

FINAL REVIEW OF APPLICATION FOR LIHI CERTIFICATION OF THE LOWELL HYDROELECTRIC PROJECT

FERC Project No. 2790 Merrimack River, Lowell Massachusetts

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This report provides final review findings and recommendations related to the application submitted to the Low Impact Hydropower Institute (LIHI) by Boott Hydropower, LLC (Applicant), a subsidiary of Enel Green Power North America, Inc., for Low Impact Hydropower Certification of the Lowell Hydroelectric Project (the Project). The application was filed on August 23, 2017 and is subject to review under the current 2nd edition LIHI Handbook (March 2016).

I. PROJECT LOCATION

The Lowell Hydroelectric Project (FERC Project No. 2790) is located on the Merrimack River in the City of Lowell, Massachusetts. The Merrimack River watershed encompasses 5,010 square miles of land within the states of New Hampshire and Massachusetts (Figure 1) and is the fourth largest watershed in New England. The Merrimack River originates at the confluence of two major rivers, the Pemigewasset and Winnipesaukee, in Franklin, N.H. From its origin, the river travels 115 miles to the Atlantic Ocean at Newburyport, Massachusetts.

The Project is located at the second dam on the mainstem at River Mile 41; Essex Dam is located ten miles downstream of the Lowell Project dam (Pawtucket Dam), and is the site of another hydrolectric project (the Lawrence Hydroelectric Project¹, FERC Project No. 2800, license expiration November 30, 2028) owned and operated by the Applicant.

As shown in Figure 2, several other dams are located on the mainstem upstream in New Hampshire. The next upstream dam, Amoskeag Dam, is federally licensed to Eversource Energy as FERC Project No. 1893 (license expiration, April 30, 2047).

¹ LIHI certified the Lawrence Hydroelectric Project, No. 121, in March 2015.



Figure 1. Merrimack River watershed.



Figure 2. Merrimack River mainstem dams.

II. PROJECT AND SITE CHARACTERISTICS

On April 13, 1983, the Federal Energy Regulatory Commission (FERC) issued a license² authorizing a significant expansion of hydropower development at Pawtucket Dam, which historically has diverted water into Lowell's canal system for operation of several mills. Pawtucket Dam was originally constructed in 1847, with a second spillway section added in 1875. The expansion involved construction of a new powerhouse, the E.L. Field Powerhouse, on the Northern Canal; the new plant was brought on line in November 1985. Construction of the new plant included excavation of a 1,000-foot-long tailrace channel in ledge; the tailrace is separated from the river by a five-foot-high training wall. The license also authorized continued operation of four power plants located in existing mill buildings on the canal system. The canal system, as shown in Figure 3, consists of two tiers, the Northern Canal, controlled by the gatehouse at the dam, and the Pawtucket Canal, controlled by the Francis Gate and Guard Locks.

Project components include: (1) the 1,093-foot-long stone-masonry gravity dam, topped by a 5-foot-high pneumatic crest gate system³; (2) an impoundment with a storage capacity of about 3,960 acre-feet; (3) the 17.3 MW E.L. Field powerhouse, containing two 8.6 MW horizontal Kaplan turbine-generator units; (4) upstream fish passage systems consisting of a fish lift system at the powerhouse and a fish ladder on the northwest (river left) end of the dam; and (5) a 5.5-mile-long canal system in downtown Lowell with four smaller power stations.

Hydroelectric and hydromechanical power was historically generated at several other mill buildings along the canal system; however, many of these the units have been either decommissioned or inoperable for some time. The four power stations housed in historic mills are the Hamilton Station, 5 units drawing from the Hamilton Canal and discharging into the Lower Pawtucket Canal (1,180 kW); the Assets Station, 3 units drawing from the Merrimack Canal and discharging into the Lower Pawtucket Canal (795 kW); the Bridge Street Station, 3 units⁴ (a.k.a. Section 8) drawing water from the Eastern Canal and discharging into the Concord River (1,080 kW) and another 4 units (a.k.a. Main Power) drawing water from the Eastern Canal and discharging into the Merrimack River (2,360 kW); and the John Street Station, 4 units drawing water from the Eastern Canal and discharging into the Concord River (2,100 kW).

² <u>https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=13583777</u>

³ The crest gate system is currently being completed and replaces an older wooden flashboard system. FERC authorized the replacement by order dated April 3, 2013.

⁴ The Applicant has a pending, March 16, 2017, application before FERC to remove four non-operational units currently located at this station.



Figure 3. Lowell Hydroelectric Project.



Figure 4. Pawtucket Dam looking downstream with entrance to Northern Canal in center.

The dam has an average height of 15 feet. At the normal pond elevation of 92.2 feet NGVD, the backwater extends upstream 23 miles to Moores Falls in Litchfield and Merrimack, N.H. The average annual generation is 88,530 MWh based on a 10-year average.



Figure 5. E.L. Field powerhouse and tailrace with training wall.

III. REGULATORY AND COMPLIANCE STATUS

In 1983, the Project was granted a FERC license (No. 2790). Because the site had had power generation facilities beginning in 1916 on a navigable river, and therefore should have been previously licensed, FERC made the license effective beginning May 1, 1973. The term was set at 50 years with an expiration date of April 30, 2023. The Massachusetts Department of Environmental Quality Engineering (now, the Massachusetts Department of Environmental Protection (MassDEP)) originally certified the Project under Section 401 of the Federal Clean Water Act on July 26, 1982, but a year later (July 27, 1983) recertified the Project with conditions that superseded those in the 1982 certification after some design modifications⁵ were made.

Several special license articles and water quality certification conditions are relevant to the LIHI criteria:

- Article 33 (Cultural Resources Protection). Requires, prior to commencement of any construction activities, carrying out a mitigation program in cooperation with the Massachusetts State Historic Preservation Officer (SHPO) and the National Park Service (NPS) to avoid or minimize adverse effects on the Locks and Canals Historic District and the Lowell National Historical Park.
- 2. Article 34 (Fish Passage). Functional design drawings for proposed upstream and downstream fish passage facilities to be filed within three months of license issuance for Commission approval, with consultation of the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), the Massachusetts Division of Fisheries and Wildlife (MassWildlife), and the SHPO.
- 3. Article 35 (Fish Passage Effectiveness Study). An operational study of passage effectiveness for the Article 34 facilities over the two years following completion, in cooperation with USFWS, NMFS, and MassWildlife. Reserved right to require additional studies or changes in facilities or operations as necessary to maintain anadromous fish migrations past the Project.
- 4. Article 36 (Instream Flow Studies). Studies to: 1) define the relationship between Project discharges and aquatic habitat downstream of the powerhouse; and 2) determine Project discharges necessary to provide for the migration of anadromous fish. Study plans to be filed within four months of license issuance, and a report on results within three months of completion of the studies. All in consultation with USFWS, NMFS, and MassWildlife.

⁵ Cultural resource concerns resulted in a change to the proposed main powerhouse location.

- 5. Article 37 (Interim Minimum Flow Release). Pending completion of the Article 36 studies, a minimum Project release of 905 cfs, or inflow if less. WQC Condition 1 further requires, when inflow equals or exceeds 905 cfs, that the flow be split such that 280 cfs or more be released at the fish passage locations or over the dam or through leakage at the dam and 620 cfs be released via the proposed powerhouse. By order dated November 27, 1984, FERC modified the minimum flow requirement, increasing it to 1,990 cfs. That order also required the licensee to assess the adequacy of flows in the bypass reach during day (500 cfs) and night (300 cfs) during the anadromous fish passage season. The assessment was to be conducted in conjunction with the 2-year study required under Article 35.
- 6. Article 38 (Recreation Plan). Within one year of license issuance, filing a revised Report on Recreational Resources, prepared in consultation with MassDEP, SHPO, and NPS, to include: 1) functional plans for a navigation lock at the Northern Canal control structure, restoration of the Northern Canal walkway near the powerhouse, repair of the Northern Canal gates, and a visitor facility at the powerhouse, and 2) a canal system water level maintenance plan to allow NPS tour boats to navigate the lower canal system.
- 7. WQC Condition 2 (Water Quality Study). A two-year water quality sampling study to determine the effects of Project operation on river water quality, with the study plan subject to MassDEP approval. The FERC license noted that the study would also address the need, if any, to maintain flows through the canal system to maintain canal water quality.

