



# Final License Application Volume I of III

Lowell Hydroelectric Project  
(FERC No. 2790)

April 30, 2021

Prepared by:



Prepared for:

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**Central Rivers Power**

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## List of Acronyms

μS/cm	microsiemens per centimeter
ACHP	Advisory Council on Historic Preservation
ADA	Americans with Disabilities Act
APE	area of potential effects
ASRSC	Atlantic Sea Run Salmon Commission
AW	American Whitewater
Boott	Boott Hydropower, LLC (or Licensee, or Applicant)
CEII	Critical Energy Infrastructure Information
CFPP	Comprehensive Fish Passage Plan
C.F.R.	Code of Federal Regulations
cfs	cubic feet per second
Chapter 91	M.G.L. Chapter 91 of the Waterways Act
CMR	Codes of Massachusetts Regulations
CSO	Combined Sewer Overflow
CSPA	Comprehensive Shoreland Protection Act
CWA	Clean Water Act
DDT	Dichlorodiphenyltrichloroethane
DLA	Draft License Application
DMMSPs	Dam Safety Surveillance and Monitoring Plan
DO	dissolved oxygen
EA	Environmental Assessment
E.L. Field	Eldred L. Field
EPT	Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddis flies)
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission (or Commission)
FGMP	Final General Management Plan
FHA	Federal Highway Administration
FLA	Final License Application
FPA	Federal Power Act
GECC	General Electric Credit Corporation
GIS	Geographic Information System

GPS	Global Positioning System
HAER	Historic American Engineering Record
ILP	Integrated Licensing Process
Integrated List	Integrated List of Waters
IPaC System	Information, Planning and Consultation System
IPANE	Invasive Plant Atlas of New England
ISO	Independent System Operator
ISO-NE	Independent System Operator – New England
ISR	Initial Study Report
kV	kilovolt
LIHI	Low Impact Hydropower Institute
LMRLAC	Lower Merrimack River Local Advisory Committee
LNHP	Lowell National Historical Park
LRWU	Lowell Regional Water Utility
M	magnitude
MADCR	Massachusetts Department of Conservation and Recreation
MADDEM	Massachusetts Department of Emergency Management
MADEP	Massachusetts Department of Environmental Protection
MADFW	Massachusetts Division of Fish and Wildlife
MADMF	Massachusetts Division of Marine Fisheries
MNHESP	Massachusetts Natural Heritage Endangered Species Program
MassGIS	Massachusetts Bureau of Geographic Information
MDMR	Maine Department of Marine Resources
MDPW	Massachusetts Department of Public Works
MEOEEA	Massachusetts Executive Office of Energy and Environmental Affairs
MESA	Massachusetts Endangered Species Act
M.G.L.	Massachusetts General Law
mg/L	milligrams per liter
MHC	Massachusetts Historical Commission
MIPAG	Massachusetts Invasive Plant Advisory Group
MOU	Memorandum of Understanding
MRI	Merrimack River Initiative
MRWC	Merrimack River Watershed Council
MW	megawatt
MWh	megawatt hours
NAI	Normandeau Associates, Inc.



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NEFMC	New England Fishery Management Council
New Hampshire NHB	New Hampshire Natural Heritage Bureau
NGOs	non-governmental organizations
NGVD 29	National Geodetic Vertical Datum 1929
NHDES	New Hampshire Department of Environmental Services
NHDFG	New Hampshire Department of Fish and Game
NHDHR	New Hampshire Division of Historical Resources
NHDNCR	New Hampshire Department of Natural and Cultural Resources
NHFGD	New Hampshire Fish and Game Department
NHL	National Historic Landmark
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NRPC	Nashua Regional Planning Commission
NTU	Nephelometric Turbidity Unit
NWI	Nation Wetland Inventory
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
PAD	Pre-Application Document
PM&E	protection, mitigation, and enhancement measures
PPA	Power Purchase Agreement
Project	Lowell Hydroelectric Project
Proprietors	Proprietors of the Locks and Canals on the Merrimack River
PSP	Proposed Study Plan
Revised PPS	Revised Process Plan and Schedule and Determination on Requests for Study Modifications for the Lowell Hydroelectric Project
RM	river mile
RMC	RMC Environmental Services
ROR	run of river
RPS	Renewable Portfolio Standards
RSA	Revised Statutes Annotated
RSP	Revised Study Plan

