rather than over the spillway. For those eels that enter the canal, most pass via the Cabot Station powerhouse, likely because of high discharges. Regardless of the selected downstream passage route, mortality is possible, but survival is typically greater than 80% and can approach 90% or more for most routes except smaller and faster units at Station No. 1. Although there are no downstream passage performance standards, CRMFRC filed an eel management plan with the Commission for consideration as a comprehensive plan (CRMFRC, 2023). In that eel management plan, CRMFRC recommends downstream eel passage survival be no less than 95%. Based on the survival estimates in Table 3.3.2.2-14, it is unlikely total project downstream eel passage meets or exceeds the 95% standard recommended in CRMFRC (2023).

Station No. 1 Trashrack—FirstLight's fish passage studies revealed no post-spawn American shad pass downstream of the project through the Station No. 1 powerhouse whereas juvenile American shad and American eel do. However, entrainment and turbine mortality of post-spawn American shad at Station No. 1 could be possible, particularly if more canal flow is

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[116] The hazard ratio describes the relationship between the exposure variable and survival time (e.g., time-to-pass). When the hazard ratio is equal to one there is no effect of the exposure variable on the time-to-pass. When the hazard ration is greater than one, the exposure variable results in an increase in the rate of passage relative to those fish not exposed to the variable, whereas a hazard ratio of less than one indicates the exposure variable decreases the rate of passage relative to those fish not exposed to the variable.

directed through Station No. 1 because, as previously discussed, out-migrating shad at the Turners Falls Project tend to select the downstream passage route with the higher flow. Currently, the turbine units at Station No. 1 are protected by an angled trashrack structure with a clear spacing between each bar of 2.625 inches that, at a normal WSE of 173.5 feet, has an area of 1,813 square feet. FirstLight conducted a computational fluid dynamics (CFD) study that demonstrated that under maximum generation flow at Station No. 1, 91% of the trashrack face had approach velocities of less than 2.0 fps (Kleinschmidt and Gomez and Sullivan, 2016d). Although adult American shad and American eel can swim at rates that can exceed 2.0 fps,[117] based on published body width to length ratios and fish lengths measured by FirstLight, only large adult American shad would be excluded from entrainment by the existing trashrack clear spacing (Bell, 1991; Kleinschmidt and Gomez and Sullivan, 2016d; Kleinschmidt and Gomez and Sullivan, 2016a).[118] Conversely, a trashrack with ¾ inch clear spacing installed at the entrance of the branch canal that leads to Station No. 1, as proposed in the FFPSA, required by NMFS's and Interior's fishway prescriptions, and specified in Massachusetts DEP condition 14, would exclude most adult American shad and American eel present in the power canal thereby preventing entrainment and turbine mortality at Station No. 1.[119] However, because juvenile American shad have body widths that are less than ¾ inch, the proposed ¾-inch rack would not prevent entrainment of juvenile American shad.

In addition, mortality may arise from impingement upon the proposed racks, particularly if the normal velocity exceeds the swimming ability of the fish and parallel sweeping velocity.[120] FirstLight estimates the new trashrack at the entrance of the branch canal would be 58 feet wide and 21 feet tall; a total area of 1,218 square feet. At Station No. 1's maximum hydraulic capacity of 2,210 cfs, which may occur during the time when adult and juvenile American shad and American eel are present in the power canal, the normal velocity in front of the proposed ¾-inch trashrack would be approximately 3.4 fps. Therefore, because adult American shad swimming ability can exceed the estimated velocity in front of the proposed ¾-inch trashrack, mortality arising from impingement would be low; however, impingement mortality could be

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[117] As reported in Bell (1991), adult American shad have prolonged and burst swimming speeds that range from 5.0 to 10.8 fps, respectively. Bell (1991), also reports eel approximately 2 feet in length have prolonged and burst swimming speeds of approximately 2.5 and 4.0 fps, respectively.

[118] As part of study 3.3.2 (Kleinschmidt and Gomez and Sullivan, 2017a), FirstLight measured for total length (mm) 793 adult American shad. Study 3.3.2 reports minimum and maximum total length of 374 to 587 mm, respectively. Using a body width to total length ratio of 0.134, as reported in Smith (1985), adult American shad within the size range reported in study 3.3.2 (Kleinschmidt and Gomez and Sullivan, 2017a), would have body widths of 2.0 to 3.1 inches.

[119] According to FWS (2019), clear bar spacing of ¾ inch effectively protects eel from entrainment.

[120] Normal velocity is the velocity component perpendicular to the trashrack, and sweeping velocity is the velocity component parallel to the trashrack (FWS, 2019).

higher for American eel because their swimming ability may not exceed the normal intake velocity.

CFD modeling of canal flow velocities in the vicinity of the branch canal entrance when only Station No. 1 is operating, or when both Cabot Station and Station No. 1 are operating, suggest that sweeping velocities may range from 2.0 to near 8.0 fps. According to FWS (2019), a guidance structure installed at a 45-degree angle or less would result in a sweeping velocity greater than or equal to the normal velocity. Because the proposed ¾-inch trashrack would be installed parallel to the canal flow, we expect the sweeping velocity to be greater than the intake velocity most of the time, which would reduce the attraction toward Station No. 1. As a result, we expect the time to pass downstream of the branch canal would improve for most American shad and American eel. Given that FirstLight would consult with the fish passage agencies regarding the rack design, we expect mortality of adult American shad and American eel due to impingement upon the proposed rack would also be minimized.

Cabot Station Trash Rack and Bypass—FirstLight's telemetry and hydroacoustic data determined that the primary downstream fish passage route at the Turners Falls Project is through the Cabot Station powerhouse and downstream bypass (Kleinschmidt and Gomez and Sullivan, 2017a). Trashrack structures can protect fish from entrainment but only if the fish is large enough to not fit through the racks clear spacing. The current configuration of the Cabot Station trashrack includes an 11-foot upper section with 0.9 inch clear spacing, and a lower 20-foot section with 5-inch clear spacing. Adult American shad in the project area likely have body widths that range in size from 2.0 to 3.1 inches, whereas juvenile shad and American eel have body widths the range from 0.3 to 0.6 inches and 0.6 to 1.4, respectively.[121] Therefore, the upper portion of the current rack is narrow enough to exclude most adult American shad, but not juvenile shad and eel. Likewise, the bottom portion with 5-inch clear spacing would not exclude either species. In addition, as previously discussed, turbine passage for adult American and juvenile shad can comprise more than 50% of the out-migrating shad, which can result in mortality upward of approximately 35% for adult shad and 5% for juvenile shad. Similarly, entrainment and turbine passage of American eel is much more likely than passing downstream via the downstream fish bypass or spillway. To be effective at excluding adult American shad and eel from becoming entrained at Cabot Station, the trashracks would need to have a clear spacing of less than 2.0 inches for adult shad, 0.3 inches for juvenile shad, and 0.5 inches for American eel. Therefore, the proposed full-depth trashrack with 1-inch clear spacing would be effective at reducing turbine induced mortality for adult shad but may not fully exclude American eel or juvenile shad. However, because the proposed trashrack would have multiple openings along the top and bottom that direct fish to the downstream bypass and be designed in consultation with the fish passage agencies, as proposed in the FFPSA, required by NMFS's and

[121] In Kleinschmidt, Gomez and Sullivan, and Aquacoustics (2016), FirstLight reported juvenile American shad in the vicinity of the FirstLight projects range in size from 60 to 120 mm. Based on body width to total length ratio of 0.134 mm, as reported in Smith (1985), juvenile shad body widths would range from 0.3 to 0.6 inches. In Kleinschmidt and Gomez and Sullivan (2017c), FirstLight reports the total length of tagged eel to range from 400 to 960 mm. Based on body width to total length ratio of 0.037 mm, as reported in Smith (1985), American eel body widths would range from 0.6 to 1.4 inches.

Interior's fishway prescriptions, and specified by Massachusetts DEP condition 14, we expect entrainment and turbine passage mortality for adult and juvenile American shad and eel to decline and the time to pass downstream would improve at Cabot Station.

As discussed above, adult and juvenile shad that locate and use the downstream bypass have a relatively higher survival rate (approaching 90%) compared to other downstream pathways. Whether or not shad use the fish bypass over becoming entrained into the turbines could be related to flow. For instance, as discussed previously, out-migrating adult shad generally select the downstream passage route with the highest flow (Kleinschmidt and Gomez and Sullivan, 2017a). CFD modeling of flow velocities in front of the Cabot Station trashracks and in the vicinity of the fish bypass indicate that higher flow velocities are located along the lower portion of the trashrack rack, especially as Cabot Station reaches its maximum hydraulic capacity (Figure 3.3.2.2-4). Specifically, CFD modeling presented in Gomez and Sullivan (2016d) indicate that flow velocities along the trashrack are not uniform and are typically between 3.0 to 4.3 fps along the bottom portion and < 2.0 fps along the top portion when Cabot Station is operating at hydraulic capacity (Figure 3.3.2.2-4). Even though adult shad exhibit swim speeds that are faster than the above intake velocities, which can allow them to escape entrainment, the hydraulic cue of the intake velocity likely elicits a negative rheotactic response that would attract adult shad to become entrained into the turbines through the lower portion of the trashrack. When Cabot Station discharges are lower, however, the flow velocity in the vicinity of the bypass is higher, which potentially attracts fish toward the bypass through the same negative rheotactic response (Figure 3.3.2.2-4).

According to FWS (2019), surface bypasses are effective in attracting fish if their combined flow is equal to or greater than 5% of the station's hydraulic capacity. During the fish passage season (April 1 through November 15), the downstream bypass typically discharges approximately 130 cfs, which is about 1% of Cabot Station's hydraulic capacity (13,728 cfs). Therefore, to be effective at attracting fish to the downstream bypass, the bypass flow would need to increase to about 686 cfs, or Cabot Station discharges would need to decrease to 2,600 cfs. As proposed in the FFPSA, required by NMFS's and Interior's fishway prescriptions, and specified by Massachusetts DEP condition 14, FirstLight would design, in consultation with the fish passage agencies, and construct a new uniform acceleration weir at the downstream bypass and resurface the sluice. FirstLight would also release 685 cfs from the downstream bypass during the fish passage season (about 5% of Cabot Station's hydraulic capacity). These measures would improve attraction to the downstream bypass and the time to pass downstream. Furthermore, resurfacing the bypass would reduce turbulence experienced by downstream migrants that could result in injury and mortality. Given the above required improvements, and because FirstLight would consult with the fish passage agencies on the improvements, we anticipate overall downstream passage survival and time to pass would improve for adult American shad, juvenile American shad, and American eel.

Plunge Pool Beneath Bascule Gate No. 1—Although most of the out-migrating adult and juvenile American shad as well as American eel tend to pass downstream through the Turners Falls Project via the power canal, as previously discussed, some pass downstream using the spillway. Telemetry and HI-Z tagging studies conducted by FirstLight determined that shad that pass over the spillway experience relatively high rates of mortality, unlike those that pass downstream using dedicated downstream fish passage facilities, like the Cabot Station downstream fish bypass. FirstLight attribute this mortality to the injurious effects of downstream

passers striking the boulder and concrete sill structures downstream of Bascule Gates No. 1 and 4 (Kleinschmidt, Gomez and Sullivan, and Aquacoustics, 2016).

The plunge pool beneath Bascule Gate No. 1 is of variable depth, with bottom elevations that range approximately between 120 to 125 feet. To evaluate whether the existing plunge pool immediately downstream of Bascule Gate No. 1 is of adequate depth, we compared the plunge pool depth when flows of approximately 400 and 4,300 cfs are provided by Bascule Gate No. 1 in relation to the plunge pool depth criteria provided in FWS (2019). FWS recommends a plunge pool depth be 25% of the fall height, where the fall height is the impoundment WSE minus the tailwater (plunge pool) WSE. Table 3.3.2.2-15 presents the results of this analysis and shows that even at the highest elevation of 185 feet and lowest flow, which corresponds to the greatest fall height, the maximum required plunge pool depth needed for safe downstream passage would be 12.2 feet, which is slightly greater than the existing pool depth at the corresponding tailwater elevation. However, CFD model results of water depths in the vicinity of the plunge pool suggest depths are shallow near the dam but the larger plunge pool exceeds 20 feet deep further downstream (Figure 3.3.2.2-5). Therefore, a shallow plunge pool depth may contribute to the observed high mortality particularly if fish land at a point of insufficient depths, such as was observed by FirstLight (Kleinschmidt, Gomez and Sullivan, and Aquacoustics, 2016). FirstLight proposes to deepen the plunge pool to at least 23 feet deep throughout the area beneath the gate. With implementation of this measure, mortality attributable to fall height and plunge pool depth would be low. Furthermore, because FirstLight would design the plunge pool in consultation with the fish passage agencies, as proposed in the FFPSA, required by NMFS's and Interior's fishway prescriptions, and specified by Massachusetts DEP condition 14, we expect the final plunge pool design would be of sufficient depth, volume, and would ameliorate other factors that contribute to mortality. As a result, we expect the proposed plunge pool, once constructed, would improve downstream passage survival of shad and eel passing over the spillway.

Adaptive Management Measures—Pending the outcome of the fish passage effectiveness testing discussed in *Turners Falls Fish Passage Facility Effectiveness Testing and Performance Goals*, FirstLight may implement adaptive management measures to improve downstream passage survival and reduce delay. Potential adaptive management measures include: (1) modifying bascule gate settings; (2) installing a behavioral barrier at Station No. 1; and (3) making various modifications to the downstream passage conveyance at Cabot Station.

We note these measures would be informed by the results of fish passage effectiveness studies discussed below in *Turners Falls Fish Passage Facility Effectiveness Testing and Performance Goals*. Therefore, at present, we have little basis to assess the effect of the adaptive management measures enhancing downstream fish passage. However, as previously discussed, the flow rate over the bascule gates affects the depth of the plunge pool; therefore, adjusting the setting may improve spillway passage survival. In addition, results from FirstLight's study of an ultrasound array installed within the Cabot Station tailrace was effective at encouraging shad to move upstream into the bypassed reach and away from the Cabot tailrace (FirstLight, 2020a). Installing a behavioral barrier near Station No. 1 may have a similar effect and reduce entrainment there. Lastly, if the proposed downstream passage conveyance system does not improve overall passage survival, additional modifications may be implemented. Nonetheless, because the selected adaptive management measures would be based on the results from the effectiveness testing and would be selected in consultation with the fish passage agencies, as

proposed in the FFPSA, required by NMFS's and Interior's fishway prescriptions, and specified by Massachusetts DEP condition 16, we expect the adaptive management measures would improve overall downstream passage effectiveness at the Turners Falls Project.

Turners Falls Effectiveness Testing Schedule and Performance Goals

Effectiveness testing and passage performance standards can be used to assess the performance of a fishway and evaluating the efficacy of an exclusion structure at increasing passage survival for a given fish species. Further, results of testing can determine whether resource agency management goals are being met or whether additional measures are needed to meet such standards and goals.

As described in FFPSA Articles A310 and A320, FirstLight proposes to complete construction of each fish passage facility, operate the fish passage facility for one season (shakedown year), and then conduct representative and quantitative fish passage effectiveness testing. Initial effectiveness testing for the Cabot Station trashrack, Cabot downstream conveyance, and Station No. 1 bar rack would occur in Years 6 and 7 post license issuance. Initial testing of the Turners Falls dam plunge pool and spillway lift would occur in Years 9 and 10. Initial testing of the upstream eel passage structures would occur in Year 14. Prior to implementing effectiveness studies, FirstLight would consult with the fish passage agencies to develop study plans and receive Commission approval to implement the studies.

The initial effectiveness studies would determine whether the new facilities are meeting the performance goals stated in the FFPSA, which include the following for upstream and downstream passage:

- 75% of adult American shad arriving 500 meters downstream of Cabot Station successfully pass into the Turners Falls impoundment within 48 hours. The 75% passage efficiency for American shad would be based on the first 90% of the American shad run. FirstLight would conduct the effectiveness testing over the entire adult American shad run, but the 75% passage efficiency goal would be based on the first 90% of the run as determined by the licensee as a posteriori analysis of run counts.[122] FirstLight and the fish passage agencies would revisit whether the 75% passage efficiency goal is achievable or should be reduced, and whether the 48-hour time-to-pass goal is achievable or should be increased, after implementing the first (Tier 1) and second (Tier 2) round of adaptive management measures as described in FFPSA Article A330.
- An internal passage efficiency of 95% within the permanent passage structure(s) for American eel. The 95% internal efficiency assumes it is possible for the licensee to successfully tag up-migrating eels. FirstLight would consult with the agencies on the appropriate size American eel, based on available technology, to test the internal efficiency.
- 95% of juvenile American shad arriving 500 meters upstream of Turners Falls dam survive migration past the Turners Falls Project within 24 hours.

[122] FirstLight would determine where and how run counts will occur in consultation with Massachusetts DFW, NMFS, and FWS during effectiveness study plan development.

- 95% of adult American shad arriving 1 kilometer upstream of Turners Falls dam survive migration past the Turners Falls Project within 24 hours.
- 95% of American eel arriving 1 kilometer upstream of Turners Falls dam survive migration past the Turners Falls Project within 48 hours of a flow event.[123]

NMFS's and Interior's fishway prescriptions, and Massachusetts DEP conditions 15 and 16, specify the same measures as proposed in the FFPSA.

In its comments on the FFPSA, Connecticut River Conservancy opposes the provision that fish passage performance thresholds may be lowered after two rounds of implementing adaptive management measures result in not meeting initial passage performance criteria.

FirstLight, in its response to comments received on its FFPSA, states a provision to lower passage thresholds is necessary because passage goals may not ultimately be achieved at the Turners Falls Project within the first 25 years after license issuance and is needed to provide a measure of economic certainty.

Our Analysis

As previously discussed, the expected outcome of FirstLight's proposed, NMFS's and Interior's prescribed, and Massachusetts DEP's (condition 14) specified fish passage measures for the Turners Falls Project would improve the overall upstream and downstream passage performance for American eel and American shad. However, to ensure the constructed facilities and implemented measures perform as designed or determine whether additional modifications are necessary, testing their respective effectiveness would be useful. Although we do not know what methods FirstLight would employ to study the effectiveness of the constructed and operational measures, FirstLight's proposal to prepare a study plan, in consultation with the agencies, and file with the Commission for approval, would provide a mechanism for ensuring that appropriate methods are used.

FirstLight's proposed, NMFS's and Interior's prescribed, and Massachusetts DEP's (condition 15) specified passage performance goals for American shad, albeit slightly modified for juvenile shad,[124] originate from the CRMFRC (2022), a comprehensive plan filed pursuant to section 10(a)(2)(A) of the FPA. The CRMFRC (2022) provides reasoning for the passage performance criteria for American shad. In short, the performance criteria were selected using a stochastic life-history based model for American shad that assessed the function of fish passage and protection measures at hydroelectric facilities in the Connecticut River Basin. According to the CRMFRC (2022), model results underscored downstream passage timeliness and high survival for adults and juveniles to realize population gains through maintaining a substantial repeat spawner component and providing access upstream at successive dams. The model

[123] FirstLight, in consultation with the fish passage agencies, would define what constitutes a flow event during development of the effectiveness study plan.

[124] CRMFRC (2022) states the downstream passage performance for juvenile American shad is to be based on those shad that approach within 1-km of a project area rather than 500-m as agreed to by FirstLight in the FFPSA, required by NMFS's and Interior's fishway prescriptions, and specified by Mass DEP condition 15.

resulted in performance standards that would need to be reached to achieve the goal of restoring and maintaining the American shad population in the Connecticut River. We anticipate that evaluating the effectiveness of the proposed upstream and downstream fish passage measures at the Turners Falls Project for American shad, relative to the performance standards proposed in the FFPSA, required by NMFS's and Interior's prescriptions, and specified by Massachusetts DEP (condition 15), would highlight the need for additional remedial measures, such as the adaptive management measures previously discussed.

On June 30, 2023, the CRMFRC filed with the Commission for consideration as a comprehensive plan pursuant to section 10(a)(2)(A) of the FPA an eel management plan in which upstream passage and downstream passage through-project mortality are to be 95% and no more than 5%, respectively (CRMFRC, 2023). CRMFRC (2023) appears to be the basis for the American eel passage goals. However, CRMFRC does not explain the selection of the 95% threshold. Interior, in its fishway prescription regarding the 95% threshold states, "the plan calls for 95% survival at each hydroelectric project on the river to address cumulative effects of eels having to negotiate multiple hydropower facilities." Therefore, the 95% threshold would serve as a target passage performance goal to assess the effectiveness of the eel passage measures proposed in the FFPSA, required by NMFS's and Interior's prescriptions, and specified by Massachusetts DEP condition 14, and determine the need for additional remedial measures to address cumulative effects of downstream passage mortality.

The purpose of the proposed and required fish passage goals is to accomplish fishery management goals and objectives set by the resource agencies. As the fish passage measures at the Turners Falls Project are implemented, new information would be provided to and collected by the resources that would inform their respective goals. For example, the effectiveness testing conducted by FirstLight may reveal that the new measures exceed the passage performance goals, but annual population monitoring conducted by the resource agencies may indicate population targets, such as the number of repeat spawner or upper basin adult run size are not met. This would suggest some other activity not under the control of the licensee, like commercial harvests, may affect the population to a greater degree than operation of the project. Given that FirstLight and the agencies would consult on the need to adjust the fish passage performance goals, there would be limited benefit in requiring FirstLight to adhere to the above fish passage performance goals through the license term as recommended by Connecticut River Conservancy.

Turners Falls Fishway Operating Periods

Operating fish passage facilities over the entire freshwater migratory period of American eel and American shad is important to provide timely fish passage so those species may complete their life cycle.

As described in the FFPSA (Article A340) FirstLight proposes to: (1) operate the Turners Falls upstream eel passage facilities from May 1 to November 15; operate the Turners Falls upstream passage facilities for anadromous species from April 4 to July 15; and (3) operate the Turners Falls downstream passage facilities from April 4 to November 15. According to the FFPSA (Article A340), FirstLight would also refine the timing of fishway operations based on new information and consultation with the fish passage agencies.

NMFS's and Interior's fishway prescriptions, and Massachusetts DEP conditions 18, 19, and 31, specify the same measures as proposed in the FFPSA.

Massachusetts DEP condition 31 also specifies FirstLight operate the fish passage facilities proposed in the FFPSA, required by the fishway prescriptions, and specified in Massachusetts DEP condition 14, in accordance with the annual schedules set by FWS, which can account for climate-induced changes in migration timing for affected fish, including American shad and American eel.

Our Analysis

Adult American shad typically arrive at the Turners Falls Project in mid- to late-April and are migrating upstream through early-July, with most of the migration complete by mid-June. At the downstream Holyoke Project (P-2004), however, adult American shad are passed upstream throughout July. After spawning, adult shad quickly emigrate and are gone from the Turners Falls project area by the end of July. Upstream American eel passage studies performed by FirstLight indicate juvenile eels are present in the Turners Falls project area from June into October (Kleinschmidt and Gomez and Sullivan, 2015b; 2016b). Eel passage monitoring performed at the downstream Holyoke Project suggests the upstream eel migration begins there in May and lasts through October (Normandeau, 2018). Accounting for the travel time from the Holyoke Project to the Turners Falls Project, juvenile American eel may be present in the project area later than October. The downstream passage studies conducted by FirstLight determined juvenile shad and American eel actively migrate downstream from August through mid-November (Kleinschmidt, Gomez and Sullivan, and Aquacoustics, 2016; Kleinschmidt and Gomez and Sullivan, 2017c). Collectively, the studies conducted by FirstLight and the monitoring performed by others demonstrate American shad and American eel would be migrating through the Turners Falls project area during the same time period as FirstLight proposes in the FFPSA and would be required to pursuant to NMFS's and Interior's fishway prescriptions and Massachusetts DEP condition 18. Therefore, operating the Turners Falls Project fish passage facilities according to the time period proposed in the FFPSA, required by the fishway prescriptions, and specified in the Massachusetts DEP 4 condition would be beneficial to American shad and American eel.

Although research has demonstrated positive correlations between earlier run timing and earlier warming of river water temperature,[125] Massachusetts DEP condition 31 does not require FirstLight to account for climate-induced changes in setting its fish passage operation schedule. Rather, condition 31) specifies that FirstLight operate the proposed fish passage facilities based on an annual schedule set by FWS. In determining the schedule, FWS could account for shifts in migratory timing that are attributable to climate change. However, the fishway operating schedule proposed by FirstLight, required by the fishway prescriptions, and specified by Massachusetts DEP condition 18 already allows the fishway operation to be adjusted based on new information, such as earlier run timing. Therefore, Massachusetts DEP condition 31 would not provide a greater level of benefit than already afforded by FirstLight's proposal, the fishway prescriptions, or Massachusetts DEP condition 18.

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[125] Examples include: Quinn and Adams (1996), Juanes et al. (2004), and Ellis and Vokoun (2009).

Turners Falls Fish Passage Operations and Maintenance Plan

To be effective in passing fish, fish passage facilities must be properly operated and maintained. Debris, including leaves, wood, or trash that collects against the fishway entrance or exit can alter flow dynamics, adversely affecting attraction, or can increase risk of injury.

No later than six months after license issuance, FirstLight would prepare, in consultation with the fish passage agencies, and implement a fish passage facilities operation and maintenance plan (FOMP). The plan would detail how and when FirstLight would operate the interim eel passage and existing fish passage facilities, including the Cabot downstream fish bypass; Cabot ladder; spillway ladder; and gatehouse ladder. The plan would describe routine maintenance activities that FirstLight would implement both during and outside of the fish passage season. The plan would also include a provision to provide annual fishway operation and maintenance reports that summarize the status of the fish passage facilities and identify needed repairs or equipment replacement. FirstLight, in consultation with the fish passage agencies, would amend the plan at least six months prior to: (1) operation of any new fish passage facilities; (2) implementation of any adaptive management measures; or (3) implementation of any operational or facilities modifications resulting from new information obtained from operation of the fish passage facilities pursuant to the annual operation and maintenance reports.

NMFS's and Interior's fishway prescriptions prescribe, and Massachusetts DEP condition 19 specifies, the same measures as proposed in FFPSA. Interior's fishway prescription would also require FirstLight to keep the fishways in proper order, clear of debris and refuse, and perform maintenance, when necessary, in accordance with the fish passage operations and maintenance plan. Connecticut River Conservancy also requests they be considered as a consulting party in the development of the fish passage operations and maintenance plan.

In its response to comments on the FFPSA, FirstLight states Connecticut River Conservancy lacks the technical knowledge to provide meaningful contributions to the development of or ongoing implementation of the fish passage operations and maintenance plan.

Our Analysis

FirstLight's proposed FOMP would be prepared in consultation with the agencies and filed with the Commission for approval. The plan would detail how and when the fishways would be operated and describe routine maintenance activities that would occur during and outside the fish passage seasons; and therefore, ensure that the fishways are in proper working order before and during the migratory fish season. The plan would also include annual reporting regarding the status of the fishways and any needed repairs or maintenance concerns. The FOMP would also be periodically amended as the proposed fish passage improvements are implemented, when adaptive management measures are placed into service or if operational or facility modifications become necessary. Overall, the FOMP proposed in the FFPSA, required by NMFS's and Interior's fishway prescriptions, and specified by Massachusetts DEP condition 19 would help to ensure that the Turners Falls Project fish passage facilities are operated and maintained to provide effective fish passage. However, FirstLight does not propose to file the FOMP when amended.

During development of the FOMP FirstLight would consult with the resource agencies and file the FOMP with the Commission for approval. We anticipate this consultation would

result in a FOMP that is best adapted to benefit fish passage. Therefore, it would provide little benefit for FirstLight to consult with Connecticut River Conservancy in developing the FOMP. FirstLight would file the FOMP with the Commission for approval, and Connecticut River Conservancy may provide written comments at that time for the Commission to consider.

Northfield Mountain Intake Barrier Net

American shad and American eel migrating upstream and downstream past the Northfield Mountain Project tailrace may experience migratory delay from the hydraulic changes related to discharges during generation operations. In addition, American shad and American eel would not be excluded from entertainment by the project's six-inch clear spacing trashrack. Consequently, American shad and American eel migrating past the tailrace would also continue to be susceptible to entrainment-related mortality from pumping operations. Similarly, drifting American shad eggs and larvae would also experience entrainment-related morality during pumping operations.

As described in the FFPSA (Articles B200, B210, B220, B230, and B240) FirstLight proposes to install a seasonally operated barrier net around the Northfield Mountain tailrace/intake to prevent entrainment of migrating juvenile and adult American shad and adult American eels. The net would have a 3/8-inch mesh on top and a three-quarter-inch mesh on the bottom. FirstLight would design the net in consultation with Massachusetts DFW, NMFS, and FWS and file the design plans with the Commission for approval. FirstLight would install the barrier net no later than June 1 and leave it in place until November 15. The barrier net would be operational no later than June 1 of the seventh year after license issuance.

Prior to initiating operation of the barrier net, FirstLight would develop a specific study plan for effectiveness monitoring, in consultation with the fish passage agencies. During the initial year of operation (license Year 7), FirstLight would operate the net for one season to identify issues or concerns with operation and effectiveness (shakedown year). During years 10 and 11, FirstLight would conduct representative and quantitative fish passage initial effectiveness testing to measure downstream passage survival and time to pass. Success criteria for passage time and survival are defined in the FFPSA as follows:

- 95% of juvenile American shad arriving 500 meters upstream of the Northfield Mountain tailrace survive migration past the Northfield Mountain tailrace within 24 hours.
- 95% of adult American shad arriving 1 kilometer upstream of the Northfield Mountain tailrace survive migration past the Northfield Mountain tailrace within 24 hours.
- 95% of American eel arriving 1 kilometer upstream of the Northfield Mountain tailrace survive migration past the Northfield Mountain tailrace within 48 hours of a flow event. The definition of what constitutes a flow event would be determined by the licensee in consultation with NMFS, FWS and Massachusetts DFW during effectiveness study plan development.

FirstLight would report the results of the monitoring in the spring of the following year. If results show that the performance criteria are not met, FirstLight would consult with NMFS, FWS and Massachusetts DFW to identify adaptive management measures to implement, which could include modifying the mesh size of the net and/or improved net maintenance measures. Additional monitoring would occur after implementation of the selected adaptive management

measure in Years 14 and 15. FirstLight would then consult with these same agencies to determine the need for another adaptive measure. If needed, FirstLight would implement and test the selected measure in Years 17-18.

Additionally, FirstLight would develop, in consultation with NMFS, FWS and Massachusetts DFW, a fish passage facilities and operation plan for the barrier net. The plan would detail how and when the net would operate and describe routine maintenance activities that FirstLight would implement both during and outside of the deployment season. FirstLight would prepare annual O&M reports summarizing the operation and status of the net.

NMFS's and FWS's fishway prescriptions contain the same measures as the FFPSA.

Massachusetts DEP conditions 20, 21, 22, 23, and 24 specify the same measures as the FFPSA and NMFS's and Interior's fishway prescription. However, Massachusetts DEP conditions 20, 21, and 22 specify the measures be implemented earlier, which we discuss in the section entitled *Fish Passage Improvements Implementation Timeline*. In addition, Massachusetts DEP condition 20 also specifies that FirstLight make modifications to the barrier net design that are necessary to protect endangered shortnose sturgeon and effectiveness testing and performance goals. Six Massachusetts state legislators recommend that FirstLight perform inspections and tests on the barrier net during the season it is installed to ensure its effectiveness throughout the whole season. If it is not performing as designed, they recommend that an adaptive management measure be in place to ensure that FirstLight improves the functioning of the barrier net and therefore the survival rate of fish species.

As an off-license provision, FirstLight would fund habitat improvement projects and/or American shad fishery management activities to offset the potential loss of shad eggs and larvae (ichthyoplankton) entrainment at the Northfield Mountain Project.

Our Analysis

Entrainment and Impingement of American Shad and American Eel—Telemetry studies conducted by FirstLight determined that no radio-tagged adult shad were entrained by the Northfield Mountain Project during their respective upstream spawning migration and downstream emigration (Kleinschmidt and Gomez and Sullivan, 2016a). Tracking data, however, indicate some upstream migrating adult shad made forays into the tailrace when the project was pumping, but most upstream movements occurred between 6:00 a.m. and noon when the project was not pumping and when flows in the river were increasing and ranged between 5,000 and 10,000 cfs (Kleinschmidt and Gomez and Sullivan, 2017a). When adult shad were migrating downstream past the Northfield Mountain Project, the telemetry data suggest most did so during early morning and evening hours when Northfield Mountain Project was not operating, and river flows were approximately 10,000 cfs (Kleinschmidt and Gomez and Sullivan, 2017a). When downstream migrating fish approached the Northfield Mountain Project's intake, they did so when the project was pumping and pumping flows were increasing (Kleinschmidt and Gomez and Sullivan, 2017a). Therefore, the greatest likelihood of adult shad entrainment occurs when the Northfield Mountain Project pumping flow is increasing, and river flow is not increasing.

As discussed in *Turners Falls Downstream Passage Measures, Juvenile American Shad Downstream Passage and Survival*, FirstLight attempted to tag and track juvenile American shad to determine downstream passage route selection without success. Nonetheless, FirstLight did detect entrainment of several tagged juvenile shad into Northfield Mountain's upper reservoir

(Kleinschmidt, Gomez and Sullivan, and Aquacoustics, 2016). In addition, LMS (1993), indicate juvenile shad do become entrained into the upper reservoir, primarily when water temperatures begin to decrease rapidly in the fall. Collectively, Kleinschmidt and Gomez and Sullivan (2016a); Kleinschmidt, Gomez and Sullivan, and Aquacoustics (2016); and LMS (1993) demonstrate juvenile American shad are susceptible to entrainment when the Northfield Mountain Project is operating in pumping mode.

As for American eel entrainment, FirstLight detected two radio-tagged eel within the Northfield Mountain Project's upper reservoir. Furthermore, analysis of the 31 radio-tagged eels not detected again, but last detected at night in the vicinity of the Northfield Mountain Project intake while Northfield Mountain Project was pumping, suggests likely entrainment. Additional analysis of what environmental conditions and operations contribute to likely entrainment revealed that the susceptibility of eel entrainment increases at night and when pumping operations are at their maximum (Kleinschmidt and Gomez and Sullivan, 2017c). Conversely, the likelihood of entrainment decreased during rain events, particularly at night (Kleinschmidt and Gomez and Sullivan, 2017c).

Our analysis above suggests entrainment is most likely for juvenile American shad and American eel and may occur for adult shad. The ability to avoid entrainment is based largely on swimming ability. As previously discussed, adult American shad can swim at velocities of 5.0 to 10.8 fps whereas juvenile shad can swim at velocities up to 2.5 fps and American eel can swim at velocities between 2.4 and 4.0 fps (Bell, 1991). Measured water velocities within the Northfield Mountain Project tailrace collected by FirstLight indicate water velocities in the tailrace range from < 1.0 to 5.0 fps during maximum pumping operations (Figure 3.3.2.2-6). Therefore, adult American shad do have the swimming performance to escape entrainment, but without the additional exclusion protection provided by the proposed barrier net juvenile American shad and American eel would continue to be entrained during pumping operations and lost from the population.