The licensee is also subject to standard license articles that address more generally: 1) construction of facilities for the conservation of fish and wildlife resources either by the licensee per Commission order or recommendation of the fish and wildlife agencies or by an agency; 2) construction of, or improvements to, recreational facilities; and 3) open public access for navigation and recreation.

FERC eLibrary includes records of regional office environmental inspections completed in 2007 and 2017. No incidences of non-compliance were in that record. The most recent inspection notes ongoing discussions and measures to improve fish passage effectiveness and a need to update the visitors center. The report also mentions a pending application before FERC to remove inoperable units located at the Bridge Street station from the license.

IV. PUBLIC COMMENTS RECEIVED BY LIHI

The LIHI application was publicly noticed on September 22, 2017. Massachusetts Division of Fisheries and Wildlife ("MassWildlife") submitted a comment letter on October 3, 2017 in support of LIHI Certification. No other public comments were received by LIHI during the notice period, which ended on November 22, 2017.

The Applicant provided communications from US Fish and Wildlife Service (USFWS) (March 24, 2017) and MassWildlife (March 16, 2017) supporting LIHI Certification and requesting the Applicant commit to continue to assess and modify the existing fish lift system; excavate ledge as necessary to improve the flow field at the fishway entrance; continue improvement of American eel passage; and continue to operate the fish ladder at the dam using the same inladder and attraction flow release protocols used in 2016 and for the full anadromous fish passage period starting with the 2017 season. MassDEP also provided communications in support of LIHI Certification and supporting the fisheries agreement received on March 27, 2017.

V. LIHI CRITERIA REVIEW AND RECOMMENDATIONS

Following are the review findings and conclusions for each of the eight LIHI criterion.

A. Ecological Flow Regime

Goal: The flow regimes in riverine reaches that are affected by the facility support habitat and other conditions suitable for healthy fish and wildlife resources.

In all locations [all river reaches where stream flows are altered by the facility], appropriate flow management should apply an ecosystem-based approach that supports fish and wildlife resources by considering base flows, seasonal variability, high-flow pulses, short-term rates of change, and year-to-year variability. (Handbook, Section 3.2.1)

Discussion

Reservoir (Zone 1). All impoundment zones qualify for the A.1 (Not Applicable/De Minimis Effect) standard. The application (p. 15) provided additional information about a new crest gate system currently being installed on the dam spillway crest that will replace existing wooden flashboards. The new system will allow the Applicant to much more quickly restore impoundment elevations after the gates are tripped during flood flows, thus benefiting littoral habitat and species, recreation and fish passage (see Bypass Reach Zone 2 discussion below). The Environmental Assessment completed as part of the FERC license amendment for the crest gate project also noted improved resident fish habitat in the impoundment (application p. 18).

Bypass Zone (Zone 2). The FERC license does not specifically require minimum flows in the bypass reach between the dam and the powerhouse tailrace, a distance of about 4,000 feet. Project minimum flows are required in the reach downstream of the powerhouse. The license did not include a requirement to conduct an instream flow study in the bypass reach (but it did require an instream flow study in the downstream reach). A Comprehensive Fish Passage Plan was developed in consultation with resource agencies and approved by FERC by order issued November 28, 2000. The plan provides for seasonal operation (typically early May through

mid-July but based on a schedule provided by the agencies and triggered by passage at the downstream Lawrence Project) of the Pawtucket dam fish ladder at an operating flow of 500 cfs, including attraction flow. The five-foot-high wooden flashboard system had added to the bypass base flow through leakage but that flow negatively affected the effectiveness of fish passage by creating false attraction whereby fish would swim to the base of the dam and are unable to locate the fish lift at the powerhouse or the fish ladder at the dam. The crest gate project is intended to correct this adverse effect on fish passage.

To meet the A.2 (Agency Recommendation) Standard, the Applicant must provide an explanation of "how the recommendation provides fish and wildlife protection, mitigation and enhancement (including in-stream flows, ramping and peaking rate conditions, and seasonal and episodic instream flow variations)." (Handbook Table B-2).

The Applicant suggests that the recent Agencies' support of the crest gate replacement project, and concurrence with the 2015 FERC approval of the Crest Gate System Operations Plan, as well as the 2000 Comprehensive Fish Passage Plan and related studies constitute an Agency Recommendation sufficient to satisfy the Ecological Flow Regime standard for the bypass zone (application p. 18-19). The current flow regime in the bypass reach meets the LIHI flow standard A.2, Agency Recommendations. While the Project does not provide year-round minimum flows in the bypass reach, the across-the-board agency support for the current flow regime upon installation of the crest gate systems constitutes a site-specific science-based recommendation in which agencies relied on their professional judgment and considered factors required in the LIHI criterion such as base flows, seasonal variability, high-flow pulses, short-term rates of change, and year-to-year variability. The agency technical rationale used broader watershed goals and information developed through the Merrimack River Anadromous Fish Committee as well as site-specific evaluations of the effectiveness of existing passage along with passage improvements. Ultimately, flood control, municipal drinking water supplies, and safe and timely fish passage were considered the highest priorities (FERC 2011 Environmental Assessment p. 33)⁶.

The Applicant provided information in support of Standard A.2 for the bypass reach zone, summarized herein as follows:

a) The Applicant has voluntarily implemented seasonal flows in the bypass reach beyond their current license requirement in consultation and concurrence with resource agencies and in support of LIHI certification by agencies. This action would not be occurring in the absence of the LIHI application, thus it provides a direct LIHI-based benefit.

⁶ FERC accession # 20111219-3034, 12/19/2011 https://elibrary.ferc.gov/idmws/common/OpenNat.asp?fileID=12844192

- The most recent agency recommendations for flow are included in the crest gate plan and those recommendations have prioritized fish passage and flood control/impoundment level management over other considerations for base flows in the bypass reach.
- In 2011, MassDEP waived water quality certification related to the Project license amendment to replace the flashboard system with the crest gate system (see appendix) and stated that that the more recently agreed to fish passage improvements "...will certainly be advantageous and are consistent with the goals of the Clean Water Act."
- b) Both agency letters from MassWildlife and USFWS included in the Application focus on concerns about zone of passage evaluations to avoid migratory fish stranding. The letters indicate the agencies and the Applicant have collaborated for many years on improvements to fish passage and that the current, voluntary flows satisfy agency concerns at least for the next five years.
- c) A preponderance of the existing evidence suggests that habitat in the bypass reach is likely to be marginal and is of little concern to agencies:
 - The 2011 FERC Environmental Assessment stated: "Our on-site observations and review of available aerial photography confirm that conditions exist downstream of Pawtucket dam that could generate false attraction flows for upstream migrating anadromous fish [with the flashboards rather than the new crest gate system]. The <u>bypassed reach is almost entirely bedrock</u>, in which numerous channels exist along cross-sections throughout the length of the reach." (FERC EA, p. 50).
 - USWFS reported in a recent email (see Appendix) that the bypass reach is composed primarily of *"braided uplifted bedrock habitat"*. This type of habitat is likely to be of limited suitability for most aquatic species other than those passing through like diadromous species (see Figure 6 below).

Agencies and the Applicant have stated that they expect a comprehensive instream flow study to be conducted as part of the upcoming relicensing. If the results of such study reveal new information about habitat quality or quantity in the bypass reach, recommendations for changes in operations or flow regime would be made by the relevant agencies.



Figure 6. Aerial view showing upper bypass reach between dam and main powerhouse.