RTE	rare, threatened, and endangered
SAV	submerged aquatic vegetation
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SDR	Supporting Design Report
SD1	Scoping Document 1
SD2	Scoping Document 2
Section 106	Section 106 of the NHPA
SPD	Study Plan Determination
SHPO	State Historic Preservation Officer
stakeholders	resource agencies, federally recognized Indian tribes, non-governmental organizations (NGOs), and other interested parties
SWQS	surface water quality standards
Technical Committee	Representatives from NHDFG, MADFW, USFWS, USFS, NMFS
THPO	Tribal Historic Preservation Officers
TMDL	total maximum daily loads
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VP	vegetation points
WPA	Wetlands Protection Act
WQC	Water Quality Certification
YOY	Young-of-year

# Executive Summary

## ES.1 Introduction

The Federal Energy Regulatory Commission (FERC or Commission), under the authority of the Federal Power Act (FPA), 16 United States Code (USC) §791(a), et seq., may issue a license for up to 50 years for the construction, operation, and maintenance of non-federal hydroelectric developments. Boott Hydropower, LLC (Boott or Licensee) is the Licensee, owner, and operator of the 20-megawatt (MW) Lowell Hydroelectric Project (FERC No. P-2790).

On April 13, 1983, the Commission issued an original license for the operation of the Lowell Hydroelectric Project (Project) in accordance with the Commission's delegated authority under the FPA. The Project's original license was issued for a term of 40 years and expires on April 30, 2023. On April 30, 2018, Boott initiated the Commission's Integrated Licensing Process (ILP) described at 18 Code of Federal Regulations (C.F.R.) Part 5. In accordance with applicable regulations, 18 CFR §5.17(a), Boott must file its application with the Commission for a subsequent license no later than April 30, 2021.

## ES.2 Summary of Lowell Hydroelectric Project

Boott acquired the Project pursuant to the December 15, 1983, Commission order approving the transfer of license<sup>1</sup> for the Project to Boott and General Electric Credit Corporation (GECC) as co-Licensees. By order dated December 23, 1985, the Commission approved a transfer of license<sup>2</sup> to Boott Hydropower, Inc., General Electric Capital Corporation (formerly, GECC), and Barclays American/Leasing, Inc. On April 1, 2005, FERC approved the transfer of license<sup>3</sup> to Boott and the Eldred L. Field Hydroelectric Family Trust. On December 8, 2015, FERC issued an Order Approving Partial Transfer of License<sup>4</sup>, which transferred the license to Boott as sole Licensee of the Project.

The Project is located at the Pawtucket Dam on the Merrimack River in the City of Lowell in Middlesex County, Massachusetts (Figure ES.2-1). The existing Project generally consists of the Pawtucket Dam topped by 5-foot-high pneumatically-operated crest gates, a 720-acre impoundment, a 5.5-mile-long canal system, the main powerhouse Eldred L. Field (E.L. Field), and four additional powerhouses located throughout the canal system (Assets, Bridge Street, Hamilton, and John Street) (Figure ES.2-2). The E.L. Field powerhouse utilizes the Pawtucket Dam and the first 2,200 feet of the Northern Canal. A 440-foot tailrace channel, surge gate, and fish passage facilities comprise other major E.L. Field powerhouse features. The Project is operated in a run of river (ROR) mode and has no useable storage capacity.

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<sup>1</sup> 25 FERC ¶ 61,386 (1983).

<sup>2</sup> 33 FERC ¶ 62,440 (1985).

<sup>3</sup> 111 FERC ¶ 62,001 (2005).

<sup>4</sup> 153 FERC ¶ 62,173 (2015).