Barrier nets installed at other hydroelectric projects have shown to be effective at reducing entrainment of small-bodied fish. For instance, a large barrier net with ½- and ¾-inch mesh seasonally deployed at the Ludington Pump Storage Project (FERC Project No. 2680) reduced entrainment of small (4 to 5 inches) and large alewife (greater than 5 inches) from Lake Michigan into the upper reservoir by approximately 86 and 92%, respectively (Consumers Energy and DTE Electric Company, 2020). Although the barrier nets are designed to reduce entrainment, they are size selective, and impingement upon the net may also result in some mortality. To estimate the potential risk of impingement on the proposed net, we examined modeled water velocities at the approximate location where the barrier net would be when four units are pumping, when impoundment WSE as measured at Turners Falls dam are 176.0 feet, and when flows in the river are approximately 1,760 cfs. Collectively, these conditions represent when water velocities in the vicinity of the barrier net would be highest during pumping operations. Under these conditions (without the barrier net in place), modeled water velocities where the proposed barrier would be located range between near 0 fps to near 3 fps (Figure 3.3.2.2-7). Because the mesh of the barrier net would block some of the overall flow-through area, areas of water velocities greater than 3 fps may occur along the net. Because the swimming ability of the juvenile American shad and American eel may not exceed 3 fps, some impingement mortality of some juvenile American shad and American eel could occur.

However, this may be mitigated to some degree if the sweeping velocity along the barrier net is greater than the normal velocity.

Based on our analysis above, we expect the proposed barrier net would effectively exclude adult American shad, some juvenile shad, and most American eel from being entrained at the Northfield Mountain Project, but juvenile American shad and American eel impingement mortality may occur. Given that FirstLight FFPSA proposes, NMFS's and Interior's fishway prescriptions require, and Massachusetts DEP condition 20 specifies consultation with the fish passage agencies, on the design of the barrier net, and Interior in its fishway prescription stated, "[d]uring the design review process, steps will be taken to ensure that juvenile shad impingement is minimized to the maximum extent possible" we expect the final design of the proposed barrier net would mitigate the risk of impingement of juvenile American shad and by extension, American eel. Furthermore, when approved by the Commission, installed and operational, we expect the barrier net to improve overall survival of American shad and eel migrating past the Northfield Mountain Project.

Entrainment and Impingement of Endangered Shortnose Sturgeon—Few adult shortnose sturgeon could be present in the Turners Falls Dam impoundment; therefore, they may be exposed to entrainment or impingement-related mortality when near the Northfield Mountain intake. The mesh size of barrier net proposed by FirstLight, prescribed by NMFS's and Interior's fishway prescription, and specified by Massachusetts DEP condition 20 is sufficiently small to exclude adult shortnose sturgeon and would protect shortnose sturgeon that venture near the Northfield Mountain intake from entrainment. Furthermore, a recent swimming performance study conducted by Castro-Santos et al. (2024), suggest shortnose sturgeon present in the Connecticut River have the ability to exceed estimated pumping velocities in the vicinity the Northfield Mountain intake. As a result, impingement upon the barrier net is not expected. Although the current configuration of the proposed barrier net would likely protect shortnose sturgeon from entrainment and impingement mortality at the Northfield Mountain Project, consulting with the fish passage agencies during the design phase of the net would provide assurance the net would not inadvertently affect endangered shortnose sturgeon.

Entrainment of Ichthyoplankton—American shad eggs are initially semi-buoyant but gradually sink during the water-hardening stage unless buoyed by currents. At hatching, larvae are less than 10 mm in length and are planktonic (Stier and Crance, 1985). In the Connecticut River, Marcy (1976) reported American shad eggs are distributed throughout the water column with larvae more than twice as abundant in surface waters. In 2015 and 2016, FirstLight undertook ichthyoplankton sampling at the Northfield Mountain Project to quantify the amount of American shad eggs and larvae entrained and estimate the equivalent numbers of juvenile and adults lost to the population (Kleinschmidt and Gomez and Sullivan, 2016i). In summary, FirstLight estimated that in 2015 and 2016, approximately 3 million to near 9.5 million shad eggs and 500,000 to 5.4 million shad larvae, respectively, were entrained by Northfield Mountain Project's pumping operations. FirstLight also estimates this level of entrainment resulted in a loss of at most 2,093 juvenile and 578 adult shad (Kleinschmidt and Gomez and Sullivan, 2016i). Overall, because shad eggs and larvae are small and passively drift, they lack the ability to avoid entrainment and would not be excluded by the proposed barrier; therefore, entrainment of shad eggs and larvae would continue unabated.

Barotrauma—Fish passing through hydropower infrastructure, such as turbines, can experience rapid changes in pressure, which can lead to injuries (barotrauma) that contribute to

mortality (Brown et al., 2014). FirstLight's proposed, NMFS's and Interior's prescribed, and Massachusetts DEP's specified barrier net at the Northfield Mountain Project's intake/tailrace area would reduce entrainment of American shad and American eel, as well as other fish species. Reducing entrainment would also reduce passage into and through the Northfield Mountain Project; thereby reducing the likelihood individuals of the above species from experiencing barotrauma.

Barrier Net Effectiveness Testing and Passage Performance—As previously discussed, the expected outcome of FirstLight's proposed, NMFS's and Interior's prescribed, and Massachusetts DEP's specified barrier net at the Northfield Mountain Project's intake/tailrace area would be reduced entrainment and some impingement of American shad and American eel. However, to assure the barrier net provides the intended efficacy, testing its effectiveness would be useful and inform any additional measures needed to improve its overall effectiveness. Although we do not know what methods FirstLight would employ to study the effectiveness of the barrier net, FirstLight's proposal to prepare a study plan that includes representative and quantitative methods to assess downstream passage survival and time to pass the Northfield Mountain Project, in consultation with the fish passage agencies, and filed with the Commission for approval, would enable Commission staff to determine the study plan's appropriateness in determining the efficacy of the barrier net.

Subsequent effectiveness testing after implementation of select adaptive management measures, if necessary, as discussed under *Barrier Net Adaptive Management Measures*, would occur and inform whether the net is performing as intended. Furthermore, because FirstLight would conduct up to three rounds of effectiveness testing, with two of the three rounds to occur after implementation of a possible adaptive management measure, we have no basis to require effectiveness testing during each season it is installed, as recommended by the six Massachusetts state legislators, because the proposed testing schedule would either reveal the net is effective or not. If the barrier net is determined not to be effective, additional measures and subsequent testing would be completed.

FirstLight's proposed, NMFS's and Interior's prescribed, and Massachusetts DEP specified (condition 20) passage performance standards for the barrier net for American shad and American eel are the same as those discussed above for juvenile American shad and American eel in *Turners Falls Effectiveness Testing Schedule and Performance Goals*. FirstLight's proposed, NMFS's and Interior's prescribed, and Massachusetts DEP's (condition 20) specified passage performance standards for the barrier net for American shad and American eel are the same as those discussed above for juvenile American shad and American eel in *Turners Falls Effectiveness Testing Schedule and Performance Goals*. Like above for the Turners Falls Project, evaluating the effectiveness of the proposed barrier net for American shad and American eel relative to the proposed and required performance standards would determine the need for additional remedial measures.

Barrier Net Operation Period—As previously discussed, we expect the final barrier net design would reduce entrainment of juvenile American shad and American eel at the Northfield Mountain Project but some impingement, particular for juvenile American shad, would occur. To be effective, however, the barrier net would need to be in place and operating during the time when juvenile American shad and American eel are migrating downstream past the Northfield Mountain Project. The juvenile shad and American eel passage studies conducted by FirstLight determined juvenile shad and American eel actively migrate downstream from August through

mid-November (Kleinschmidt, Gomez and Sullivan, and Aquacoustics, 2016; Kleinschmidt and Gomez and Sullivan, 2017c). Therefore, the barrier net operating period of June 1 through November 15, proposed in the FFPSA, prescribed by NMFS's and Interior's fishway prescriptions, and specified by Massachusetts DEP condition 23, would correspond with the time period when juvenile shad and American eel would be most susceptible to entrainment by the Northfield Mountain Project. As a result, operating the barrier net from June 1 through November 15 would benefit and improve juvenile shad and American eel downstream passage past the Northfield Mountain Project.

The proposed barrier net operating period of June 1 through November 15 would not prevent the entrainment or enhance passage of adult American shad migrating past the Northfield Mountain Project prior to June 1. As previously discussed, results from FirstLight's adult shad passage studies suggest that adult shad move downstream relatively quickly and that no adult shad entrainment occurs (Kleinschmidt and Gomez and Sullivan, 2017a). Therefore, installing the barrier net prior to June 1 to protect adult shad from entrainment into the Northfield Mountain Project and enhance downstream passage is not needed. We do note that adult shad typically spawn no later than mid-June in the project area; therefore, some post-spawn adult shad would benefit for the short period when they are present in the area and when the barrier net being in place by June 1. We also note that FirstLight and the agencies propose to refine the operating period of the barrier net, which would benefit shad and eel, if their respective migration timing shift. Therefore, Massachusetts DEP condition 31 that specifies FirstLight install and remove the barrier net according to a schedule set by FWS is not needed.

Barrier Net Operations and Maintenance Plan—Throughout the deployment period of the barrier net, it would likely experience biofouling[126] and could be torn by debris. In addition, the net may also become submerged or lifted because of generation and pumping operations. Biofouling, tears, and net submergence and lifting would decrease its overall effectiveness. FirstLight's proposed barrier net fish passage FOMP would be prepared in consultation with the agencies and filed with the Commission for approval. The plan would detail how and when the barrier net would be operated and describe routine maintenance activities that would occur during and outside the downstream fish passage seasons. We expect that the FOMP would include routine inspection of the net during its deployment. Performing regular inspections of the net, as recommended by the six Massachusetts state legislators, for biofouling, tears, submergence or lifting during its deployment would allow FirstLight to identify and promptly address such issues that would decrease the barrier net's effectiveness. The plan would require annual reporting regarding the status and needed repairs, maintenance concerns, or replacement, which would assist Commission staff and the resource agencies in assessing the barrier net effectiveness.

FirstLight would also amend the barrier net FOMP if any adaptive management measures are determined to be needed, or operational or physical modifications are necessary. As proposed in the FFPSA, required by the fishway prescriptions, and specified by Massachusetts DEP condition 24, FirstLight would update the barrier net FOMP prior to implementing the adaptive management measures. However, neither the FFPSA, the fishway prescriptions, nor the

[126] Biofouling is the accumulation of microorganisms, algae, plants, and animals on submerged surfaces.

Massachusetts DEP condition indicate that the barrier net FOMP, if and once amended, would be filed with the Commission. Filing the barrier net FOMP with the Commission, when amended, would keep the Commission apprised of the barrier net operations and maintenance activity and provide for enforcement of the measures in the plan.

Barrier Net Adaptive Management Measures—Pending the outcome of the barrier net effectiveness testing discussed in *Barrier Net Effectiveness Testing and Passage Performance*, FirstLight may, in consultation with the fish passage agencies, select and implement adaptive management measures to improve downstream passage survival and reduce delay at the Northfield Mountain Project. Adaptive management measures identified in the FFPSA and fishway prescriptions germane to the barrier net include: (1) alter the arrangement and size of the net panels; and (2) improve maintenance measures; these measures would be informed by the results of barrier net effectiveness studies. Therefore, at present, we have little basis to assess the effect of the adaptive management measures enhancing downstream fish passage at the Northfield Mountain Project. Nonetheless, because the selected adaptive management measures would be based on the results from the effectiveness testing and selected in consultation with the fish passage agencies, as proposed in the FFPSA and required by NMFS's and Interior's fishway prescriptions, we expect the adaptive management measures would improve overall downstream passage effectiveness at the Northfield Mountain Project.

Fish Passage Improvements Implementation Timeline

Timely execution of measures to improve fish passage is important to protect, mitigate, and enhance migratory fish populations. If implementation of these measures is delayed or prolonged, effects on these populations would persist.

In the FFPSA, FirstLight proposes to complete studies, design and construct any identified improvements, and have all downstream and upstream fish passage measures in place and operational within 13 years after license issuance at the Turners Falls Project. FirstLight also proposes to have the proposed barrier net installed at Northfield Mountain no later than seven years after license issuance.

NMFS's and Interior's fishway prescriptions include the same implementation and schedule as proposed in the FFPSA. However, Massachusetts DEP conditions 20, 21, and 22 specify earlier implementation and the following schedule:

- Install and operate the barrier net no later than June 1 of Year 5 after license issuance.
- Conduct initial effectiveness testing of the barrier net in Years 7 and 8 after license issuance, and provide reports of the initial effectiveness testing in Years 8 and 9 after license issuance.
- If adaptive management measures are needed, conduct effectiveness testing of the first round of adaptive measures in Years 10 and 11 after license issuance, and provide reports on the measure's effectiveness in Years 11 and 12 after license issuance.
- If additional adaptive management measures are necessary, conduct effectiveness testing of the second round of adaptive management measures in Years 14 and 15 after license issuance, and provide reports on the measure's effectiveness in Years 15 and 16 after license issuance.

American Rivers, Connecticut River Conservancy, and six Massachusetts state legislators all recommend FirstLight implement the proposed measures sooner. American Rivers recommends the proposed upstream measures be operational no later than 4 to 6.5 years after license issuance, and downstream measures should be operation no later than 3 to 3.5 years after license issuance. Connecticut River Conservancy and six Massachusetts state legislators recommend the barrier net at Northfield Mountain be in place no later than two years after license issuance.

FirstLight, in its response to comments received on the FFPSA, emphasizes the timeline is based on the time necessary for agency review and consultation, permitting, modeling, construction, and working around time-of-year constraints. In addition, FirstLight reiterates the explanation for the proposed timeline for fish passage improvements provided in Interior's prescription. In summary, FirstLight states providing downstream passage for American shad is a priority, and having the downstream measures in place performing to required standards is needed before introducing more fish upstream. Regarding American eel, FirstLight states that interim upstream eel passage will be provided within the first year of license issuance, and the first expected out-migrants would occur no earlier than seven years after license issuance, at which point the downstream passage measures, including the barrier net at Northfield Mountain, would be operating.

Our Analysis

Table 3.3.2.2-16 provides the implementation schedule of FirstLight's proposed upstream and downstream fish passage improvements as proposed in the FFPSA, required by NMFS's and Interior's fishway prescriptions, and specified by Massachusetts DEP conditions. Table 3.3.2.2-16 indicates that, other than the upstream interim eel passage at the Turners Falls Project, the downstream fish passage measures would be constructed and become operational before the proposed upstream passage measures. Constructing and operating the downstream passage measures first would be more consistent with the Connecticut River Atlantic Salmon Commission (CRMFRC) (2022) than constructing the upstream measures.[127] For instance, a goal of CRMFRC (2022) is to increase the number of American shad repeat spawners and establish a diverse age structure. Repeat spawners have higher fecundity, which results in greater reproductive potential and development of a population with a diverse age structure. In turn, a population with a diverse age structure and cohorts that have higher reproductive potential promotes a population that is resilient to stochastic environmental factors that negatively impact annual recruitment and survival (Davis and Schultz, 2009; Holsinger, 1995). Conversely, a homogeneous population composed mostly of first-time spawners suggests reduced population viability (Leggett and Carscadden, 1978; Leggett et al., 2004; Olsen et al., 2004). Constructing the upstream passage facility firsts, on the other hand, would result in more fish being passed upstream, but that benefit would be negated through the cumulative effect of reduced downstream passage survival. Constructing the downstream passage facilities first also has a practical advantage of avoiding dewatering constraints associated with constructing the plunge pool beneath Bascule Gate No. 1. At that time, all river flow would be spilled when the power

[127] CRMFRC (2022) is comprehensive plan filed pursuant to section 10(a)(2)(A) of the FPA.

canal is dewatered to facilitate the construction of downstream passage improvements at Cabot Station and Station No. 1.

According to Interior's fishway prescription, "[t]he intent of this [schedule] is to identify and rectify passage problems that hinder achievement of performance standards before new upstream passage facilities are in place and passing many more fish upstream that then need to pass through the project on their downstream outmigration." It is possible the passage measures proposed in the FFPSA and required by NMFS's and Interior's fishway prescriptions could be implemented sooner, as FirstLight would not be prevented from starting the improvements earlier. However, FirstLight would implement the fish passage measures through iterations of design, consultation, testing, and reporting with the fish passage agencies, a process that can be time consuming but necessary to assure the efficacy of the measure. Considering time-of-year construction restrictions, the schedule and implementation timeline proposed in the FFPSA and specified in NMFS's and Interior's fishway prescriptions for the Turners Falls Project is reasonable.

FirstLight would install and operate the proposed barrier net at the Northfield Mountain Project's intake after the downstream Cabot Station and Station No. 1 downstream measures are in place (no later than Year 7 after license issuance), but before the spillway lift and plunge pool at the Turners Fall dam is operational. FirstLight and Interior state the construction of the net in Year 7 would accomplish the goal of improved downstream passage being in place before the spillway lift operations introduces more American shad upstream. FirstLight and Interior also state that at Year 7 the first of the additional American eel being passed upstream from the interim eel passage would emigrate. Therefore, it appears FirstLight's proposal to install the barrier net in Year 7 is driven by future abundances of juvenile American shad and American eel rather than mitigating existing levels of entrainment and mortality. As previously discussed, juvenile American shad and American eel entrainment at Northfield Mountain is documented. Without installing the barrier net sooner, as specified by Massachusetts DEP condition 20 (by June 1 Year 5 after license issuance), and recommended by Connecticut River Conservancy and Massachusetts state legislators, existing levels of juvenile American shad and American eel entrainment would continue, at least until the net is installed in Year 7 after license issuance. However, if the net is installed earlier than the downstream measures at Cabot Station and Station No. 1 are implemented, then the benefit of the barrier net enhancing downstream passage survival of juvenile American shad and American eel would be reduced. In short, installing the barrier net earlier than Year 7 after license issuance would benefit the juvenile shad and American eel more than deferring installation to Year 7 after license issuance. We see no reason that the barrier net could not be installed no later than June 1 in Year 5 after license issuance, consistent with Massachusetts DEP condition 20, with initial effectiveness testing in Years 7 and 8.

Resident Fish Impingement and Entrainment

The passage of large volumes of water through trashracks and turbines can result in fish impingement and entrainment mortality at hydropower projects. Blade strikes are thought to be the primary source of mortality for fish entrained through hydropower projects (Franke et al., 1997; Pracheil et al., 2016). Fish size plays an important role in entrainment susceptibility and turbine mortality (smaller fish are more likely to be entrained, but experience lower turbine mortality), although the physical properties of turbine units also play a role in turbine mortality

(Winchell et al., 2000; Čada et al., 1997; Pracheil et al., 2016). Depending on the demographic traits of the species that experience turbine mortality and their ability to recolonize areas, effects of mortality attributable to hydropower operations could influence a population's sustainability (Čada and Schweizer, 2012).

FirstLight does not propose specific measures to minimize resident fish mortality related to impingement and entrainment at the Northfield Mountain or Turners Falls projects. However, FirstLight's downstream passage measures proposed in the FFPSA and required by NMFS's and Interior's fishway prescriptions, to replace the existing Cabot Station trashrack structure with a new full-depth trashrack, construct a clear-spaced bar rack at the entrance to the Station No. 1 branch canal, and seasonally operate a barrier net at the Northfield Mountain Project's intake may affect existing level of impingement, entrainment, and turbine mortality for all fish species at the projects.

Gerald Szal, a member of the Western MA Right of Nature, recommends FirstLight install a rotating screen with an approach velocity of 0.5 fps at the Northfield Mountain Intake to mitigate impacts to shortnose sturgeon, American shad, and other resident fish.

FirstLight did not provide a response to Mr. Szal's recommendation.

Our Analysis

FFPSA and Section 18 Prescribed Measures—As discussed in section 3.3.2.1, *Fisheries Resources*, the Connecticut River in the project areas supports a diverse assemblage of cold- and warmwater resident fish species. Table 3.3.2.1-12 lists the resident fish species collected by FirstLight within the Turners Falls power canal and near the Northfield Mountain intake. These species utilize a variety of lotic and lentic habitats and do not require downstream passage from the impoundment to complete their life-history requirements. However, they could still encounter the project's intakes while moving among habitats and experience mortality related to impingement and turbine mortality from entrainment.

We assessed the potential impingement of the species in Table 3.3.2.1-12 through a comparison of the existing and proposed trashrack spacing at Cabot Station and Station No. 1, respectively, relative to fish body widths based on published body width to length ratios. Tables 3.3.2.2-17 and 3.3.2.2-18 present this comparison and show that most fish species would not become impinged but fit through the existing and proposed trashrack at Cabot Station and bar rack at Station No. 1. Tables 3.3.2.2-17 and 3.3.2.2-18 also show that no fish present in the Turners Falls impoundment in the vicinity of the Northfield Mountain Project likely would have a body width that would result in impingement upon the Northfield Mountain Project's trashrack.

Resident fish that are small enough to fit through trashrack bars are likely to behaviorally avoid entrainment and could escape entrainment if their burst speed is greater than the water velocity at the intake (Knapp et al., 1982). 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 sense flow acceleration near the trashrack and sound from the turbine operation. Resident fish sensing these cues would typically respond by swimming away from the intake at burst speed. To assess possible entrainment for the species listed in Table 3.3.2.1-12, we compared estimates of the respective intake approach velocities to estimates of the fish species swim speed. This comparison reveals that most smaller individuals do not have the burst swimming ability escape the intake velocity at Cabot Station, Station No. 1, or

Northfield Mountain, particularly relative to estimated intake velocities of the proposed trash and bar rack at Cabot Station and Station No. 1, respectively. As a result, those smaller individuals could experience turbine mortality.

Winchell et al. (2000) describes the average composition of entrained fishes by size-class and compiled entrainment survival data across 37 projects to evaluate trends in survival related to fish size, turbine type, rotational speed, and hydraulic capacity. Winchell et al. (2000) found that small fish (8 inches or less), make up over 90% of all entrained fish with small fish (4 inches or less) accounting for 61% or more of all entrained fish regardless of trashrack spacing. In addition, Winchell et al. (2000) found survival rates observed for radial-flow (Francis) were generally highest for smaller fish and for turbines with rotational speeds less than 250 revolutions per minute, like those at Cabot Station. For fish less than 8 inches, 48-hour survival rates were greater than 46% for higher-speed turbines (like Unit 2 at Station No. 1), and 88% for lower-speed turbines (like Units 1 through 6 at Cabot Station). Considering these data and the only higher-speed turbine is Unit 2 at Station No. 1, we expect the average entrainment survival rate for small and juvenile resident fish that are entrained to be greater than 85% and 75% at Cabot Station and Station No. 1, respectively.

As discussed for American shad and American eel, we expect resident fish near the intake of Cabot Station would be guided to and utilize the downstream fish bypass, particular with the proposed improvements. Furthermore, we anticipate that entrainment through the proposed branch canal entrance bar rack leading to Station No. 1 would be mitigated by the higher sweeping velocities relative to the normal intake velocity. Therefore, we expect entrainment mortality at Cabot Station and Station No. 1 would be reduced relative to existing levels. At the Northfield Mountain Project, however, only when the proposed barrier net is in place (June 1 through November 15) would entrainment and subsequently passage mortality be reduced. Otherwise, entrainment and passage mortality would continue at existing levels.

Northfield Mountain Intake Rotating Screen—Rotating screens are generally employed to reduce entrainment at cooling water intakes, water supply intakes, and irrigation canals. For a screen to be installed at the Northfield Mountain tailrace, the screen would need to be sized to pass the expected maximum pumping flow or about 15,200 cfs at the allowable approach velocity of 0.5 fps. To compute this area, we followed the guidance provided in NMFS (2023), which states, "[t]he minimum effective screen area required is defined as the maximum screen flow divided by the allowable approach velocity." Therefore, at Northfield Mountain, a screen would need to be at least 30,400 square feet, which excludes major structural elements that support the panels or rotating drums or cylinders. As a result, the cost to construct the proposed screening facility would be significant and not outweigh the benefit of the proposed barrier net.

Mitigation Funds

As an off-license provision, FirstLight proposes to fund habitat improvement projects and/or American shad fishery management activities to offset the potential loss of shad eggs and larvae (ichthyoplankton) entrainment at the Northfield Mountain Project.

In response to FirstLight's proposed off-license ichthyoplankton mitigation fund, American Rivers recommends, "[t]he mitigation fund should be calculated on impacts to all life stages of American shad and should be adaptive based on actual returns." To do this, American

Rivers recommends basing payment to the fund "on a rolling average (i.e., a three-year window) of passage at Turners Falls."

The Ashuelot River Local Advisory Committee recommends that FirstLight and Great River create and fund a mitigation enhancement fund to compensate for future impacts and support restoration and enhancement projects.

FirstLight provided no response to American Rivers' or the Ashuelot River Local Advisory Committee's recommendations.

Our Analysis

As a general matter, the mere establishment of a mitigation fund would be an administrative action that would have no direct project-related benefit to environmental resources affected by the projects. Moreover, because the Commission only has authority over a licensee through a license, the Commission could not ensure that the fund would be used to fulfill a project-related purpose without a requirement that the licensee also implement the measure (or ensure implementation) to be funded. However, there are no specific measures to analyze in this case because neither the parties to the FFPSA nor the Ashuelot River Local Advisory Committee have proposed a specific project to be funded. Consequently, there is no method for staff to determine the benefits of these funds.

3.3.3 Terrestrial Resources

3.3.3.1 Affected Environment

FirstLight's study area for terrestrial resources in the Northfield Mountain and Turners Falls projects encompasses the following: (1) upland areas along the Turners Falls impoundment, including areas within the Turners Falls project boundary, and areas up to 200 feet from shore where the Turners Falls project boundary is along the shoreline; (2) upland areas adjacent to the bypassed reach, extending from the Turners Falls dam to the Cabot Station tailrace; and (3) the Connecticut River from the Cabot Station tailrace to the Route 116 bridge in Sunderland.

General Vegetation

FirstLight mapped vegetation community types within the terrestrial study area (Kleinschmidt and Gomez and Sullivan, 2016j) (Table 3.3.3.1-1). Plant communities surrounding the projects consist mostly of northern hardwood forest, white pine-oak forest, hemlock ravines, cropland, and developed areas. A full description of the community types, including dominant species, is provided in the project license application and FirstLight's baseline study of terrestrial wildlife and botanical resources (Kleinschmidt and Gomez and Sullivan, 2016j).

Wetland, Riparian, and Floodplain Habitats

FirstLight documented approximately 1,382 acres of wetland habitat within the study area by reviewing the National Wetlands Inventory data set and conducting field surveys to confirm features identified in the National Wetlands Inventory data. Table 3.3.3.1-2 presents acreages of wetlands by wetland type. FirstLight did not quantify the acreage of riparian habitat but completed botanical assessments to determine species composition, structure, and

distribution of vegetative communities within riparian habitats at the Northfield Mountain and Turners Falls projects (Kleinschmidt and Gomez and Sullivan, 2016l,m, 2017d).

The Northfield Mountain Project has no floodplains, and FirstLight did not quantify the area of floodplains within the Turners Falls Project. The upstream reach of the Turners Falls impoundment, extending approximately 15 miles from Vernon dam tailrace to the Northfield Mountain Project tailwater, is located within a broad floodplain.

State-listed Plants and Exemplary Natural Communities

The Connecticut River and adjacent lands support a number of state-listed RTE plant species and exemplary natural communities.[128]

FirstLight referred to a botanical survey by Tighe and Bond (2006) on lands where project activities occurred and consulted with the state to identify state-listed RTE species with potential to occur in the study area and be subject to potential project effects. Massachusetts DFW indicated that the projects intersect Priority Habitat[129] and Estimated Habitat.[130] In 2014 and 2015, FirstLight conducted field surveys for potential suitable habitat and historic RTE plant occurrences, focusing on 10 target species that could occur below normal operational flows or impoundment elevations, or within or partially within normal operational flows or impoundment elevations (Kleinschmidt, Gomez and Sullivan, and NEE, 2015). FirstLight confirmed the occurrence of seven of nine state-threatened or endangered plant species known to occur within the study area and two state species of concern (see Table 3.3.3.1-3). The bypassed reach provides most of the suitable and preferred habitat, particularly for Tradescant's aster, which was the most abundant targeted state-listed species recorded at the projects.

Invasive Plants

Invasive plant species are prevalent throughout the Connecticut River Valley and have been observed in abundance along the riverbanks and in most vegetation communities within the study area.

FirstLight conducted surveys of the project shorelines and recorded locations of species on the Massachusetts Invasive Plant Advisory Group list of invasive plant species occurring in Massachusetts to document the current distribution of noxious weeds at the Northfield Mountain and Turners Falls projects. FirstLight identified 25 invasive plants in the study area (see Table 3.3.3.1-4). The five most common invasive plant species were oriental bittersweet, Japanese knotweed, multiflora rose, Japanese barberry, and black swallow-wort. Invasive species occurring within the study area are present in areas that have been cleared in the past and

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[128] Exemplary natural communities are outstanding examples of natural community types representing the best remaining occurrences in the state.

[129] Priority Habitats are designated by the Massachusetts Endangered Species Act and include the known geographical extent for state-listed rare plant and animal species.

[130] Estimated Habitats are a subcategory of Priority Habitats, designated by the Wetlands Protection Act, and include the geographical extents of habitat of state-listed rare wetlands wildlife.

are subsequently labeled as disturbed habitat. The forested habitat in the study area along the river has varying amounts of invasive species abundance and distribution. Invasive species cover is between 26% and 50% of the vegetative cover along the shoreline in the Turners Falls impoundment from the Route 10 bridge upstream to Stebbins Island (just below Vernon dam). Invasive species concentrations generally decrease downstream of the Route 10 bridge. However, Barton Cove hosts a high concentration of invasive plants, particularly around the shoreline of Unity Park and around the Massachusetts State Boat Launch, which is owned, managed, and maintained by the Massachusetts Department of Conservation and Recreation. Invasive species around the Barton Cove area are routinely mechanically cut following roadside mowing practices.

The eastern side of the bypassed, which has historically been altered many times, maintains an invasive cover of 26% to 50% along the shoreline. This contrasts with the undisturbed banks along the western shore of the bypassed, which contain less than 5% invasive plant cover. Downstream of Cabot Station, invasive plant species are largely limited to discrete patches and river islands where purple loosestrife and Japanese knotweed occur. Invasive shrubs, particularly Japanese barberry and multiflora rose, exist among the periphery of many of the recreation sites. Seed and vegetative reproduction sources for invasive species recorded at the site are prevalent in the surrounding landscape.

FirstLight reported several invasive aquatic species, including variable leaf milfoil, Eurasian milfoil, curly-leaf pondweed, fanwort, and water chestnut, occurring in the Turners Falls project boundary. In total, 41 of the mapped 107 SAV beds (38%) had some level of exotic species presence. Most exotic species were immediately upstream of the Turners Falls dam, with fewer occurrences upstream of the French King bridge. In general, exotic species upstream of the French King bridge are not as widespread and occur at lower densities. No exotic SAV was identified in mapped SAV beds below the bypassed reach. The greatest area of SAV beds are dense, with the largest beds located near Barton Cove and the Turners Falls dam. These beds account for approximately 223 acres of the total area of dense SAV beds (approximately 75%) mapped with estimated density of 51% to 100%. In most cases, very dense stands were dominated by exotic species, primarily variable leaf and Eurasian milfoil (Kleinschmidt and Gomez and Sullivan, 2016l).

General Terrestrial Wildlife

The Connecticut River provides habitat for a variety of wildlife species common to northeastern forests, woodlands, and wetlands. At the Northfield Mountain and Turners Falls projects, FirstLight conducted wildlife surveys and directly and indirectly observed 36 mammal species and 64 bird species; and documented 23 species of amphibians and reptiles via observations or likely occurrence due to suitable habitat (Kleinschmidt and Gomez and Sullivan, 2016j). Common mammals observed across the projects included white-tailed deer, black bear, coyote, grey fox, red fox, beaver, muskrat, opossum, grey squirrel, red squirrel, eastern chipmunk, mice, and voles. Common amphibians included spring peeper, bullfrog, wood frog, green frog, American toad, and several salamander species. Common reptiles included eastern garter snake, northern water snake, painted turtle, snapping turtle, and spotted turtle. Bird species commonly observed on or near the river are discussed below under *Wetland-Dependent Birds and Waterfowl*. Upland birds included various species of warblers, woodpeckers, and sparrows; American crow, common raven, blue-headed vireo, blue jay, black-capped chickadee,

cedar waxwing, eastern wood peewee, eastern phoebe, indigo bunting, northern cardinal, oven bird, red-eyed vireo, orchard oriole, scarlet tanager, and veery.

Migratory Birds

Migratory birds are protected under the Migratory Bird Treaty Act of 1918, enforced by FWS. FWS's Information for Planning and Conservation (IPaC) database identifies 28 species of birds of conservation concern that have potential to either nest in the project vicinity or migrate through the projects to nesting areas elsewhere. Table 3.3.3.1-5 lists these species and provides preferred habitat characteristics, nesting season (for species that nest in the project area), and notes whether FirstLight observed the species during field studies.

Wetland-Dependent Birds and Waterfowl

The Connecticut River corridor provides important habitat within the Atlantic Flyway for more than 150 bird species (Smith College et al., 2006). Throughout the year, the river and its adjacent wetlands provide food for numerous birds. During the spring and summer, many species breed and nest along the river. In spring and fall, the river is a major migratory corridor, and during winter, it provides habitat for species of waterfowl that nest farther north. Locations within the terrestrial project area providing stopover habitat for migratory species are especially important.

During relicensing studies for other wildlife, FirstLight reported 64 species of birds were observed on or near the river. Most species were found in the surrounding upland floodplain, rather than using aquatic habitat. FirstLight observed 17 bird species that are typically associated with wetlands or open waters in the Northeast; these species included bald eagle, bank swallow, belted kingfisher, Canada goose, common merganser, common nighthawk, double-crested cormorant, great blue heron, great egret, green heron, mallard, osprey, red-winged blackbird, spotted sandpiper, wood duck, northern rough-winged swallow and the nonnative mute swan.

State-listed Terrestrial Wildlife

FirstLight consulted the Massachusetts DFW Natural Heritage and Endangered Species Program to identify state-listed wildlife species with potential to occur in the Northfield Mountain and Turners Falls project areas. In summers 2014 and 2015, FirstLight conducted shoreline surveys of the Turners Falls impoundment, by boat, for any state-listed species. FirstLight performed additional wildlife surveys concurrently with vegetation and wetland surveys.

Of the state-listed wildlife that could occur in the study area, FirstLight documented the occurrence of five species: (1) bald eagle (*Haliaeetus leucocephalus*), (2) bank swallow (*Riparia riparia*), (3) peregrine falcon (*Falco peregrinus*), (4) riverine clubtail (*Stylurus amnicola*), and (5) spine-crowned clubtail (*Hylogomphus abbreviates*). Additionally, although not encountered during surveys, suitable habitat is present for five state-listed reptiles and amphibians: (1) eastern box turtle (*Terrapene carolina*), (2) eastern spadefoot (*Scaphiopus holbrokii*), (3) Jefferson salamander (*Ambystoma jeffersonianum*), (4) marbled salamander (*Ambystoma opacum*), and (5) wood turtle (*Glyptemys insculpta*).