Downstream Zone (Zone 3). Backwater from the downstream Lawrence Project extends upstream almost to the Concord River confluence. The Lowell Project is operated in a run-ofriver mode subject to a license requirement to pass a minimum flow of 1,990 cfs downstream of the Project. The licensee stipulated to that flow in lieu of completing the Article 36 instream flow habitat study at the time of license issuance. The 1,990 cfs flow (0.5 cfs per square mile of watershed area, or 0.5 csm) is the summer Aquatic Base Flow derived from the USFW *Interim Regional Policy for New England Stream Flow Recommendations* (1981). The 0.5 csm value is an estimation of the August median daily flow based on an analysis of unregulated regional U.S. Geological Survey surface water gages. August was selected as the biologically significant lowflow month of the year. This standard-setting hydrologic policy is often also used to prescribe alternate higher flows for protection of spawning and incubation periods where such uses are critical, with 4.0 cfs prescribed for the spring spawning and incubation period and 1.0 csm for fall spawning and fall/winter incubation periods.

The application, at Page 20, suggests that future operation, with the improved impoundment level control resulting from the soon-to-be-completed new crest gate system, meets LIHI's runof-river definition. Normally true run-of-river operation would have a Not Applicable/De Minimis Effect on the river ecology downstream of a project (standard A.1). However, the application correctly considers the downstream reach to qualify under Standard A.2 since the Project operation is in accordance with an Agency Recommendation and flow releases are not cycled for peaking generation. After flood flows that occurred in 2006 and 2007 throughout the region, FERC required the Applicant to develop alternative strategies to alleviate backwater impacts from operation of wooden flashboards at the dam. The Applicant developed a Crest Gate Operational Plan with concurrence of resource agencies, which the Applicant states represents the most recent agency recommendation for flows at the Project as a whole.

Canal System (Zone 4). The main powerhouse utilizes up to about 8,000 cfs, and the canal units, about 2,000 cfs. Priority of water use is directed to the main powerhouse due to its greater head and efficiency. When Project inflows at Pawtucket Dam exceed the 8,000 cfs plus the fishway operational flows during fish passage periods, flows can be directed to the canal units when their minimum hydraulic capacities are attained. The Applicant considers the Zone 4 canal system to be "essentially a conduit system" yet some flows from the canal system ultimately discharge to the Merrimack or Concord rivers. However, since the Project is a run-of-river Project, the appropriate standard is still A.1 (Not Applicable/De Minimis Effect) and the Project meets this Standard in this reach. No minimum flows are required through the canal system, but the Applicant maintains an operating agreement with the National Park Service to provide flows for tour boat operations and manages water levels for recreation within the canal system (which is part of the Lowell National Historical Park and Lowell Historic Preservation District, see Section G below).

Therefore, this review concludes that the Project meets the Ecological Flows Criterion, conditionally relative to the bypass reach (see <u>Section VI</u> below).

B. Water Quality

Goal: Water Quality is protected in waterbodies directly affected by the facility, including downstream reaches, bypassed reaches, and impoundments above dams and diversions.

The applicant shall define all waterbodies where water quality is directly affected by the facility, including those affected areas outside the facility boundary. The applicant shall demonstrate compliance for each of these waterbodies with the appropriate state/provincial or federal water quality standards. In all cases, if any waterbody directly affected by the facility has been defined as being water quality limited (for example, on a list of waters with quality that does not fully support designated uses), the applicant must demonstrate that the facility has not contributed to the substandard water quality in that waterbody. (Handbook, Section 3.2.2).

Discussion for all Zones of Effect

The final Massachusetts Year 2014 Integrated List of Waters⁷ includes the Section 303(d) listing of impaired waters. Listings are updated in a two-year cycle based on the latest assessment information and corrective actions. The draft 2016 list is available but not yet approved by EPA; it contains essentially the same status conditions for waters at the Project as the 2014 list. It is important to note that the Project bypass reach and the downstream reach are combined in the impaired waters list (Table 1).

Project Zone	MassDEP	Waterbody Description
	Waterbody ID	
Impoundment	MA84A-01	State line at Hudson, NH/Tyngsborough, MA to
		Pawtucket Dam, Lowell (9 miles)
Bypass and	MA84A-02	This reach stretches from the Pawtucket Dam,
Downstream Reach		Lowell, downstream to a point below the
(dam to Concord		powerhouse at the Lowell Regional Wastewater
River)		Utilities outfall at Duck Island (3.2 miles)
Canal System	MA84A-29	Canal system near Pawtucket Falls, Lowell (4.9
		miles)

Table 1. Clean Water Act waterbodies containing the Project zones.

All Project reaches are listed as impaired for one or more designated uses including fish consumption (due to atmospheric deposition of mercury as virtually all New England water bodies are listed), primary contact recreation (due to coliform bacteria), and in the bypass and upper downstream reach for fish, other aquatic life, and wildlife. The canal system is also listed as impaired for lead, PCBs and DDT with the source(s) unknown. All reaches are impaired based on pollutants such as phosphorus due to stormwater runoff, municipal wastewater treatment or other sources. The combined bypass reach and downstream reach impairment for fish, other aquatic life, and wildlife and hydro-modification.

The Applicant selected Standard B.2, Agency Recommendation for all zones of effect. The application includes information discussed above in Section A for the Ecological Flows Criterion to support Standard B.2. This review agrees that Standard B.2, agency recommendation, is appropriate for all Project zones. Additional information supports Standard B.3, site-specific study, for Zones 1 and 3.

Discussion for Standard B.2 in all Zones. Standard B.2 requires "compliance with water quality conditions contained in a science-based agency recommendation providing reasonable assurance that water quality standards will be met...Such recommendations, whether based on a generally applicable water quality standard or one that was developed on a site-specific basis, must include consideration of all water quality components necessary to preserve healthy fish

⁷ http://www.mass.gov/eea/docs/dep/water/resources/07v5/14list2.pdf

and wildlife populations, human uses, and recreation." (Handbook Section 3.2.2).

MassDEP is the certifying agency in Massachusetts which issued water quality certification to the Project in 1982 and then revised the certification in 1983 with three conditions. The first two conditions are outlined on pp. 6-7 above; the third condition was related to initial construction activities which are not relevant to this review. The two-year water quality study was to be undertaken after the start of operations with the new powerhouse. The study plan and report were not available in FERC eLibrary. Since many state water quality certification conditions become federal license or permit requirements, it is not clear why the documentation was not in eLibrary. Presumably, water quality issues, if any, identified during the study were resolved at the time, assuming the study was done. Since the water quality certification is over 10 years old, it cannot be used to satisfy the Water Quality criterion.

As noted in Section A above, MassDEP also waived water quality certification in 2011 at the time of the Project's non-capacity FERC license amendment to install the crest gate system. MassDEP stated "After review of correspondence from the Massachusetts Division of Fisheries and Wildlife and the Massachusetts Division of Marine Fisheries that both strongly support the installation of an inflatable crest gate system, it is the opinion of the Department that the requirement for State 401 Water Quality Certification for this project be waived. This decision is based primarily upon demonstrated successful operations using an inflatable crest gate system at two other dams in Massachusetts (Holyoke and Essex) and the belief that the owner will be better able to comply with the current water quality certificate upon installation of the inflatable crest gate system." ⁸ The agency was not concerned about potentially substandard water quality at the Project at that time and even believed that crest gate installation would improve the Project's water quality conditions. Section A above includes a note that MassDEP stated in 2017 that the recent fish passage improvements "…will certainly be advantageous and are consistent with the goals of the Clean Water Act." (see appendix).

The most recent state-listed water quality impairments for pollutants with quantitative standards are not attributable to the Project or its operations as noted in the 2014 impaired waters list probable sources and causes of impairment (summarized below).