Boott has concluded that the continued operation of the “downtown” mill units is no longer economically feasible. Therefore, Boott proposes to remove the four downtown powerhouses (Assets, Bridge Street, Hamilton, and John Street) and associated canals infrastructure from the Project’s new FERC license, retaining only that portion of the Northern Canal necessary to operate the E.L. Field powerhouse, and the upper portion of the Pawtucket Canal from the Project impoundment to and including the Guard Lock and Gates Facility (Figure ES.2-3; Figure ES.2-4). Boott will continue to manage the canal structures, water levels and flows using best practices and consistent with current agreements with the National Park Service and other stakeholders. Further details of Boott’s proposal are provided in the following sections of this license application.

Figure ES.2-1. Lowell Project Location Map and Existing Project Boundary

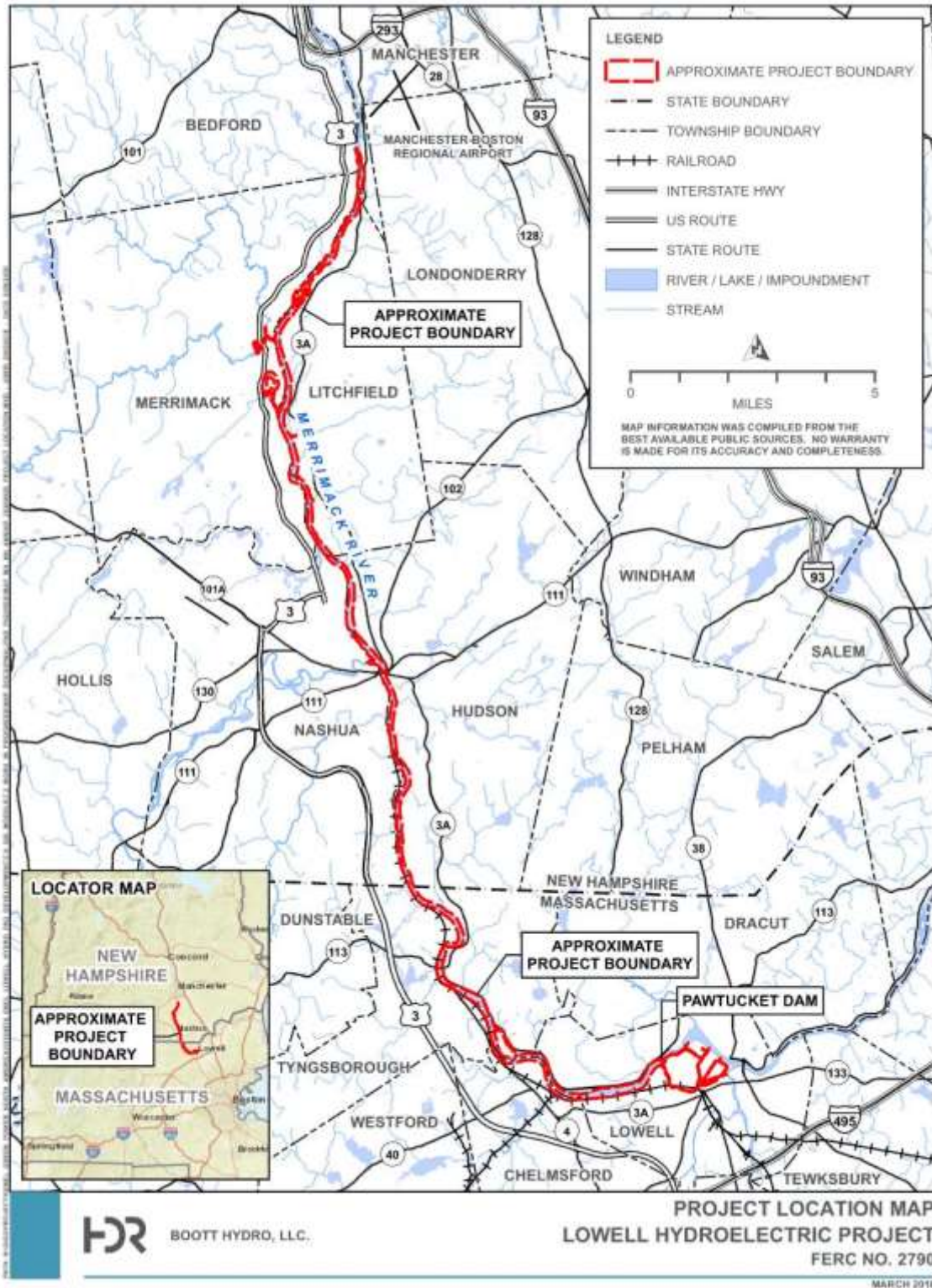


Figure ES.2-2. Existing Project Boundary and Facilities

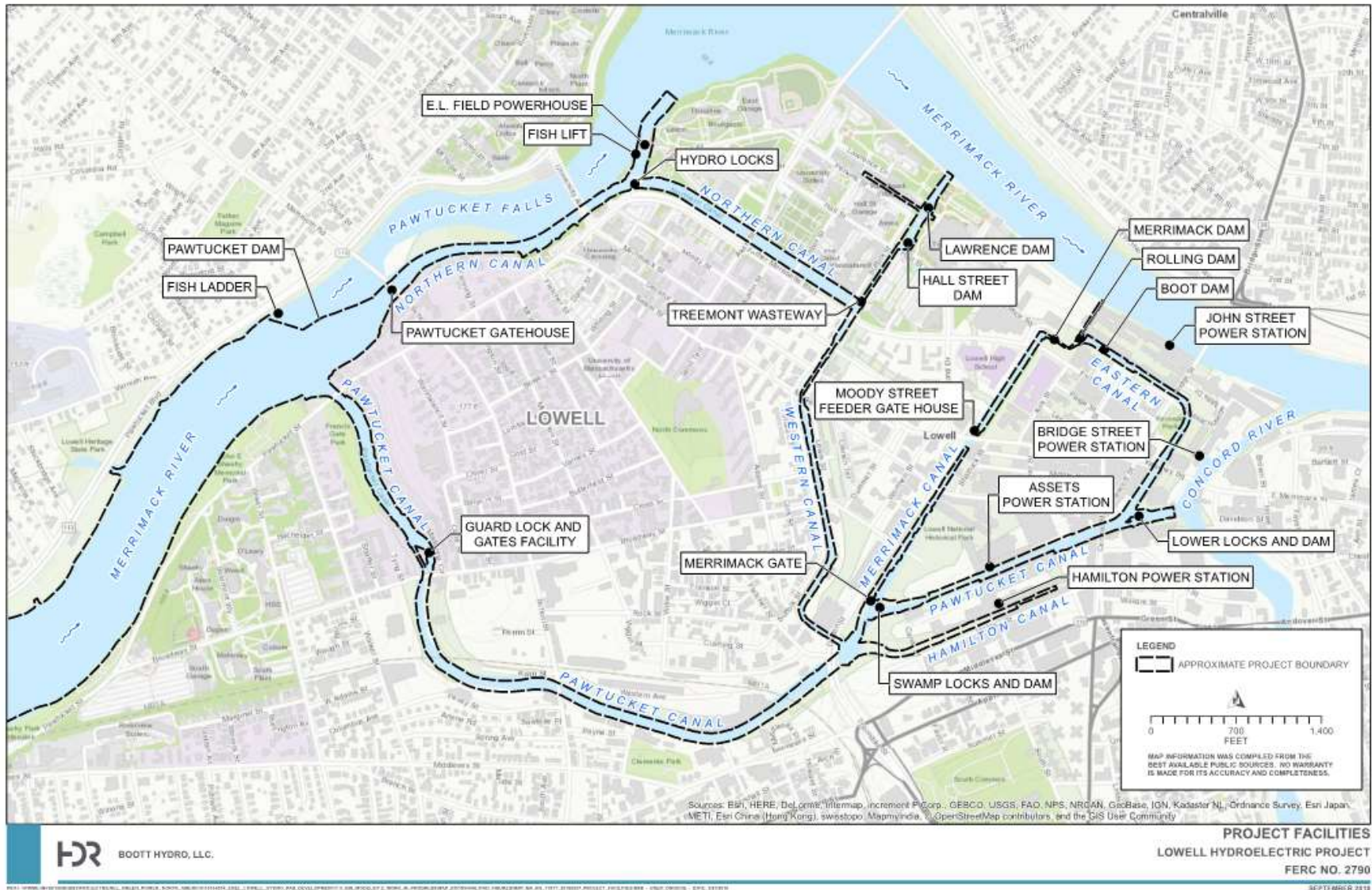


Figure ES.2-3. Lowell Project Location Map and Proposed Project Boundary

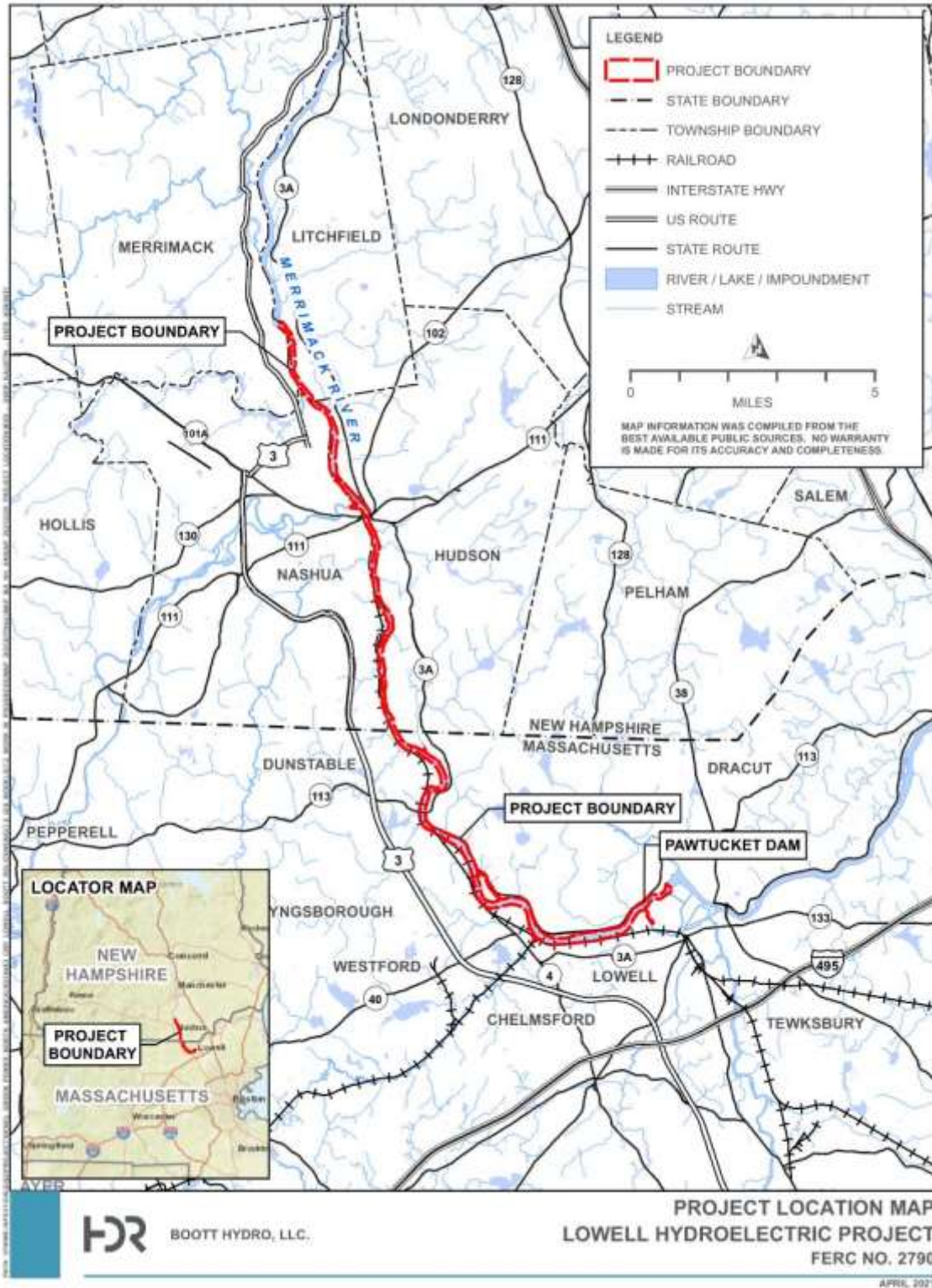
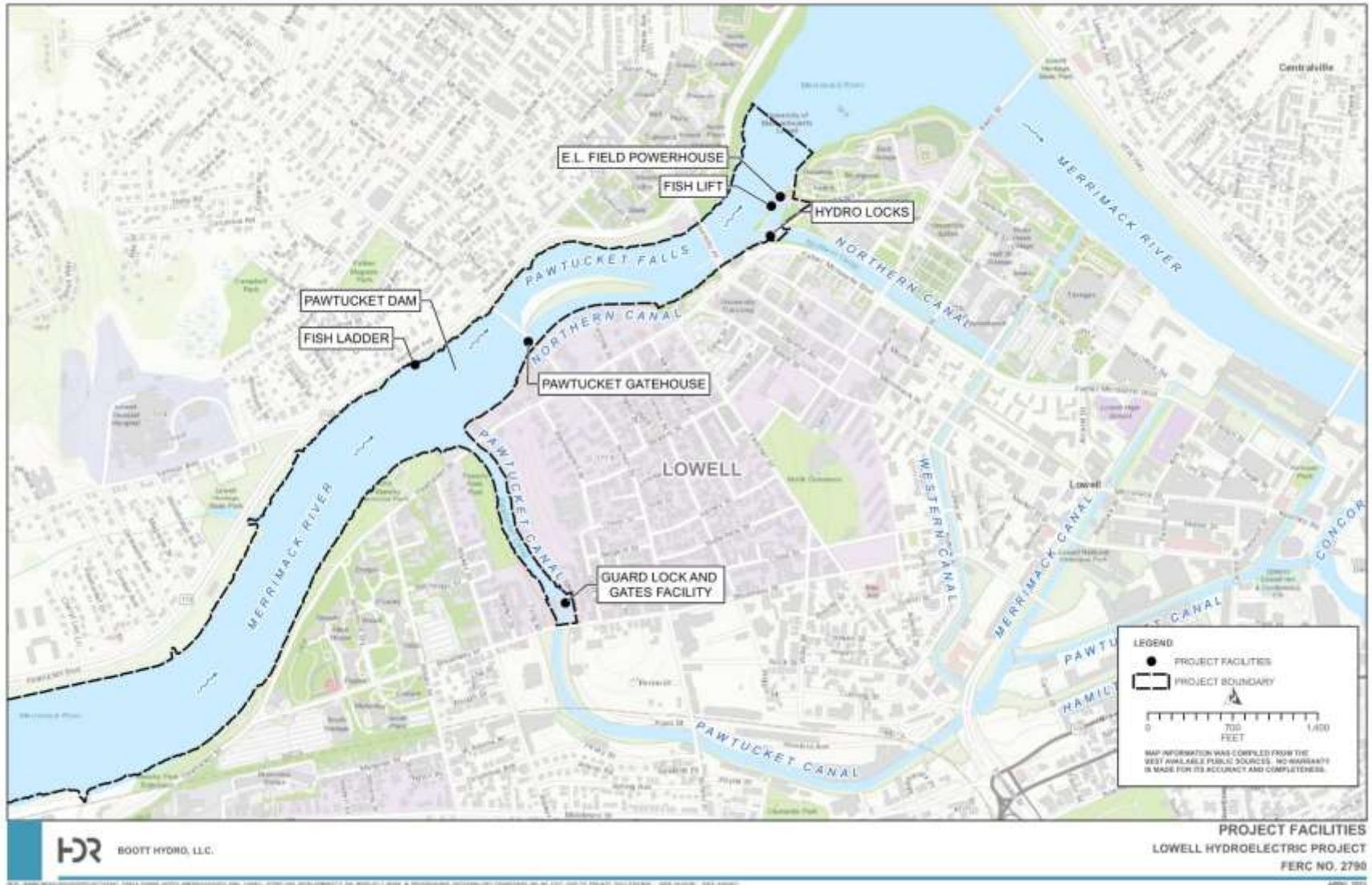