Bald eagles have been delisted but remain protected by states and the Bald and Golden Eagle Protection Act (see Table 3.3.3.1-6). They are year-round residents along the Connecticut River, roosting and nesting in riverbank trees and foraging over the river. FirstLight noted that bald eagles are present at the Northfield Mountain and Turners Falls projects, and reported three occupied nests located downstream on Third Island (below Cabot Station), near Smead Island; Barton Island in Barton Cove; and along the east bank of Turners Falls impoundment across from Stebbins Island. FirstLight also has anecdotal reports of two bald eagle nests within the Turners Falls impoundment, one in the vicinity of Kidd's Island and another on a hillside in the vicinity of the Turners Falls Airport. During winter, large numbers (greater than 20) of bald eagles congregate around ice-free water and roost at two locations, one downstream of Wilder dam near Westmoreland, New Hampshire, and another just below the Vernon dam.

The cobblestone tiger beetle occurs the banks of the Connecticut River, but has extremely restricted habitat (see Table 3.3.3.1-6). FirstLight completed reconnaissance surveys of known and historic locations of cobblestone tiger beetle habitat, identified beaches that provide suitable cobblestone tiger beetle habitat from Cabot Station downstream to Rainbow Beach, and performed surveys during August when adults are active (Kleinschmidt and Gomez and Sullivan, 2016l). Surveys located no cobblestone tiger beetles, and the single known population from a site in Montague, Massachusetts, was likely extirpated during severe floods associated with Hurricane Irene in August 2011.

FirstLight surveyed the Turners Falls impoundment, the bypassed reach, and downstream reach in 2014, 2015, and 2016 for the abundance and distribution of odonates (Biodrawversity and Gomez and Sullivan, 2016b). In 2014, 11 species were identified during presence/absence observations. Biologists collected 662 individuals representing 16 species in 2015 and 156 individuals representing 4 species in 2016 (see Table 3.3.3.1-7). *Epitheca princeps* was the most common species collected in Barton Cove. *Perithemis tenera* and *Libellula sp*. were also found in Barton Cove, but they were not found at any of the survey sites in the bypassed reach or downstream of Cabot Station. Species most abundant in the Turners Falls bypassed reach and downstream from Cabot Station included *Gomphus vastus* (55% of total), *Stylurus spiniceps* (13% of total), and *Boyeria vinosa* (12% of total). Massachusetts state-listed odonates collected during the 2014 through 2016 surveys included the state-endangered *Stylurus amnicola,* the state-threatened *Gomphus ventricosus*, and the state species of concern *Gomphus abbreviates.* No state-listed species were found in the impoundment surveys. Fourteen *Gomphus abbreviates* were found in the bypassed reach upstream and downstream from Rock dam. *Stylurus amnicola* were collected in very low numbers from the Deerfield River confluence downstream to the Route 116 bridge.

3.3.3.2 Environmental Effects

Wetland, Riparian, and Floodplain Habitats

Project dams modify spring flood flows that transport nutrients into littoral, wetland, riparian, and floodplain habitats, and have altered the natural fluctuation of water levels on which many plants and animals depend. The wetland plant communities along the river and impoundments have thus developed based on their positions relative to water level fluctuations. Littoral vegetation communities occur almost exclusively below the lower limit of water level fluctuations. Proposed changes in project operations could alter the seasonal timing, frequency,

intensity, and duration of inundation for some plants growing within the project boundaries. Areas with increased inundation could see a shift toward wetland-dominated vegetation communities. Conversely, areas with decreased inundation could trend toward more upland-dominated communities. Bank erosion could also reduce the width of riparian vegetation growing within the project areas.

As described in the FFPSA, FirstLight would increase the usable storage at the Northfield Mountain Project from the current elevation range of 1,000.5 to 938 feet to 1,004.5 to 920 feet. FirstLight would continue to operate the Northfield Mountain and Turners Falls projects such that project-related fluctuations in the Turners Falls impoundment remain between 176.0 feet and 185.0 feet, as measured at Turners Falls dam. FirstLight would also increase minimum flows in the bypassed reach and reduce the variation in outflows downstream of Cabot Station, although more fluctuation would be allowed for a limited number of hours per month during peaking operations.

As a component of the Recreation Settlement Agreement, FirstLight proposes to place undeveloped FirstLight lands not used for specific project activities along the Turners Falls impoundment shoreline in conservation easement to maintain riparian buffers.

Massachusetts DEP condition 13 specifies the FFPSA Article B100 Northfield Mountain impoundment WSEs, and condition 10 amends FFPSA Article A190 for Turners Falls impoundment WSEs. As specified in the condition, FirstLight would maintain Turners Falls impoundment water levels between elevation 178.5 feet and 185 feet except under specified provisions for discretionary events to operate between elevations 178.5 and 177.5 feet for no more than 168 hours per year and 12 hours per event; and provide the ability to draw down to the extent necessary but no lower than 177.5 feet for nondiscretionary events.

Massachusetts DEP condition 28 specifies FirstLight prepare a riparian management plan and map for lands along the Connecticut River that FirstLight owns in fee and are not needed for specific project purposes. The goal of the plan would be to maintain a 75-foot vegetated riparian zone along the river to: (1) serve as a filter to reduce non-point source discharges of oil and grease, sediment, nutrients and fertilizers, pesticides, and other contaminants that may be transported to the Connecticut River in overland runoff; (2) protect near shore fish, aquatic life, and wildlife habitat from degradation resulting from adjacent uses and disturbances and from alterations to the riparian zone including docks, riprap, and other structural modifications; (3) provide significant wildlife habitats and buffers adequate to avoid disturbance from adjacent uses for species using the river and associated wetlands, including threatened, or endangered wildlife species, or other state or federally listed species of concern; and (4) provide shade and cover, which cools water and air temperatures; increases food and oxygen availability; serves as an area for shelter, breeding, and migratory and overwintering stops; and promotes amphibious organisms.

To achieve the stated goals the riparian management plan would: (1) specify how a 75-foot riparian zone adequate to protect water quality and designated and existing uses would be implemented, specifically addressing how long-term conservation of important riparian areas would be assured; (2) allow the revegetation and protection of existing vegetation on all project lands within 75 feet of the riverbank and prevent any alteration of such land, except to the extent necessary to enhance revegetation or to the extent of a conflict with deeded rights, the Recreation Settlement Agreement filed with the Commission on June 12, 2023, or the FERC "Order

Modifying and Approving Non-Project Uses of Project Lands and Waters" dated October 28, 2009; (3) specifically propose how the entire plan would be implemented; (4) specify which parcels are excluded from the riparian management plan because they are used for the specific project purposes identified above; (5) be subject to existing deeded or contractual rights held by third parties with respect to land owned by FirstLight; (6) not require the use of Conservation Restrictions or easements, except where required by the Recreation Settlement Agreement; and (7) be consistent with state laws related to wetland protection and the management of inland fish and wildlife resources.

Our Analysis

The sparse or lack of littoral vegetation in riverine sections is expected to persist because although water levels would fluctuate less often, flow velocities would remain too strong for most aquatic species to persist. Emergent and scrub-shrub wetlands commonly occur within the zone influenced by normal project operations and would increase as a result of more stable water levels under FirstLight's proposed project operations. Forested wetlands are typically located above the upper limit of water level fluctuations, as are other riparian vegetation communities bordering the river. The disturbance regime in these areas is primarily driven by large flood flows. The project has no influence over the frequency and magnitude of these large flows. It is unlikely that project fluctuations in water levels would adversely affect forested wetlands and riparian areas surrounding Turners Falls impoundment because the existing upper and lower limits of operation effects on the water surface would remain. However, the FFPSA flow regime would reduce the magnitude and duration of inundation at the upper limits of the fluctuation zone, which are typically inundated following peaking operations at Northfield Mountain. At a local scale within the fluctuation zone, there may be conversion between emergent and scrub-shrub wetlands because higher elevations would tend to be drier, and lower elevations would tend to be wetter than under existing conditions. Proposed project operations, as described in the FFPSA, would reduce existing adverse impacts on wetland, riparian, and floodplain communities by reducing overall water level fluctuations.

Limiting reservoir fluctuations by increasing the minimum reservoir elevation to 178.5 feet would further reduce fluctuations in reservoir levels. Raising the normal minimum reservoir level above the existing condition would increase inundation frequencies for vegetation occurring between 176 feet and 178.5 feet. Under current and proposed conditions, this area is periodically exposed and is likely to support wetland vegetation. Permanently inundating this area would likely result in the conversion of some shrub-scrub or forested wetlands to emergent wetlands and could convert some areas of emergent wetland to submerged aquatic vegetation or open water.

The proposed increase in minimum flows in the bypassed reach and downstream of Cabot Station would increase soil moisture and could convert some forested wetlands to scrub-shrub or emergent wetlands, particularly on islands. The FFPSA operations would support the regeneration and maintenance of wetland vegetation by providing a more stable water table during the growing season, compared to current operations. This flow regime would likely contribute to the development of new forested wetlands because base flows would be higher and better able to support riparian tree seedlings at higher elevations than current minimum flows, likely expanding riparian tree development in the floodplain (Mahoney and Rood, 1998; Shafroth et al., 2002; Polzin and Rood, 2006).

Placing the undeveloped FirstLight lands along the Turners Falls impoundment shoreline and downstream of Cabot Station into conservation easements would protect these areas from potential development or vegetation removal in the future. This measure would maintain the existing health and function of riparian vegetation and bank stability, as well as protect habitat value for wildlife. Development of a riparian management plan, as specified in Massachusetts DEP condition 28 would provide a formal framework to manage these lands and to meet specific goals associated with ecological functions of riparian buffers, including benefits to water quality and habitat for fish and wildlife. Development of the plan, in consultation with Massachusetts DEP; FRCOG; Connecticut River Conservancy; the towns of Northfield, Montague, Erving, and Gill; the Nolumbeka Project; and the Chaubunagungamaug Band of Nipmuck Indians would provide for stakeholder input.

Invasive Plants

FirstLight manages vegetation in areas around the Northfield Mountain upper reservoir for dam safety and surveillance. FirstLight also manages vegetation along the power canal. FirstLight proposes to continue these existing practices, which primarily entail mowing herbaceous vegetation during the growing season.

Invasive plants have the potential to displace native plant communities and degrade wildlife habitat. Some invasive plants are toxic to wildlife as well as humans, while others provide limited ecological value compared to native species that have co-evolved with local wildlife. Project O&M activities, such as vegetation trimming and clearing, hazard tree removal, and snow removal, could disturb soil and native vegetation or introduce and spread invasive plants. FirstLight is proposing some limited ground-disturbing activities in connection with the development of mountain biking trails at Northfield Mountain and construction of the plunge pool at Turners Falls. However, there is no proposed large-scale ground-disturbing activities or vegetation removal such as construction or land-clearing that could facilitate the spread of invasive plant species within the project boundaries.

Fluctuating water levels may affect the spread of invasive plants because high flows clear areas for plants to establish by removing existing vegetation, spreading propagules, and making nutrients available. Declining water levels expose soil, making space and resources available to invasive plants that are often better adapted than native species to fluctuating water levels (Richardson et al., 2007).

FirstLight proposes to implement a Northfield Mountain Invasive Plant Species Management Plan and a Turners Falls Invasive Plant Species Management Plan (FirstLight, 2024a,b). Both plans include implementing the following measures during routine maintenance: (1) prohibit active planting of invasive species; (2) monitor areas of disturbance caused by routine project O&M to ensure invasive plants do not out-compete desirable vegetation; (3) instruct personnel to visually inspect boating equipment for attached vegetation; (4) clean and dry boats following removal from the water and remove all visible plants and animals; and (5) post signage at project recreation sites that explains the threats of nonnative aquatic species and steps to prevent their spread.

Both plans include the following measures associated with construction or major maintenance activities: (1) train personnel to identify invasive plants and understand the importance of infestation prevention; (2) remove vegetation material from construction

equipment before entering an invasive-free area; (3) remove invasive plants from areas where they could potentially be spread by workers or construction vehicles, including along roads; (4) use gravel and fill from invasive-free sources, where practical; and (5) use certified invasive-free straw, mulch, fiber rolls, and sediment logs for erosion and sediment control, where practical.

Both plans include the following measures to be implemented by licensee personnel and contractors during seeding and planting activities: (1) use soil and mulches from invasive-free sources, where practical; (2) make a reasonable effort to only use native seed mixes for reseeding disturbed areas; (3) conduct seeding and planting operations in a manner to promote vigorous growth of native species and discourage invasive species; (4) seed bare ground following disturbance; (5) monitor seeded areas for infestation by invasive species; (6) remove invasive species from seeded areas during the first growing season; (7) use mulch to limit undesirable seeds from reaching bare soil, where practical; and (8) following construction, monitor any areas of disturbance caused by project activities on licensee-owned lands within the project boundaries as needed to ensure that invasive species do not out-compete desirable vegetation during reestablishment.

In addition to the measures described above, the Turners Falls plan includes specific measures for aquatic invasive species. In the first summer after license issuance, FirstLight proposes to survey the entire Turners Falls impoundment and the bypassed reach from Turners Falls dam to Cabot Station. The survey would map all invasive aquatic plants and collect information on species, stand dimensions, and stand density. FirstLight would provide a report of the survey results to FWS and the Massachusetts Natural Heritage Endangered Species Program for review and comment prior to filing with the Commission. FirstLight proposes to repeat this survey every five years for the duration of the license. Additionally, on an annual basis, FirstLight proposes to survey from Turners Falls dam upstream to French King bridge.

Upon review of the reports, if FWS and the Massachusetts Natural Heritage Endangered Species Program demonstrate that aquatic invasive plants are significantly affecting fish and wildlife populations in the Turners Falls impoundment or bypassed reach, FirstLight proposes to consult with FWS and the Massachusetts Natural Heritage Endangered Species Program to undertake reasonable measures, as determined by FERC and Massachusetts DEP, to control aquatic invasive plant species in the Turners Falls impoundment and bypassed reach, commensurate with the licensee's level of responsibility.

FWS (10(j) recommendation NM3) and Massachusetts DFW (10(j) recommendation 5) recommend that FirstLight modify the proposed plan for the Northfield Mountain Project to include treatment of invasive plants that are found to out-compete desirable vegetation during reestablishment in revegetated areas. FWS (10(j) recommendation TF11) and Massachusetts DFW (10(j) recommendation 5) recommend FirstLight implement FWS' recommended plan for managing invasive species at the Turners Falls Project. FWS' recommended plan for Turners Falls includes many of the same measures as FirstLight's proposed plan, with several notable differences. First, starting the year after FirstLight's proposed baseline survey, FirstLight would conduct annual early detection and rapid response surveys from Vernon dam to Cabot Station. These surveys would be targeted in areas where initial colonization of new invasive species are most likely to occur; these areas would be identified in consultation with FWS, the Massachusetts Natural Heritage Endangered Species Program, and Massachusetts DEP. Additionally, FWS' recommended plan breaks the project area into three subareas and includes

surveys following the baseline survey methodology such that each section is surveyed once every five years (e.g., surveys in Years 6–8, 11–13, 16–19).

FWS's recommended plan for Turners Falls also includes measures for controlling aquatic invasive plant species. FirstLight would implement control measures for water chestnut and potentially additional species identified in the future. FirstLight would provide annual reports detailing the locations, methods, amount, and percentage of total species removed or treated, along with maps and geospatial data to describe the control measures implemented in the previous year. The plan also requires FirstLight to monitor areas of disturbance caused by routine O&M and to treat invasive species to prevent them from out-competing desirable species. Massachusetts DFW (10(j) recommendation 5), the Ashuelot River Local Advisory Committee, and Connecticut River Conservancy support FWS's recommended plan. Massachusetts DFW also recommends (10(j) recommendation 5) implementation of the same plan as FWS.

Massachusetts DEP also specifies implementation of an invasive species management plan (condition 27). Massachusetts DEP's specified plan is similar to the FWS and Massachusetts DFW plans with several notable exceptions. First, the condition limits surveys for invasive species in the Turners Falls impoundment to the area from Turners Falls dam to the Massachusetts state line, rather than to Vernon dam. The condition also specifies a new baseline survey in the summer of Year 2 after license issuance, following the same methodology as the FWS baseline survey. FirstLight would then repeat this survey every five years for the duration of the license, starting in Year 5 after license issuance. The conditions also specifies that FirstLight allocate $50,000 in Year 1, and $10,000/year thereafter for the treatment of water chestnut, curly-leaf pondweed, Eurasian milfoil, and fanwort in Barton Cove. Massachusetts DEP specifies that FirstLight manage the funds and implement remediation measures, within the constraints of the available funds, as directed by FWS, Massachusetts DEP, Massachusetts DCR, and Massachusetts DFW. By February 1 of the year following the control work, the Massachusetts DEP condition specifies FirstLight provide a summary memorandum, including locations, methods, amount and percent of total removed or treated in Barton Cove, maps, and geospatial data) to FWS, Massachusetts DEP, Massachusetts DCR, and Massachusetts DFW. The condition also specifies annual early detection and rapid response surveys between Cabot Station and the Massachusetts state line and identifies the same activities to prevent the spread of invasive plants as those included in the FWS plan.

FRCOG and the town of Gill recommend FirstLight modify its proposed plan to include recurring surveys for terrestrial invasive species, control actions for existing terrestrial invasive plant populations, and measures to address non-plant invasive species. Specifically, FRCOG and the town of Gill recommend the revised plan include: (1) early detection and removal of new invasive species in the project area, both aquatic and upland, and potentially including non-plant species, in coordination with relevant agencies and organizations; (2) continued participation in managing and removing aquatic invasive plants in the entire project area, including staff assistance and expenses; (3) regular monitoring of a priority set of upland invasive plants in the project area at intervals throughout the term of the license (e.g., once every five years); (4) controlling and reducing the further spread of established priority invasive plants in priority areas that are identified in coordination with interested parties; (5) coordination with agencies on any non-plant invasive species when they become an active threat; and (6) meeting with agencies and other interested parties once every five years after surveys are completed to provide a

summary of the current state of invasive species, management techniques, and input on the upcoming efforts of the next five years in coordination with the parties attending.

Additionally, the town of Gill recommends FirstLight eliminate the practice of requiring permit holders of residential and club properties located on FirstLight land within the project boundaries to pay for invasive species removal, except where the presence of the invasive species is directly related to the permit holder's activities. American Rivers suggests that improving recreation infrastructure at Cabot Camp should include reclaiming the Connecticut River shoreline beach area by actively managing the significant Japanese knotweed infestation.

Our Analysis

Invasive plants are widespread in the Connecticut River Basin, including at the projects. Project-related recreation, as well as construction and maintenance activities could introduce and spread upland and aquatic invasive species at the projects. No site-specific information regarding the presence of invasive plant species has been documented at the locations where FirstLight proposes minor ground-disturbing activities, including construction of mountain biking trails at Northfield Mountain or construction of the plunge pool at Turners Falls. Additionally, fluctuating water levels cause disturbance along the Connecticut River, impoundment shorelines, and riparian areas, and may increase the spread of invasive plants. The risk primarily occurs when water levels drop and expose disturbed or unvegetated soils for extended periods.

At the Northfield Mountain and Turners Falls projects, FirstLight's proposed activities with potential to introduce or spread invasive plants are associated with the use of motorized vehicles on project roads and waters; maintenance activities that result in the removal of or disturbance to existing vegetation cover; and project-related recreation. Propagules of invasive plants, including seeds or vegetative matter that could regenerate new plants, can be easily transported in clumps of dirt or vegetative debris on tires, bumpers, vehicle undercarriages, or other equipment. Aquatic vegetation can be transported clinging to boats, trailers, anchors, or other equipment used in aquatic environments. Transporting these propagules to other locations in the project boundaries as part of normal project operations could spread invasive species. Removal of vegetation creates areas of bare soil that are highly conducive to the germination of seeds. Seed sources can include seeds that are naturally brought to the site, or are already existing in the soil seed bank, lying dormant until suitable conditions for germination are present. These seed sources often include invasive plants found in the surrounding landscape. Recreation activities could also disperse invasive species, primarily through the vehicular methods described previously.

Activities to Prevent the Spread of Invasive Plants—FirstLight's proposed Invasive Plant Species Management Plans would limit the potential introduction and spread of invasive plants by training employees, inspecting and washing vehicles and equipment, and educating the public at project boat ramps. FirstLight's proposed measures for using weed-free materials, revegetating disturbed areas with native species, and removing invasive species during the first growing season would greatly reduce potential for the introduction of invasive plants in these areas. These measures are also included in FWS's recommended plan.

Following the initial growing season, FirstLight proposes to monitor previously disturbed areas for invasive species, but it is not clear whether the proposed plan includes treatment of

these areas, as needed, should invasives persist into subsequent growing seasons. Invasive species commonly persist following initial treatments because small pieces of roots or stems left in the soil following mechanical removal can often regenerate new plants. There is also potential for plants to set seed following treatment or for seeds to be left during removal activities. Continuing to treat any areas disturbed by project activities that support invasive species out-competing desirable species, as included in FWS' recommended plan, would further reduce potential project effects.

Annual Aquatic Plant Surveys—The principal difference between the proposed Turners Falls Invasive Plant Species Management Plan, FWS's recommended plan, and the Massachusetts DEP specified plan is the monitoring frequency and treatment of aquatic plants in the Turners Falls impoundment and bypassed reach. All three plans include an initial survey of aquatic vegetation to establish a baseline and inform future monitoring and treatment needs. All three plans also include an annual monitoring effort. FirstLight proposes to survey from Turners Falls dam to French King bridge, following the same methods as the baseline survey. FWS recommends and Massachusetts DEP specifies surveys of the full project area (stopping at the state line in the case of the Massachusetts DEP condition), but using a rapid assessment method that would be targeted at identifying and treating new occurrences of the most aggressive invasive species. When an invasive plant becomes established in a new area, it typically starts with a small number of individuals that expands over time. Control or eradication of a new population is thus much easier in the initial stage of the colonization, and as the population grows, it is much more difficult to remove and requires long-term and costly management (Ahmed et al., 2022). FirstLight's proposed annual surveys would track changes to existing populations in the lower third of the Turners Falls impoundment. This information would be useful in identifying new populations in that area and measuring the effect of any treatment occurring in the survey area. However, a similar level of effort spread across the entire impoundment, focused on identifying targeted new species and implementing early intervention, as FWS recommends, would provide more benefit to the long-term management of aquatic invasive species in the project area.

Treatment of Existing Aquatic Invasive Plants—FirstLight recognizes that the project may contribute to the introduction and spread of invasive aquatic plants but does not propose to contribute to control efforts unless FWS and Massachusetts DFW can demonstrate that aquatic invasive plant species are significantly affecting fish and wildlife populations in the Turners Falls impoundment or bypassed reach and that control measures are needed. FWS notes that, in the past, FirstLight has contributed to community efforts to treat invasive plants in Barton Cove and recommends FirstLight implement annual control measures for water chestnut (with potential to add additional species in the future). However, FWS does not comment on what level of effort is needed or expected. Massachusetts DEP specifies a specific level of effort on an annual basis ($50,000 in Year 1 and $10,000/year thereafter) for the control of water chestnut, curly-leaf pondweed, Eurasian milfoil, and fanwort in Barton Cove. As discussed in section 3.3.2.1, *Water Quality*, Table 3.3.2.1-8, Massachusetts DEP indicates the presence of invasive aquatic species in Barton Cove, including water chestnut, does not support the beneficial uses of fish, other aquatic life, and wildlife, which indicates a significant effect on fish and wildlife populations. Including treatment of water chestnut as a component of any management of invasive species at the project would mitigate any project effects. Including a description of the annual level of effort, as specified in the Massachusetts DEP condition, would make the plan more enforceable and clearly set expectations of FirstLight. Given the prevalence

of invasive plants present in Barton Cove and the volume of project-related recreation in the cove, the level of effort specified in Massachusetts DEP condition is reasonable.

Treatment Monitoring Surveys—FirstLight's proposed plans, FWS' recommended plan, and Massachusetts DEP's specified plan for managing invasive species include surveys and mapping of aquatic plants in the Turners Falls impoundment and bypassed reach on a recurring basis and following the same methodology as the baseline survey FirstLight conducted in 2016 (Kleinschmidt and Gomez and Sullivan, 2016l). FirstLight proposes and Massachusetts DEP's specifies a survey of the impoundment and bypassed reach once every five years; however, the survey specified in Massachusetts DEP condition 27 would end at the state line. For its plan, FWS recommends a three-year survey period, with roughly one-third of the project surveyed each year. Neither FirstLight, Massachusetts DEP, nor FWS provide justification for their respective survey schedules, and we have not identified any particular benefit of one over the other from a resource perspective. All three would result in updating the map of aquatic vegetation in the project on a five-year interval, which would be an appropriate time scale to facilitate tracking the efficacy of control measures, guide future control efforts, and promote the adaptive management of aquatic invasive species.

Treatment of Existing Terrestrial Invasive Plants and Non-plant Invasive Organisms—FRCOG, American Rivers, and the town of Gill recommend FirstLight monitor and treat existing upland invasive plants and monitor and treat other non-plant invasive organisms, as needed. Much of the shoreline of the Connecticut River, both within, upstream, and downstream of the project boundaries, supports invasive plants. As discussed in section 3.3.1.1, *Geology and Soils*, the Connecticut River flows through an active floodplain, and its shorelines are susceptible to erosion. Eroding soils can contain seeds for invasive species that are then transported downstream and deposited in new areas as water levels recede. However, there is limited evidence of a project nexus for the spread of invasive species along the riverbank because most of the erosion processes are driven by high flows beyond the project's control. Further, the project boundaries include little upland habitat, and, where maintenance activities would occur, FirstLight's proposed plans include measures to address the potential for introduction and spread of invasive upland plants, as discussed above. Regarding non-plant invasive organisms, there is no evidence in the project record that indicates a project nexus to such species. If that changes during the license period, the Commission has procedures in place to address future issues as needed. Regarding FirstLight's practice of requiring private parties with licensed access to project lands to pay for invasive species removal, it is the licensee's prerogative to determine the conditions under which it grants permission to access project lands for non-project use, within the bounds set by the Commission's standard Use and Occupancy license article. Requiring permittees to control, or pay for the control, of invasive plants in the permitted use area ensures the permitted use is consistent with the purposes of protecting and enhancing the scenic, recreational, and other environmental values of the projects.

State-Listed Plants

Proposed changes in project operations, including modifications in the FFPSA, would alter the timing, frequency, and volume of flows in areas supporting state-listed threatened and endangered plants. The potential for these modifications to cause adverse effects on individuals or populations would depend on whether the proposed flow regime reduces their survivorship or reproductive success. Because these species all occur in the river floodplain, they are adapted to

survive the high flows, scour, and sediment deposition associated with the spring runoff period, when flows are typically higher than what the Turners Falls Project can regulate. However, regulated flows during the growing season could affect the ability of plants to flower and set seed, potentially reducing reproductive success.

FirstLight proposes eight construction projects associated with improvements to upstream and downstream fish passage facilities at the Turners Falls Project (see section 2.2.1), but notes that no sensitive plant species would be affected by any of these construction projects, except for the spillway fish lift, plunge pool, and eelway. Installation of these three new structures would affect populations of Tradecant's aster and sandbar cherry located in the immediate vicinity (FirstLight, 2021d). Approximately 12 populations of Tradescant's aster and 23 individual sandbar cherry shrubs are adjacent to the construction footprint. FirstLight's analysis indicates that the proposed construction could affect about 12% of the sandbar cherry population and less than 2% of the Tradescant's aster population in the Turners Falls project boundary (FirstLight, 2021d). FirstLight states the disturbance of sensitive plants in these areas is unavoidable and does not propose any measures to limit potential effects.

At the Northfield Mountain Project, FirstLight proposes to construct about 5 miles of mountain biking trails and add a 135.5-acre parcel associated with the Northfield Mountain Trail and Tour Center to the project boundary. FirstLight also proposes to remove two parcels totaling 8.3 acres.

The Massachusetts Natural Heritage Endangered Species Program indicates that the Northfield Mountain recreational trails are not located within Priority Habitat or Estimated Habitat for state-listed plants and concludes that existing uses of the recreation facilities described in the license application would not require review under the Massachusetts Endangered Species Act for the protection of state-listed plants

The Massachusetts Natural Heritage Endangered Species Program comments in its response, dated August 29, 2013, that several surveys along this stretch of the river have shown that many state-listed plant species are dynamic local populations and often display meta-population dynamics, with changes in size and location from year to year. The Massachusetts Natural Heritage Endangered Species Program notes that this is particularly true for plant species inhabiting sand bars and high-energy shore and cobble islands. Large and/or rapid changes in WSE and/or flow dynamics may adversely affect existing and potential habitats for these state-listed plant species.

Massachusetts DFW (10(j) recommendation 7) states that, following license issuance, FirstLight would need state authorization, as required by the Massachusetts Endangered Species Act (321 Code of Massachusetts Regulations 10), to proceed with projects within mapped priority habitat, including the proposed fish passage facilities. FirstLight, in its reply comments, states that such permitting could enable Massachusetts DFW to block implementation of new project license requirements based on need for a state permit.

Connecticut River Conservancy commented that it is inappropriate to maintain lower minimum flows in the bypassed reach to protect sensitive plants at the expense of providing benefits to other resources. Connecticut River Conservancy states that there is no evidence in the project record indicating the plants survived high flows in July 2023, but if they did survive, then the plants should be able to survive at Connecticut River Conservancy's recommended minimum flows.

Our Analysis

Many state-listed plants exhibit dynamic local population fluctuations, changing in size and location from year to year in response to natural processes of flooding, scouring, and sediment deposition. This is particularly true for plant species inhabiting sand bars and high-energy shore and cobble, including intermediate spike-sedge, ovate spike-sedge, Frank's lovegrass, and tufted hairgrass, which are known to occur in the project boundary. Project-related large or rapid changes in WSE and/or flow dynamics could adversely affect existing and potential habitats for these state-listed plants. However, the proposed changes in project operations would have little effect on inundation timing and duration in locations where state-listed plants are known to occur, compared to current operations. Therefore, the proposed changes in project operations are not expected to adversely affect state-listed plants.

Connecticut River Conservancy's argument that if state-listed plants were able to survive high flows in 2023, the plants should be able to survive Connecticut River Conservancy's recommended higher minimum flows fails to consider the effects of periodic inundation at high flows compared to prolonged inundation during the growing season. The species in question are adapted to living in rocky shoals that are frequently inundated during high flows but are then exposed to air and sunlight after floods recede. The ability of these species to withstand the stresses of temporary inundation provides a competitive edge over other plants. However, the effects of permanent inundation would be quite different. Permanent inundation would remove access to atmospheric carbon dioxide and reduce sunlight—resources that these plants require for survival. If Connecticut River Conservancy's recommended minimum flows result in permanent inundation of these plants, they would be unlikely to survive, even though they are able to withstand prolonged, but temporary inundation.

FirstLight's proposed construction of the spillway fish lift, plunge pool, and eelway would require construction equipment adjacent to areas supporting sandbar cherry and Tradescant's aster. However, many of the plants are located on rocky outcrops on Great Island, outside the apparent construction zone, and could be protected from inadvertent disturbance. FirstLight states adverse effects on these species are unavoidable and propose no protection measures; however, implementation of avoidance and protection measures would likely reduce potential effects. Measures that would reduce potential disturbance to state-listed plants could include clearly delineating areas where construction activities are necessary, and flagging areas where disturbance is not permitted or where additional caution is needed. Prior to construction, FirstLight would need to consult with Massachusetts DFW to determine whether such protection measures are warranted. Contrary to FirstLight's statement, issuance of a FERC license does not remove the responsibility of the licensee to comply with state laws, including permitting for project construction activities.

Siting the new mountain bike trails would occur post-licensing, and it is not currently apparent where those trails would be constructed. However, the Massachusetts Natural Heritage Endangered Species Program indicates no Priority Habitat or Estimated Habitat for sensitive plant species occurs in the area of the existing trails, and none of the sensitive species included in Table 3.3.3.1-3 occur in upland deciduous forest. Therefore, construction of the mountain bike trails and incorporating lands associated with the Northfield Mountain Trail and Tour Center into the Northfield Mountain project boundary would not adversely affect sensitive plants.

FERC licensees are required to abide by state and local laws and regulations during the implementation of the license. As stipulated in the Massachusetts Endangered Species Act, Massachusetts DFW is responsible for reviewing proposed projects in mapped priority habitat to determine whether there would be adverse effects on state-listed species (321 Code of Massachusetts Regulations 10.18) or if the project is exempt based on provisions within the law. Through this process, Massachusetts DFW and FirstLight would identify BMPs to avoid adverse effects on the state-listed species near the proposed construction. If adverse effects are unavoidable, the permitting process would require mitigation measures to ensure a net benefit to the affected species.

General Terrestrial Wildlife

Terrestrial wildlife habitat at the projects is affected by seasonal and daily water level fluctuations, but the wildlife communities present, including wetland-dependent birds, waterfowl, amphibians, and aquatic reptiles, are generally adapted to the daily hydrology of the river. FirstLight's proposed improvements to project recreation facilities would disturb some wildlife habitat, including clearing approximately 0.35 acres of hardwood forest. Additionally, FirstLight would need to remove a small number of individual trees for the proposed Poplar Street access trail and take-out, Riverview boat dock relocation, and Station No. 1 dog-leg exclusion. FirstLight would also construct approximately 5 miles of new mountain biking trails at the Northfield Mountain Trail and Tour Center.

FirstLight proposes several changes to the project boundaries that could affect wildlife. At the Northfield Mountain Project, FirstLight proposes removal of a 0.2-acre parcel at the end of Riverview Drive in Gill, Massachusetts; removal of an 8.1-acre parcel on Millers Falls Road in Northfield, Massachusetts; and addition of a 135.5-acre parcel in the towns of Northfield and Erving, Massachusetts. At the Turners Falls Project, FirstLight proposes to remove a 0.2-acre residential parcel at 39 Riverview Drive in Gill and a 20.1-acre parcel associated with the Conte Fish Lab. FirstLight states these lands are not needed for project operations. FirstLight also proposes to add a 0.8-acre parcel currently owned by FirstLight at 21 Poplar Street in Montague to use as a project recreation site.

FirstLight proposes to permanently conserve, through easement, FirstLight-owned lands within the Bennett Meadow WMA, around the Turners Falls impoundment shoreline, and shoreline and on river right (looking downstream) downstream of the Turners Falls dam. Additionally, as discussed above in section 3.3.3.2, *Invasive Plants*, when routine maintenance activities disturb existing vegetation, FirstLight would implement measures to restore native vegetation.

With the exception of the species-specific measures discussed below for bald eagle and bats (see section 3.3.4, *Threatened and Endangered Species*), no stakeholders filed comments or recommendations regarding terrestrial wildlife.

Our Analysis

Adverse effects of current project operations on wildlife, including wetland-dependent birds, waterfowl, amphibians, and aquatic reptiles are primarily due to daily fluctuations in water levels that affect shoreline habitat suitability. Nesting behavior for many species in riparian, wetland, or lacustrine habitats is influenced by WSE, with some species preferring to nest near the waterline. Rapidly rising and falling water levels can disrupt nest site selection. Nests

constructed near the maximum water elevation are less likely to flood but may become less accessible or protected as water levels drop. Conversely, nests located at lower elevations would be more prone to regular inundation and may be less successful. Under proposed project operations, including the FFPSA, the Turners Falls impoundment would continue to experience daily fluctuations in WSE, and to some extent, these potential adverse effects would continue. However, the reduced rate and magnitude of these fluctuations are expected to have beneficial effects on local wildlife.