Impoundment:

Probable Source	Probable Source Group	Cause(s) of Impairment
Atmospheric Deposition - Toxics	Atmospheric Deposition	Mercury in Fish Tissue
Combined Sewer Overflows	Municipal Discharges/Sewage	Fecal Coliform
Source Unknown	Unknown	Mercury in Fish Tissue
Unspecified Urban Stormwater	Urban-Related Runoff/Stormwater	Fecal Coliform

⁸ https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=12786164

Bypass/Downstream Reach:

Probable Source	Probable Source Group	Cause(s) of Impairment
Atmospheric Deposition - Toxics	Atmospheric Deposition	Mercury in Fish Tissue
Impacts From Hydrostructure Flow Regulation/Modification	Hydromodification	Low Flow Alterations
Municipal Point Source Discharges	Municipal Discharges/Sewage	Phosphorus, Total
Source Unknown	Unknown	Escherichia Coli (E. Coli); Mercury in Fish Tissue
Unspecified Urban Stormwater	Urban-Related Runoff/Stormwater	Phosphorus, Total
Wet Weather Discharges (Point Source and Combination of Stormwater, Sso Or Cso)	Municipal Discharges/Sewage	Escherichia Coli (E. Coli)

Canal System:

Probable Source	Probable Source Group	Cause(s) of Impairment
Atmospheric Deposition - Toxics	Atmospheric Deposition	Mercury in Fish Tissue
Source Unknown	Unknown	DDT; Lead; Mercury in Fish Tissue; PCB(s) in Fish Tissue

The sources of impairment in the canal system are unknown for DDT, lead, and mercury (other than by atmospheric deposition) but are not attributed to Project operations. It is likely that these constituents are present due to historical contamination from the mills and industrial facilities that line the canal system.

This review concludes that despite the listed impairment due to hydro-modification in the combined water body segment encompassing the bypass and downstream reaches, the jurisdictional agency recommendations included consideration of all water quality components as required to meet the B.2 Standard, and that the agency determined that the Project meets the state's requirements substantially enough to not warrant issuing a new water quality certification or to make other recommendations when given the opportunity to do so.

Supplemental quantitative information supports the Project also meeting Standard B.3 in Zones 1 and Zone 3 and includes baseline water quality data that was collected in 2009 by the Merrimack River Watershed Council.⁹ Standard B.3 requires: "In the absence of an applicable agency recommendation specific to the facility, the facility owner demonstrates that it is in compliance with the <u>quantitative</u> water quality standards established by the state..." (Handbook Section 3.2.2).

Water quality monitoring information was discovered during the application review, but it was not included in the LIHI application. A monitoring station was located in the lower impoundment (river mile 41.1) just upstream of the Pawtucket canal entrance near the Lowell Motor Boat Club. Another monitoring station was located in the downstream reach (river mile 40.0) at the Oulette Bridge (Aiken Street bridge) where only limited sampling occurred. Parameters measured included bacteria, temperature, dissolved oxygen, specific conductivity, total dissolved solids, salinity, pH, and clarity. Continuous monitoring data was also collected over two weeks at the impoundment site and included temperature, dissolved oxygen, specific conductivity, total dissolved solids, and pH. Results indicate that readings at both stations were within state quantitative water quality standards for parameters with numeric limits. Exceptions were: a single high bacteria sample at the downstream station, and episodic low pH readings at most river stations sampled including the two in the Project vicinity. There was no apparent cause of the low pH readings.

Nutrients and metals levels were also measured at the impoundment site and sites farther upstream and some constituents were found in concentrations higher than action levels. As a result, at the time of the 2009 report, MRWC intended to target some monitoring sites from the Project impoundment upstream for future monitoring of nutrients and metals, although no more recent data was found. Nowhere did the MRWC report suggest that the Project is a cause of pollutant-based water quality impairment in the river and given the elevated levels upstream of the Project it is not likely that the Project or current operations is a cause of water quality concerns in the river.

It should also be noted that the Merrimack River was included in American Rivers' 2016 list of the Ten Most Endangered Rivers¹⁰ and nowhere was it suggested that the presence or operations of dams on the river is a factor in that listing. Rather, the report states: *"Pavement is rapidly replacing trees across the Merrimack River watershed. The impact of unsustainable development on land, forests, habitat, and water quality* [polluted stormwater runoff] *is the largest threat that the Merrimack River watershed faces today."* The report also acknowledges, as related to the flow and fish passage criteria: *"The Merrimack River is one of the three most important large rivers on the East Coast in its conservation value to migratory river herring and one of the six most important for 12 migratory fish species."*

 ⁹ http://www.merrimack.org/oldsite/publications/documents/MRWC2009WaterQualityReport.pdf
 ¹⁰ https://s3.amazonaws.com/american-rivers-website/wpcontent/uploads/2016/02/20135708/MER2016_FullReport.pdf

The Project is in compliance with its water quality certificate which, despite being more than 10 years old, was not amended by MassDEP in 2011 during regulatory proceedings related to the crest gate project. The agency also reported in its LIHI certification support letter that the current voluntary seasonal flows in the bypass reach support the Clean Water Act's goals. The available site-specific water quality data shows that water quality standards are being met for parameters under the potential control of the Project (dissolved oxygen and temperature). The river's impairment listings for pollutants are attributed to sources other than the Project, and factors outside the Applicant's control. Therefore, this review concludes that the Project conditionally meets the Water Quality Criterion with provisions in Condition 3 (see Section VI) to ensure that water quality continues to be monitored and improved where applicable.

C/D. Fish Passage and Protection

Goals: The facility allows for the safe, timely, and effective upstream passage of migratory fish. This criterion is intended to ensure that migratory species can successfully complete their life cycles and maintain healthy, sustainable fish and wildlife resources in areas affected by the facility. (Handbook, Section 3.2.3) The facility allows for the safe, timely, and effective downstream passage of migratory fish. For riverine (resident) fish, the facility minimizes loss of fish from reservoirs and upstream river reaches affected by Facility operations.

All migratory species are able to successfully complete their life cycles and to maintain healthy, sustainable fish and wildlife resources in the areas affected by the Facility. (Handbook, Section 3.2.4)

Discussion for all Zones of Effect

According to the *Strategic Plan & Status Review, Anadromous Fish Restoration Plan, Merrimack River* (Technical Committee for Anadromous Fishery Management of the Merrimack River Basin and Advisors to the Technical Committee, October 16, 1997), anadromous fish were well distributed in the upper Merrimack River basin historically. The Pemigewasset River basin served as the principal source of Atlantic salmon production, while American shad and river herring (alewives and blueback herring) more likely utilized the Winnipesaukee, the Merrimack River mainstem and other Merrimack tributaries. In 1847, the Essex Dam in Lawrence, Massachusetts was constructed at River Mile 30, blocking anadromous fish runs to upstream habitat. Atlantic salmon became extirpated, while shad and river herring maintained diminished populations by using available habitat downstream of Essex Dam. Current restoration initiates focus on shad and herring, while attempts to restore salmon have been suspended.

The upstream fish passage facilities include a fish elevator and a downstream fish bypass at the E.L. Field powerhouse and a secondary-use vertical-slot ladder at the left dam abutment. Passage facilities were designed in consultation with the USFWS, and ongoing operation, evaluation, and facility modifications are done in consultation with the Policy and Technical Committees for the Restoration of Anadromous Fish to the Merrimack River, which includes as

members, USFWS, U.S. Forest Service, NMFS, MassWildlife, the Massachusetts Division of Marine Fisheries, and the N.H. Department of Fish and Game. Downstream passage facilities consist of a fish bypass located upstream of the E.L. Field powerhouse trashracks. The passage operates from spring through fall and flow from the passage facility discharges into the bypassed reach just upstream of the powerhouse. The upstream and downstream passage program at Lowell follows the Comprehensive Fish Passage Plan for the Lowell Hydroelectric Project (March 2000), which is a revision of the original FERC-approved plan from 1993.



Figure 7. Fish ladder at left abutment and weirs in downstream channel.



Figure 8. Fish lift at E.L. Field powerhouse.

Under the plan as approved by FERC, the Applicant has operated and monitored both the upstream fish ladder and fish lift daily during spring/summer of each year when a cumulative number of 50 American shad or 200 river herring have passed upstream at the Lawrence Project. The downstream bypass facility is operated from April 1 through July 15 and from September 1 through November 1. The Applicant made significant improvements prior to the 2016 season and voluntarily committed to make additional enhancements to the design and operation of the fish-lift system and spillway fish ladder which are in progress at this time. These include tailrace rock excavation¹¹ to improve the effectiveness of the fish lift and operation of the fish ladder (in addition to the fish lift) for the entire duration of the anadromous fish upstream passage season starting in 2017.

In 2016 record numbers of herring were counted along with more modest numbers of shad even though the fish ladder was only open for 4 weeks¹². Fewer numbers of both species were counted in 2017 (there were likely to be more passed than counted due to limitations in recording capability at the dam which have since been improved). Overall, about 10% to 20%

¹¹ The excavation was to occur during the 2017 construction season.

¹² <u>https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=14565120</u>

of fish that pass Lawrence also pass Lowell. Spawning habitat downstream and in tributaries exists and also limits the numbers of migratory fish arriving at Lowell to about 50% of those that have passed the Lawrence Project.

According to information provided by the applicant¹³, 2017 was also a much higher flow year during the fish passage season than was 2016. Historically fish do not attempt to move upstream of the Project when flows are very high (>10,00 Ocfs). In the lowest flow periods (<5,000 cfs) is when fish passage numbers normally spike. This is specifically true for shad (herring are more versatile). 2017 river flows did not drop below 10,000 cfs until the end of the season. There was a spike of shad but that late in the season most shad had already stopped moving upstream.

Downstream anadromous fish passage effectiveness testing was conducted in the 1990s for herring and shad. After the initial studies the downstream passage was enlarged which resulted in greater downstream passage numbers in subsequent follow up studies. The last downstream passage study was conducted in 2001 for Atlantic salmon smolt survival. It showed high turbine survival and thus high project survival no matter whether bypass or turbines were used. However, striped bass in the tailrace had a greater effect on smolt survival than did turbine passage. No further studies have been requested by resource agencies.

The USFWS is also engaged in an ongoing effort to protect and enhance the depleted coastwise stock of American eel, a catadromous fish species, which historically had unimpeded access to the upper Merrimack River basin and its tributaries and persists there. During the review of the 2000 fish passage plan, the fisheries agencies initiated a discussion about the need to provide eel passage at Pawtucket Dam. An eel upstream passage ramp is now operated at the dam although numbers are low as they are throughout the region. Passage improvements are also in progress as part of the larger project work at the dam. The Applicant also voluntarily participates in and helps to fund USFWS regional upstream and downstream eel passage research in the Merrimack River basin.

Historically, the federally endangered shortnose sturgeon accessed the Merrimack River upstream of Lowell for spawning, which may have occurred at Amoskeag Falls in Manchester NH. More recently, spawning has been documented at Haverhill, Massachusetts, downstream of the Lawrence Project's Essex Dam, which originally cut off access to Amoskeag Falls. The Merrimack River sturgeon are from the Gulf of Maine regional population. (*Biological Assessment of Shortnose Sturgeon*, NMFS, November 1, 2010) The biological assessment indicated that shortnose sturgeon may have adapted to solely using habitat in the lower river for spawning as none were utilizing the fish lift at Essex Dam.

¹³ 02/14/2018 email to LIHI in response to request for additional details.

The Project conforms to Standards C.2 and D.2 (both Agency Recommendation) with respect to the provision and operation of upstream and downstream fish passage facilities following the recommendations of the federal and state fisheries agencies. The facilities are evaluated on a continuing basis and modified as necessary. The 2016 annual report suggests the facilities at both the Lawrence and Lowell Projects are passing a substantial number of river herring as well as shad.

E. Shoreline and Watershed Protection

Goal: The Facility has demonstrated that sufficient action has been taken to protect, mitigate and enhance the condition of soils, vegetation and ecosystem functions on shoreline and watershed lands associated with the facility.

Discussion for all Zones of Effect

The Project dam and hydroelectric infrastructure are located in a densely developed urban area. The dam creates a riverine impoundment that extends 23 miles upstream to Moores Falls in New Hampshire, between the cities of Nashua and Manchester; however, the shoreline is not owned or controlled by the Applicant. The license does not require the Applicant to manage the river shoreline under a shoreline management plan. The record does not indicate a need for the Applicant to provide special protection of the shoreline soils, vegetation or ecosystem functions.

It should be noted that operationally the new crest gate system will reduce impoundment drawdowns previously caused by flashboard failure. This may reduce riverbank erosion if such problems exist upstream.

The Applicant selected Standard E.2 for the impoundment zone since it is difficult to quantify the ecological value of the shoreline. In practice, Standard E.2 would be used if the shoreline was ecologically significant in some way. Since the area is urbanized and the Applicant does not own shoreline land, Standard E.1 (Not Applicable/De Minimis Effect) is appropriate. The Applicant did select Standard E.1 for the bypass reach, downstream reach, and canal zones. The Project meets Standard E.1 (Not Applicable/De Minimis Effect) in all zones.

F. Threatened and Endangered Species Protection

Goal: The Facility does not negatively impact listed species.

Facilities shall not have caused or contributed in a demonstrable way to the extirpation of a listed species. However, a facility that is making significant efforts to reintroduce an extirpated species may pass this criterion.

Discussion for all Zones of Effect

Several federally listed species may occur in Middlesex County, Massachusetts where the Project is located, as summarized in Table 2. Habitat requirements for all of these species precludes their likely presence at the Project, although the Northern long-eared bat could potentially roost in the vicinity during the summer.

Table 2. Federally listed threatened and endangered species in Middlesex County,Massachusetts. 14

Group	Name	Status	Recovery Plan
Birds	Red knot (Calidris canutus rufa)	Threatened	
Flowering Plants	Small whorled pogonia (Isotria medeoloides)	Threatened	yes
Flowering Plants	Sandplain gerardia (Agalinis acuta)	Endangered	yes
Mammals	Northern Long-Eared Bat (Myotis septentrionalis)	Threatened	

Table 3 includes state-listed species in the City of Lowell, and given the urban environment at the Project, it is unlikely that species other the Peregrine falcon and perhaps the dragonfly species could be present in the vicinity of the Project.

Taxonomic Group	Scientific Name	Common Name	MESA Status	Federal Status	Most Recent Observation
Bird	Falco peregrinus	Peregrine Falcon	Т	n/a	2016
Butterfly/ Moth	Cicinnus melsheimeri	Melsheimer's Sack Bearer	Т	n/a	Historic
Dragonfly/ Damselfly	Gomphus vastus	Cobra Clubtail	SC	n/a	2004
Dragonfly/ Damselfly	Neurocordulia obsoleta	Umber Shadowdragon	SC	n/a	2004
Reptile	Emydoidea blandingii	Blanding's Turtle	т	n/a	2007
Vascular Plant	Deschampsia cespitosa ssp. glauca	Tufted Hairgrass	E	n/a	1882
Vascular Plant	Elymus villosus	Hairy Wild Rye	E	n/a	1882
Vascular Plant	Liatris scariosa var. novae-angliae	New England Blazing Star	SC	n/a	1882

Table 3. State-listed threatened and endangered species for the City of Lowell.¹⁵

Priority habitats for these state-listed or rare species are found upstream of the Project but not within the Project itself. Priority Habitat No. 1987 covers a reach of the impoundment over three miles long (Figure 9).

¹⁴ <u>https://ecos.fws.gov/ecp0/reports/species-by-current-range-county?fips=25017</u>

¹⁵ <u>https://www.mass.gov/service-details/rare-species-by-town-viewer</u>



Figure 9. MassGIS map showing Priority Habitats of Rare Species at Lowell.¹⁶

Priority habitat for Bald Eagle, a state-threatened species encompasses the Merrimack River within the Project area (Figure 10).