Massachusetts DFW would continue to manage the Bennett Meadow WMA for wildlife habitat and hunting. Placing FirstLight-owned lands in a conservation easement would protect these areas from future development and benefit wildlife in the area. Creating conservation easements on undeveloped FirstLight-owned land that is not used for project purposes would also provide a benefit to local wildlife. These lands would remain in the project boundary and be subject to project license conditions.

FirstLight's proposed measures to limit tree clearing from April 1 through October 31, while intended to protect roosting bats, would also protect nesting migratory birds. FirstLight's proposed fishways and recreational improvements are located in areas that are already disturbed by ongoing project activities, wildlife habitat and wildlife populations at the projects would not be significantly affected relative to current conditions.

Proposed measures at the Northfield Mountain Trail and Tour Center would include some tree removal for construction of mountain biking trails. However, as the new trails have not been sited or designed, it is not possible to know the trail width or the extent to which the trails would require tree removal or wind between existing trees. It is also not known whether the new trails would be sited within the existing trail network or constructed within areas of intact forest adjacent to the existing trails. If tree removal is included in trail construction, there would be potential for adverse effects on nesting birds, if tree trimming or removal occurred during the nesting season. The FFPSA includes measures to avoiding cutting trees equal to, or greater than, 3 inches in diameter at breast height within the project boundaries from April 1 through October 31. Modifying this measure to include all tree trimming and tree removal, regardless of stem size would further protect nests potentially occurring in smaller trees.

The addition of trails would also increase habitat fragmentation for small wildlife species and increase potential for disturbance and injury. If the new trails are constructed within the existing trail system, this effect would be minor as the area already contains about 26 miles of trails for hiking, biking, horseback riding, snow shoeing, and cross-country skiing. If the new trails are sited within existing areas of relatively intact forest without existing trails, the effect to local wildlife would be greater; however, we expect any adverse effects would occur at the individual level and not result in any population level effects. Incorporating the existing trails into the Northfield Mountain project boundary would have minimal effect, as there are no proposed changes to existing trail use or maintenance activities in this area. However, adding this area to the project would ensure that any maintenance activities conducted in this area are in accordance with the Northfield Mountain Project license conditions and associated project plans. The additional changes to the project boundary are small areas where there would be minimal change in land use, and we anticipate there would be no effects to wildlife in these areas.

State-Listed Terrestrial Wildlife

FirstLight evaluated potential project effects on state-listed terrestrial wildlife species with known occurrences within the projects according to state natural heritage databases and requests from stakeholders, including FWS, New Hampshire Fish and Game Department, Vermont FWD, and Massachusetts DFW. Species that were specifically targeted during pre-licensing studies are discussed below, including bald eagle, cobblestone tiger beetle, and dragonflies and damselflies.

Bald Eagle

Bald eagles use habitat surrounding the Turners Falls Project for nesting and winter roosting. FirstLight's proposal to clear approximately 0.35 acres of hardwood forest to construct recreation facilities has potential to remove bald eagle roost or nesting trees. Human activity associated with project O&M, or recreation, could potentially disturb bald eagle foraging and nesting activities. Bald eagles that roost during winter at the Turners Falls Project could also potentially be affected by human disturbance. If human activity agitates a bald eagle to a degree that causes injury or substantially interferes with their breeding, feeding, or sheltering behavior and causes, or is likely to cause, injury, a decrease in its productivity or nest abandonment, it constitutes a violation of the Bald and Golden Eagle Protection Act's prohibition against disturbing eagles (FWS, 2007). FirstLight did not evaluate the potential effects of project-related recreation on bald eagles and their habitat.

Bank erosion associated with project-related water level fluctuations could cause bald eagle winter roost trees to fall over during high-flow events that scour or undercut banks. However, large trees suitable for bald eagle nesting are typically located outside the reservoir fluctuation zone, and erosion surrounding these trees would continue to be driven by the large flood flows that are outside project control. Project-related tree removal would also have potential to remove nest or roost trees. To address potential project effects, FirstLight proposes to implement the Bald Eagle Protection Plans that were included in the FFPSA for both the Northfield Mountain and Turners Falls projects (FirstLight, 2023c). Both plans would require that prior to any tree clearing, FirstLight would survey areas within 660 feet of the proposed clearing for bald eagle nests. If such nests are discovered, FirstLight would consult with FWS and Massachusetts DFW and perform the tree clearing in accordance with applicable regulations and guidance. During the nesting season (January 1 through September 30), no tree clearing would occur within 330 feet and no construction activities would occur within 660 feet of bald eagle nests. Any project-related construction activities that require blasting or create extremely loud noises within 0.5-miles of bald eagle nests would be avoided during the nesting season.

FWS 10(j) recommendations NM1 and TF8 and Massachusetts DFW 10(j) recommendation 8 recommend, and Massachusetts DEP condition 33 specifies, implementation of the Bald Eagle Protection Plans included in the FFPSA.

Connecticut River Conservancy comments that FirstLight's proposed license conditions do not sufficiently protect aquatic and aquatic-dependent species that are listed as threatened, endangered, or sensitive under federal and state laws, including bald eagles. It recommends that FERC require the most stringent prescriptions needed to uphold the protection of the state and federally endangered, threatened, and sensitive species present in the project areas. Connecticut River Conservancy recommends that FirstLight modify the Bald Eagle Protection Plans to

include monitoring of hydrilla, an aquatic invasive plant species. Connecticut River Conservancy states that neurotoxins associated with cyanobacteria that occur in hydrilla mats have potential to adversely affect bald eagles.

Our Analysis

In summer, bald eagles are known to nest on islands downstream of Cabot Station. Winter roosting occurs on Turners Falls impoundment, immediately below Vernon dam, where there is open water available for foraging. Project-related activities, including tree removal, recreation, and construction and maintenance, could disturb bald eagles if these activities occur in proximity to eagle nests or roosts. Activities that create loud staccato noises, similar to blasting, could adversely affect bald eagles over greater distances. However, there is no blasting associated with the proposed project activities. The *National Bald Eagle Management Guidelines* (FWS, 2007) identify buffer distances, based on season and type of activity, that FWS recommends implementing to avoid disturbance to bald eagles. The buffers and timing identified in FirstLight's Bald Eagle Protection Plans are consistent with these guidelines and would protect eagles during tree clearing associated with construction associated with fish passage and recreational improvements. Incorporating the 135.5-acre parcel associated with the Northfield Mountain Trail and Tour Center would ensure that any tree removal needed in this area would be conducted in accordance with the plans and further protect bald eagles.

Bald eagles are generally wary of people, and recreational activities similar to those at the projects (e.g., boating, jet skis, hiking, camping, fishing, kayaking, and canoeing) can potentially disturb nesting eagles. However, there is no evidence of recreational impacts on bald eagles in the Turners Falls project area, and the proposed changes to project operations are not expected to substantially alter existing recreation activity levels in areas where eagles are known to occur. Therefore, implementing formal buffers for recreation activities is not warranted.

Connecticut River Conservancy's recommendation that FERC require the most stringent prescriptions is challenging to interpret, in that it does not specify the protection measures it wants FERC to include in the license. Frequently, state and federal agencies recommend protection measures that are focused on the specific effects of the proposed activity. As an example, specific to bald eagles, the *National Bald Eagle Management Guidelines* identify a range of protection measures, including various buffer distances relevant to the level of disturbance anticipated. Implementing the most stringent protection buffer would require restricting activities within 0.25 miles[131] of bald eagle nests, regardless of the level of noise a specific activity would create. This would be overly burdensome and could limit the projects' ability to implement vegetation maintenance or invasive species removal during the summer. Regarding potential effects of hydrilla on bald eagles, recent studies have determined that bacteria associated with *Hydrilla verticillata* were responsible for large-scale bald eagle and waterfowl mortality events in the southeastern U.S. (Breinlinger et al., 2021). While hydrilla is known to occur in Massachusetts (USDA, 2023), it was not recorded during FirstLight's surveys. Additionally, to our knowledge, the disease-causing bacteria identified in the Southeast have not

[131] The *National Bald Eagle Management Guidelines* identify a maximum protection buffer distance of 0.25 miles. This buffer is implemented to protect nesting eagles from loud staccato noise, typically associated with explosives or fireworks.

been recorded north of North Carolina (Breinlinger et al., 2021). We discuss project-related effects on invasive plants in section 3.3.3.2, *Invasive Plants*. However, there is no evidence to indicate that additional invasive species measures in the Bald Eagle Protection Plans would benefit bald eagles at the projects.

Cobblestone Tiger Beetle

Project operations affect potential cobblestone beetle habitat due to altered hydrology and possible human disturbance associated with maintenance and recreation. Additionally, periodic scouring by high flows prevents dense vegetation from establishing on riverine shorelines, while depositing and exposing cobbles; thus, suitable habitat is maintained by spring floods, other seasonal flooding, and ice scour.

Although cobblestone tiger beetles have not been detected in the project boundaries since Hurricane Irene in 2011, there is potential for recolonization of suitable habitat over the course of any license term, or for remnant populations to grow to detectable numbers. To assess potential effects of the FFPSA on formerly occupied cobblestone tiger beetle habitat, FWS used FirstLight's flow model to determine inundation frequencies at elevations associated with Montague Beach, located about 3.3 river miles downstream of Turners Falls dam at the confluence of the Deerfield and Connecticut rivers (see Table 3.3.3.2-1). In its comments, FWS concludes that the flow provisions in the FFPSA would benefit cobblestone tiger beetle.

Our Analysis

Cobblestone tiger beetle habitat is largely dependent upon flow regimes that allow for spring flooding or ice scour, and prevent the prolonged inundation of adult or larval cobblestone tiger beetle habitat. Based on evidence provided by FWS in its terms and conditions, the flow stabilization measures in the FFPSA would increase inundation frequency at the lowest elevations of Montague Beach but reduce it for the majority of habitat during periods of adult and larva activity. Thus, the proposed changes in project operations would expand suitable habitat for cobblestone tiger beetle and benefit any individuals that may occur in areas influenced by operation of the projects.

Dragonflies and Damselflies

The rate and magnitude of shoreline water level fluctuations due to project operations may affect dragonfly and damselfly (odonate) emergence. When mature, aquatic larvae crawl out of the water to metamorphose into adults (i.e., eclose), they climb onto the riverbank, emergent vegetation, or woody debris to shed their larval exoskeleton before taking flight. For a short period after adults enclose, their wings and exoskeleton are soft and they cannot fly, making them susceptible to fluctuating water levels. Species that crawl farther up the shore and gain a greater vertical distance from the water's surface are less at risk from fluctuating water levels. Odonates dislodged from their eclosure substrate by rising water levels are vulnerable to predation and drowning.

FirstLight evaluated potential project effects on state-listed odonates (Biodrawversity and Gomez and Sullivan, 2016a). The study included field observations of eclosing odonates in the Turners Falls project area and presents data, by species, on average distances from the water surface and from the water's edge that larvae eclosed. Biologists also observed larvae exiting the water or crawling on land and recorded the time that elapsed for eclosure, before the adult was

able to fly. These data were then compared to anticipated rates and magnitude of water elevation changes under proposed project operations to evaluate the likelihood of rising water levels dislodging eclosing odonates.

A total of 17 species were confirmed present within the project areas in 2014 and 2015, three of which (spine-crowned clubtail, skillet clubtail, and riverine clubtail) are state-listed. For all species combined, larvae crawled an average vertical height of 5.0 feet from the water's surface, and an average distance of 12.4 feet from the water's edge. There was considerable variation within and among species. The crawl height for spine-crowned clubtail was near or above 7 feet, while for riverine clubtail, it was 3.2 feet. The survey did not encounter any eclosing skillet clubtail. FirstLight concluded that the primary concern for state-listed odonate species is for riverine clubtail downstream of Cabot Station. Based on the results of FirstLight's study, water level fluctuations associated with proposed project operations would not affect 70% of riverine clubtail due to their crawl height and potential effects would be greatest for the 10% of the river clubtail population that eclosed within one inch of the water surface. FirstLight also noted that these 10% of individuals could also be dislodged by natural water level increases, waves, and boat wakes.

During development of the FFPSA, the settlement parties defined a proposed flow regime that, compared to existing conditions, would reduce the rate and magnitude of water level fluctuations associated with project operations to 0.9 foot per hour specifically to reduce project effects on odonates. Pursuant to section 10(j), FWS made recommendations for minimum flows below Turners Falls dam, minimum bypass flows below Station No. 1, minimum flows below Cabot Station, Cabot Station ramping rates, variable releases from Turners Falls dam and variable flow below Station No. 1, flow stabilization below Cabot Station and allowable deviations for flexible operations, and management of the Turners Falls impoundment water level. FWS's 10(j) recommendations are the same as those included in the FFPSA. The specifics of these recommendations and discussion of specific effects of these recommendations on stream flow and reservoir elevation are provided in section 3.3.2.2, *Effects of Impoundment Fluctuations on Aquatic Resources*, *Effects of Minimum Flows on Aquatic Resources*, and *Effects of Flow Fluctuations on Aquatic Resources in Riverine Reaches*. No stakeholders filed additional comments or recommendations related to project effects on odonates.

Our Analysis

Water level fluctuations associated with project operations could dislodge eclosing odonates from their enclosure substrate, increasing potential for predation or drowning. However, due to the limited research conducted on these species, general information on average eclosure height is not available, limiting the accuracy and specificity of our analysis of potential project effects. Species and individuals that eclose closest to the water's edge, such as the state-listed riverine clubtail (and potentially the state-listed skillet clubtail, midland clubtail, and rapids clubtail), would have the greatest potential for adverse effects.[132] For species that climb farther

[132] The skillet clubtail, midland clubtail, and rapids clubtail may also be included in the low-crawling category, but no eclosing individuals of these species were observed during the survey, and typical eclosing locations are unknown and not reported in scientific literature for these species.

from the water surface, such as the state-listed spine-crowned clubtail, project effects are unlikely because these species would eclose above the level of water fluctuations. The project operations included in the FFPSA would result in reduced duration and magnitude of rising WSEs, thereby reducing potential effects on eclosing odonates compared to current project operations. While there may be some mortality associated with project operations, the existing odonate populations would persist in the project areas, and the new flow regime would reduce adverse effects on odonates compared to current operations.

Other State-Listed Species

Although several state-listed species could potentially occur within the projects based on suitable habitat, none were observed during pre-licensing surveys. No stakeholders filed comments or recommendations to reduce potential project effects for these species.

Our Analysis

Table 3.3.3.2-2 provides a summary of potential project effects on all state-listed terrestrial wildlife that could occur at the projects. There are no anticipated project effects on most state-listed species due to their low likelihood of occurrence within the area of normal operational flows. However, fluctuating water levels could potentially affect the nesting of two birds (least bittern and pied-billed grebe), one amphibian (northern leopard frog), and one reptile (wood turtle) which build nests within the reservoir fluctuation zone.

3.3.4 Threatened and Endangered Species

Section 7 of the ESA requires federal agencies to ensure 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. According to FWS's IPaC system,[133] the federally endangered northern long-eared bat (*Myotis septentronalis*), proposed endangered tricolored bat (*Perimyotis subflavus*), proposed threatened monarch butterfly (*Danaus plexippus*), and federally endangered northeastern bulrush (*Scirpus ancistrochaetus*) have potential to occur in or be affected by the projects. The projects are also within the range of the federally threatened Puritan tiger beetle (*Cicindela puritana*), which is believed to be extirpated in Vermont and New Hampshire but could occur downstream of the projects along the Connecticut River. Additionally, there have been recent reports of the federally endangered shortnose sturgeon (*Acipenser brevirostrum*) isolated in rock pools directly below the Turners Falls dam, with two single fish stranding instances in July 2024[134] (Larabee, 2024; Myer, 2024). A PhD candidate from UMass Amherst has collected environmental DNA

[133] *See* Commission Staff's April 17, 2025, memorandum on *List of Threatened, Endangered, Candidate, and Proposed Species Generated by ECOS-IPaC Website* for the Turners Falls (accession no. 20250417-3018) and Northfield Mountain (accession no. 20250417-3019) projects; *see also*, IPaC, FWS, https://ipac.ecoshpere.fws.gov/.

[134] These strandings are discussed in letters filed by Connecticut River Conservancy on December 21, 2024 (accession no. 20241223-5058); the Nolumbeka Project Tribal Coalition filed on December 16, 2024 (accession no. 20241216-5236); and by members of the Western Mass Rights of Nature filed on December 16, 2024 (accession no. 20241216-5028).

evidence suggesting shortnose sturgeon occur "at multiple locations within the reaches of the Connecticut River upstream of the Turners Falls and Vernon dams," with strong hits signaling presence, but likely in lower numbers than they are found farther south (Buckman, 2024[135]; Garner, 2024). There is no critical habitat within the lands affected by the projects that federally listed threatened and endangered species would inhabit.

Our description of the affected environment and analysis of project effects on the listed and proposed species are presented in Appendix F, *Biological Assessment*. Based on the available information, we conclude that the proposed action, relicensing the Northfield Mountain and Turners Falls projects, would likely adversely affect the shortnose sturgeon and Puritan tiger beetle. We conclude that the proposed action would not likely adversely affect the northern long-eared bat, and that there would be no effect on northeastern bullrush.

Although proposed species are provided no special protection under the ESA, we nevertheless provide an analysis of the proposed action on these species in Appendix F, *Biological Assessment*, because they may later be added to the list of federally endangered and threatened species. We conclude that relicensing the projects would not likely jeopardize the continued existence of the tricolored bat or the monarch butterfly.

3.3.5 Recreation

3.3.5.1 Affected Environment

Regional Recreation Resources

Regional opportunities for recreation in the Connecticut River Valley are available on land managed by federal, state, county, and local governments. Two national forests, a national historic park, six state parks, and a state forest are all within about 30 miles of the projects. Recreation opportunities include boating, fishing, hiking and nature observation, camping, picnicking, swimming, and hunting.

The Connecticut River Paddlers' Trail is a regional boating resource that extends the length of the Connecticut River in Vermont and New Hampshire, provides an opportunity for a multi-day canoe/kayak trip, and includes a series of access points and primitive campsites. The Connecticut River is also a National Blueway[136]; and although the program was dissolved in 2014, the Connecticut River has retained its designation, and regional importance for recreation.

Numerous other FERC-licensed hydropower projects along the Connecticut River also provide recreation opportunities in the region, including the upstream Great River-owned Wilder (FERC No. 1892), Bellows Falls (FERC No. 1855), and Vernon (FERC No. 1904) projects. Upstream of the Great River projects, the Fifteen Mile Falls (FERC No. 2077) and the Dodge

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[135] James Garner also discusses his findings in a letter filed November 19, 2024 (accession no. 20241119-5175).

[136] The Connecticut River was designated the first National Blueway on May 24, 2012, by the U.S. Department of Interior. The federal designation comprises the entire river, as well as its watershed. The Blueway designation was intended to provide for better coordination of local, state, and federal groups to promote BMPs, information sharing, and stewardship.

Falls (FERC No. 8011) projects also provide recreation opportunities. Downstream of the Turners Falls dam, the Deerfield River flows into the Connecticut River and has nine additional dams that provide recreation opportunities. The Corps operates several flood control projects in the region that also provide water and land-based recreation opportunities.

Informal areas also provide recreation opportunities in the area including fishing, camping, and rock climbing (e.g., Farley Ledge and Rose Ledge). Farley Ledges is a large chain of ledges used for rock-climbing, and the Western Massachusetts Climbing Coalition owns property that provides parking and access to the loop trail that encompasses the climbing ledge known as Farley Ledge. Rose Ledge is a 40 to 60-foot cliff line used for rock-climbing; it is located on land owned by FirstLight and is accessed by a path from the Northfield Mountain Tour and Trail Center trails.

In addition to formal and informal recreation sites and facilities in the vicinity of the projects, there are also whitewater boating opportunities in the region including several reaches of the Deerfield River, the Ashuelot River, the West River, and the Millers River. Some of these opportunities are subject to natural flows while others are supported by scheduled whitewater releases. Natural flow dependent boating opportunities are seasonal in nature and are usually more available in spring and fall than in summer. However, those supported by scheduled flow releases provide regional boaters with significant whitewater boating opportunities throughout the recreation season, including in the summer and on weekends.

Recreation at the Projects

The recreation facilities at the FirstLight projects span about a 20-mile stretch of the Connecticut River. The area provides diverse recreation opportunities including access for boating (flatwater and whitewater), boat fishing, bank fishing, hiking, camping, picnicking, swimming, wildlife viewing, and educational programming. Hunting is also a popular activity near the projects.

FirstLight owns and operates 10 recreation sites, which include boat ramps, picnic areas, camping, restrooms, and trails (Table 3.3.5.1-1). However, in addition to these sites, many additional non-project recreation sites are available to the public that are adjacent to or within the project boundaries but are not considered part of the existing licensed hydroelectric projects. These sites are listed in Table 3.3.5.1-2 and provide additional boating, camping, climbing, and other recreation opportunities around the projects.

Recreation Use and Demand

The estimated total annual recreation use at the projects' recreation sites is shown in Table 3.3.5.1-3. These estimates represent the total recreation use for the study period, which occurred in 2018, and included data from traffic counts, spot counts, interviews, and estimates that were obtained as part of the relicensing recreation studies. The total annual recreation use of all project recreation sites was estimated at about 100,000 recreation days. For most of these sites, peak use occurred in the summer; however, several sites experienced higher use during the fall and winter seasons. According to the relicensing recreation studies, recreation use and demand are expected to grow in the future.

People using recreation facilities at the projects largely originated from counties and states adjacent to the projects. Many of the recreation sites have informal parking spaces;

however, vehicle counts at most project recreation sites did not exceed the capacity for the site. The most popular activities in or around the project included walking, jogging, hiking, boating, and fishing, as well as biking and picnicking and are described by activity and percent distribution in Table 3.3.5.1-4.

Whitewater Boating

The Turners Falls Project bypassed reach provides whitewater boating opportunities. The reach is characterized by a series of rock ledges and outcroppings that create a whitewater play area under a range of flows. Boaters found this area to be boatable at all flows (between 2,500 cfs and 13,000 cfs) and rated this stretch as Class II–IV depending on flow, with optimal boating flows in the range of 5,000 to 8,000 cfs. Farther downstream, the bypassed reach is characterized by a series of riffles, small rapids, and some flat water, with more Class II-III features around the Station No. 1 powerhouse. The Rock dam feature located about 5,000 feet downstream of Station No. 1 is a natural rock ledge feature rated Class III-IV. Flows in the Turners Falls bypassed reach depend on river flows, which are largely determined by discharge from the upstream hydropower projects.

3.3.5.2 Environmental Effects

Recreation Management Plan

As described in the Recreation Settlement Agreement, FirstLight proposes to implement the RMP[137] for the Northfield Mountain and Turners Falls projects. The RMP includes construction of new recreation facilities, modifications to existing recreation facilities, an implementation schedule for enhancements, ongoing management and maintenance measures, a monitoring schedule to evaluate recreation use and demand, and a provision to revisit the RMP every 10 years.

The 14 signatories[138] of the Recreation Settlement Agreement support the RMP, which was included in the settlement. Other organizations outside the settlement agreement have also expressed support for the RMP. Massachusetts DEP specifies the proposed RMP in condition 29. Connecticut River Conservancy supports the RMP and recommends inclusion of a provision for debris management procedures, and a schedule for upgrades to reduce light pollution (section 3.3.6.2, *Effects of Project Operation of Aesthetics*). Several individuals recommend a budget for future recreational improvements because recreational needs and demands change over time.

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[137] The RMP for both projects was included with the Recreation Settlement Agreement filed by FirstLight on June 12, 2023, and is consistent with the Massachusetts DEP condition 29 issued on April 22, 2025.

[138] The National Park Service; Massachusetts DCR; FRCOG; the towns of Erving, Gill, Montague, and Northfield; Access Fund; American Whitewater; Appalachian Mountain Club; Crab Apple Whitewater, Inc.; New England FLOW; Western Massachusetts Climbing Coalition; and Zoar Outdoor.

In response to the Recreation Settlement Agreement, the Nolumbeka Project Tribal Coalition acknowledges the settlement and participation by stakeholders. However, it also identifies the absence of any Tribal entities or other underserved populations as participants and signatories within this agreement and the lack of a process to guarantee Tribal oversight to protect cultural resources that may be affected by proposed recreational improvements described in the RMP.

Our Analysis

FirstLight's proposal to implement the RMP for the projects, as specified in the Massachusetts DEP condition, would guide the maintenance, operation, and monitoring of the project recreation sites, and allow for monitoring and updating the plan every 10 years, which would provide the information needed to make future enhancements to facilities or provide additional recreation amenities to accommodate increases or changes in recreation use and demand through the term of any license issued.

While the RMP includes a schedule for monitoring and evaluating recreation use and needs in the future, it would be beneficial to include a provision to evaluate the efficacy of existing methods for communicating flow information to the public (see *Flow Information/Public Safety*, later in this section), should more effective communication methods become available. Similarly, including a provision to evaluate existing lighting in the RMP and incorporating lighting improvements for recreation sites would allow for use of enhanced lighting and reduce negative effects of lighting on visitors in the area and on any artificial light-sensitive aquatic species during the life of the license.

Including the federally recognized Tribes in future updates to the RMP, or as part of recreation advisory groups, would ensure that that Tribal stakeholders are consulted and can provide ongoing input into measures to protect areas of cultural importance from adverse effects related to the proposed recreation facility improvements as well as from project O&M activities.

Recreation Facility Maintenance and Improvements

As part of the RMP, FirstLight proposes to make the following improvements at the Northfield Mountain Project:

1) Permanently conserve FirstLight's lands within Bennett Meadow WMA that are not already under conservation easement and enhance existing riverfront trails south of Route 10 off the parking lot at Bennett Meadow WMA to include installation of a bench and historical/cultural interpretive signage (RMP measure 6.2.1 and RMP Table 6.3-1).

2) Provide a permanent trail easement for the 1.3-mile-long portion of the New England National Scenic Trail that lies inside the Northfield Mountain project boundary on the eastern side of the project's upper reservoir (RMP, Table 6.3-1).

3) Relocate the boat tour dock from the tailrace to a location upstream of the fish barrier net and provide for an accessible/barrier dock layout that supports motorboats, canoes/kayaks, and riverboat tours (RMP measure 6.2.2).

4) Construct approximately 5 miles of new trails for mountain biking (RMP measure 6.2.3).

5) Construct and maintain a new paddle access campsite in the Barton Cove area (RMP measure 6.2.4).

6) Make Rose Ledges a designated project recreation facility to allow climbing, with access to remain free of charge (RMP measure 6.2.5).

7) Add the ability to lock canoes and kayaks during the day at Barton Cove (RMP measure 6.2.6).

FirstLight also proposes to make the following improvements at the Turners Falls Project:

1) Install a "pocket park" (i.e., a viewing point and picnic table) at the Pauchaug-Schell Bridge Greenway and signage for historical and cultural interpretation (RMP measure 6.1.1).

2) Construct and maintain a new paddle access campsite at Barton Cove and Mallory Brook or another location in the town of Northfield selected in consultation with the Appalachian Mountain Club and the town of Northfield (RMP measure 6.1.2).

3) Construct a new formal path leading from the Cabot Camp parking area to a put-in to the Millers River, construct a picnic area, and attempt to preserve the Cabot Camp historic buildings (RMP measure 6.1.3) or repurpose the buildings consistent with the HPMP.

4) Construct a new car-top access and put-in at Unity Park, provide a means of storing and locking vessels, install signage to assist paddlers portaging to below the dam, and reconfigure the parking lot to improve vehicle and pedestrian safety (RMP measure 6.1.4).

5) Construct a new river access point below Turners Falls dam including one path designed for rafters to launch upstream of Peskeomskut Island and another path to allow pass-through boaters to portage around the island (RMP measure 6.1.5).

6) Construct a new site with a viewing platform, picnic area, and signage below Turners Falls dam with the best feasible view of the dam (RMP measure 6.1.6).

7) Construct a new formal access for fishing and non-motorized boats upstream of the Station No. 1 tailrace (RMP measure 6.1.7).

8) Install new stairs and signage at the Cabot Woods fishing area just below Rock dam (RMP measure 6.1.8).

9) Construct a new portage trail around Rock dam (RMP measure 6.1.9).

10) Construct improvements at the Poplar Street put-in and take-out to include stairs with a boat slide railing leading to a landing/concrete abutment, gangway, and floating dock (RMP measure 6.1.10).

11) Install interpretive signage at Cabot Woods (Rock dam) and Peskeomskut/Great Falls (Turners Falls dam) (RMP measure 6.1.11).

12) Make safety improvements to abandoned water passages in the Turners Falls bypassed reach (RMP Table 6.3-1).

13) Install interpretive cultural signage at key locations in consultation with area Tribes and the town of Montague.

All existing and proposed project recreation sites are shown in Figures 3.3.5.2-1 and 3.3.5.2-2. As part of the Recreation Settlement Agreement, FirstLight also proposes to place undeveloped FirstLight-owned lands not used for specific project activities in a conservation easement, including lands along the river immediately downstream of Turners Falls dam, as well as lands along the shoreline of the Turners Falls impoundment, after consultation with the relevant towns and Massachusetts DCR. FirstLight also proposes to conduct a programmatic assessment of existing recreation facilities and buildings to ensure the needs of people with disabilities were considered in the planning and design of each facility, implement applicable improvements, and evaluate recreation use and demand every 10 years with the RMP update cycle. FirstLight also proposes, as a component of the RMP, to donate used sports equipment to local youth organizations when available.

These improvements are supported by the 14 entities that signed the Recreation Settlement Agreement. The Nolumbeka Project Tribal Coalition recommends that FirstLight create safe access down to the west bank of the Connecticut River below Great Falls for Tribal people to conduct ceremonies and other special activities. Numerous individual stakeholders also comment about the need to improve access and recreation opportunities in the project area, including boat ramps, parking areas, trails, and other water- and land-based activities.

The Montague Historic Commission recommends new or updated interpretive signs at Unity Park, the Turners Falls Fishway, below Turners Falls dam, Cabot Woods at Rock dam, Cabot Camp, and Cabot Station, and seeks consultation on the content of the signs in collaboration with nearby Tribal and recreational organizations, and to replace any missing signs at these locations.

The Ashuelot River Local Advisory Committee comments about the inadequacy of recreational components addressed in the amended final license application and the need for improved access, portages, and accessible/barrier-free recreation amenities, as well as adequate flows for paddlers, and recommends mandating a minimum flow at both projects to enable boating and recreation, while protecting the habitats of macroinvertebrates and fish.

In comments on the draft EIS, Ashuelot River Local Advisory Committee requests that FirstLight build and maintain infrastructure for boaters to enter and exit the river at the places where hydropower practices make it impossible to keep boating, such as above Turners Falls dam and the portage route to Cabot Station. Two other commenters supported Ashuelot River Local Advisory Committee's comments on the need for improved access and portages.

Our Analysis

Currently, recreation site capacity appears adequate; however, the additional new recreation sites and improvements to existing facilities would help to accommodate the anticipated increased use over the term of any license issued. Ensuring improvements consider the needs of people with disabilities would allow more of the public to use and enjoy these facilities. Improvements to put-ins, take-outs, and portage trails around the Turners Falls Project would improve access for boating, fishing, and other recreational uses. Construction of new river access points upstream and downstream of Peskeomskut Island and Rock dam would improve access for whitewater boaters to experience the rapids as well as facilitate portages for

boaters that wish to avoid them. FirstLight's proposal to add 5 miles of mountain biking trails to Northfield Mountain and maintain climbing opportunities at Rose Ledges would allow consistent future management of these sites in accordance with the RMP and allow for future improvements during the term of a new license.

FirstLight's proposal to place undeveloped lands into a conservation easement would protect undeveloped lands along the Connecticut River. However, the specific lands highlighted by the Tribal Coalition Stakeholder are not located within the boundaries of the Turners Falls or Northfield Mountain projects, and FirstLight is not currently proposing to create easements or recreational access to those lands. Recreational monitoring efforts, as described in the RMP, and consultation as part of the HPMP (see section 3.3.7, *Cultural Resources*) regarding TCPs would facilitate discussions and help to establish a need for improving access to these lands in the future. If additional access to these areas is needed, future updates to the RMP could include improvements that could address the access needs highlighted by the Nolumbeka Project Tribal Coalition and other interested parties, while continuing to protect sites of cultural importance.

As defined in the RMP, signage in locations such as those defined by Montague Historic Commission would be updated or improved, and if any signs are in disrepair, they may be replaced as part of maintenance efforts defined in the RMP. The content of the signs can be reevaluated in accordance with section 5.12 of the HPMPs, and after consultation as part of the RMP. The need for additional signage and content would be determined during the consultation cycles throughout the term of the license.

The proposed recreational improvements and minimum flows would likely address the Ashuelot River Local Advisory Committee concerns and improve access and infrastructure at Turner Falls dam and along the portage to Cabot Station. Further, additional recreational improvements and upgrades can also be considered in update cycles of the RMP as use and needs change with time.

Effects of Impoundment Levels on Recreation

FirstLight proposes to continue to maintain the water level in the Turners Falls impoundment between elevation 176.0 feet and 185.0 feet as required by the current license. The FFPSA signatories and FWS (10(j) recommendation TF7) support this proposal.

FirstLight also proposes to establish a boat wake restriction, consistent with Massachusetts DEP condition 25, in coordination with Massachusetts DCR, from the Turners Falls dam extending upstream approximately 2 miles to where the Turners Falls impoundment narrows, to mitigate the impact of boat waves in the Barton Cove area.

Massachusetts DEP condition 13 specifies FFPSA Article B100 Northfield Mountain impoundment WSEs, and condition 10 amends FFPSA Article A190 for Turners Falls impoundment WSEs. FFPSA Article B100 expands operations at the Northfield Mountain Project, whereas Massachusetts DEP condition 10 specifies that the Turners Falls impoundment water levels be maintained between elevation 178.5 feet and 185 feet, except under specified provisions for discretionary events to operate between elevations 178.5 and 177.5 feet for no more than 168 hours per year and 12 hours per event; and provide the ability to draw down to the extent necessary but no lower than 177.5 feet for nondiscretionary events.

The town of Montague argues that 179 feet is a sufficient low-end elevation threshold to operate under normal conditions, with clearly defined protocols to govern emergency conditions that might require lower levels.

Connecticut River Conservancy recommends that the impoundment be kept within the range of 179 to 184 feet. Deviations below 179 feet would need to be an exceptional occurrence. Deviations above 184 feet would happen only during high water times of the year. Connecticut River Conservancy also recommends continuation of annual cross section surveys to determine net sediment deposition. Under its recommendation, if there is a significant net increase, FirstLight would be required to oversee and pay for the appropriate dredging to improve boating navigability, but dredging would be limited to the boat channels and would avoid sensitive areas.

FRCOG recommends establishing a target elevation and target WSE bandwidth for Turners Falls dam at its current measurement location, and a new location at the USGS gage at the Route 10 bridge in Northfield. FRCOG does not recommend specific upper or lower elevations for the target bandwidth, or the percentage of time that the elevation would need to be within the bandwidth.

The town of Gill recommends FirstLight include input from the four local conservation commissions, FRCOG, Massachusetts DCR, the Massachusetts Environmental Police, and Massachusetts DEP on any boat wake restriction policies.