Figure 10. OLIVER mapping of Lowell Project (PH 1321 = Bald Eagle).¹⁷

 ¹⁶ Massachusetts OLIVER GIS program of Natural Heritage and Endangered Species Program habitat data layer.
 ¹⁷ LIHI application p. 38.

According to the application, no tree removal is planned at the Project. Consequently, there should be no potential impact on Bald Eagle or Northern Long-Eared Bat. Northern long-eared bat populations have been decimated by white-nose syndrome. The northern long-eared bat 4(d) rule prohibits incidental take that may occur from tree removal activities within 150 feet of a known occupied maternity roost tree during the pup season (June 1 to July 31) or within a 1/4 mile of a hibernation site, year-round.

As indicated previously, the federally (and state) endangered shortnose sturgeon historically accessed and used habitat upstream of Lowell but is not currently present and the biological assessment indicated that shortnose sturgeon may have adapted to solely using habitat in the lower river for spawning as none were utilizing the fish lift at the downstream Lawrence Project (Essex Dam). Therefore, the Lowell Project is not the cause of extirpation of this species in the Project area. Atlantic sturgeon is also state listed as endangered and federally listed as threatened for the Merrimack River (Gulf of Maine) population. As of 2007, there was no evidence of species presence in the river although the estuary could be used as nursery habitat.¹⁸ Spawning habitat is limited to the fall line of large rivers¹⁹; therefore, the Pawtucket Falls in Lowell or the falls at the downstream Lawrence Project may have historically formed a natural barrier to this species in the river. Over harvesting of the species throughout its range, particularly for its roe used as caviar, is identified as the leading cause of its decline and threatened status.²⁰

Multi-year telemetry studies conducted in the river with both shortnose and Atlantic sturgeon downstream of the Lowell Project and downstream of the Lawrence Project's Essex Dam found that both species primarily utilized the lower most reaches of the river.²¹ The 2013 revised Lawrence Project Comprehensive Fish Passage Plan developed in consultation with the resource agencies defers future evaluation of both species indefinitely (see Lawrence Project, LIHI # 121 application Attachment C).²²

This LIHI application review has therefore determined, in agreement with the application, that there is no apparent conflict with listed species present in the area. The Project appears to meet Standard F-2 (Finding of No Negative Effect).

¹⁸ <u>http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/atlanticsturgeon2007.pdf</u>

¹⁹ <u>http://www.nmfs.noaa.gov/pr/pdfs/species/atlanticsturgeon_detailed.pdf</u>

²⁰ Ibid.

https://www.researchgate.net/profile/B_Kynard/publication/250019542_Annual_Movements_of_Shortnose_and Atlantic_Sturgeons_in_the_Merrimack_River_Massachusetts/links/543bf9660cf2d6698be35c2c/Annual_ Movements-of-Shortnose-and-Atlantic-Sturgeons-in-the-Merrimack-River-Massachusetts.pdf

²² <u>https://lowimpacthydro.org/wp-content/uploads/2015/03/Lawrence-LIHI-Application</u> Attachments-C-FISH-PASSAGE.pdf

G. Cultural Resource Protection

Goal: The Facility does not inappropriately impact cultural or historic resources that are associated with the Facility's lands and waters, including resources important to local indigenous populations, such as Native Americans.

Discussion for all Zones of Effect

The Project is located in downtown Lowell, with several historic features that symbolize the early Industrial Revolution. In 1976, the Locks and Canals Historic District was listed on the National Register of Historic Places and in 1977 the area was designated a National Historic Landmark. In 1978, Congress passed the Lowell Act, which recognized the historical value of this area and established the Lowell National Historical Park and Lowell Historic Preservation District. Historic features affected by this Project include the Pawtucket Dam and the canal system and associated mill buildings.

The canal system was initially constructed in 1796 as a means of bypassing Pawtucket Falls and enabling the transportation of timber and agricultural products from New Hampshire to the Atlantic Ocean. As the textile industry emerged in the early 1800s, the canal system was expanded and numerous mills were constructed along the canal system, harnessing the flow of water to provide electrical and mechanical power for operations. NPS currently offers historical boat tours of the canal system, and the Applicant facilitates this through an operating agreement.

The most recent activity that triggered a review of Project impacts on cultural resources was the crest gate project, which was opposed by NPS as being inconsistent with the Lowell Act and the 1966 National Historic Preservation Act. The FERC approval decision was litigated by NPS but affirmed by the First Circuit Court of Appeals in 2015. FERC determined both during original construction done under the current license and subsequent modifications that the Project has "no adverse effect on the Locks and Canals Historic District." For the original construction, License Article 33 includes specific mitigation measures agreed to by the Massachusetts SHPO and the Advisory Council on Historic Preservation. For the crest gate project, the FERC decision was based on the fact that the flashboards being replaced by the crest gate system were not part of the original dam design; measures implemented as part of the crest gate project included mimicking the appearance of the flashboards and interpretive exhibits that would effectively mitigate any negative effects of replacing the flashboards (application p. 40).

I suggest that the Project be considered as meeting Standard G-2 (Approved Plan). Although there is no Cultural Resources Management Plan, activities that may threaten cultural resources at the Project are regulated under Article 33 of the license, as well as the Lowell Act and the National Historic Preservation Act.

H. Recreation Resources

Goal: The facility accommodates recreation activities on lands and waters controlled by the Facility and provides recreational access to its associated lands and waters without fee or charge.

In all cases, the applicant shall demonstrate that flow-related recreational impacts are mitigated to a reasonable extent in all zones where there is flow-related recreation. Where there is recognized, flow-related recreational use, the facility shall provide the public with relevant and up-to-date information on reservoir levels and river flows, preferably real-time updates. It is understood that recreational activities must be consistent with the assurance of reasonable safety of employees and the public, and with critical infrastructure protection dictated by state or federal authorities.

Discussion for all Zones of Effect

License Article 38 required the filing of a revised Report on Recreational Resources containing functional plans, site development costs and schedules for the following recreational facilities at the site: (1) a navigation lock at the Northern Canal control structure; (2) a visitor facility at the powerhouse; (3) restoration of portions of the Northern Canal Walkway near the powerhouse; and (4) repair of the Northern Canal gates. The final report, which FERC approved by order dated September 10, 1984, also included a canal system water elevation maintenance plan to allow the NPS to operate tour boats to navigate the lower canal system (see Section A above). The Licensee agreed to drop canal water levels approximately 6 inches during the May 15 to October 15 recreational season. The report, and recreational improvements, were done in consultation with federal and state agencies.

As part of the approval of the crest gate project, FERC required the Applicant to install two interpretive exhibits, one featuring a replica of the original flashboard system and one featuring the new crest gate system, to enhance visitor understanding of the history of Pawtucket Dam and the Lowell Hydroelectric Project. As mentioned above, the most recent FERC environmental inspection suggests that updating the visitors center should be considered. Since relicensing of the Project is to commence soon, FERC indicated acceptance that potential improvements to the visitor center be discussed as part of relicensing consultation. It is also reasonable to expect that a thorough review of current recreational needs will be done at that time.

The Project can be considered to meet Standard H.2 (Agency Recommendation) since there are recreational facilities provided by the Applicant and open public access is allowed.

VI. CERTIFICATION RECOMMENDATION

I recommend that the Project be conditionally LIHI Certified based on:

- the current agency recommendations described in the application and this report;
- the ongoing collaboration and consultation between the Applicant and resource agencies; and
- the across-the-board agency support of the LIHI application.

The agencies fully support LIHI Certification for this Project and have consciously chosen to defer making additional or alternative recommendations to the relicensing process. Agencies are all in agreement that the Applicant has continued to constructively collaborate with them and has instituted voluntary measures prior to relicensing. The Applicant has also stated that they fully intend to conduct any additional needed evaluations as part of the relicensing process.