Individual stakeholder recommendations about the Turners Falls Project include opposition to relicensing the project or more restrictive impoundment WSEs. Several individuals commented and submitted pictures concerned about the effects of low water levels on private docks in Barton Cove.

In its reply comments, FirstLight states that its proposed operations (as defined in the FFPSA) would cause the impoundment levels at the Pauchaug Boat Ramp to be at or above 181 feet for a greater percentage of the time compared to those under existing conditions during the peak recreation season (except for during May).

In comments on the draft EIS, FRCOG, Connecticut River Conservancy, and American Whitewater recommend modifying FFPSA Article A190 to include: (1) an average target elevation of 181.5 feet for the Turners Falls impoundment; (2) a target operating bandwidth where the impoundment's daily elevation change for 50% of the hours per year would be less than 1.2 feet, for 75% of hours per year the daily elevation change would be less than 1.5 feet, and for 90% of hours per year, the daily elevation change would be less than 2.1 feet; and (3) for the remaining 10% of hours, WSEs would be between 179 and 184 feet.

Massachusetts DEP provides detailed information about how boating conditions in the Turners Falls impoundment are compromised at elevations lower than 178.5 feet and notes that without its specified Turners Falls impoundment limitations (condition 10), unlimited fluctuations between 176 feet and 185 feet could seriously degrade boating on the impoundment.

Other commenters also express concerns about low water levels, river channels narrowing (specifically the channel coming out of the boat ramp area used by the Franklin County Boat Club), and sedimentation around the Barton Cove area, with some recommending more restrictive WSEs.

Our Analysis

Data from FirstLight's Recreation Use/User Contact Survey (Gomez and Sullivan and TRC, 2016a) conducted January through December 2014 for both Northfield Mountain and Turners Falls projects indicates that, of the 427 responses, about 93% of recreation user respondents expressed satisfaction with project water levels, while only 7% of respondents expressed dissatisfaction. Specifically,

37% of the responding recreationists reported being satisfied, 43% were moderately satisfied, and 13% were extremely satisfied; whereas 5% reported being only slightly satisfied and only about 2% reported being unsatisfied. Conversely, residents residing along the Turners Falls impoundment expressed greater dissatisfaction (39%) with impoundment water levels, stating reasons such as water level fluctuations (too low and too high) and negative effects on the recreational experience, including boating and fishing.

FirstLight's proposal to maintain an elevation of 176.0 feet to 185.0 feet at the Turners Falls dam could continue to cause boat launching challenges at some of the boat ramps on the Turners Falls impoundment when elevations are at the lower end of this range. Based on an assessment of boat ramp accessibility conducted by FirstLight (Gomez and Sullivan and TRC, 2016b), and using National Park Service design guidance for canoe and kayak launches that recommends a minimum of 2 feet of water depth for paddling, the Pauchaug Boat Launch and the launching area at the Barton Cove Canoe and Kayak Rental Area need a WSE of about 181 feet to be usable, whereas the State Boat Launch needs about 179 feet, and the boat tour and Riverview Picnic Area needs about 175 feet (Table 3.3.5.2-1). The only boat access on the Turners Falls impoundment that would be accessible at all proposed elevations would be the floating dock at the Munn's Ferry Boat Camping Recreation Area, located about 7 miles upstream of Barton Cove, which needs a minimum WSE of about 167 feet. Cabot Camp Access Area also provides informal shoreline access to the impoundment at all proposed elevations; however, some survey respondents noted that water levels could be higher.

Based on FirstLight's assessment of boat ramp accessibility, under existing conditions, recreational boaters found Pauchaug Boat Launch to be unusable about 15 to 20% of the time, especially in drier summer months, and they found the launch at Barton Cove Canoe and Kayak Rental Area to be unusable about 7% to 11% of the time during peak recreation season because of lower water levels in the impoundment. Evaluation of simulated daily minimum WSE for baseline conditions in 1981–2003 at the dam (Table 3.3.5.2-2) further support the launch at Barton Cove Canoe and Kayak Rental Area being unusable about 10% of the of the time during peak recreation season. However, elevations at the Barton Cove Canoe and Kayak Rental Area between 180 feet and 181.5 feet were found to provide about 2 feet of water depth within 20 feet of the shoreline; bathymetry data show the bottom of Barton Cove Canoe and Kayak Rental Area between 178 feet and 179.5 feet in elevation. Therefore, water levels were found to be sufficient for launching canoes and kayaks 89% to 93% of the time in the peak season, noting that occasionally, a canoeist or kayaker may have to walk a short distance further (15 to 30 feet) to get to deeper water to launch, thereby maintaining access.

FirstLight reports that, under current operations, the water levels in Barton Cove are above elevation 179 feet about 98% of the time during peak recreation months, and states that the primary channel remains usable by nearly all types of watercraft at all impoundment elevations greater than 179 feet. Further, under the FFPSA, the water levels would be

maintained above elevation 179 feet anywhere from 92% to 98% of the time during peak season. However, given the results of FirstLight's assessment of boat ramp accessibility and comments from the public, it is expected that any time during lower water periods where the WSE is less than 179 feet would have a negative effect on access for boating in Barton Cove.

FirstLight's operational proposal would alter the WSEs in the Turners Falls impoundment and change outflows from both the Northfield Mountain Project and the Turners Falls Project. The expanded operations at Northfield Mountain would cause the WSE in the Turners Falls impoundment to fluctuate, and potentially increase the frequency of drawdowns in the 176-foot to 179-foot range, which would affect recreation on the impoundment. Massachusetts DEP condition 10 specifies that FirstLight maintain a minimum elevation of 178.5 feet, which is about 2.5 feet higher than the WSE under proposed operation and would be a greater increase in WSEs compared to those under current conditions. Higher water levels in the Turners Falls impoundment would benefit recreation by improving access to boat ramps and docks and improve navigability in the shallow Barton Cove area. These higher elevations would reduce the time boat ramps are considered unusable. Limits on drawdowns for discretionary and nondiscretionary events would also limit any negative effects and frequency of low-water scenarios.

The town of Montague, FRCOG, American Rivers, and Connecticut River Conservancy's recommendations for minimum WSEs of 179 feet or higher would further improve the accessibility of boat launches on the Turners Falls impoundment. A water level of 179 feet or higher would allow for nearly all boat ramps on the impoundment to be usable almost 100% of the time.

Increased WSEs would improve access to boat ramps and docks in and near Barton Cove and improve navigation conditions within Barton Cove, which would benefit recreation on the impoundment. Emergency access would also benefit by having higher WSE's in the Turners Falls impoundment. Although emergency rescue operations continue to use the boat ramps on the impoundment at lower levels than recreational boaters, higher WSEs would make it easier to launch emergency rescue operations. The recommendations to modify FFPSA Article A190 to include an average target elevation and a target operational bandwidth would encourage consistently higher WSEs in the Turners Falls impoundment and reduce negative effects on recreation resources. Consistently higher WSEs could also introduce new patterns of recreation in Barton Cove and allow for access in areas that have been historically too shallow for boating.

As discussed in section 3.3.1, *Geology and Soils*, FirstLight's proposed operations could change sediment dynamics in localized areas due to fluctuations in water levels but are not likely to have a noticeable effect on sediment deposition in Turners Falls impoundment. However, Barton Cove would continue to be a shallow area with potential navigational issues. Connecticut River Conservancy's recommendation for continued cross-sectional surveys and dredging, if needed, may provide insight about the effects of these changes and allow for improved water depths for boating, but may not consider the abundance of aquatic vegetation that can also limit navigation.

Many boaters in this area have adapted to shallow water and navigational limitations by using designated deeper channels, but there is still potential for new project operations to change WSE, sediment deposition, and recreational access patterns in this area. Therefore, a navigability monitoring plan for both projects that assesses the effects of any new operational

regime on the navigability of the Barton Cove area would allow for all potential navigational constraints (i.e., water levels, sediment deposition, and vegetation) to be considered in one study. This would also help determine whether and where future actions like dredging are warranted. The plan could include the following provisions: (1) monitor potential navigational constraints at Barton Cove for three years, including, but not limited to, water levels, sediment deposition, and vegetation; (2) file annual reports with the Commission that describe all monitoring done in the previous year and recommended measures to maintain or improve navigability at Barton Cove, particularly during low water periods; and (3) file a final report with the Commission after three years of monitoring that summarizes all monitoring results, measures implemented, and any recommended additional monitoring that may be needed along with a schedule for future actions and reporting to the Commission. The plan would need to be consistent with efforts to survey invasive species, monitor sedimentation and erosion, comply with section 5.4.1, *Review of Ground Disturbing Activities,* of the Turners Falls HPMP, and be developed in consultation with agencies and stakeholders.

FirstLight's proposal to establish a boat wake restriction, consistent with Massachusetts DEP condition 25, would slow down the speed of boaters and reduce the impact of boat wakes to the area around the no-wake zone; however, this type of restriction would only be enforceable by the state resource agency responsible for boating laws and regulations. Consultation with other interested parties including local conservation commissions, FRCOG, Massachusetts DCR, the Massachusetts Environmental Police, and Massachusetts DEP, as recommended by the town of Gill, would confirm these policies are developed in a way that is enforceable and satisfactory to all parties.

Effects of Downstream Flows on Recreation

The 2.7-mile bypassed reach from Turners Falls dam to Cabot Station provides whitewater boating opportunities for a variety of watercraft and skill levels over a wide range of flow conditions. The first 2,500 feet below Turners Falls dam provides rock ledges and outcroppings that create a whitewater play area under a range of flows that have been rated as Class II-IV. About 4,000 feet downstream of Turners Falls dam is another series of riffles, some flat water, and a Class II-III feature just before the Station No. 1 powerhouse. The lower section of the bypassed reach from Station No. 1 to Cabot Station consists of Rawson Island, which has boatable channels on both sides, and the Rock dam feature, which is a rock ledge rated as Class III-IV by most boaters. From Rock dam to Cabot Station is a 4,000-foot reach of flat water and riffle areas.

FirstLight proposes to increase minimum flows in the bypassed reach (FFPSA Articles A110 and A120) and, consistent with Massachusetts DEP condition 6, to provide variable whitewater releases (FFPSA Article A150) including 4-hour releases of 4,000 cfs from Turners Falls dam for two consecutive weekend days during five separate events in the summer/fall recreation season, as well as maintaining 4-hour flows of 2,500 cfs below Station No. 1 for two consecutive weekend days during seven separate events in the summer/fall recreation season. These releases are intended to enhance boating opportunities and provide ecological benefits in the bypassed reach and are consistent with conditions recommended by NMFS and Massachusetts DFW, and are supported by all signatories of the FFPSA.

FFPSA Articles A130 and A160 would alter FirstLight's proposed flow regime in the mainstem river downstream of Cabot Station. FirstLight proposes to operate such that the total

flow downstream of Cabot Station ranges from 3,800 cfs to 8,800 cfs, or the NRF, whichever is less (FFPSA Article A130), and maintain a stabilized flow regime below Cabot Station except during winter by providing ±10% of the NRF with deviations up to ±20% for a certain number of hours each month (FFPSA Article A160). Changes in its project operations would increase minimum flows and reduce the frequency and magnitude of flow and water level fluctuations in the river downstream of the project.

FirstLight also proposes to consult American Whitewater, the Appalachian Mountain Club, commercial outfitters, Massachusetts DEP, Massachusetts DFW, National Park Service, New England FLOW, and FWS no later than March 1 annually over the license term to develop a mutually agreeable schedule for the variable releases. When developing the schedule, there would be at least one weekend per month, between July 1 and October 31, when no variable releases are provided.

Six Massachusetts state legislators, American Rivers, and Connecticut River Conservancy find FirstLight's proposed minimum flow of 500 cfs below the dam from July 1 to November 15 insufficient to support recreational activities and recommend a minimum flow below the Turners Falls dam of 1,400 cfs from July 1 to November 15, specifically in the 1-mile section of the river between the dam and Station No. 1. Numerous private individuals also request higher flows downstream of Turners Falls dam, some of which agree with the 1,400 cfs minimum flow recommendation. The Nolumbeka Project Tribal Coalition recommends a minimum continuous flow of 2,000 cfs to allow sensitive cultural resources to remain submerged and inaccessible to the public year-round

The town of Gill recommends FirstLight establish license conditions that reduce the amount of river level fluctuation due to project operations.

In its reply comments, FirstLight disagrees with comments regarding the insufficiency of 500 cfs flow releases for recreational boating in the bypassed reach and indicates that 500 cfs reflects a balance that allows for competing resource uses and protects plants and other sensitive resources that could be adversely affected by higher flows.

In comments on the draft EIS, the Connecticut River Conservancy, the Ashuelot River Local Advisory Committee, and other individuals express concern about low water levels and flows in the river. Several of the commenters recommend that FirstLight be required to maintain a 1,400 cfs flow in the river between July 1 and November 1 to benefit recreational access.

Our Analysis

FirstLight conducted a study to evaluate navigability of the bypassed reach at flow releases of 214, 276, 376, and 545 cfs made from Bascule Gate No. 1 into the bypassed reach (Gomez and Sullivan, 2021). During this study, boaters found that the left channel at Peskeomskut Island was unnavigable under all assessed flows, but the center-right and far-right channels could be paddled with varying difficulty under all flows. At Rawson Island, boaters were able to navigate the far-right channel with no issues under all assessed flows; however, the center-right channel was unnavigable under all flows, and the left channel (over Rock dam) was not recommended for novice paddlers. During the study, 8 of 10 participants found the reach to be navigable (rating of neutral, acceptable, or totally acceptable) at a flow release of 545 cfs, while a majority of participants considered the reach to be unacceptable for navigation at flow releases of 214, 276, and 376 cfs. During the 545 cfs flow release, an additional 71 cfs was

contributed from the Fall River and 560 cfs from Station No. 1 for a total flow of about 616 cfs below Peskeomskut Island and 1,007 cfs below Station No. 1 (Table 3.3.5.2-3).

FirstLight also conducted a whitewater boating evaluation to assess the effects of a range of flow releases into the Turners Falls bypassed reach on whitewater recreation opportunities (Gomez and Sullivan and TRC, 2015b). This study evaluated whitewater boating at six flow releases (2,500 cfs, 3,500 cfs, 5,000 cfs, 8,000 cfs, 10,000 cfs, and 13,000 cfs). Results of the study found the minimum acceptable whitewater flow varied by watercraft: 2,500 cfs for all canoes and stand-up paddleboards; 3,500 cfs for catarafts/shredders; and 5,000 cfs for kayaks and rafts. The optimal whitewater flow also varied by watercraft: 3,500 cfs for closed canoes; 5,000 cfs for open canoes and catarafts/shredders; 8,000 cfs for rafts and stand-up paddleboards; and 10,000 cfs for kayaks.

Analysis of historical flow records indicates that, under existing conditions, acceptable boating flows of at least 2,500 to 3,500 cfs are expected to occur approximately 45 days during the boating season (April–November), and optimal flows would be in the range of 5,000 to 8,000 cfs about 40 days during the boating season. However, most of the flows in the acceptable or optimal ranges occur during April and May and are much less frequent during the summer and fall months when water temperatures are more conducive to water contact recreation.

Under existing conditions, flows above 400 cfs in the bypassed reach are not typical of normal project operations and currently occur only during periods of high river flows, typically in the spring. The minimum flows released in the bypassed reach from Turners Falls dam usually range between 120 cfs and 400 cfs between May and October. Therefore, FirstLight's proposal to release a minimum flow of 500 cfs and to release varied whitewater flows, consistent with Massachusetts DEP condition 6, would increase flows in the bypassed reach compared to existing conditions. FirstLight's proposal to release flows suitable for both navigation and whitewater boating between July 1 and October 31 would improve boating opportunities in the bypassed reach. All recreation access sites in the bypassed reach and downstream would remain usable with the increase in released flows; however, the amount of shoreline available for bank fishing would decrease as flow releases increase. As signatories of the FFPSA, organizations representing the interests of recreational boaters (American Whitewater, Appalachian Mountain Club, Crab Apple Whitewater, Inc., New England FLOW, and Zoar Outdoor) and the state and federal fish and wildlife agencies appear to be satisfied with FirstLight's proposal for flow releases.

Six Massachusetts state legislators, American Rivers, Ashuelot River Local Advisory Committee, and Connecticut River Conservancy's recommendations to increase the minimum flow releases from Turners Falls dam from the proposed 500 cfs to 1,400 cfs seasonally would increase flows below Turners Falls dam into the bypassed reach during peak recreation months and could allow for additional boating opportunities but would likely reduce the shoreline available for bank fishing and could have effects on other sensitive resources, including sensitive plant species. For example, Massachusetts DEP concludes that increasing flows to 1,400 cfs or higher would introduce high spring floods year-round into an otherwise dry section of the upper bypassed reach, resulting in persistent inundation and loss of rare plant species.

Overall, FirstLight's proposal, consistent with Massachusetts DEP condition 6, would improve boating conditions beyond those under the existing operational regime and continue to preserve sensitive resources. Further, FirstLight's proposal would provide higher flows in the

bypassed reach and variable whitewater releases that would allow for flows to be closer to or within the optimal range for whitewater boating. Minimum flow increases and stabilization of the flow regime downstream of Cabot Station would reduce frequency and magnitude of flow and water level fluctuations in the river and create a more predictable boating experience, specifically for paddlers continuing down the mainstem of the Connecticut River.

Flow Information/Public Safety

Providing flow and water level information, as well as flow forecasts to the public would allow visitors to plan for fluctuating flows and water levels, adjust accordingly, and help protect public safety. Consistent with Massachusetts DEP condition 12, FirstLight proposes to implement FFPSA Article A210 to provide the following information year-round on a publicly available website: (1) hourly Turners Falls impoundment WSE, Turners Falls dam discharge, and Station No. 1 discharge; (2) hourly anticipated Turners Falls dam and Station No. 1 discharge for a 12-hour window into the future; and (3) the anticipated timing of the annual power canal drawdown within one month of the planned event.

NMFS (10(j) recommendation TF5), Massachusetts DFW, and Interior support implementation of FFPSA Article A210. Six Massachusetts state legislators support FirstLight's proposal (A210) for year-round hourly information on flows out of Turners Falls dam and recommend additional, publicly available data and analyses, including real-time data on the flows pumped by the Northfield Mountain Project and released from the Northfield Mountain and Turners Falls hydropower facilities. Several individuals also comment about the need for real-time data and notifications of releases to protect the visitors swimming, boating, and participating in other recreation in the area.

Additionally, Massachusetts DEP condition 12 specifies reporting requirements, including (1) quarterly continuous hydrographs showing hourly impoundment levels as measured at the Turners Falls dam; (2) weekly and monthly statistics showing average impoundment elevation with standard deviations, median impoundment level, maximum elevation, minimum elevation, average daily elevation change with standard deviations, and number of elevation changes that exceed 2 feet/day; (3) a summary of discharges from the Turners Falls dam, Station No. 1, and Cabot Station on a daily, weekly, and monthly basis; and (4) an annual summary report filed by February 1 of each year that includes the preceding information and delineates the timing, frequency, magnitude, and duration of impoundment levels below 178.5 feet and above 184 feet.

Our Analysis

Public access to accurate water elevation and flow information would benefit boaters, anglers, and sightseers using the Turners Falls impoundment and the Connecticut River. Providing real-time flow information could be a determining factor for boaters, anglers, and sightseers deciding whether to paddle or fish downstream of the Turners Falls dam or whether to visit specific locations on certain days. Visitors could also use the flow information to plan trips that could happen with short notice or to cancel trips when flow is inappropriate for their skill level.

NMFS, Massachusetts DFW, Interior, and six Massachusetts state legislators support FirstLight's proposal, and the proposal appears to provide access to these data. However, the state legislators recommend FirstLight also make operations at Northfield Mountain (pumping

and releases) publicly available in real time. Because these operations would result in changes in the Turners Falls WSE, which FirstLight would report on an hourly basis, it is not clear how the specific pumping or release rates would provide valuable information to the public. Additionally, it appears that notification regarding the drawdown of the power canal could happen any time within 30 days of the drawdown, which may not allow enough notice for visitors to shift their plans. Notification to the public via the website as soon as possible but at least 30 days in advance of the annual drawdown would allow time for planning and adjusting for this drawdown and allow sufficient time for recreational users to take advantage of the available flow in the bypassed reach.

During the term of any new license issued, it is possible that more effective means for communicating flow information to the public may be developed. Including a provision to periodically review the efficacy of the public communication methods in the RMP would allow for use of improved communication methods and provide the public access to the information it needs to optimize recreational planning and safety at the project.

Operational compliance monitoring and reporting measures are typical requirements in Commission-issued licenses that allow the Commission to verify compliance with the environmental requirements of a license. Therefore, there is no additional benefit to the reporting, as specified by Massachusetts DEP condition 12 because it would be redundant to the operation compliance monitoring plan and other operation and deviation reporting that would be required by the license.

3.3.6 Land Use and Aesthetics

3.3.6.1 Affected Environment

Land Use

Land use in the Connecticut River Valley is mostly rural and agricultural, and much of it is undeveloped and forested. Small cities with residential, commercial, and industrial development are dispersed within the rural areas along the river valley. The primary land uses adjacent to the projects outside the cities are recreation, agriculture, and wildlife habitat.

The Northfield Mountain and Turners Falls projects include about 7,246 acres within the project boundaries. About 3,043 acres are open water and wetlands, while most of lands are designated as recreation (1,835 acres), agricultural (1,047 acres), forested (951 acres), developed (333 acres), and natural/undeveloped (37 acres) lands. No federal lands are within the project boundaries, except for land (20.1 acres) associated with the Conte Fish Lab, which is owned and operated by USGS.

No segments of the Connecticut River within the projects have been designated under the National Wild and Scenic River System. There are no other lands in the project boundaries that have been recommended for special wilderness designations.

Aesthetics

The Connecticut River Valley is recognized for its scenic mountains, historic villages, and open farmland. The mix of open space, villages, farms, country roads, mountainous terrain, historic architecture, and surface waters provide scenic vistas and a serene landscape. The valley

is surrounded by the Green Mountains on the west and the White Mountains on the east. Several road segments along the river have been designated as part of the Connecticut River National Scenic Byway, including Vermont Route 63 through Northfield, Erving, and Montague, Massachusetts, and Route 47 through Sunderland, Hadley, and South Hadley, Massachusetts. Designated waypoints along the byway include the Northfield Mountain Trail and Tour Center and the Great Falls Discovery Center in Turners Falls.

The Northfield Mountain Project, apart from the intake/tailrace and upper reservoir, are underground and generally out of public view. However, the Metacomet-Monadnock Trail, a New England National Scenic Trail, provides views of the Northfield Mountain Project's upper reservoir where the trail traverses open ledges along Crag Mountain. The trail is a long-distance hiking footpath that extends from the Connecticut state line to Mount Monadnock in New Hampshire.

The Turners Falls dam, gatehouse, power canal, Station No. 1, and Cabot Station are in an industrial area with several roads, town office buildings, and residential housing. The Gill-Montague bridge just below Turners Falls dam provides scenic views of the dam and bypassed reach for pedestrian and automobile traffic. The French King bridge along Route 2, connecting Gill to Erving, provides scenic views to the north and south of the Turners Falls impoundment.

3.3.6.2 Environmental Effects

Project Boundary

FirstLight proposes to modify the project boundaries at the Northfield Mountain and Turners Falls projects as described in section 2.2.2, *Proposed Project Boundary*. FirstLight's proposal includes the removal of 20.1 acres where the Conte Fish Lab is located, 52.3 acres in the vicinity of Farley Ledges, 8.1 acres referred to as Fuller Farm, and a 0.2-acre parcel at 39 Riverview Drive. The proposal also includes the addition of a 135.5-acre parcel of land located south of the Northfield Mountain switching station in the towns of Northfield and Erving.

Our Analysis

Project boundaries should enclose only those lands necessary for O&M of the project and for other project purposes, such as recreation, shoreline control, or protection of environmental resources.[139]

For the Northfield Mountain Project, FirstLight's proposal to remove a 0.2-acre parcel at 39 Riverview Drive and an 8.1-acre parcel referred to as Fuller Farm, located near 169 Millers Falls Road in Northfield, Massachusetts, appears warranted because both parcels are used for private residential and agricultural uses, and not needed for project purposes. In the Recreation Settlement Agreement, FirstLight proposes to remove a 52.3-acre parcel known as Farley Ledges indicating it is not needed for project purposes. As described in 3.3.5, *Recreation,* Farley Ledge climbing area is part of Farley Ledges—a larger chain of ledges used for rock-climbing and

[139] 18 C.F.R. § 4.41(h)(2) (2025).

accessible from parking and trails on privately held property outside the project boundary. After examining the record and project boundary files, while Farley Ledges was partially included in the original project boundary, it has not been designated a project facility, there are no formal developed amenities, and it remains located on undeveloped forested lands. Western Massachusetts Climbers Coalition purchased land to preserve access to Farley Ledges in 2007 and has developed a trailhead with a parking lot and access corridor to the ledges (Town of Erving, Massachusetts, 2025). This access corridor is a trail known as the Farley Ledges approach trail; it creates a loop around the crags and ledges that make up the climbing area and appears to be partially located within the project boundary. FirstLight does not propose to remove this trail from within the project boundary, and it appears that even if the Farley Ledge climbing area is removed from the project boundary, a portion of the loop trail would continue to remain within the project boundary on FirstLight-owned lands. As such, it would seem appropriate that FirstLight remove both the climbing area and the access trail from within the project boundary. Further, FirstLight agreed, as an off-license agreement in the Recreation Settlement, to grant a conservation restriction to permanently preserve a portion of Farley Ledges for public recreational purposes, which would protect the area following the proposed project boundary change. While not specifically stated, including this trail loop within the conservation restriction would preserve access to the climbing areas. Therefore, in combination with the off-license agreement, there is no indication in the project record that land use on these parcels would change if they were removed from the project boundary. However, removal from the project boundary would remove the Commission's authority and any license requirements for this area.

For the Turners Falls Project, FirstLight's proposal includes removal of a 0.2-acre parcel at 39 Riverview Drive (this parcel is located in an area where the Northfield Mountain and Turners Falls project boundaries overlap and would be removed from the project boundary for both projects) and a 20.1-acre parcel on which the Conte Fish Lab is located just north of Cabot Station. FirstLight states that the 0.2-acre parcel would be removed from the project boundary because it serves no project purposes. This property appears to be a private residence; therefore, removal from the project boundary seems appropriate. The 20.1-acre parcel on which the Conte Fish Lab is located is on land that was transferred from FirstLight's predecessor, Western Massachusetts Electric Company, to FWS in 1987 and then later transferred to USGS. USGS supports FirstLight's proposal to remove Conte Fish Lab from the Turners Falls project boundary. As such, existing land uses on the parcels FirstLight proposes to remove from the project boundary are residential, agricultural, and forested. There is no indication on record that land use on these parcels would change if they were removed from the project. These lands are not needed for project O&M or other project purposes, and thus their removal from the project boundary is warranted.

FirstLight's proposal to add a 135.5-acre parcel of land located south of the Northfield Mountain switching station in the towns of Northfield and Erving to the project boundary would add existing recreational trails associated with the Northfield Mountain Trail and the existing Tour Center to the project boundary. The addition of this parcel to the Northfield Mountain project boundary would be necessary because the parcel includes project recreation facilities that were not previously included in the project boundary.

Shoreline/Land Use Management Plan

FirstLight does not propose a shoreline or land use management plan. However, in 2009, the Commission approved a permitting program[140] for non-project use of projects lands and included policies to protect the scenic, recreational, cultural, and other environmental values. Each permit is issued by FirstLight for a term of five years and is consistent with the standard land use articles, Commission regulations, and land use designations. FirstLight's permitting program, as described on its website, recognizes and divides proposed non-project use into four categories including for miscellaneous uses and/or conveyances (Category A), single-family residential uses (Category B), and municipal or utility uses (Category C), and municipal or utility uses including private or public marinas (Category D) (FirstLight, 2016). Non-project uses currently permitted within the project boundaries include 24 camps, 46 docks, 8 landscape uses for adjoining property owners, and 8 water withdrawals. FirstLight proposes to update the existing land use classifications in its inventory to include agricultural, natural/undeveloped, developed, forested, open water, wetland, and recreation.

FirstLight proposes to place lands it owns that are not used for specific project activities (e.g., power production, project recreation facilities, conflicting existing uses) located on river right immediately downstream of the Turners Falls dam, along the Turners Falls impoundment shoreline, and at Bennett Meadow WMA into conservation easement/restriction subject to existing third-party property rights. Within two years of license issuance, FirstLight proposes to consult with the towns of Gill and Greenfield, and the Massachusetts DCR, on to the details of the conservation easement/restriction and a timeline for implementation, with implementation to be completed within six years of license issuance, contingent on any necessary FERC approvals. FirstLight also proposes to conserve lands in the Northfield Mountain project boundary on the eastern side of the upper reservoir for the protection of the 1.3-mile portion of the New England National Scenic Trail.

FRCOG and the town of Gill recommend FirstLight develop a land use management plan in consultation with interested parties, allowing for public comment, and include information about FirstLight's permit process for non-project use of project lands and a schedule for shoreline buffer maintenance and erosion control. As part of this management plan, the town of Gill recommends FirstLight include clarification about license agreements. They recommend that the plan include details about the process for obtaining a new agreement when or if a private club or residential camp is sold, and details about the length or term of each agreement. Further, the town of Gill recommends including details about the types of permits required, such as for private docks and water withdrawals, and include details about the permitting process, water withdrawal amounts, associated permit fees, requirements, and any other relevant information.

The town of Gill recommends FERC establish license articles that require a review and summary of outstanding orders of conditions issued by the four local conservation commissions (Gill, Montague, Erving and Northfield) prior to any sale, transfer, or restructuring of FirstLight's ownership.

The town of Montague requests cooperation from FirstLight and the Commission with ongoing efforts to remove or replace blighted mills and bridges from the former industrial center

[140] 129 FERC ¶ 62,075.

in the village of Turners Falls. In its reply comments, FirstLight states that they are unclear as to what the town of Montague is requesting and believes that the existing redevelopment agreement from August 9, 2021, sufficiently addresses cooperation between these two parties. This redevelopment agreement is off-license and outlines each parties' obligations concerning the demolition and replacement of the Strathmore Bridge, and grants easements from FirstLight to the town of Montague to construct other bridges or improvements on FirstLight's property.

Several individuals also commented regarding the need for a shoreline management plan to protect the shoreline and landowners from fluctuating flows and water levels due to the operation of Northfield Mountain.

Our Analysis

FirstLight's proposal to continue the permitting program and update land use classifications would typically be included as part of other Commission-approved shoreline/land use management plans, and shoreline classifications. Therefore, incorporating these existing programs and policies into a single document such as in a shoreline or land use management plan, as recommended by FRCOG and the town of Gill, would provide consistent shoreline classifications, guidelines, policies, and an overall framework for managing shoreline development at both projects over the term of any new license. A land or shoreline management plan would help protect both project shorelines, and any associated recreational, scenic, and environmental values. It would also provide details and clarification regarding the existing permitting program for private docks and water withdrawals, license agreement terms and details, and identify land use classifications. This document would also be a good location to promote BMPs to adjoining shoreline owners and provide education about reducing shoreline erosion, maintaining vegetative buffers, and protecting sensitive resources. A shoreline or land use management plan would also provide a periodic review and update schedule for consultation with agencies and interested parties for future input regarding shoreline management issues or other land management related concerns over the term of any new license if issued at either project.

Regarding the mill and bridge replacement projects in the project area, these actions have no nexus to the project and are outside the requirements of the license.

Effects of Project Operation on Aesthetics

Fluctuating flows and changes in reservoir elevation associated with FirstLight's proposed project operations can affect viewpoints and aesthetic resources in the project areas. FirstLight proposes to continue to maintain the water level in the Turners Falls impoundment between elevation 176.0 feet and 185.0; and to increase the minimum flows released from Turners Falls dam, through Station No. 1, and from Cabot Station in accordance with FFPSA Articles A110, A120, A130, 150 and 160, which would directly affect flows and WSEs in the Turners Falls impoundment, the Turners Falls bypassed reach, and in the Connecticut River downstream of Cabot Station. These proposed changes in project operations would alter flows and water level fluctuations in the impoundment and river downstream of the projects, which have the potential to alter the aesthetics by changing the amount of streambed that is exposed and the appearance of flowing water.

Most stakeholders support FirstLight's proposed operations. However, six Massachusetts state legislators, Connecticut River Conservancy, and American Rivers oppose the proposed minimum flows below Turners Falls dam and recommend a minimum flow of at least 1,400 cfs be released into Turners Falls bypassed reach July 1–November to enhance aesthetics, increase available habitats for fish and aquatic resources, and provide adequate recreation opportunities. Several individuals also express a general desire for flows higher than those proposed by FirstLight to improve aesthetics.

Connecticut River Conservancy recommends including debris management procedures in the RMP to determine how and when FirstLight would remove accumulated debris and trash from the boat barrier to minimize adverse effects of debris accumulation on aesthetics. Connecticut River Conservancy also recommends an assessment of existing debris and a schedule for upgrades to reduce light pollution, use of responsible outdoor lighting principles, and a review of artificial lighting progress as part of the 10-year review cycle of the RMP. Connecticut River Conservancy and individual commenters also mention the negative effects of the bright lights on the dam and other facilities.

Massachusetts DEP condition 13 specifies FFPSA Article B100 Northfield Mountain impoundment WSEs, and condition 10 modifies FFPSA Article A190 for Turners Falls impoundment WSEs.

In comments on the draft EIS, FRCOG, Connecticut River Conservancy, and American Whitewater recommend that FFPSA Article A190 be modified to include an average target elevation and a target operating bandwidth.

Our Analysis

Under FirstLight's proposed operations, WSEs in the Turners Falls impoundment and outflows from both the Northfield Mountain Project and the Turners Falls Project would change. As discussed in 3.3.2.2 *Effects of Impoundment Fluctuations on Shoreline Erosion*, the expanded operations at Northfield Mountain would cause the WSE in the Turners Falls impoundment to fluctuate, and potentially increase the frequency of drawdowns, which would expose additional shoreline on the impoundment and negatively affect views.

FirstLight's proposed operations include variable releases from Turners Falls dam and below Station No. 1 allowing higher flows and increased water depth in the bypassed reach which would help to cover the riverbed and improve aesthetics. Currently, flows above 400 cfs are not typical of normal project operations, and occur only during periods of high river flows, typically in the spring. Existing minimum flows released in the bypassed reach from Turners Falls dam usually range between 120 cfs and 400 cfs between May and October; therefore, FirstLight's proposal would increase flow levels and improve aesthetics.

FirstLight's proposal would also reduce flow fluctuations in the bypassed reach and downstream most of the time, yet allow peaking operations to occur for a limited number of hours each month. As shown in the 10 photos of flows at 500 cfs submitted by FirstLight in reply comments, the riverbed and some rocks might still be visible in some areas along the river; however, the additional water releases, and lesser fluctuations below Turners Falls dam would improve the aesthetics of the river downstream over existing conditions.

Connecticut River Conservancy argues that its minimum flow recommendation is appropriate because the aesthetic baseline has been reduced for years, and the proposed minimum flows (500

cfs) would fail to provide enough water to fully cover the riverbed, thereby failing to protect the aesthetics. Connecticut River Conservancy acknowledges that a 500 cfs minimum flow release would improve aesthetics over existing conditions. A flow release of 1,400 cfs would provide even higher flows and increase riverbed coverage; however, these recommended flows would reduce the shoreline available for bank fishing; reduce certain types of habitat, as described in section 3.3.2.2 *Aquatic Resources, Effects of Minimum Flows on Aquatic Resources*, would lessen power production; and could have negative effects on other resources, including sensitive plant species.

As described in Connecticut River Conservancy's comments, debris can collect along the Turners Falls dam boat barrier during high-flow events. Including provisions in the RMP for debris management at the boat barrier would formalize removal practices and ensure that debris accumulations are removed in a timely manner to reduce adverse effects on aesthetics.

In response to Connecticut River Conservancy recommendations for upgraded lighting, FirstLight states that it has replaced all exterior lighting with LEDs for energy efficiency. However, over the term of any new license issued, new technologies could become available that would reduce light pollution. For example, such technologies could include LED lights with automated color variability based on time of day or season. Therefore, including a provision within the RMP to periodically examine existing lighting at project facilities and recreation sites, incorporate advancements in lighting technology, and ensure compliance with any applicable local, state, and federal standards for light pollution standards would reduce the negative impacts of lighting on aesthetics, particularly views of the night sky.

Massachusetts DEP condition 10 specifies restrictions on the Turners Falls impoundment WSE which would require the licensee to maintain WSE higher than those under current conditions, and higher than FirstLight's proposal. This would improve aesthetics at the projects by reducing the exposed shoreline on the Turners Falls impoundment. Target WSEs and a target operating bandwidth would also lessen water fluctuations on the impoundment and improve aesthetic resources at the projects.

3.3.7 Cultural Resources

3.3.7.1 Affected Environment

Section 106 of the National Historic Preservation Act

Section 106 of the NHPA, as amended, and its implementing regulations found at 36 C.F.R. 800, require the Commission, as lead federal agency, to consider the effect of its undertakings on any historic properties, and allow the Advisory Council an opportunity to comment.

Historic properties are defined as any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places (National Register). In this document, we also use the term *cultural resources* to include properties that have not been evaluated for eligibility for listing in the National Register. Historic properties generally must possess integrity of location, design, setting, materials, workmanship, feeling, and association, and must meet one or more of the criteria specified in 36 C.F.R. 60.4. For example, dilapidated structures or heavily disturbed archaeological sites may not have enough contextual

integrity to be considered eligible. TCPs are a type of historic property eligible for listing in the National Register because of their association with cultural practices or beliefs of a living community that: (1) are rooted in that community's history; or (2) are important in maintaining the continuing cultural identity of the community (Parker and King, 1998). In most cases, cultural resources less than 50 years old are not considered eligible for listing in the National Register. However, properties that are less than 50 years old may be considered eligible for the National Register if they have achieved significance within the past 50 years and are of exceptional importance or if they are a contributing part of a National Register-eligible district.

Section 106 also requires that the Commission seek concurrence with the SHPO on any finding involving effects or no effects on historic properties and allow the Advisory Council an opportunity to comment. Section 106 also requires the Commission to consult with interested Tribes regarding relicensing activities. If properties have been identified that Tribes that might attach religious or cultural significance to (i.e., TCPs), section 106 requires that the Commission consult with interested Tribes. A summary of Tribal consultation is provided above in section 1.5, *Tribal Consultation*, a summary of consultation pursuant to section 106 is provided in Appendix D, *National Historic Preservation Act*, and a record of Tribal consultation is provided in Appendix C, Table 1.5-1.

Construction activities, maintenance, and operation of the projects could adversely affect historic properties (i.e., cultural resources listed or eligible for listing in the National Register). These historic properties could include pre-contact or post-contact archaeological sites, districts, buildings, structures, and objects, as well as locations with traditional value to Tribes or other groups. Direct effects could include destruction or damage to all, or a portion, of a historic property. Indirect effects could include the introduction of visual, atmospheric, or audible elements that affect the setting or character of a historic property.

If existing or potential adverse effects to historic properties have been identified at the projects, FirstLight must develop a historic properties management plan (HPMP) for each project, providing measures to avoid, minimize, or mitigate the effects. During development of the HPMPs, FirstLight should consult with the Commission, Advisory Council, the SHPOs, and Native American Tribes to obtain their views on the management of historic properties. In most cases, the HPMPs would be implemented by execution of programmatic agreements (PAs) that would be signed by the Commission, Advisory Council (if it chooses to participate), the appropriate SHPOs, and other consulting parties as appropriate.

Areas of Potential Effect

Pursuant to section 106, the Commission must take into account whether any historic properties within a project's APE could be affected by the issuance of a license for the project. The Advisory Council 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, including TCPs (36 C.F.R. § 800.16[d]).

In its September 13, 2013, study plan determination, Commission staff determined that the APEs for the Northfield Mountain and Turners Falls projects are defined as all lands within each project's current FERC project boundaries in addition to any other lands outside the FERC project boundaries where historic properties could be affected by project-related adverse effects. On lands adjacent to the project boundaries, the APEs would also include an additional 10 meters

(33 feet) of land inland from the top of banks of the Connecticut River and associated tributaries. By letter filed on December 27, 2013, the Massachusetts SHPO concurred with this definition.

Commission staff determines that the definition of the APEs should be revised to consist of all lands within each project's current FERC project boundaries in addition to any other lands outside the FERC project boundaries where historic properties could be affected by project-related adverse effects.[141] Because a project could result in adverse effects on a historic property as a whole, this definition would include the full boundaries of the six National Register-eligible or listed historic or archaeological districts that cross over the project boundary (Turners Falls Historic District, "The Patch" Historic District, Riverside Historic District, the Turners Falls Power & Electric Company Historic District, Riverside/Peskeompskut Archaeological District in Massachusetts; the Hinsdale Historic District in New Hampshire). An additional 10 meters of land outside the project boundary need not be included in the APE because any cultural resources that cross the project boundary into these areas would already be included in the APE as revised by Commission staff.

Cultural History Overview

Pre-contact Period

The prehistory of the Connecticut River watershed is divided into the three periods: the Paleoindian period, the Archaic period, and the Woodland period. During post-glacial Paleoindian period (12,000–10,000 before present [B.P.]), highly mobile hunter-gatherer groups relied heavily on the pursuit of large game species using large, Clovis-like, fluted spear points. In the Connecticut River Valley and in vicinity of the projects, very few Paleoindian archaeological sites have been documented. Those that have been identified primarily consist of short-term campsites.

The Archaic period (10,000–3,000 B.P) is represented by a warming trend and a greater reliance on deer, smaller game, birds, mammals, and fish. Evidence of the Early Archaic in the Connecticut River Valley is scant; this may be because sites dating to this period may remain deeply buried in alluvial deposits. Sites attributed to the Middle Archaic period are more common and are found in both lowland river/stream locations and in upland areas. This may reflect a shift to seasonal subsistence practices and increased establishment of cultural territories. Middle Archaic sites reflect an increase in three types of stemmed projectile points (Neville, Neville-variant, and Stark) often found with other tools such as choppers, scrapers, adzes, and other implements. Heavier stone tools may indicate the manufacture of dugout canoes. Late Archaic period sites are more prevalent in the vicinity of the projects. Large sites dating to this time are found in several locations where a variety of resources would have been plentiful, while smaller sites of this period are often located in upland areas, suggesting that they were used to procure specific resources. Quarry sites are also more common. The Late Archaic is divided into three major traditions that include the Laurentian, Small-Stemmed (or "Narrow Point"), and Susquehanna traditions that are distinguished by different projectile point styles. It is not clear if these differences are related to local adaptations, migration of people from different areas, or

[141] The results of cultural resources studies provided in this section apply to the APE as originally determined on September 13, 2013 and not to the APE as currently defined.

environmental changes. Several sites dating to the Late Archaic have been documented at the projects.

The Woodland period (ca. 3,000 B.P.–500 B.P.) is characterized by trends of cultural adaptation. Woodland period sites are common in the Connecticut River Valley and are marked by the first indication of horticulture and pottery manufacture. During the Early Woodland period, evidence for mortuary activity and establishment of a widespread trade system has been identified. The Middle Woodland period is characterized by different pottery styles frequently with incised, stamped, and dentate decoration. This period also saw the establishment of horticulture in the region. The emergence of horticulture would have led to increased occupation in areas where fertile soils could be found. The Late Woodland period is marked by the continued development of horticulture, changing pottery styles, and the presence of distinctive triangular projectile points. In general, the Woodland period was a time of cultural adaptation and use of diversified local resources. In addition, the nature of artifact forms and types of stone recovered from Woodland period sites indicate trade and communication with people from far-off regions. By the end of the period, historical evidence suggests core settlement areas had developed in the lowlands of the valley with peripheral areas occupied during certain times of the years for hunting and gathering. The Woodland period ended with European contact around 450–500 years ago. At this time, referred to as the contact period, trade goods, such as copper and beads, emerge in the record.

Post-contact Period

Prior to European contact, the Connecticut River served as a corridor for travel and trade between indigenous groups, and its banks were used for gathering, fishing and fish processing, and planting of squash and corn. During the subsequent Contact period (1500–1620), direct and indirect interaction between indigenous populations and Europeans was intermittent. However, a number of European settlements were developed during the subsequent Plantation period (1620–1675), including those in the town of Northfield. During this time, contact between Europeans and the indigenous populations increased, leading to the introduction of widespread disease, decimation of Native American populations, and the abandonment of Native American settlements.

During the Colonial period (1675–1775), settlement of the Connecticut River Valley was generally dispersed and short term, and until 1738, New Hampshire was part of the Massachusetts Bay Colony. Great Falls, the location of present-day Bellows Falls, gained its name from the 1676 “Battle of Great Falls” between Native American Tribes and English settlers and military. The region was only lightly resettled after the conflicts, but a 1753 decree by New Hampshire’s Royal Governor created the two towns north of Northfield on either side of the Connecticut River, both named Hinsdale. Vermont saw its first European settlement in the 1740s with a population boom during the Federal period (1775–1830) and gained statehood on March 4, 1791. Turners Falls was settled in 1792, and by 1798, a canal and dam were constructed to provide navigation around Turners Falls and South Hadley. This provided a connection in the 300-mile-long waterway system from Wells River, Vermont, to Hartford, Connecticut. The earliest European settlement of Bellows Falls was in 1749, and the village was named for Benjamin Bellows, one of its first settlers. In October 1802, the town of Hinsdale on the Vermont side of the Connecticut River was changed to Vernon. At this time, the Connecticut

River Valley began to see the construction of sawmills, tanneries, and paper and textile mills. In 1802, the region's first paper mill was established in Bellows Falls.

During the Early Industrial period (1830–1870), the construction of railroads resulted in a further increase in settlement and development of the Connecticut River Valley area. New immigrants to the area sought farming or factory jobs. The first railroad line to reach the area began service in 1846. In 1866, Colonel Alvah Crocker and Wendell T. Davis acquired the Upper Locks and Canals facilities, water rights, and 700 acres of land in the Turners Falls area. They founded the Turners Falls Company and built a wood-and-stone crib dam in early 1867 at the Turners Falls rapids. The Late Industrial period (1870–1915) saw an even greater increase in industrial development in the region, including construction of the Montague Paper Company in 1871, the Keith Paper Company (later Hammermill Paper) Mill in 1873, the Turners Falls Cotton Mill in 1874, and other mills in the village of Bellows Falls, Newbury, Thetford, Hartford, Putney, and Brattleboro, Vermont, and in Haverhill, New Hampshire. By the early 1880s, Hinsdale also held a well-developed industrial infrastructure.

History of Hydroelectric Generation

The Modern period represents the time from 1915 to the present. While generating facilities had been constructed in the Connecticut River Valley during the late 1800s, it is during the Modern period that hydroelectric generation within the region greatly expanded.

A generating station opened at the Turners Falls gatehouse in 1886. It was replaced between 1903–1904, and in 1905, the company constructed Station No. 1, approximately 3,000 feet downstream of the Turners Falls gatehouse at the upstream end of the power canal. By 1913, the station had five Francis-type generating units with a total capacity of 5,000 kW. In 1908, the Turners Falls Company was reorganized and renamed the Turners Falls Power & Electric Company. The original Crocker-built dam was replaced with the Gill and Montague (Turners Falls) dams, and the power canal was extended and widened. In 1915, the new Turners Falls dam was built to replace the original dam. That same year, construction began on the Cabot Station powerhouse located at the south end of the power canal. When it was completed, Cabot Station was the largest hydroelectric facility in Massachusetts.

Construction of the Northfield Mountain Project began in 1968, with the construction of a 2,500-foot tunnel, ventilation shaft, pressure shaft, a 286-acre upper reservoir and rock fill dam, the 10-story-high underground powerhouse, and the mile-long tail race between the powerhouse and the Connecticut River. At the same time, the Turners Falls dam was raised to increase the surface area of Turners Falls impoundment to 2,110 acres. The Northfield Mountain Project began operation in early 1972.

Previous Investigations

To determine the extent of previous studies and to identify previously recorded cultural resource sites documented within 0.25 miles of the project APEs, FirstLight reviewed records housed at the Massachusetts Historical Commission. Local repositories, literature, and maps were also consulted to provide cultural contexts for the projects.

Archaeological Resources

Following completion of the record searches, FirstLight conducted intensive archaeological and built environment field investigations within the project APEs in accordance with the study plans filed for the projects.

In accordance with the study plan for its Phase IA, IB, and II archaeological studies (FirstLight, 2013), FirstLight conducted Phase IA reconnaissance surveys of the Northfield Mountain Project and Turners Falls Project APEs in July and August of 2014 with the goal of identifying archaeologically sensitive areas and to identify locations for subsequent Phase IB surveys. As part of the Phase IA study, 65 survey segments within the APEs were selected for fieldwork based on landform, geology, and setting (48 segments in Massachusetts, seven segments in Vermont, and 10 segments in New Hampshire). Phase IA fieldwork consisted of a walkover and boat survey of the Connecticut River shoreline within the APEs and documentation of conditions, soil deposition, and any observed archaeological resources. The results of the Phase IA archaeological surveys were presented in an initial study report summary filed on September 16, 2014 (Gomez and Sullivan and TRC, 2014a), a final report filed on May 15, 2015 (FirstLight, 2015a), and in an updated study report summary filed on September 14, 2015 (FirstLight, 2015b).

Background research associated with the Phase IA study indicated that 79 previously recorded sites and a portion of a historic archaeological district, the Riverside/Peskeompskut Archeological District), have been previously documented within the APEs established for the two projects. The Riverside/Peskeompskut Archeological District)was nominated for the National Register in 1975, and several sites within the APEs are located within the boundaries of the district. Phase IA field investigations consisted of walkover inspections and a boat survey of the shoreline within archaeologically sensitive portions of the APEs. This work led to the documentation of five new sites within the two APEs.

Additionally, the University of Massachusetts also conducted surveys for bank restoration work at Camp 3E in Montague, Massachusetts, and the results were filed on July 7, 2015 (FirstLight, 2015c). A number of early twentieth-century artifacts and one Native American projectile point were observed in disturbed fill material. No further survey work was recommended.

Subsequent intensive Phase IB field surveys of lands within the APEs were also undertaken. Information and the results were filed on December 14, 2018 (FirstLight 2018a,b). Phase IB studies were conducted where sensitivity modeling indicated the potential for erosion and where property owners had granted access. The work was undertaken in May and October 2018 and included the excavation of shovel test pits to determine the potential for buried cultural deposits. As a result of the Phase IB surveys, 29 new archaeological sites were documented at the projects.

By letter dated March 7, 2019 (filed on May 6, 2019, with the final license application), the Massachusetts SHPO concurred that 15 of the sites discussed in the Phase IB report are not eligible for listing in the National Register but recommended additional Phase II fieldwork at 17 sites to more fully ascertain their data potential and National Register eligibility. The Phase II work was completed in July and August 2019 and was conducted in actively eroding areas containing documented sites that are potentially eligible for listing in the National Register. Phase II work included the excavation of additional test pits and radiocarbon dating of organic

material recovered from features such as hearths and storage pits. By letter filed on December 3, 2019, the Massachusetts SHPO concurred that five of the 17 Phase II sites in Massachusetts are eligible for listing in the National Register (sites 19-FR-342, 19-FR-465, 19-FR-470, GIL.HA.7, and GRE.HA.9) and seven are not eligible (19-FR-451, 19-FR-455, 19-FR-456, 19-FR-457, 19-FR-458, 19-FR-459, and 10FR461). The letter identifies one additional site (site 19-FR-349) as both eligible and ineligible. For the purpose of this analysis, the site is presumed to be eligible because it also contributes to the eligibility of the Riverside/Peskeompskut Archaeological District). The letter does not discuss the eligibility of the remaining four sites (19-FR-464, 19-FR-466, 19-FR-467, and 19-FR-468). Until confirmation of eligibility of these four sites is obtained, their National Register status remains undetermined for the purpose of this analysis. A final report for the Phase II work at these sites was filed on October 18, 2019, and was updated on February 3, 2020 (FirstLight, 2019b, 2020b).

Phase IB and Phase II investigations were also recommended at two sites located in New Hampshire (27-CH-244 and 27-CH-245). A report for this work was filed on December 14, 2018 (FirstLight, 2018b). By letter dated August 16, 2018, and filed with the report, the New Hampshire SHPO concurred that the two sites are not eligible for listing in the National Register. The Vermont SHPO did not request any Phase II studies.

In its March 15, 2021, response to Commission staff's request for additional information (FirstLight, 2021c), FirstLight provided an updated table that identified 124 archaeological sites and one archaeological district (Riverside/Peskeompskut Archaeological District) documented at the Northfield Mountain and Turners Falls projects and their current National Register status. However, in an updated HPMP filed on July 8, 2024, FirstLight indicated that there are only 96 resources within the APE. On August 22, 2024, the Commission requested clarification of this discrepancy. In a letter filed on September 19, 2024, FirstLight explained that upon further inspection of mapping data, it found that only 95 sites and the Riverside/Peskeompskut, Riverside Archaeological District (a total of 96 resources) were located within the APEs of the two projects and the remaining 29 sites were located outside APEs. No mapping data or concurrence from the Massachusetts SHPO or New Hampshire SHPO on this change was provided in FirstLight's response.

Of the 96 resources that FirstLight states are located within the APEs of the Northfield Mountain and Turners Falls projects, 84 of the individual sites and the archaeological district are located within the APEs of both projects, and the remaining 12 sites are located only within the APE of the Turners Falls Project. FirstLight's reports indicate that of the 96 resources, 47 are pre-contact resources (including the archaeological district), 16 are sites containing both pre-contact and post-contact components, and 11 are sites dating only to the post-contact period. The nature of the remaining 22 sites (all previously recorded) was identified as unknown.

The tables filed by FirstLight in its additional information request (AIR) response, its updated HPMPs, and in its response to Commission staff's request for clarification summarize the National Register eligibility of all the sites documented at the projects. However, for some sites, there are discrepancies between the eligibility status provided in the tables and determinations provided in previous correspondence from the Massachusetts SHPO. The filed documents specify that there has been no determination of eligibility for three sites (19-FR-345, 19-FR-450, and 19-FR-372). However, in its letter of March 7, 2019, the Massachusetts SHPO found that these three sites are not eligible for listing in the National Register. Additionally, FirstLight's table and updated HPMPs indicate that four additional sites that were among the 17

sites selected for Phase IB evaluation are ineligible for listing in the National Register (19-FR-464, 19-FR-466, 19-FR-467, and 19-FR-468). No documentation of concurrence from the Massachusetts SHPO on these recommendations has been filed with the Commission.

Table 3.3.7.1-1 identifies the 96 resources that FirstLight states are located within the project boundary as well as the 29 sites that it states are located outside the project boundary, including their National Register status. For the most part, the information provided in this table is adapted from FirstLight's table provided in its March 15, 2021, AIR response; the July 8, 2024, HPMPs; and the September 19, 2024, response to Commission staff's request for clarification.

Built Environment Resources

During field studies for the projects, built environment resources associated with the FirstLight projects were identified and documented by individuals meeting the Secretary of the Interior's Standards for Architecture and Engineering Documentation.

FirstLight conducted architectural research and surveys of the Northfield Mountain and Turners Falls APEs (as originally determined) in accordance with its study plan for its National Register evaluation of historic architectural resources surveys. The results were presented in study summary reports filed on September 16, 2014, and updated on September 14, 2015, (Gomez and Sullivan and TRC, 2014b; 2015d), in full reports filed on December 31, 2014, and January 21, 2015, (FirstLight, 2014; Gomez and Sullivan and TRC, 2015e), and in an addendum filed on November 16, 2015 (Gomez and Sullivan and TRC, 2015c). This work resulted in the identification of four previously identified historic districts in Massachusetts (Turners Falls Historic District, "The Patch" Historic District, Riverside Historic District, and the Turners Falls Power & Electric Company Historic District) and one historic district in New Hampshire (Hinsdale Historic District). In a letter filed on February 17, 2021 (dated January 7, 2021), the Massachusetts SHPO stated that the Northfield Mountain Project also meets the requirements for National Register-eligibility.[142] No eligible structures or districts were identified in the Vermont portion of the APEs.

In addition to the five historic districts, 31 previously identified individual structures were also identified located within Massachusetts and New Hampshire, 28 of which are contained within one or more of the five historic districts. Of the 31 identified resources, 13 resources are eligible for listed in the National Register as contributing resources to the Turners Falls Historic District, six resources had been previously determined to be individually eligible for listing in the National Register, three had been determined not eligible, and eight structures had not yet been evaluated for listing. One additional historic structure, the Cabot Station gantry crane, was previously determined to be eligible for listing, but was demolished following Historic American Engineering Record (HAER) documentation.

FirstLight's field surveys of the project APEs identified an additional 38 structures greater than 50 years old. These structures, and the eight previously documented but unevaluated structures, were evaluated for listing in the National Register.

[142] Accession no. 20210217-0010.

According to FirstLight's studies, there are a total of 65 historic architectural resources within the APEs of the Northfield Mountain and Turners Falls projects. Thirteen of these structures are listed in the National Register as contributing to the eligibility of the Turners Falls Historic District. An additional 22 structures are either individually eligible for listing in the National Register or contribute to the eligibility of the five other historic districts. Thirty structures are ineligible for listing. A summary of all individual historic structures identified within the project APEs and their National Register eligibility is provided in Table 3.3.7.1-2.

The Turners Falls Historic District was listed in the National Register in 1983 and contains 17 commercial, industrial, and residential structures. Thirteen of the structures are located within the project APEs; four of which are also located within the Turners Falls Power and Electric Historic District and one is also located within "The Patch" Historic District. The 13 structures include seven bridges, two historic mills, three historic paper company buildings, and an electrical switch building. FirstLight owns three of the structures that contribute to the significance of the district (Keith's Mill footbridge, Turners Falls power canal, International Paper Company bridge over the power canal). These structures are also located within the Turners Falls Historic Power & Electric Company District. FirstLight does not operate or manage the remaining 10 structures.

"The Patch" Historic District is a residential area in Turners Falls. The district contains two structures within the project APEs that are eligible for listing in the National Register: the Eleventh Street bridge over the power canal (structure MNT.904) and a historic house (structure TRC-4). The Eleventh Street bridge is also located within the boundaries of the Turners Falls Power & Light Company Historic District. Neither of the structures is owned, operated, or managed by FirstLight.

The proposed Riverside Historic District encompasses various streets in Gill, Massachusetts. The town of Gill filed a district nomination form with the Massachusetts Historical Commission in July 2014. The district contains three historic houses (structures GIL.037, GIL.043, GIL.059) that are eligible for listing in the National Register and are located within the project APEs. FirstLight does not own or manage any of the houses.

The Hinsdale Historic District is located along the Ashuelot River in Hinsdale, New Hampshire, and was determined to be eligible for listing in the National Register under Criteria A and C. The district contains three significant structures that are within the project APEs: the Route 63 (Northfield Street) bridge over the Ashuelot River (TRC-31), a historic culvert (TRC-32), and the Ashuelot River gaging station (TRC-33). None of these structures is owned by FirstLight.

The Turners Falls Power and Electric Company Historic District has also been recommended to be eligible for listing in the National Register under Criteria A and C as the first large-scale hydroelectric project built in New England and as an example of early twentieth-century hydropower engineering. Seven elements of the district are owned by FirstLight and contribute to its historic significance. These include Turners Falls dams 1 and 2 (Montague and Gill dams), Power Station No. 1, Cabot power station and dam, Turners Falls gate house, Turners Falls power canal (sections), International Paper Company bridge, and Keith's Mill footbridge. Two additional structures within the boundary of the district, the Boston & Main railroad bridges over the power canal and branch canal, are also owned by FirstLight but were determined not to contribute to the district's importance. FirstLight's updated HPMPs (Tables 3.2-1 of FirstLight

2024c,d) indicate that three additional structures, the electrical switch building, the Eleventh Street pedestrian bridge, and the Schell Memorial bridge over the Connecticut River also contribute to the significance of the district but are not owned by FirstLight. Several of the structures within the Turners Falls Power & Electric Company Historic District that are owned by FirstLight are also contributing elements of the Turners Falls Historic District (Keith's Mill footbridge, Turners Falls power canal, and the International Paper Company bridge) or "The Patch" Historic District (the Eleventh Street bridge).

According to FirstLight's license application and the updated HPMP for the Northfield Mountain Project and Visitor's Center (FirstLight 2024d)), the project met the 50-year-old threshold for National Register consideration in 2018. It is considered eligible for listing under Criteria A and C as the world's largest pumped-storage facility when it was constructed and for its association with the history of hydroelectric power in the Connecticut River Valley.

By letter filed August 4, 2015, the New Hampshire SHPO commented that no additional architectural surveys or evaluations in New Hampshire are necessary. On November 16, 2015, FirstLight filed documentation of the Vermont SHPO's concurrence that there are no structures located in the APEs within Vermont that are eligible for listing in the National Register. By letter filed December 11, 2015, the Massachusetts SHPO accepted FirstLight's report and stated that it looked forward to reviewing the Commission's determinations of eligibility.

Traditional Cultural Properties

The following federally recognized Tribes, interested state-recognized Tribes, and Tribal organizations have been contacted regarding TCPs and/or have filed comments regarding TCPs for the relicensing of the projects:

- Abenaki Nation Coalition
- Cowasuck Band-Pennacook-Abenaki People (Cowasuck Band)
- Elnu Abenaki Tribe
- Koasek Traditional Band of the Koas Abenaki Nation
- Koasek Traditional Band of the Sovereign Abenaki
- Mashpee Wampanoag Tribe
- Narragansett Tribe
- Nolumbeka Project
- Nolumbeka Project Tribal Coalition
- Nulhegan Abenaki Tribe
- Sovereign Abenaki Nation of Missisquoi
- Stockbridge-Munsee Band of Mohican Indians
- Wampanoag Tribe of Gay Head

In an August 14, 2013, letter to the Narragansett Tribe,[143] FirstLight provided the Tribe with information regarding a proposed TCP study at the Northfield Mountain and Turners Falls projects. In a conference call on January 20, 2014, FirstLight discussed the study with the Tribe, and in a letter filed on February 3, 2014,[144] FirstLight further consulted with the Narragansett Tribe and with the Nolumbeka Project Tribal Coalition regarding the documentation of potential TCPs at the projects. In this letter, FirstLight requested a meeting with both the Narragansett Tribe and Nolumbeka Project Tribal Coalition to introduce the ethnographer selected to conduct the work. As detailed in a memo filed on March 12, 2014,[145] Commission staff participated in conference calls on February 27 and March 11, 2014, with a representative of the Narragansett Tribe regarding the conduct of cultural resources studies.[146] The Narragansett Tribe stated that it wanted the Commission to require FirstLight to retain the Narragansett Tribe to conduct its own study of areas of traditional importance. Commission staff explained that it could not compel FirstLight to hire the Narragansett Tribe to do an independent study but stated that it would consult with FirstLight regarding the Narragansett Tribe's participation in the cultural resources studies. Commission staff encouraged the Narragansett Tribe to work with FirstLight to document cultural resources of religious and traditional importance within the project area. In a follow-up letter to the Narragansett Tribe issued on April 11, 2014,[147] Commission staff stated that it had discussed the Narragansett Tribe's comments with FirstLight and that FirstLight had indicated that it would continue to engage the Narragansett Tribe in study implementation. Subsequent attempts to meet with the Narragansett Tribe and Nolumbeka Project Tribal Coalition to conduct interviews and field visits were not successful. In response to a May 1, 2015, request from the Nolumbeka Project,[148] FirstLight filed a letter on June 9, 2015,[149] agreeing to visit a property that is presumed to be located outside the APEs with Nolumbeka Project Tribal Coalition representatives; however, the visit did not take place.

During study implementation, the Nolumbeka Project Tribal Coalition expressed concern regarding a ceremonial stone landscape that it stated was located within the Turners Falls APE. FirstLight responded that it believed that the property was located outside the APE but offered to meet with the Nolumbeka Project Tribal Coalition to discuss the site. This meeting did not take place. While initially participating in consultation on development of the TCP study, the Narragansett Tribe and Nolumbeka Project Tribal Coalition discontinued participating with FirstLight. No other contacted federally recognized Tribe, state recognized Tribe, or tribal organization chose to participate in the TCP study. For this reason, FirstLight filed a TCP report on September 14, 2015 (FirstLight, 2015d) that was based on existing, documented information. This report reflected that one TCP that is listed in the National Register is located near the

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[143] Accession no. 20130814-5106.

[144] Accession no. 20140203-5080.

[145] Accession no. 20140312-5064.

[146] Accession no. 20140312-5064.

[147] Accession no. 20140411-3018.

[148] Accession no. 20150501-5057.

[149] Accession no. 20140609-5167.

projects, but it is not located within the APEs of the Northfield Mountain and Turners Falls projects. The report also acknowledged stone features in the vicinity of the projects but stated that Tribal participation was required to determine if they are located within the APE and to evaluate their significance.

In a letter filed on January 17, 2017, the Narragansett Tribe expressed concern regarding the TCP report and recommended a plan and budget for further study.[150] The Elnu Abenaki Tribe's January 17, 2017, letter[151] regarding TCPs at Great River's Wilder, Bellows Falls, and Vernon hydroelectric projects also pertained to areas of cultural importance at the Northfield Mountain and Turners Falls projects. On March 1, 2017, FirstLight filed responses to both the Narragansett Indian Tribe[152] and the Elnu Abenaki Tribe,[153] explaining that further consideration of potential TCPs is provided for in the draft HPMP for both projects that was sent to the Tribes and Tribal organizations for review on April 29, 2016. FirstLight's letter also included an invitation to meet with the Tribe and Tribal organizations to further discuss its interests. Commission staff also participated in teleconference calls with the Narragansett Tribe and the Nolumbeka Project Tribal Coalition in August 2015 and with the Cowasuck Band in November 2017 regarding the projects and recommended that they continue to coordinate with FirstLight regarding properties of religious and cultural significance to the Tribes.

To date, FirstLight has not documented any potential TCPs within the APEs of the Northfield Mountain and Turners Falls projects. However, in a letter filed on May 22, 2024,[154] the Nolumbeka Project Tribal Coalition states that a Ceremonial Stone Landscape District is located adjacent to the Turners Falls project boundary, and that the 1676 Great Falls Massacre Site is inundated by the Turners Falls impoundment.

3.3.7.2 Environmental Effects

Project-related effects on cultural resources within each project's APE (see definition in section 3.3.7.1, *Areas of Potential Effect*) are likely to occur from O&M and construction activities. Project effects are considered adverse when an activity may alter—directly or indirectly—the characteristics of a historic property that qualify the property for inclusion in the National Register. If adverse effects are found, consultation with the Massachusetts, New Hampshire, and Vermont SHPOs as appropriate and other parties would be required to develop alternatives or modifications to avoid, minimize, or mitigate such adverse effects.

Over the license terms, various project-related actions including routine O&M of buildings and structures, impoundment inundation and fluctuation, vegetation management, road maintenance, construction and use, recreation, emergency repairs, and artifact

[150] Accession no, 20170117-5126.

[151] Accession no. 20170117-5125.

[152] Accession no. 20170301-5326.

[153] Accession no, 20170301-5328.

[154] Accession no. 20240522-5138.

collection/management may affect historic properties at the projects. FirstLight has identified project effects on eligible or unevaluated resources that may occur as a result of these activities.

Archaeological Resources

Archaeological sites located within drawdown or seasonal fluctuation zones of an impoundment may be subject to erosion, scouring, hydrologic sorting, and the horizontal and vertical movement of artifacts. Impoundment fluctuations and/or drawdowns may also result in the exposure of previously submerged cultural resources, making them more susceptible to artifact collection and vandalism. Additionally, public access to project waters and recreational activities, such as camping, fishing, picnicking, boating, and hiking, may result in artifact collection and site vandalism. During field investigations at the projects (see section 3.3.7.1, *Previous Investigations*), whenever possible, the condition of each archaeological site was assessed to aid in the identification of project-related effects.

FirstLight initially identified 124 archaeological sites and one archaeological district (Riverside/Peskeompskut Archeological District) within the project APEs. There is substantial overlap in the APEs for the two projects with 114 sites located in both APEs and 17 sites located in the Turners Falls APE only. No sites are located only in the Northfield Mountain APE. FirstLight subsequently clarified with the Commission that upon further inspection of mapping data, only 95 individual sites and the archaeological district are located within the APEs. Twenty-four of the 96 resources are ineligible for listing in the National Register. No further assessment of effects or continued management of these 24 ineligible resources would be required under section 106 of the NHPA. Of the 71 remaining individual archaeological sites (excluding the archaeological district), 11 are eligible for listing in the National Register, of which five contribute to the archaeological district, and 61 remain unevaluated.

During its field investigations, FirstLight did not identify any disturbances at 22 of these 71 sites. Disturbances at the remaining 49 sites fell into three categories: erosion (two sites), artifact collection (27 sites), and sites experiencing both erosion and artifact collection (20 sites) (FirstLight, 2020e,f; 2021c; FirstLight 2024e,g,h). Identified site disturbances at the Northfield Mountain and Turners Falls projects are summarized in Table 3.3.7.2-1.

FirstLight evaluated the causes of erosion at the projects as part of its streambank erosion study (Choi, 2014b). The results of this study are presented in section 3.3.1.1, and the potential erosional effects of project operations on shorelines are discussed in section 3.3.1.2, *Environmental Effects*, *Shoreline Erosion Monitoring*. Based on these studies, FirstLight determined that there are generally two shoreline banks within the Turners Falls impoundment: an upper bank that is typically above water except during high flows, and a lower bank that is frequently submerged. The impoundment riverbanks were found to be generally stable; there was little or no erosion through much of this reach (84.4%), but 14.1% of the reach had some erosion, 0.5% had some-to-extensive erosion, and 0.6% had extensive erosion. Based on the 2013 survey, streambanks in the Turners Falls impoundment generally consist of an upper bank that is often above water except during high-flow conditions, and a lower bank that is frequently submerged (Choi, 2014a). Most (78%) of the upper riverbanks in the impoundment surveyed had moderate or steep slopes, heights greater than 12 feet, consisted of silt and sand, and had heavy vegetation. Most of the lower riverbanks had flat (beach) to moderate slopes, consisted of silt and sand, and had no or sparse vegetation. In terms of erosion (conditions in 2013), the riverbanks of the entire impoundment were generally stable; there was little or no erosion

through much of this reach (84.4%), 14.1% of the reach had some erosion, 0.5% had some-to-extensive erosion, and 0.6% had extensive erosion.