Studies are expected to be completed and additional agency recommendations may occur during the upcoming FERC relicensing which is slated to begin on April 30, 2018 with the Applicant's filing of a Pre-Application Document. Under the FERC Integrated Licensing Process (ILP) that filing is followed by several months or up to one year of FERC scoping, agency consultation, and study planning prior to implementation of studies which could occur as early as mid-2019 under the ILP. It is also possible for the Applicant to proactively conduct flow and/or water quality studies prior to study plan development (e.g., during the 2018 summer season) with agency and FERC concurrence.

LIHI would generally discourage an Applicant from pursuing certification if they were already in relicensing. In this case, the original application was received in April 2017, a full year before the Applicant must file its notice of intent to relicense. The Applicant promptly filed a revised application in response to the intake review and has made repeated good faith efforts to provide supplemental information requested by the original reviewer. Therefore, I recommend that the Project be Certified conditionally as follows:

Condition 1. The Owner shall continue to maintain the current voluntary seasonal flows in the bypass reach and proactively consult with the resource agencies regarding possible interim opportunities to enhance flows in the bypass reach and in the canal system (if needed) while the upcoming FERC relicensing activities are underway. Such opportunities may involve study of habitat quantity/quality, alternative flow regimes, and/or water quality monitoring so that modifications can be implemented more quickly once a new license is issued, or even prior to a new license if agreed to by all parties. During the term of this LIHI Certification, should a resource agency request implementation of enhanced bypass and/or canal flow measures as part of their recommendations or jurisdictional mandates under the relicensing proceedings, the Owner shall provide to LIHI in the annual compliance report a copy of the request, and describe the Owner's plans to address these requests along with a schedule and progress toward implementation.

Condition 2. The Owner shall provide to LIHI as part of the annual compliance report, a status report of the FERC licensing progress listing significant agency interactions that have occurred in the past year that are relevant to any of LIHI's Certification criteria, and highlighting major topics of agreement or disagreement. LIHI reserves the right to request additional details if necessary, if highlighted topics are relevant to LIHI Certification criteria and their associated goals. LIHI also reserves the right to modify the Certificate conditions again if needed.

Condition 3. The Owner shall work toward removing the state's water quality impairment listing for hydromodification in the combined bypass and downstream reach of the Project. This may be accomplished by working proactively with MassDEP and: a) ensuring that any water quality studies conducted as part of relicensing adhere to state quality control/quality assurance (QA/QC) protocols and that results are submitted to the state timely and in the proper format for use by the state in its biennial review(s) of the State's Clean Water Act Integrated List of Waters; b) providing results of other relicensing studies (e.g., instream flow studies) to the state for inclusion in upcoming biennial reviews of the state's impairment listings; and c) by submitting public comments relative to results from flow and water quality studies in that reach during the public comment process when the state's draft lists are made available. Activities and any changes in the impairment listing for the reach shall be summarized and reported to LIHI in the annual compliance reports.

Condition 4. The Merrimack River basin is highly developed for water resources and the operation of multiple hydropower facilities and other water uses in the basin are interconnected to a degree that requires a systematic approach for future management. Solutions for individual facilities are insufficient to achieve the environmental protection and restoration needed for long-term, sustainable water uses. Therefore, the Owner of the Lowell facility shall continue to play a constructive, supportive role in promoting integrative water management in the basin, both in the Project's upcoming FERC relicensing and in other regulatory proceedings and voluntary activities that may develop in the basin. The Owner shall report to LIHI on its activities relative to this condition each year in its annual compliance report. LIHI reserves the right to modify the Certificate conditions again if needed.

APPENDIX – RELEVANT AGENCY AND APPLICANT COMMUNICATIONS

Water Quality and Crest Gate System

Peter Drown <peter.drown@cleantechanalytics.com> Image: Composition of the second state of the secon</peter.drown@cleantechanalytics.com>	December 6, 2017 at 3:19 PM Details Cthydro.org>			
Siri found new contact info in this email: Peter Drown peter.drown@cleantechanalytics.com	add to Contacts 🛞			
Jeff - Sorry, attached is the Crest Gate Ops plan. My opinion is that this does represent the most recent agency recommendation pertinent to water quality, for the below reasons. It specifically addresses the designated use of the impaired reach - fish, other aquatic life, and wildlife. The agencies are clearly on the same page about this, as shown in both their original comments on the crest gate installation (below,) and the comments supporting the LIHI application and the operation of flows into the fish passage system into the bypassed				

#1.) This system alleviates water level fluctuation effects in the impoundment Zone, and backwater analysis and technical evaluation found the system would enhance project operational control and generation and would provide significant advantages for other resources that are dependent on water levels, including flood control, recreation, and fish passage. The proposal was strongly endorsed by the Massachusetts Department of Fisheries and Wildlife, and the National Marine Fisheries Service, who both noted the project's beneficial effect on fish habitat and movement within the project area.

#2.) The EA noted: "The proposed pneumatic crest gate system likely would reduce the false attraction for upstream migrating fish by reducing the amount of leakage from the dam and would improve upstream passage efficiencies. Resident fish upstream of the project would benefit from the reduced frequency of sudden and extended drawdowns because the river would behave more like an unregulated river and nearshore spawning and nursery habitat would remain submerged."

"May 14, 2010: "The proposed system would allow different sections of the dam crest to be lowered as river flows change. This type of system also allows rapid re-inflation after periods of high river flows, thereby avoiding delays to upstream fish passage posed by lost or damaged sections of wooden flashboards... the Division strongly endorses Enel's proposal to replace the existing wooden flashboards at the Lowell project with an inflatable crest-gate system." (Caleb Slater, Massachusetts Division of Fisheries and Wildlife)

June 22, 2010: "Installation of the proposed crest gate system would maintain more consistent water levels, reduce water leakage from the dam, and minimize the need for impoundment drawdowns, all contributing to improved fish passage to their spawning habitat." (Paul Diodati, Massachusetts Division of Marine Fisheries)

MDEP Support Letter

F&W Letter for concurrence

Johnson, Arthur (DEP) <Arthur.Johnson@massmail.state.ma.us> To: Peter Drown <peter.drown@cleantechanalytics.com> Mon, Mar 27, 2017 at 3:38 PM

Cc: "Kubit, Robert (DEP)" <robert.kubit@state.ma.us>, "Groff, Kimberly (DEP)" <kimberly.groff@state.ma.us>

Hi Peter – Thank you for the opportunity to discuss with you the proposed enhancement of fish passage at the Boott Hydro facility at Pawtucket Dam in Lowell, MA. As I indicated to you on the phone, a segment of the Merrimack River directly downstream from Pawtucket Falls has been listed on the Massachusetts Integrated List of Waters as impaired by low-flow alterations since 2002. This was in response to MADEP's 1999 water quality assessment of the Merrimack River Watershed which found that a 0.7-mile bypass reach of the Merrimack River (Pawtucket Falls) is periodically dewatered during low-flow conditions. Therefore, measures to enhance fish passage, such as those proposed for the Lowell Hydroelectric project, including fish lift and ladder improvements and operation of the passage facilities for increased lengths of time, will certainly be advantageous and are consistent with the goals of the Clean Water Act. Please let me know if you have any questions. Thank you for the opportunity to comment on this project.

Art Johnson

Arthur S. Johnson

Massachusetts Department of Environmental Protection

DWM Environmental Monitoring Program

8 New Bond Street

Worcester, MA 01606

Phone: (508) 767-2873

FAX: (508) 791-4131

arthur.johnson@state.ma.us

USFWS Letter of Support



United States Department of the Interior



FISH AND WILDLIFE SERVICE

New England Field Office 70 Commercial Street, Suite 300 Concord, NH 03301-5087 http://www.fws.gov/newengland

REF: Lowell Hydroelectric Project - FERC No. 2790

March 24, 2017

Mr. Randald Bartlett, P.E. ENEL Green Power North America, Inc. 100 Brickstone Square, Suite 300 Andover, MA 01810

Dear Mr. Bartlett:

This letter refers to upstream fish passage at your Lowell Hydroelectric Project, located on the Merrimack River in Lowell, Massachusetts.