At the Northfield Mountain Project, the upper reservoir is constructed on dikes and includes areas that are cut into bedrock. This shoreline experiences little to no erosion. While erosion was observed at 22 of the 95 individual eligible or unevaluated archaeological sites at the projects, FirstLight states that project operations are not a major cause of the erosion, rather the erosion is either primarily due to naturally occurring high flows or boat waves. FirstLight states that the Northfield Mountain and Turners Falls projects are responsible for less than 1% of the observed erosion at the projects. In its letter filed on May 22, 2024, the Nolumbeka Project Tribal Coalition disagrees with this assessment and recommends that a shoreline erosion action plan be developed and implemented.

FirstLight reported that artifact collection is occurring at 47 of the 95 individual sites that are either eligible for listing in the National Register or remain unevaluated. In Commission staff's November 4, 2020, request for additional information, FirstLight was asked to clarify which sites being affected by artifact collection are accessible as a result of project facilities, such as hiking trails, and whether these sites would otherwise be accessible absent project features. In its March 15, 2021, response (FirstLight, 2021c), FirstLight stated that, while there are no specific sites being targeted by modern-era collectors and/or visitors to the projects, the potential for artifact collecting remains. FirstLight explained that areas along the Connecticut River, including lands controlled by FirstLight and under FERC jurisdiction, have been historically popular for illegal artifact removal.

In Commission staff's November 4, 2020 request for additional information, FirstLight was asked to clarify if any documented archaeological resources could be affected by FirstLight's proposed recreational improvements (i.e., Riverview boat tour; proposed access trail at Riverview; proposed formal access trail put-in at Cabot Camp; downstream of Turners Falls dam at the proposed access trail put-in; proposed Poplar Street take-out). In its March 15, 2021, response (FirstLight, 2021c), FirstLight explained that there are no known archaeological resources within the currently proposed boundaries of the new recreational improvement sites but the proposed formal access trail put-in at Cabot Camp is located adjacent to the Cabot Camp archaeological site (19-FR-353), a site that FirstLight initially determined to be located within the project APEs but subsequently stated is outside the APEs. FirstLight acknowledged that during the planning stages of these recreation projects, it would be required to consult with the Massachusetts SHPO through submittal of Project Notification Forms and plans for any recreation development for the SHPO's review and comment. FirstLight's subsequent Recreation Settlement Agreement (filed June 12, 2023) identified proposals for a number of other additional recreation facilities at the Northfield Mountain and Turners Falls projects. The full effects on archaeological resources as a result of implementation of the subsequent Recreation Settlement Agreement are unknown, and consultation with the appropriate SHPO prior to implementation of recreational improvements would be required.

According to 36 C.F.R. 800.5(a)(2)(vii) of the regulations implementing the NHPA, the transfer, lease, or sale of property out of federal control without conditions to ensure the long-term preservation of historic properties on the property may constitute an adverse effect. In section 3.3.7.4 of Exhibit E of FirstLight's amended final license application, FirstLight identified two parcels of land that are proposed for removal from the Turners Falls project boundary (Riverview Drive [0.2 acres] and the Conte Fish Lab [20.1 acres]). In its March 15,

2021, response to Commission staff's request for additional information (FirstLight, 2021c), FirstLight also acknowledged that the transfer of these lands out of the project boundary has the potential to adversely affect historic properties. According to the two updated HPMPs filed with the Commission on July 8, 2024 (see *Historic Properties Management Plans,* below), the Riverview Drive property contains one historic-period structure, the privately held Frank Smith House (GIL.043). FirstLight also proposes to remove two areas from within the Northfield Mountain project boundary. These include the Fuller Farm, a historic farmstead located on an 8.1-acre parcel of land, because the lands are not needed for project operations, and 52.3 acres in the vicinity of Farley Ledges that is not needed for project purposes.[155] In its November 11, 2020 request for additional information, Commission staff requested that FirstLight describe any specific measures, including consultation with the Massachusetts SHPO, for the lands proposed for removal. In a letter filed on February 17, 2021 (dated January 7, 2021),[156] the Massachusetts SHPO requested that an intensive archaeological survey of the Riverview Drive and Fuller Farm areas be conducted to identify any intact, significant archaeological resources prior to transfer or removal from the project boundary and preparation of a plan to address any potential effects of the transfer on properties determined to be eligible for listing in the National Register. In its March 15, 2021, response, FirstLight stated that it intends to conduct the survey of the Riverview Drive property prior to transfer and that it would also prepare and implement a plan for avoidance or mitigation of effects to any intact, significant archaeological resources prior to any transfer or removal out of FERC jurisdiction. Fuller Farm was subject to Phase IA archaeological reconnaissance and was identified as archaeologically sensitive for pre-contact and post-contact resources.[157] However, because no erosion or other project-related effects were observed on the property, it was not subject to intensive Phase IB studies and no sites were documented. In its response, FirstLight states that it will also conduct an intensive archaeological survey of the farm.

In Exhibit E, FirstLight notes that the Conte Fish Lab parcel contains several previously recorded archaeological resources, none of which have been evaluated for listing in the National Register. However, in its March 15, 2021, response, FirstLight stated that if the transfer of the land outside the Turners Falls project boundary is approved, the Conte Fish Lab parcel will remain under USGS ownership (a federal governmental entity), which is subject to section 106 requirements. For this reason, FirstLight states that there would be no adverse effect as a result of removing the Conte Fish Lab parcel from the Turners Falls project boundary. However, in its January 7, 2021, letter referenced above, the Massachusetts SHPO requested that the boundaries of each of the previously identified archaeological resources within the Conte Fish Lab parcel be

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[155] Farley Ledges is not mentioned in section 3.3.7.4 of the amended final license application but is discussed in a footnote in the application cover letter and in section III.B.2 of the Recreation Settlement Agreement.

[156] Accession no. 20210217-0010.

[157] FirstLight's Phase IA archaeological report states that structures on the property correspond to resource number NFL.178 (the Frederick Morgan House) which is more fully discussed in FirstLight's historic architectural resources report. This structure was recommended as ineligible for listing in the National Register.

verified and identified on the Turners Falls project boundary maps as "Sensitive Resource Areas: No Impact." FirstLight acknowledged this request in its response.

FirstLight has not filed any specific measures for the proposed removal of the Farley Ledges from the Northfield Mountain project boundary.

Built Environment Resources

O&M of the Northfield Mountain and Turners Falls projects could adversely affect historic structures over any new license terms. As discussed in section 3.3.7.1, of the 65 built environment resources documented within the Northfield Mountain and Turners Falls projects' APEs, 35 structures are either listed in the National Register, contribute to the eligibility of a historic district, or are individually eligible for listing. Of these, FirstLight owns 11 structures within the project APEs that are either listed or eligible for listing in the National Register: six of these structures are facilities associated with the Turners Falls Project and three are other historic structures not related to or required for hydroelectric generation. Additionally, the Northfield Mountain Project and Visitor's Center, while not formally evaluated, is considered eligible for listing in the National Register.

FirstLight has not identified any specific effects or changes to historic structures at the projects. However, in its March 15, 2021, response to Commission staff's November 11, 2020, request for additional information, FirstLight stated that the proposed formal access trail put-in at Cabot Camp is located adjacent to the boundary of the "Cabot Camp Historic District" (Cabot Camp is also identified as structure MNT-450) and, as mentioned above, the Cabot Camp archaeological site (19-FR-353), a site that FirstLight states is located outside the project APEs). Additionally, in its response, FirstLight stated that the proposed Riverview boat tour dock relocation and proposed access trail at Riverview both occur within the State-inventoried "Northfield Farms Agricultural/Residential District" and that the proposed access trail put-in immediately downstream of Turners Falls dam occurs within the Turners Falls Historic District. In its response, FirstLight stated that it did not anticipate any impacts to these resources as a result of recreational improvements.

The full effects on historic properties and structures as a result of implementation of the measures provided in FirstLight's FFPSA are unknown. FirstLight's FFPSA filed on August 3, 2022, could affect project structures that are eligible for listing in the National Register. Such effects would be determined upon completion of settlement studies and determination of appropriate system modifications/additions and operating regimes. Additionally, implementation of FirstLight's Recreation Settlement Agreement could also affect historic structures. These effects could include, but not be limited to, potential adverse effects on Cabot Camp historic structures and the adjacent archaeological site.

Traditional Cultural Properties

Project-related activities have the potential to adversely affect areas of traditional or cultural importance to Tribes. As detailed in section 3.3.7.1, between 2012 and fall 2015, FirstLight and Commission staff consulted with interested Tribes and Tribal organizations to identify areas of particular traditional concern that may be considered to be TCPs. During study implementation, the Nolumbeka Project stated that a potential TCP was located within the APE of the Turners Falls Project; FirstLight responded that the property appeared to be located outside the APE but offered to meet with the Nolumbeka Project regarding this location. No

meeting occurred, and none of the consulted Tribes and Tribal organizations chose to participate in consultation related to TCPs. The TCP study report was filed by FirstLight on September 14, 2015 (FirstLight 2015d). Subsequent to this filing, the Elnu Abenaki, Abenaki Nation, Cowasuck Band, Narragansett Tribe, and the Nolumbeka Project expressed concerns regarding potential TCPs at the projects that were not addressed by FirstLight in the TCP report, including a ceremonial stone landscape, a potential TCP that the Nolumbeka Project Tribal Coalition states is located within the APE.

In a May 22, 2024, letter, the Nolumbeka Project Tribal Coalition states that dewatering the Turners Falls bypassed reach has exposed the ceremonial stone landscape and requests that flows in this reach of the river be increased to 2,000 cfs year-round to cover the dry riverbed and protect cultural resources located in the riverbed. Additionally, in its letter, the Nolumbeka Project Tribal Coalition explained that the 1676 Great Falls Massacre Site is inundated by the Turners Falls impoundment. As a result, indigenous people no longer have access to this site for ritual or remembrance purposes. The Nolumbeka Project Tribal Coalition requests that the Commission require FirstLight to create a safe access trail to the area for ceremonial and other purposes and to support its recommendation that FirstLight purchase lands associated with archaeological site 19-FR-268, a site located outside the projects' APEs and owned by the town of Gill, as a "substitute place" for people to gather and pay their respects. Additionally, the Nolumbeka Project Tribal Coalition requests that the Wissatinnewag Village (also known as 19-FR-12) and its associated trail systems to the river, located in Greenfield, Massachusetts, and Fort Hill, a property within the Riverside Historic District, be included within the APE.

In its May 22, 2024, letter, the Nolumbeka Project Tribal Coalition also provides a summary of subsequent efforts between its members and FirstLight regarding a Memorandum of Understanding in Principle (MOUIP) that had been signed by FirstLight and the members of the Nolumbeka Project Tribal Coalition.[158] According to the MOUIP, the parties agreed to negotiate a settlement agreement for the Turners Falls and Northfield Mountain projects related to cultural resources, specifically to address further consultation regarding TCPs, amendment of the proposed HPMPs, access to cultural sites, a remediation plan for flooded cultural resources, and interpretive signage to be posted at appropriate locations. The Nolumbeka Project Tribal Coalition states that a final agreement had not yet been reached and reiterates the need for further identification of TCPs at the projects. The Nolumbeka Project Tribal Coalition requests that FirstLight sign or reject an agreement and also that the Commission facilitate "shared proponent/Tribal relationship and stewardship responsibilities." In its July 8, 2024, reply comments, FirstLight states that it remains supportive of the commitments in the MOUIP, but expresses concern that conducting a TCP study almost 10 years after its initial attempts to do so would "unreasonably delay and disrupt" the relicensing of the two projects. In a letter filed on August 28, 2025, FirstLight acknowledges the location of the 1676 Great Falls Massacre and notes that any potential dredging in this area could impact cultural resources.

[158] On March 24, 2023, FirstLight filed an update of cultural resources discussions regarding the Turners Falls and Northfield Mountain projects that have occurred since the TCP study was completed. This filing included a copy of the MOUIP. *See* Accession no. 20230324-5108.

The FRCOG recommends that Commission staff and FirstLight meet with Tribes to discuss completion of a TCP study with results to be included in an updated HPMP to be developed in consultation with the Tribes, historical commissions, and other parties as appropriate.

Historic Properties Management Plans

Continued project operation and enhancements, recreational use, and new construction could affect cultural resources that are listed or eligible for inclusion in the National Register. FirstLight proposes to manage effects on historic properties through the implementation of separate HPMPs for the two projects. The purpose of the HPMPs is to resolve (i.e., avoid, minimize, or mitigate) existing or potential project-related adverse effects on historic properties within the Northfield Mountain and Turners Falls Project APEs throughout the term of each license.

FirstLight provided an initial draft of a combined Turners Falls/Northfield Mountain HPMP to the SHPOs, interested Tribes, and historical commissions on April 29, 2016. Comments on this initial combined HPMP were received from the Massachusetts SHPO (May 24, 2016), Northfield Historical Commission (May 27, 2016), Gill Historical Commission (July 22, 2016), and Montague Historic Commission (March 31, 2016). [159] The combined HPMP was subsequently separated into individual HPMPs for each project, which were filed on December 4, 2020, with the amended final license application for the Turners Falls and Northfield Mountain projects. On January 7, 2021, the Massachusetts SHPO provided its comments on the December 2020 individual HPMPs (filed on February 17, 2021).[160]

On July 8, 2024, FirstLight filed updated HPMPs that included new information, including a reduced number of sites within the project APEs. Most of the Massachusetts SHPO's January 7, 2021, comments were addressed in the new HPMPs (exceptions are discussed below). The Massachusetts SHPO, New Hampshire SHPO, or Vermont SHPO did not file comments on the updated July 8, 2024, HPMPs.

The 2024 HPMPs were prepared in accordance with the Advisory Council and Commission's *Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects* (Advisory Council and Commission, 2002) and contained copies of all previous comments received from the Massachusetts SHPO and historical commissions, except for the Massachusetts SHPO's January 7, 2021, comments. Compared to the combined 2016 HPMP, the 2024 individual HPMPs address the results of Phase IB and Phase II surveys and most of the comments that had been received from the Massachusetts SHPO and historical commissions.

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[159] These comments from the Massachusetts SHPO, Northfield Historical Commission, Gill Historical Society, and Montague Historic Commission were provided with FirstLight's separated HPMPs filed on December 4, 2020 (accession no. 20201204-5121) and July 8, 2024 (accession no. 20240708-5138).

[160] Accession no. 20210217-0010.

In both HPMPs, FirstLight proposes general and specific management measures. General measures include: (1) identification of a cultural resources coordinator; (2) a plan for the curation of recovered archaeological materials; (3) a plan and schedule for periodic reporting, including the submittal of annual HPMP status reports to the Commission, SHPOs, and historical commissions; (4) a plan for public interpretation (e.g., interpretive signage, public education programs, etc.); (5) a plan for HPMP review and amendment; (6) a program for future cultural resources inventories on unsurveyed lands as conditions allow; (7); training for project personnel; (8) procedures for unanticipated discoveries of cultural materials and human remains; and (9) implementation of a monitoring program for future project activities. Additionally, the HPMPs include plans for the review of future ground-disturbing activities (including activities associated with implementation of the proposed June 21, 2023, RMP), additional Phase I and Phase II archaeological studies as needed, and review of activities requiring modification of historic structures, including consultation with the applicable SHPO(s).

Regarding the appointment of a cultural resources coordinator, in its HPMPs, FirstLight states cultural resource studies associated with the projects would be directed by employees who have received training in the section 106 process. As appropriate, the coordinator would consult with cultural resource professionals who meet the Secretary of the Interior's Professional Qualification Standards (36 C.F.R. Part 61). The Nolumbeka Project Tribal Coalition and the Montague Historical Commission recommend that this individual be an archaeologist. The Massachusetts SHPO recommends that this individual should also meet the Secretary of the Interior's Professional Qualifications Standards in archaeology or historic preservation.

Each of the HPMPs provide tables of potential threats to documented archaeological sites at the projects, including shoreline erosion and artifact collection. FirstLight indicates that none of the identified threats are project-related. It therefore does not propose any specific protective or management measures to avoid, minimize, or mitigate effects on those sites that are unevaluated, eligible, or potentially eligible for listing in the National Register are provided.

FirstLight proposes specific management measures to address project-related effects to historic architectural features. Section 5.5.1 of the HPMPs includes a list of activities that are exempt from section 106 consideration. In a May 24, 2016, letter included in Appendix A, *Agency, Tribal, and Interested Party HPMP Consultation Letters*, of the HPMPs, the Massachusetts SHPO concurred that these activities would not adversely affect historic structures as long as they were conducted using similar materials and construction methods and in accordance with the *Secretary of the Interior's Standards and Guidelines for Rehabilitation of Historic Properties* (36 C.F.R. 67). Activities that are not identified on the list as being exempt from consultation would require further section 106 review, including consultation with the SHPOs, per the protocols provided in the HPMPs. For example, any modification to a historic project structure that cannot be undertaken using "in-kind" materials would require further consultation in accordance with section 106 requirements. The Turners Falls Project is eligible for listing on the National Register, and the Northfield Mountain Project met the 50-year threshold for National Register consideration in 2018 and is also eligible for listing for management purposes. In its HPMP, FirstLight states that it will consult with the Massachusetts SHPO and Commission regarding any further documentation of the Northfield Mountain Project structures to facilitate a formal National Register determination.

To address the potential for undocumented TCPs at the projects, section 5.6 of the HPMPs includes a provision that, if eligible TCPs are ultimately identified within the APE, management measures would be developed at that time.

Our Analysis

Area of Potential Effects

Further revision of the HPMPs to reflect APEs that include all land enclosed by the project boundary and any land outside the project boundary where historic properties could be affected by project-related actions, including the full boundaries of any historic districts that cross over the project boundary, as discussed in section 3.3.7.1, *Areas of Potential Effect*, would ensure that all historic properties within the APE (which includes the full extent of all historic districts that cross the project boundaries) are appropriately addressed. Such revision would include the Fort Hill property, located in the Riverside Historic District, that was mentioned by the Nolumbeka Project Tribal Coalition. Additionally, while most of the Massachusetts SHPO's February 17, 2021, comments were addressed in the July 8, 2024, HPMPs, several comments were not, including but not limited to revision of project boundary maps to also depict site locations, replacement of temporary inventory site numbers with permanent state-issued designations, and qualifications for cultural resources professionals. A summary of the Massachusetts SHPO's relevant requests and the extent to which they are addressed in the 2024 HPMPs is provided in Table 3.3.7.2-2. Revision of the HPMPs to address Massachusetts SHPO's outstanding comments and several other items identified by Commission staff, as described below, would ensure that the HPMPs identify all potentially affected resources and appropriate management measures. Continued consultation with the Massachusetts SHPO, New Hampshire SHPO, and Vermont SHPO regarding project-related effects on National Register-eligible archaeological resources within project APEs and the resolution of these effects would ensure that these resources are appropriately addressed in the revised HPMPs accordance with section 106 of the NHPA. Additionally, revision of the HPMPs' Appendix A*, Agency, Tribal, and Interested Party HPMP Consultation Letters,* to include the complete consultation record, including the Massachusetts SHPO's February 17, 2021, letter, would ensure that all consultation is appropriately documented.

In response to a November 11, 2020, request for additional information from Commission staff, FirstLight filed an updated site table on March 15, 2021, that summarizes the National Register eligibility of and threats to all archaeological resources identified at the Northfield Mountain and Turners Falls projects. However, this table differs from the information provided in the two HPMPs filed in December 2020 and the updated HPMPs filed on July 8, 2024. For example, section 3.1 of the updated HPMPs indicates that there are 96 recorded archaeological sites within the projects' APEs, while the table filed in March 2021 indicates that there are 124 sites. It its September 19, 2024, response to Commission staff's request for clarification, FirstLight stated that further inspection of mapping data indicated that 29 sites were located outside the APEs and could be removed from further consideration in the HPMPs. Because no mapping data and no concurrence from the Massachusetts SHPO (28 sites) or Vermont SHPO (one site) regarding this change was filed, these 29 sites must remain within the APEs until SHPO concurrence with FirstLight's findings has been received. Revision of the HPMPs in consultation with the SHPOs and other parties as appropriate to reflect Commission staff's new determination of the APEs (lands within the project boundaries, the full boundaries

of all historic and archaeological sites or districts that pass into the project boundaries, and no buffer zone) would provide clarification regarding the number of sites at the projects, ensure that the HPMPs are up-to-date, and address all resources potentially affected at the projects. Additionally, inclusion in the revised HPMPs of an appendix containing detailed maps depicting the project boundaries, the revised APEs, and the locations of all archaeological resources within or adjacent to the APEs as defined in section 3.3.7.1, *Areas of Potential Effect*, would assist FirstLight's cultural resources coordinator and land managers with implementation of the HPMPs and its required measures.

Shoreline Erosion

FirstLight identified erosion at 47 of the original 124 individual archaeological sites at the Turners Falls and Northfield Mountain projects. Twenty-three of these sites are not eligible for listing in the National Register, and 24 sites are either eligible for listing (two sites) or unevaluated (22 sites). FirstLight explains that its streambank erosion study (Choi, 2014b), summarized in section 3.3.1, *Geology and Soils*, found that the causes of erosion at the projects are primarily attributed to high natural flows (86% of erosion) and boat wakes (14%). Additionally, Bank Stability and Toe Erosion Model methods applied by FirstLight also found that project operations would have no measurable impact on 97% of the lands at both projects. While most erosion is not project-related, as discussed in section 3.3.1.2, FirstLight proposes to develop a shoreline erosion monitoring plan that would require FirstLight to monitor the Massachusetts portion of the Turners Falls impoundment for project-related erosion effects.

Expanding the plan, including the proposed shoreline erosion survey, to include the entire Turners Falls impoundment, not just the portion within Massachusetts, would ensure project-related erosion is monitored throughout the entirety of the impoundment. Section 5.4.4, *Monitoring Identified Archaeological Resources,* of the HPMPs includes a plan for regular monitoring of eligible or unevaluated resources located within the APE. Incorporating the results from the initial shoreline erosion monitoring survey (i.e., locations of identified project-related erosion, areas recommended for stabilization, and stabilization methods) into the archaeological monitoring program described in section 5.4.4 of the HPMPs would inform the subsequent monitoring schedule and archaeological sites that could be potentially impacted by any identified project-related erosion. These revisions would ensure the condition of archaeological sites is documented and that project-related adverse effects on historic properties, including any resulting from project-induced shoreline erosion, are adequately addressed.

The proposed HPMPs also include protocols for unanticipated discovery of cultural resources in the event that previously unidentified archaeological sites are discovered during project operation and maintenance, to include during any shoreline erosion monitoring activities. Additionally, adherence to section 5.4 of the HPMPs (*Management Measures for Archaeological Resources*) for future activities that have the potential to impact archaeological resources, which could include any changes in flows, would ensure that eligible and unevaluated sites are appropriately considered. As stated in section 5.4.4 of the HPMPs, if it is determined that historic properties are being adversely affected by project-related erosion, FirstLight would need to consult with the appropriate SHPO and Tribes to develop appropriate mitigation measures.

Effects to Historic Properties

Section 5.4 of the HPMPs (*Management Measure for Archaeological Resources*) focuses on ground-disturbing activities and does not address other project-related activities that have the

potential to affect historic properties. These activities include illicit artifact collection in the immediate vicinity of project facilities, due to public use of project land and water for recreation, provided by FirstLight. The HPMPs do not discuss whether or not the 75 of the 124 individual sites at the projects that are subject to illicit artifact collection are accessible as a result of project access roads or recreation facilities. Twenty-four of these sites are not eligible for listing in the National Register and 51 either are eligible (four sites) or have not been evaluated (47 sites). Artifact collection can be attributed to project operations if project facilities, such as project roads, recreation sites, or trails, can provide public access to these sensitive locations.

In its March 15, 2021, response to Commission staff's November 11, 2020, request for additional information, FirstLight states that it is not aware of any specific sites that are being targeted by modern-era collectors and/or visitors to the project and that there are no project recreation facilities, such as hiking trails, in the vicinity of archaeological sites where artifact collection has been known to occur. However, according to FirstLight's recreation report (Gomez and Sullivan and TRC, 2016a), there are six Commission-approved recreation facilities at the projects. Four of these facilities are located in proximity to archaeological sites that have been subject to artifact collection and are eligible for listing in the National Register (19-FR-347, 19-FR-349, 19-FR-462, GIL.HA.9). Other unevaluated sites that have experienced collection may also be located near project recreation facilities.

Section 5.12 of the HPMPs (*Public Interpretation*) describes interpretive signage already in place at several project recreation facilities and identifies other potential locations for signage. However, given that illicit artifact collection has been a common activity at the projects, inclusion in the HPMPs of measures to address this activity and language on the signs that also informs the public of the damaging effects to archaeological sites as a result of unauthorized artifact collection and, where applicable, the potential legal ramifications of illicit artifact collecting would also help to discourage site vandalism. Additionally, implementation of a regular monitoring program for eligible or unevaluated sites on FirstLight lands that have experienced artifact collection, particularly those in the vicinity of recreation areas, would also help to ensure that any new site vandalism is documented, and appropriate measures are undertaken.

In its March 15, 2021, response, FirstLight also explained the proposed access trail put-in at Cabot Camp is located adjacent to the Cabot Camp archaeological site (19-FR-353). However, this site is not identified in FirstLight's 2024 HPMPs. Because of the site's proximity to the proposed recreation site, the site has the potential to be accessible to the visiting public. For this reason, inclusion of the site in the APE and HPMPs, installation of interpretive signs at the new put-in (as discussed above), and regular monitoring would ensure that the site does not experience effects associated with nearby project recreation.

FirstLight proposes to remove the Conte Fish Lab, Riverview Drive, Fuller Farm, and 52.3 acres of land at Farley Ledges from the FERC boundaries. According to 36 C.F.R. 800.5(a)(2)(vii), the transfer, lease, or sale of property out of federal control without conditions to ensure the long-term preservation of historic properties on the property may constitute an adverse effect. The Massachusetts SHPO recommended that the boundaries of each of the previously identified archaeological resources at the Conte Fish Lab property be verified and identified on the project boundary maps as sensitive areas and that full Phase IA archaeological surveys of the Riverview Drive and Fuller Farm areas be conducted prior to the removal of the lands from FERC jurisdiction. The Advisory Council has recently advised the Commission that

under the NHPA, the removal of lands from a FERC project boundary would not result in adverse effects to any National Register-eligible resources on these lands.[161] However, the lands could be experiencing other project-related effects that would warrant consideration and further study. The Conte Fish Lab will remain under the federal jurisdiction of the USGS and is not experiencing any project-related effects. The Riverview Drive area and Fuller Farm are privately held lands that also do not experience project-related impacts. Finally, access to the Farley Ledges is obtained from a parking area on Route 2 that is owned and maintained by the Western Massachusetts Climbers Coalition.[162] This parking area is not related to project operation or recreation activities. For these reasons, the removal of these four areas from the boundaries of the Turners Falls and Northfield Mountain projects would not result in adverse effects to any National Register-eligible resources that could be located on these lands and additional cultural resources surveys would not be necessary.

Exhibit G of the license application and FirstLight's March 15, 2021, response for additional information identify lands that FirstLight proposes to acquire for recreational purposes (0.8-acre parcel at 21 Poplar Street in Montague; 135.5 acres south of the Northfield Mountain switching station in the towns of Northfield and Erving). Inclusion in the HPMPs of requirements to conduct Phase IA and other research as necessary on these and any other lands that may be acquired for future project-related purposes would ensure that any historic properties located on these lands are managed appropriately.

Built Environment Resources

While FirstLight has not identified any specific effects to historic architectural structures, it is proposing changes to system infrastructure at the Turners Falls Project (also see section 2.2.1 above), and these changes could impact historic architectural structures. These changes include the following proposals for structures that are eligible for listing in the National Register:

- Modification/replacement of equipment at Turners Falls Station No. 1
- Installation of upstream and downstream fish passage facilities at the Cabot Station tailrace, Turners Falls dam, and Turners Falls Station No. 1 forebay
- Retirement of the fish ladders at Cabot Station and the Turners Falls gatehouse
- Installation of an access trail and kayak/canoe put-in at the Turners Fall dam and power canal

Additionally, in its RMP, FirstLight proposes to construct a boater access trail and boater put-in near the Cabot Camp historic structures and the "Cabot Camp Historic District." Cabot Camp is a FirstLight-owned property that is eligible for listing in the National Register. While the Cabot Camp historic structures (structures MNT-450) are identified in FirstLight's application and HPMPs, the "Cabot Camp Historic District" is not among the five districts discussed in these documents. FirstLight also states that the proposed Riverview boat tour dock

[161] Advisory Council, Comments, Docket Nos. 14836-000 and 1250-020, at 1 (filed May 14, 2024); Advisory Council, Comments, Docket Nos. 14836-000 and 1250-020 at 1 (filed November 14, 2024).

[162] https://www.erving-ma.gov/tourism/pages/farley-ledges. Accessed April 4, 2025.

relocation and proposed access trail at Riverview both occur within the state-inventoried "Northfield Farms Agricultural/Residential District." FirstLight does not identify or describe this district in its license application or HPMP and it is unclear if it is a historic district that is eligible for listing on the National Register.

These proposed changes, new construction, and other modifications (including measures associated with the FFPSA) to or near eligible facilities that may become necessary over any new license term could result in adverse effects to the qualities of the structures that contribute to their eligibility for listing in the National Register. Section 5.5 of the Turners Falls HPMP provides management measures for architectural resources at the project. Implementation of these measures prior to conducting any modifications to structures that are eligible for listing in the National Register and consultation with the Massachusetts SHPO regarding potential effects and the appropriate resolution of effects would ensure that the qualities of these structures that contribute to their National Register eligibility are not compromised. However, revision of the HPMPs to include descriptions of the Cabot Camp Historic District and the Northfield Farms Agricultural/Residential District (as applicable), their inclusion in their entirety in the project APEs, and a discussion of the status of their National Register eligibility would be appropriate. Should the districts be determined eligible for listing, inclusion in the HPMPs of measures to resolve any potential adverse effects would ensure that these additional properties are considered during project O&M activities, including recreational improvements. Additionally, inclusion in the HPMPs of the entirety of all other historic districts that cross the project boundaries and the properties that they contain would ensure that these properties are also appropriately considered throughout any new license term.

Traditional Cultural Properties

FirstLight conducted a TCP study within the Northfield Mountain and Turners Falls projects' APEs and filed the final study report on September 14, 2015 (FirstLight, 2015d). Consultation to date with participating Tribes has not resulted in the identification of any TCPs at the projects. However, several Tribes, including the Elnu Abenaki, Abenaki Nation, Cowasuck Band, Narragansett Tribe, and the Chaubunagungamaug Band of Nipmuck Indians, have expressed an interest in further consultation with FirstLight to address issues regarding areas of traditional concern and importance and have provided information regarding potential TCPs that may be located within the APEs of the two projects.

The continued consultation with participating Tribes regarding TCPs would ensure that dialogue between FirstLight and the Tribes continues, and that potential TCPs, including properties within the APE identified by Nolumbeka Project Tribal Coalition, are documented and managed appropriately. Modification of this section of the HPMP to also include consultation with the Nolumbeka Project Tribal Coalition would provide an opportunity for Tribal organizations to voice concerns and ensure that all Tribal views are considered. Additional consultation with the Tribes regarding TCPs is also supported by the Northfield Historic Commission (letter filed May 23, 2024), the Montague Historical Commission (letter filed May 21, 2024), and the Gill Historical Commission (letter filed May 20, 2024).

The Commission cannot require a licensee to enter into formal agreements or settlements or require licensees to have any specific shared relationship or stewardship programs with Tribes or other entities. However, further post-licensing consultation between FirstLight, Tribes, and

Tribal organizations regarding TCPs and other historic properties would ensure that any TCPs within the APEs are identified, and incorporating them into the HPMP would ensure they are documented and potential project-related effects are addressed. Such consultation could also include discussions of access to sacred areas within the APE. Additionally, if TCPs are identified within the APE during post-licensing consultation, the APE should be revised to include any TCP, in its entirety, if the boundary of the TCP extends outside of the defined APE.

In its August 28, 2025, comments, FirstLight commented that any potential dredging in the Barton Cove area could affect cultural resources that are associated with the 1676 Great Falls Massacre site. Section 3.3.5.2, *Effects of Impoundment Levels on Recreation,* discusses a navigability monitoring plan to assess the effects of any new operational regime on the navigability of the Barton Cove area. Inclusion of a provision in the navigability monitoring plan for assessing the effects of any potential dredging on cultural resources and, should dredging be proposed, requirements for compliance with section 5.4.1, *Review of Ground Disturbing Activities,* of the Turners Falls HPMP, would ensure that any adverse effects to cultural resources in the Barton Cove area are appropriately considered in accordance with section 106.

Effects of Bypassed Reach Minimum Flows on Cultural Resources

The current license requires FirstLight to provide a continuous minimum instream flow of 200 cfs in the Turners Falls bypassed reach starting on May 1 and increasing to a minimum flow to 400 cfs when fish passage begins. This 400 cfs flow would be continuous through July 15, unless the upstream fish passage season concludes early, in which case the 400 cfs flow is reduced to 120 cfs to protect shortnose sturgeon. FirstLight proposes to increase minimum flows below Turners Falls dam to range from approximately 400 cfs up to 4,290 cfs with the lowest flows in the winter and the highest flows in the spring. Downstream of Station No. 1, minimum flows would be increased from to range from approximately 400 cfs up to 6,500 cfs. State legislators, the Connecticut River Conservancy, and the Ashuelot River Local Advisory Committee's recommend a 1,400 cfs minimum flow in the Turners Falls bypassed reach. The Nolumbeka Project Tribal Coalition recommends a minimum continuous flow of 2,000 cfs to allow sensitive cultural resources to remain submerged and inaccessible to the public year-round.

As stated in section 2.1, *No Action Alternative*, existing environmental conditions are the baseline for comparison with other alternatives (i.e., the current lower minimum flow requirement, as stated above). As discussed in section 3.3.2.2, *Effects of Minimum Flows on Aquatic Resources,* and section 3.3.5.2, *Effects of Downstream Flows on Recreation*, higher minimum flows in the bypassed reach would increase aquatic habitat and recreational opportunities downstream of Turner Falls dam. Higher minimum flows in the bypassed reach would also provide protection to cultural resources by submerging and limiting access to them. The higher year-round flows recommended by American Rivers, Connecticut River Conservancy, Massachusetts state legislators, and the Nolumbeka Project Tribal Coalition would provide greater protection to cultural resources by completely inundating culturally sensitive locations. Most types of archaeological deposits retain better preservation in non-oxygenated environments. Generally, archaeological sites that are typically inundated and then subsequently exposed can be subject to erosion, visitor impacts, and vandalism. According to the Nolumbeka Project Tribal Coalition, culturally sensitive locations in the bypassed reach become exposed when minimum flows reach 545 cfs. Under FirstLight's proposal, seasonal minimum flows at or below 500 cfs would occur January 1 through March 31 and July 1 through December 31. Flows

exceeding 2,000 cfs, as proposed by the Nolumbeka Project Tribal Coalition, would occur from April 1 through June 30, except during dry years (see Appendix C, Table 2.2.3-1). Requiring FirstLight to conduct regular monitoring of eligible or unevaluated archaeological resources, particularly during times when the minimum flow is at or below 500 cfs, and install interpretive signs detailing the damages and legal ramifications of illicit artifact collection, could also mitigate any adverse effects to culturally significant sites that may be exposed during periods of low flow. In addition, further post-licensing consultation between FirstLight, Tribes, and Tribal organizations regarding TCPs and other historic properties, as described above, would ensure TCPs are accurately documented and further inform best practices for mitigating any damage to culturally significant sites and artifacts.

The revision and implementation of FirstLight's proposed HPMP would ensure that measures are in place to protect historic properties in the APE from adverse effects related to the operation and maintenance of project facilities and potential adverse erects related to recreation enhancements and use. An HPMP would also ensure that any previously undiscovered archaeological resources within the APE are not adversely affected by the project during the term of any new license.

3.4 NO-ACTION ALTERNATIVE

Under the no-action alternative, the projects would continue to operate as they have in the past. None of FirstLight's proposed measures or the resource agencies' recommendations and mandatory conditions would be required. In addition, none of the measures FirstLight is currently implementing on a voluntary basis would be required (e.g., granting permissions for non-project uses of project lands for a parking area, the Conte Fish Lab, a fire pond, a privately owned boat club, private camps, landscaping activities, agricultural uses, communications antennae, docks, a National Pollutant Discharge Elimination System discharge, and water withdrawals). Lastly, none of the staff-recommended measures would be implemented, including measures to enhance environmental conditions for fish and wildlife and recreation within the project-affected areas.

4.0 DEVELOPMENTAL ANALYSIS

In this section, we look at the Northfield Mountain and Turners Falls projects' use of the Connecticut River for hydropower generation to see what effect various proposed or recommended environmental measures would have on the cost to operate and maintain the projects and on the projects' power generation. Under the Commission's approach to evaluating the economics of hydropower projects, as articulated in *Mead Corp.*,[163] the Commission compares the current cost to produce project power to an estimate of the cost to provide the same amount of energy and capacity[164] for the region using the most likely alternative source of power (cost of alternative power). In keeping with the policy described in *Mead Corp.*, our economic analysis is based on current electric power cost conditions and does not anticipate or estimate changes in fuel costs that could occur during a project's license term.

For each licensing alternative, our analysis includes an estimate of: (1) the annualized cost of providing the individual measures considered in the EIS; (2) the cost of the most likely alternative source of project power; (3) the total annual project cost (i.e., for construction, operation, maintenance, and environmental measures); and (4) the difference between the cost of the current alternative source of project power and the total annual project cost. If the difference between the cost to produce an equivalent amount of power from an alternative source and the total annual project cost is positive, the project produces power at a cost less than the cost of producing power from the most likely least-cost source of alternative power. If the difference between the alternative source of power's annual cost and the total annual project cost is negative, the project costs more to produce power than the cost to produce an equivalent amount of power from the most likely least-cost source of alternative power. This estimate helps support an informed decision concerning what is in the public interest with respect to a proposed license. However, project economics is only one of many public interest factors the Commission considers in determining whether, and under what conditions, to issue a license.

Although pumped storage projects are net energy consumers, because they require more energy to pump water to the upper reservoir than they produce when generating, they have the benefit of being able to store the energy produced by other generating facilities during periods of low demand. This storage occurs by pumping water into the upper reservoir during periods of low demand and then using that water for generation during periods of higher demand. The ability of pumped storage facilities to quickly switch between pumping and generating, as needed, provides unique benefits to the electric grid. Pumped storage facilities can provide

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

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

several ancillary services to the grid. Among these services are spinning reserve,[165] non-spinning reserve, grid frequency regulation,[166] voltage support and regulation,[167] load following capability, peak shaving, and black-start capability.[168] Pumped storage facilities can operate as base load, load following, or peaking power facilities. When in load following mode, the output of the pumped storage facility can be adjusted as necessary to meet widely varying load requirements.

The power and economic benefits of the Northfield Mountain and Turners Falls projects, and the comparison of the cost of each alternative for the projects, are discussed in Appendix H, *Developmental Analysis*. Appendix I presents the cost of the environmental enhancement measures considered in our analysis for each project.

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[165] Spinning reserve is the extra generating capacity that is available by increasing the power output of generators that are already connected to the power system. Non-spinning reserve or supplemental reserve is the extra generating capacity that is not currently connected to the system but can be brought online after a short delay.

[166] Grid frequency is a system-wide indicator of overall power imbalance. These imbalances are removed by requesting generators to operate in frequency control mode, altering their output continuously to keep the frequency near the required value.

[167] System voltage levels vary over the course of a day due to a variety of factors, including: (1) the location of the local distribution line, (2) proximity to large electricity consumers, (3) proximity to utility voltage regulating equipment, (4) seasonal variations in overall system voltage levels, and (5) load factor on local transmission and distribution systems.

[168] Black-start is the procedure to recover from a total or partial shutdown of the transmission system, which has caused an extensive loss of supplies. This entails starting isolated power stations individually and gradually reconnecting them with each other to form an interconnected system again.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a)(1) of the FPA require the Commission to give equal consideration to the power development purposes and to the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife; the protection of recreation 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 Northfield Mountain and Turners Falls projects. Appendix J, *Comprehensive Development*, contains a discussion of staff's rationale for recommending or modifying FirstLight's proposals for the Northfield Mountain and Turners Falls projects. 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 projects and our evaluation of the environmental and economic effects of the proposed projects and alternatives, we selected the staff alternative as the preferred alternative for the projects. We recommend this alternative because: (1) issuing new licenses for the projects would allow the applicant to continue operating the projects to produce and transmit a dependable source of electrical energy; (2) the 1,234.139 MW of electric capacity from the Northfield Mountain and Turners Falls projects comes primarily from a renewable resource that does not contribute to atmospheric pollution; (3) the public benefits of the staff alternative would exceed those of the no-action alternative; and (4) the recommended measures would protect and enhance fish and wildlife resources, recreation, aesthetics, and cultural resources.

In the following section, we make recommendations as to which environmental measures proposed by FirstLight, or recommended by agencies or other entities, should be included in any new license issued for the projects. In addition to FirstLight's proposed environmental measures listed below, we recommend additional staff-recommended environmental measures to be included in any new license issued for the projects, and present these staff-recommended measures as draft license articles in Appendix R, *License Conditions Recommended By Staff*.

5.1.1 Measures Proposed by the Applicant

Based on our environmental analysis of FirstLight's proposals in section 3, *Environmental Analysis*; the costs presented in section 4, *Developmental Analysis*; and the accompanying appendices; we conclude that the following environmental measures proposed by FirstLight (with minor administrative modifications made by Commission staff)[169] would protect and enhance environmental resources and would be worth the cost. Therefore, we recommend including these measures in any licenses issued for the projects.

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[169] The modifications, among other things, are intended to preserve the Commission's review and approval authority regarding changes in project structures, operations, and license requirements.

5.1.1.1 Measures Proposed for Both Projects

- Implement the Bald Eagle Protection Plans filed with the FFPSA (Articles B300 and A400).
- Implement the following measures to protect northern long-eared bat habitat: (1) avoid cutting trees equal to or greater than 3 inches in diameter at breast height within the project boundaries from April 1 through October 31, unless they pose an immediate threat to human life or property (hazard trees); and (2) where non-hazard trees need to be removed, only remove non-hazard trees between November 1 and March 31 (FFPSA Article B310 and A410).
- Place undeveloped FirstLight land not used for specific project activities along the Turners Falls impoundment shoreline into a conservation easement to maintain riparian buffers (Recreation Settlement Agreement).
- Conduct a programmatic assessment of existing recreation facilities and buildings to ensure the needs of people with disabilities were considered in the planning and design of each facility and implement applicable improvements (RMP, Table 6.3-1).
- Revisit the RMP once every 10 years to evaluate recreation use and demand (RMP, Table 6.3-1).
- Implement the Historic Properties Management Plans (HPMPs) filed on July 8, 2024.

5.1.1.2 Northfield Mountain Project

- Continue to operate the Northfield Mountain Project in a store-and-release mode by pumping water from the Turners Falls impoundment during low-load periods when energy costs are low, and then discharging water back into the Turners Falls impoundment during high-load periods when energy costs are high.
- Continue to coordinate operation of the Northfield Mountain and Turners Falls projects in accordance with an existing agreement between FirstLight and the Corps (FFPSA Article B100, part a).
- Operate the Northfield Mountain Project's upper reservoir with a normal maximum WSE of 1,004.5 feet and an 84.5-foot maximum allowable drawdown (i.e., 1,004.5 feet to 920 feet)[170] (FFPSA Article B100, part b).
- Implement the Upper Reservoir Dewatering Protocols filed on June 30, 2017, which include conducting a bathymetric survey of the upper reservoir and intake channel once every two years. If the average sediment depth throughout the middle of the intake channel exceeds 5 feet, review the potential need for sediment removal and conduct annual bathymetric surveys until sediment removal.

[170] Under existing conditions, the Northfield Mountain upper reservoir elevation may fluctuate between 1,000.5 and 938 feet. The reservoir was designed to allow for fluctuation between 1,004.5 and 920 feet, and FERC has granted six temporary license amendments between 2001 and 2017 that permitted use of this range of storage capacity to support grid reliability.

- To reduce the entrainment of migratory fish, install and maintain a barrier net across the Northfield Mountain Project tailrace/intake from June 1 to November 15 each year (FFPSA Articles B200 and B230). This operating period may be refined based on consultation among FirstLight, Massachusetts DFW, NMFS, and FWS.
- Upon completion of construction of the fish barrier net, operate it for one season (shakedown year), and then conduct effectiveness testing (FFPSA Article B210).
- Conduct up to three additional rounds of downstream fish passage effectiveness testing and reporting during the first 20 years of the license term, as needed, to meet the fishery agency performance goals. If performance goals are not being met, implement one or more of the adaptive management measures listed in FFPSA Article B220. No adaptive management measures other than those specified in the proposed license article would be required for the first 25 years after license issuance unless agreed to by FirstLight, Massachusetts DFW, NMFS, and FWS.
- Develop a fish passage O&M plan for the barrier net in consultation with Massachusetts DFW, NMFS, and FWS to include annual reporting on the status of the barrier net and any needed repairs or equipment replacement (FFPSA Article B240).
- Implement the Northfield Mountain Invasive Plant Species Management Plan filed on March 22, 2024.[171]
- Permanently conserve FirstLight's land within Bennett Meadow WMA that is not already under conservation easement and enhance existing riverfront trails south of Route 10 off the parking lot at Bennett Meadow WMA to include installation of a bench and historical/cultural interpretive signage (RMP measure 6.2.1 and RMP Table 6.3-1).
- Provide a permanent trail easement for the 1.3-mile-long portion of the New England National Scenic Trail that lies inside the Northfield Mountain project boundary on the eastern side of the project's upper reservoir (RMP Table 6.3-1).
- Relocate the boat tour dock from the tailrace to a location upstream of the fish barrier net and provide for an accessible/barrier-free dock layout that supports motorboats, canoes/kayaks, and riverboat tours (RMP measure 6.2.2).
- Construct approximately 5 miles of new trails for mountain biking (RMP measure 6.2.3).
- Construct and maintain a new paddle access campsite in the Barton Cove area (RMP measure 6.2.4).
- Designate Rose Ledges as a project recreation facility to allow climbing, with access to remain free of charge (RMP measure 6.2.5).
- Add the ability to lock canoes and kayaks during the day at Barton Cove (RMP measure 6.2.6).
- Donate used sporting equipment to local youth organizations (RMP Table 6.3-1).

[171] Accession no. 20240322-5086.

5.1.1.3 Turners Falls Project

- Based on the Naturally Routed Flow (NRF),[172] discharge the seasonal minimum flows defined in FFPSA Article A110 (Table 2.2.3-1) from the Turners Falls dam or gate located on the power canal just below the dam provide.
- Based on the NRF, maintain the total minimum flow downstream of Station No. 1 as defined in FFPSA Article A120 (Table 2.2.3-2).
- Based on the NRF, maintain the minimum flow downstream of Cabot Station as defined in FFPSA Article A130 (Table 2.2.3-3).
- Maintain the water level in the Turners Falls impoundment between elevation 176.0 feet and 185.0 feet and limit the rate of rise to less than 0.9 foot per hour between the hours of 8:00 a.m. and 2:00 p.m. from May 15 to August 15 to protect odonates (FFPSA Article A190).
- Ramp Cabot Station outflows as defined in FFPSA Article A140 (Table 2.2.3-4) except for a limited number of hours in July, August, September, October, and November, as defined in FFPSA Article A160 (Table 2.2.3-5), when flexible operations would be allowed.
- Beginning three years after license issuance, provide flow stabilization downstream of Cabot Station by maintaining ±10% of the NRF in the months of April through November except for the following: (1) a limited number of hours in those months when deviations within ±20% of the NRF would be allowed, as defined in FFPSA Article A160 (Table 2.2.3-6); and (2) a limited number of hours in July, August, September, October, and November, as defined in FFPSA Article A160 (Table 2.2.3-5), when flexible operations would be allowed.
- Based on the NRF, provide variable releases from the Turners Falls dam as defined in FFPSA Article A150 (Table 2.2.3-7) and downstream of Station No. 1 as defined in Article A150 (Table 2.2.3-8), to provide recreational boating opportunities.
- Develop a project operation, monitoring, and reporting plan (FFPSA Article A200) describing how the licensee would document compliance with proposed Articles A110, A120, A130, A140, A150, A160, and A190. The plan would include filing an annual report detailing any allowable deviations and documenting progress toward meeting the flow stabilization measures downstream of Cabot Station (Article A160). Operational requirements may be modified under the conditions listed in Table 2.2.3-10.
- Use the Cabot emergency gates only under the following conditions: (1) in case of a Cabot load rejection; (2) in the case of dam safety issues such as potential canal

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[172] The NRF represents the inflow to the Turners Falls dam. From December 1 through June 30, the NRF is defined as the hourly sum of the discharges from 12 hours previous as reported by: (1) the Vernon Project (FERC No. 1904); (2) the Ashuelot River USGS gage no. 01161000, *Ashuelot River at Hinsdale, NH*; and (3) the Millers River USGS gage no. 01166500, *Millers River at Erving, MA*. From July 1 through November 30, the NRF is defined as the hourly sum of the discharges averaged from 1 to 12 hours previous as reported by these sources.

overtopping or partial breach; and (3) to discharge approximately 500 cfs between April 1 and June 15 for debris management. If flows higher than 500 cfs need to be released through the gates from April 1 to June 15, FirstLight would coordinate with NMFS to minimize potential impact on shortnose sturgeon in the area downstream of Cabot Station (FFPSA Article A180).

- Continue to operate the Turners Falls Project in accordance with the existing agreement with the Corps (FFPSA Article A170).
- In the event of a conflict among the operational requirements of the new license, maintain the operation priority list provided in Table 2.2.3-9.
- Develop a shoreline erosion monitoring plan that includes: (1) conducting an initial shoreline erosion survey within two years of license issuance and additional surveys in Years 10, 20, 30, and 40 of any new license; (2) following completion of each erosion survey, preparing a report summarizing the survey methods, results, and identifying any riverbank segments that require stabilization or repair of existing stabilization measures; and (3) upon approval from Massachusetts DEP and the Commission, completing the stabilization or repair measures identified in the report, if any, within five years.
- Within one year of license issuance, provide the following information year-round on a publicly available website: (1) hourly Turners Falls impoundment water elevations, Turners Falls dam discharge, and Station No. 1 discharge; (2) hourly anticipated Turners Falls dam and Station No. 1 discharge for a 12-hour window into the future; and (3) the anticipated timing of the annual power canal drawdown (FFPSA Article A210).
- Construct and operate the proposed upstream and downstream fish passage facilities described in section 2.2.1.4 (FFPSA Article A300).
- Conduct initial fish passage effectiveness testing per the schedule defined in FFPSA Article A310 (Table 2.2.3-11).
- Conduct up to three additional rounds of upstream and downstream fish passage effectiveness testing and reporting during the first 20 years after license issuance, as needed to meet fishery agency performance goals. If the initial effectiveness testing shows that performance goals are not being met, FirstLight would implement one or more of the adaptive management measures listed in FFPSA Articles A320 for downstream passage and A330 for upstream passage. No adaptive management measures other than those specified in the proposed license article would be required for the first 25 years of the license unless expressly agreed to by FirstLight, Massachusetts DFW, NMFS, and FWS.
- Operate the fishways during the following periods: (1) May 1–November 15 for upstream eel passage; (2) April 4–July 15 for upstream anadromous fish passage; and (3) April 4–November 15 for downstream passage. The operating periods may be refined on an annual or permanent basis based on consultation among FirstLight, Massachusetts DFW, NMFS, and FWS (FFPSA Article A340).
- Develop and implement a fish passage O&M plan in consultation with Massachusetts DFW, NMFS, and FWS (FFPSA Article A350).

- Implement the Turners Falls Invasive Plant Species Management Plan filed on March 22, 2024.[173]
- Install a "pocket park" (viewing point and picnic table) at the Pauchaug-Schell Bridge Greenway and signage for historical and cultural interpretation (RMP measure 6.1.1).
- Construct and maintain a new paddle access campsite at Mallory Brook or another location in the town of Northfield selected in consultation with the Appalachian Mountain Club and the town of Northfield (RMP measure 6.1.2).
- Construct a formal path leading from the Cabot Camp parking area to a put-in on the Millers River, construct a picnic area, and attempt to find a qualified organization to take responsibility for preserving the Cabot Camp historic buildings (RMP measure 6.1.3).
- Construct a new car-top access and put-in at Unity Park; provide a means of storing and locking vessels, install signage to assist paddlers portaging to downstream of the dam, and reconfigure the parking lot to improve vehicle and pedestrian safety (RMP measure 6.1.4).
- Construct a new river access point downstream of Turners Falls dam, including one path designed for rafters to launch upstream of Peskeomskut Island and another path to allow pass-through boaters to portage around the island (RMP measure 6.1.5).
- Construct a viewing platform, picnic area, and signage downstream of Turners Falls dam with the best feasible view of the dam (RMP measure 6.1.6).
- Construct a formal access for fishing and non-motorized boats upstream of the Station No. 1 tailrace (RMP measure 6.1.7).
- Install new stairs and signage at the Cabot Woods fishing area just downstream of Rock dam (RMP measure 6.1.8).
- Construct a portage trail around Rock dam (RMP measure 6.1.9).
- Construct improvements at the Poplar Street put-in and take-out to include stairs with a boat slide railing leading to a landing/concrete abutment, gangway, and floating dock (RMP measure 6.1.10).
- Install interpretive signage at Cabot Woods (Rock dam) and Peskeomskut/Great Falls (Turners Falls dam) (RMP measure 6.1.11).
- Make safety improvements to abandoned water passages in the Turners Falls bypassed reach (RMP Table 6.3-1).
- Establish a boat wake restriction, in coordination with the Massachusetts DCR, from the Turners Falls dam extending upstream approximately 2 miles to where the Turners Falls impoundment narrows, to mitigate the impact of boat waves in the Barton Cove area.

[173] Accession no. 20240322-5086.

5.1.2 Additional Measures Recommended by Staff

Under the staff alternative, the projects would be operated with FirstLight's proposed measures identified above and the following additions and modifications. We discuss the basis for the staff-recommended measures and the rationale for modifying FirstLight's proposal in Appendix J, *Comprehensive Development*.

5.1.2.1 Measures Applicable to Both Projects

Threatened and Endangered Species

- Restrict tree removal or trimming (except for hazard trees that need to be removed to ensure public or project safety) on project lands from April 1 to October 31 to protect roosting northern long-eared and tricolored bats, as well as nesting migratory birds. Within two business days of an unplanned safety/emergency action, consult with FWS, Vermont FWD, New Hampshire Fish and Game Department (New Hampshire FGD), and Massachusetts DFW, as appropriate, and file a report with the Commission providing a description of the action and any measures taken to protect bats, and an assessment of potential disturbance to bats.

Recreation

- Revise the proposed RMP to include: (1) procedures to ensure that debris accumulations at the Turners Falls dam boat barrier are removed in a timely manner commensurate with safety protocols; (2) a provision to evaluate the efficacy of the existing methods for communicating flow information to the public should more effective communication methods become available in the future; and (3) a schedule to periodically evaluate and minimize light pollution caused by lighting from project facilities and recreation, as part of the RMP updates, including a description of activities completed, how advancements in lighting technology have been incorporated including the use of outdoor lighting principles, and compliance with any applicable local, state, or federal standards for controlling light pollution.
- Develop a navigability monitoring plan to include: (1) a provision to monitor potential navigational constraints at Barton Cove for three years, including, but not limited to, water levels, sediment deposition, and vegetation; (2) a provision to file annual reports with the Commission that describe all monitoring done in the previous year and recommended measures to maintain or improve navigability at Barton Cove, particularly during low water periods; (3) a provision to assess the effects of any potential dredging on cultural resources and, should dredging be proposed, requirements for compliance with section 5.4.1, *Review of Ground Disturbing Activities* of the Turners Falls HPMP; and (4) a provision to file a final report with the Commission after three years of monitoring that summarizes all monitoring results, measures implemented, and any recommended additional monitoring or measures that may be needed to allow for safe navigation in Barton Cove.

Land Use and Aesthetics

- Develop a shoreline or land use management plan to incorporate the existing permitting program, land use/shoreline classifications, guidelines, and policies to protect project

lands and shorelines, and associated recreational, scenic, and environmental values. Also provide a periodic review and update schedule for consultation with agencies and interested parties. This plan was intended to apply to all project lands within Northfield Mountain and the Turner Falls project boundaries.

Cultural Resources

- Revise each of the July 8, 2024, HPMPs to include: (1) a revised APE that includes all land enclosed by the project boundary and any land outside the project boundary where project operation or project-related recreational development or any other enhancements may cause changes in the character or use of historic properties, including, but not limited to, the Riverside/Peskeompskut Archaeological District, Turners Falls Historic District, "The Patch" Historic District, Riverside Historic District, the Turners Falls Power & Electric Company Historic District), Hinsdale Historic District, the Cabot Camp Historic District, and the Northfield Farms Agricultural/Residential District (as applicable); (2) a map or maps that clearly show the revised APE in relation to the project boundary; (3) clarification of the number of archaeological sites within the revised APE and inclusion of maps depicting their location in relation to the revised APE; (4) measures to address potential project-related effects associated with illicit artifact removal, and to include text on interpretive signs to explain the damages and legal ramifications of illicit artifact removal; (5) revisions to section 5.4.4, *Monitoring Identified Archaeological Resources*, to include a plan for regular monitoring of eligible or unevaluated archaeological resources located within the APE; (6) revisions to section 5.4.4 to include the results from the initial shoreline monitoring survey (i.e., locations of identified project-related erosion, areas recommended for stabilization, and stabilization methods); (7) revisions to section 5.4.4 to include monitoring protocols for archaeological sites within the bypassed reach, particularly during times when the minimum flow is at or below 500 cfs; (8) a description of the Cabot Camp Historic District and Northfield Farms/Agricultural/Residential District, and description of site 19-FR-343 (Cabot Camp archaeological site) and provisions for regular monitoring of the site; (9) requirements to undertake archaeological survey of lands to be acquired for recreational and other future project-related purposes; (10) requirements for additional post-licensing consultation with participating Tribes regarding potential TCPs within the APEs; and (11) updates to *Appendix A: Agency, Tribal, and Interested Party HPMP Consultation Letters* to reflect the complete consultation record for the HPMP, including, but not limited to, the comment letter from the Massachusetts SHPO filed with the Commission on February 17, 2021.

5.1.2.2 Measures Applicable Only to the Northfield Mountain Project

Aquatic Resources

- Limit the use of additional storage (FFPSA Article B100, part b) as follows: (1) additional volume of water (3,009 acre-feet) would not be allowed to be used for generating; and (2) additional storage may not be pumped beyond 12,318 acre-feet during Apil 1 – May 31 for the protection of shortnose sturgeon spawning.

- Develop an operations compliance monitoring plan describing how the FirstLight would document compliance with the operational requirements of any license issued for the project.
- Modify FirstLight's proposed schedule for installing the barrier net in front of the Northfield Mountain tailrace/intake (FFPSA Article B200), and conducting the initial (FFPSA Article B210) and subsequent (FFPSA Article B220) effectiveness testing, to be the same as the schedule as specified by Massachusetts DEP conditions 20, 21, and 22, respectively (installation in license Year 5 and initial effectiveness testing in license Years 7 and 8 and again in Years 10, 11, 14, and 15).

5.1.2.3 Measures Applicable Only to the Turners Falls Project

Geology and Soils

- Modify FirstLight's proposed shoreline erosion monitoring plan to be consistent with Massachusetts DEP condition 25 and include the additional provision: (1) expand the shoreline erosion survey to cover the entire Turners Falls impoundment, with the first survey completed within the first 2 years of any license and then every 10 years starting in Year 10.

Aquatic Resources

- Maintain water levels between elevation 178.5 feet and 185.0 feet except under the specified circumstances when the reservoir could be lowered to 177.5 feet and limit the rate of rise to less than 0.9 foot per hour between the hours of 8:00 a.m. and 2:00 p.m. from May 15 to August 15 (consistent with Massachusetts DEP condition 10(a-b)).
- Develop a canal drawdown protection plan, in consultation with FWS, Massachusetts DFW, and Connecticut River Conservancy that includes, at a minimum: (1) a provision to develop long-term protective measures, such as drawdown rates and time periods for the drawdowns; (2) an evaluation of the feasibility of conducting drawdowns every other year rather than annually; (3) an evaluation of the feasibility of increasing the interconnectedness between pools in the canal and minimizing no water in areas with hardened substrate; (4) a provision for salvage efforts led by FirstLight during all planned drawdowns; (5) a provision for filing the results of salvage efforts each year with the Commission.
- Implement the following drawdown protection measures for the first year immediately following issuance of any future project license: (1) conduct the annual canal drawdown no earlier than mid-September; (2) draw down the canal over a one-day period, consistent with the rate of drawdown performed during Study 3.3.18 in 2014; and (3) install cones to identify paths for large machinery to follow while undertaking maintenance work in the canal during the drawdown.

Terrestrial Resources

- Develop a riparian management plan to provide a 75-foot vegetation buffer along the Connecticut River for all FirstLight-owned lands not needed for specific project purposes.
- Modify the Turners Falls Invasive Plant Species Management Plan specified by Massachusetts DEP condition 27 to extend the baseline survey for aquatic invasive plants in the Turners Falls Impoundment to include the area between the state line and Vernon dam.

Threatened and Endangered Species

- Develop a sturgeon stranding management plan, in consultation with NMFS, FWS, and Massachusetts DFW that includes, at a minimum: (1) identification of spill conditions with potential to result in stranding sturgeon in the Turners Falls bypassed reach; (2) a provision to conduct surveys in the Turners Falls bypassed reach after each spill over Turners Falls dam or whitewater release into the bypassed reach that meets the conditions identified for potential sturgeon stranding, and to relocate any stranded sturgeon to safe areas within the bypassed reach; (3) a provision to file a report with the Commission within 30 days of any stranding event that identifies the date and time that the survey was conducted, the number, condition, and location of stranded sturgeon, a record of the hourly flows that occurred during the spill or whitewater release preceding the survey, any recommended measures to mitigate from future stranding; and (4) a provision to file an annual report with the Commission by March 1 that summarizes the previous year's stranding surveys as well all previous stranding surveys and any recommendations to the Commission, for approval, for changes to the monitoring schedule.

Recreation Resources

- Modify FirstLight's proposal to post the start and end time and date of the annual canal drawdown on its proposed flow information website (FFPSA Article A210) to require notification as soon as possible, but at least 30 days in advance of the annual drawdown, to allow sufficient time for the public to plan as needed for the drawdown.

5.1.3 Conclusion

Based on our review of the agency and public comments filed for the projects and our independent analysis pursuant to sections 4(e), 10(a)(1), and 10(a)(2) of the FPA, we conclude that licensing the Northfield Mountain and Turners Falls projects, as proposed by FirstLight with the additional staff-recommended measures, would be best adapted to a plan for improving the Connecticut River Basin.

5.2 UNAVOIDABLE ADVERSE EFFECTS

The continued operation of the Northfield Mountain and Turners Falls projects would result in some unavoidable, adverse effects on geologic, soil, geomorphic, water quality, aquatic, and terrestrial resources. Effects on geology and soils would include the continued bank erosion associated with project operations. Overall, under proposed operations, increased stability in flow velocities and reductions in magnitude of changes in flow and water level fluctuations would reduce adverse effects of bank erosion along riverine sections. Additionally, the ongoing

effects of erosion at priority sites would be addressed by implementing appropriate measures at locations where project operations are found to be a predominant cause of bank erosion.

Construction of new facilities and project maintenance have the potential to adversely affect aquatic habitat by introducing silt through erosion into the aquatic environment. However, the extent of proposed new construction is limited and the Commission typically includes construction-related license articles in any new licenses that include new construction which require development of site-specific erosion and sediment control plans for each construction project.

Project operation would continue to alter flows in the Connecticut River, resulting in unavoidable adverse effects on some fish and aquatic resources (see section 3.3.2, *Aquatic Resources*). Impoundment storage and manipulation of flow releases for power production would continue to cause fluctuations in river flow and aquatic habitat downstream of the projects, potentially affecting resident and migratory species. However, the magnitude and frequency of these fluctuations would typically be reduced compared to current operations. Some injury or mortality to resident fish, out-migrating American eels, and American shad would continue to occur through impingement, entrainment, or turbine mortality.

Construction of new facilities at the Turners Falls Project would have unavoidable adverse effects on state-listed plants occurring in the areas of the proposed plunge pool and eelway. Removal of these individuals would affect about 12% of the sandbar cherry population and less than 2% of the Tradescant's aster population in the Turners Falls project boundary. Project operation would have few adverse effects on terrestrial resources in the Turners Falls project area, although a few unavoidable adverse effects could occur (see section 3.3.3, *Terrestrial Resources*), such as negative effects of water level fluctuations on odonate emergence and their shoreline habitat, or where imminent erosion threatens populations of state-listed threatened and endangered plants. Effects on vegetation and terrestrial wildlife habitat, however, would be reduced by implementation of FirstLight's proposed measures included in the FFPSA, with staff-recommended modifications, to minimize project effects associated with invasive plants.

Project operations would continue to cause water level fluctuations, which could have some unavoidable adverse effects on damselflies, dragonflies, and Puritan tiger beetle. However, compared to current operation, the frequency and magnitude of water surface fluctuations would be reduced under proposed operation and would provide a benefit to these species. Emergency removal of hazard trees could adversely affect bats roosting in the tree or in adjacent trees; however, these events would be of short duration, localized, and rare, and would not have long-term effects on bat populations.

Project operation would continue to cause fluctuations in water levels which could have some unavoidable adverse effects on recreation in the river and on the impoundment during lower water periods. However, the frequency and magnitude of flow fluctuations would be reduced compared to current operation, which would stabilize the river and lessen the negative effects on river recreation. Under the staff alternative, improved warnings and notifications would allow river visitors to plan for and expect specific flows, further reducing adverse effects on recreation. Under the proposed action, there would continue to be unavoidable low water periods on the impoundment; however, these would be occasional, likely occur outside the peak recreation months, and limited by proposed and staff-recommended measures. The staff recommendation would also allow for monitoring of the already shallow Barton Cove area and

establish mitigation measures for any negative operational effects, thereby improving boating navigability in this area.

Under the proposed action, the continued operation of the projects could adversely affect some archaeological sites by exposure, erosion, scouring, hydrologic sorting, and the horizontal and vertical movement of artifacts. Regular monitoring of eligible or unevaluated sites within the APE would help to confirm FirstLight's assertion that erosion is not project-related. Recreational use and enhancements also have the potential for unavoidable adverse effects on cultural resources. Inclusion of language on interpretive signs at project recreation facilities, including at the proposed Cabot Camp access trail put-in, that informs the public of the damaging effects on archaeological sites as a result of unauthorized artifact collection would help to discourage site vandalism. Additionally, implementation of a regular monitoring program for eligible or unevaluated sites on FirstLight lands that have experienced artifact collection would help to ensure that any new site vandalism is documented and appropriate measures are undertaken. Additionally, the conduct of appropriate cultural resources studies of lands to be added to the project boundaries would also ensure that any resources on these lands and potential project-related impacts are addressed.

Proposed construction and/or modifications to historic structures within the APE could also result in adverse effects. Implementation of FirstLight's measures for these activities contained within the proposed HPMPs, as well inclusion in the HPMPs of a discussion of the National Register eligibility of the Cabot Camp Historic District and the Northfield Farms Agricultural/Residential District (as applicable), would ensure appropriate management of these resources. Finally, while appropriate consultation with participating Tribes regarding the relicensing of the projects has occurred, continued consultation with Tribes during the term of the licenses regarding areas of traditional importance would ensure that potential project-related effects on these resources are appropriately addressed. The execution of PAs for each project that call for implementation of updated HPMPs that address these, and other issues, would ensure proper protection and management of significant cultural resources within the projects' APEs and provide satisfactory resolution of any project-related adverse effects.

5.3 LAND MANAGEMENT AGENCIES' SECTION 4(e) CONDITIONS

On May 16, 2024, Interior requested that the Commission include a reservation of authority to prescribe conditions as may be identified by Interior pursuant to the authority provided in section 4(e) of the FPA, as necessary for the adequate protection and utilization of land and interests in land under Interior's authority. Interior filed a modified reservation on July 2, 2024, specifying that any conditions filed under the reservation of authority be consistent with the terms of the Memorandum of Agreement between FirstLight and Interior filed with the Commission on June 28, 2024.

5.4 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 February 22, 2024, notice accepting the applications to relicense the Northfield Mountain and Turners Falls projects and soliciting motions to intervene, protests, comments, recommendations, preliminary terms and conditions, and preliminary fishway prescriptions, Interior, on behalf of FWS, filed recommendations pursuant to section 10(j) for the Northfield Mountain and Turners Falls projects on May 16, 2024. Massachusetts DFW and NMFS filed recommendations pursuant to section 10(j) for the Northfield Mountain and Turners Falls projects on May 20 and May 21, 2024, respectively. Collectively, the agencies filed 23 recommendations under section 10(j) of the FPA.[174] We found 19 recommendations to be within the scope of 10(j). Of these 19 recommendations, we determined that one may be inconsistent with the purpose and requirements of the FPA or other applicable law. Appendix N, *Fish and Wildlife Agency Section 10(j) Recommendations*, lists the recommendations filed pursuant to section 10(j) for the Northfield Mountain and Turners Falls projects. Appendix N also indicates whether the recommendations are included under the staff alternative, as well as the basis for our preliminary determinations concerning measures that we consider inconsistent with the FPA. Environmental recommendations that we consider outside the scope of section 10(j) are considered under section 10(a) and addressed in the specific resource sections of this document and the previous section.

[174] As shown in Appendix N, *Fish and Wildlife Agency Section 10(j) Recommendations*, NMFS filed five recommendations for the Turners Falls Project; FWS filed 11 recommendations for the Turners Falls Project and three recommendations for the Northfield Mountain Project; and Massachusetts DFW filed eight recommendations for each project.

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6.0 LITERATURE CITED

Appendix L contains the literature cited for this EIS.

7.0 LIST OF PREPARERS

Appendix M contains the list of preparers for this EIS.