The Fish and Wildlife Service (Service) has been working with ENEL Green Power, North America (ENEL), parent company of the project licensee, Boott Hydro, for many years to address upstream fish passage performance at the Lowell Project. ENEL has made significant efforts in recent years to address passage questions and problems. Progress has been made on improved fish lift operations protocols, fish lift entrance evaluations, and fish ladder repairs and maintenance. However, the Service and other fisheries agencies have indicated in prior meetings and correspondence that additional measures are necessary at both the tailrace fish lift and spillway fish ladder in order to achieve adequate American shad and river herring passage effectiveness.

In a telephone conversation on January 27, 2017 with John Warner of my staff, you indicated that Boott Hydropower is seeking a Low Impact Hydropower Institute (LIHI) Certification for the Lowell Project. As part of the application for LIHI Certification, Boott Hydro is proposing to commit to implementing additional fish passage measures at the project to address agency concerns.

In addition to ENEL's current commitments to evaluations of and modifications to the fish lift system, including tailrace rock excavation and American eel passage improvements, outlined in letters from ENEL dated March 21, 2016 and November 3, 2016, and minutes of an October 20, 2016 interagency meeting dated October 26, 2016, Boott Hydro is also proposing to operate the fish ladder located at the Pawtucket Dam for the entire duration of the anadromous fish upstream passage season, consistent with the operating timeframes defined for the powerhouse fish lift in the project's FERC-approved Comprehensive Fish Passage Plan.

4. 1

Mr. Randald Bartlett March 24, 2017 2

For spring 2017. Boott Hydro agrees to operate and maintain the fish ladder for the entire season with the same in-ladder and attraction flow release protocols followed in 2016. Upon receiving LIHI Certification, Boott Hydro will similarly continue full season ladder operation in 2018 and each year thereafter until issuance of a new FERC license for the project.

With full season ladder operation until relicensing and the other commitments to continue consultations on and implementation of improvements to the passage facilities and operations, we support Boott Hydro's application for LIHI Certification for the Lowell Project.

We look forward to continued cooperation to address fish passage at the project. Please contact Mr. Warner at 603-227-6420, or via e-mail at john_warner@fws.gov, if you have any questions or need assistance.

Sincerely rours.

Thomas R. Chapman Supervisor New England Field Office

MassWildlife Letter of Support



FISHERIES & WILDLIFE

1 Rabbit Hill Road, Westborough, MA 01581 p: (508) 389-6300 | 1: (508) 389-7890 MASS.GOV/MASSWILDLIFE

Jack Buckley, Director

REF: Lowell Hydroelectric Project - FERC No. 2790

March 16, 2017

Mr. Randald Bartlett, P.E. ENEL Green Power North America, Inc. 100 Brickstone Square, Suite 300 Andover, MA 01810

Dear Mr. Bartlett

This letter refers to upstream fish passage at your Lowell Hydroelectric Project, located on the Merrimack River in Lowell, Massachusetts.

The Massachusetts Division of Fisheries and Wildlife (MassWildlife) has been working with ENEL Green Power, North America (ENEL), parent company of the project licensee, Boott Hydro, for many years to address upstream fish passage performance at the Lowell Project. ENEL has made efforts in recent years to address passage questions and problems, although the Service and other fisheries agencies have indicated in prior meetings and correspondence that additional measures are necessary at both the tailrace fish lift and spillway fish ladder.

In a telephone conversation on January 27, 2017, you indicated that Boott Hydropower is seeking a Low Impact Hydropower Institute (LIHI) Certification for the Lowell Project. As part of the application for LIHI Certification, Boott Hydro is proposing to commit to implementing additional fish passage measures at the project to address agency concerns.

In addition to ENEL's current commitments to evaluations of, and modifications to, the fish lift system, including tailrace rock excavation and American Eel passage improvements, outlined in letters from ENEL dated March 21, 2016 and November 3, 2016, and minutes of an October 20, 2016 interagency meeting dated October 26, 2016, Boott Hydro is also proposing to operate the fish ladder located at the Pawtucket Dam for the entire duration of the anadromous fish upstream passage season, consistent with the operating timeframes defined for the powerhouse fish lift in the project's FERC-approved Comprehensive Fish Passage Plan.

For spring 2017, Boott Hydro agrees to operate and maintain the fish ladder for the entire season with the same in-ladder and attraction flow release protocols followed in 2016. Upon receiving LIHI Certification, Boott Hydro will similarly continue full season ladder operation in 2018 and each year thereafter until issuance of a new FERC license for the project.

With full season ladder operation until relicensing and the other commitments to continue consultations on and implementation of improvements to the passage facilities and operations, MassWildlife supports Boott Hydro's application for LIHI Certification for the Lowell Project.

We look forward to continued cooperation to address fish passage at the project. Please contact me if you have any questions or need assistance.

Sincerely,

Calel Ketter

Caleb Slater Anadromous Fish Project Leader Massachusetts Division of Fisheries and Wildlife

 cc: CNEFRO–Joe McKeon, Mike Bailey (via email) RO/Fisheries - Bryan Sojkowski (via email) NHFGD–Matt Carpenter (via email) USFWS-John Warner (via email) MDMF-Gloucester–Ben Gahagan (via email) NMFS–Sue Tuxbury, Bjorn Lake (via email) FERC-Div. of Hydropower Administration and Compliance

Original reviewer communication with agency staff

Dr. Caleb Slater <caleb.slater@state.ma.us> RE: Low Impact Hydropower Institute application for Lowell Hydroelectric Project To: Jeffrey Cueto <ompompanoo@aol.com></ompompanoo@aol.com></caleb.slater@state.ma.us>	1:56 PM
 Sorry Jeff, As John said, We have no idea of the habitat value of the Lowell bypassed reach. When the FERC license was issued there was no call for a significant min flow. We expect a thorough IFIM type study during relicensing- and expect a significant increase in the Z flows. Flows below the project are not an issue- the project is run of river Caleb Slater, PhD Anadromous Fish Project Leader Massachusetts Division of Fisheries and Wildlife 1 Rabbit Hill Road, Westborough, MA 01581 p: (508) 389-6331 e: Caleb.Slater@state.ma.us mass.gov/masswildlife facebook.com/masswildlife	one of Passage and minimum
Jeffrey Cueto <ompompanoo@aol.com> Re: Low Impact Hydropower Institute application for Lowell Hydroelectric Project To: Dr. Caleb Slater <caleb.slater@state.ma.us>, Cc: John P. Warner <john_warner@fws.gov> & :</john_warner@fws.gov></caleb.slater@state.ma.us></ompompanoo@aol.com>	1:43 PM Details 2 more
Caleb — I don't think I heard back from you. Did you have anything to add? Thanks. Jeff John P. Warner <john_warner@fws.gov> Decemi Re: Low Impact Hydropower Institute application for Lowell Hydroelectric Project</john_warner@fws.gov>	ber 4, 2017 at 7:28 AM Details
To: Jeffrey Cueto <ompompanoo@aol.com>, Cc: Dr. Caleb Slater <caleb.slater@state.ma.us> &</caleb.slater@state.ma.us></ompompanoo@aol.com>	2 more update (8)

Jeff - I do not know the circumstances re: the previous license decisions regarding bypass flows, but there was an era when salmon and fish passage measures were 100% paramount and habitat less so (think 0.2 csm flows from Wilder but we have a fish ladder!). The habitat value of the bypass reach is pretty much undetermined - We would anticipate a rigorous IFIM study and some zone of passage evaluations given the braided uplifted bedrock habitat. The project does run ROR, with fluctuations appeared to be minimized - more so with rubber dam, although AMoskeag upstream fluctuates some (another issue we are looking into) so there maybe some perturbations below Lowell that are not of ENEL's making. -- jw