Figure ES.2-4. Proposed Project Boundary and Facilities





## ES.3 Agency Consultation and the Relicensing Process

On April 30, 2018, Boott, as the Licensee, filed a Pre-Application Document (PAD) and Notice of Intent (NOI) to seek a new license for the Project. The PAD provided a description of the Project and summarized existing, relevant, and reasonably available information to assist resource agencies, federally recognized Indian tribes, non-governmental organizations, and other interested parties (collectively, “stakeholders”) in identifying issues, determining information needs, and preparing study requests. A preliminary list of potential studies and information needs was included in the PAD. With the NOI, Boott requested designation as the non-federal representative for informal consultation with relevant agencies under Section 7 of the Endangered Species Act (ESA)<sup>5</sup> and Section 106 of the National Historic Preservation Act (NHPA)<sup>6</sup>. FERC granted these requests on June 15, 2018.

FERC issued Scoping Document 1 (SD1) on June 14, 2018 (dated June 15, 2018). SD1 was intended to advise stakeholders as to the proposed scope of the Environmental Assessment (EA) and to seek additional information pertinent to the Commission’s analysis of the license application. As provided in 18 C.F.R. §§ 5.8(a) and 5.18(b), the Commission issued a notice of commencement of proceeding concomitant with SD1 and provided stakeholders with a 60-day period to request studies and provide comments on the PAD and SD1. The Commission held two public scoping meetings in Lowell, Massachusetts on July 17, 2018. A site visit at the Project was held on July 18, 2018. FERC received seven comment letters on SD1, including comments from resource agencies. FERC issued Scoping Document 2 (SD2) on September 27, 2018 to reflect issues or alternatives to be considered in the EA based on stakeholder comments and study requests filed in response to SD1.

Pursuant to the requirements of the ILP, Boott developed a Proposed Study Plan (PSP) describing Boott’s intent to conduct 13 relicensing studies to address the comments and study requests submitted by stakeholders related to terrestrial resources, aquatic resources, recreational resources, and cultural resources. Boott’s PSP was filed with FERC on September 28, 2018. In accordance with 18 C.F.R. § 5.11(e), a PSP Meeting was held with stakeholders on October 18 and 19, 2018 in Andover, Massachusetts. The purpose of the PSP Meeting was to clarify the intent and contents of the PSP, explain any initial information gathering needs, and address outstanding issues associated with the proposed studies.

In response to comments from stakeholders, Boott filed a Revised Study Plan (RSP) on January 28, 2019 that included 13 proposed relicensing studies. However, due to the funding lapse at certain federal agencies between December 22, 2018 and January 25, 2019, the Commission extended the comment period on the RSP to February 27, 2019, and the issuance date for the Commission’s SPD to March 14, 2019. FERC issued its Study Plan Determination (SPD) with modifications to the RSP on March 13, 2019. In the

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<sup>5</sup> 16 U.S.C. § 1536(a)(2)

<sup>6</sup> 54 U.S.C. § 306108

SPD, FERC approved eleven studies as proposed in the RSP and approved two studies with modifications:

1. Downstream American Eel Passage Assessment
2. Juvenile Alosine Downstream Passage Assessment
3. Upstream and Downstream Adult Alosine Passage Assessment
4. Fish Passage Survival Study
5. Three-Dimensional Computational Fluid Dynamics (CFD) Modeling
6. Instream Flow Habitat Assessment and Zone of Passage Study in the Bypassed Reach
7. Fish Assemblage Study
8. Recreation and Aesthetics Study
9. Historically Significant Waterpower Equipment Study
10. Resources, Ownership, Boundaries, and Land Rights Study
11. Water Level and Flow Effects on Historic Resources Study
12. Whitewater Boating and Access Study
13. Operation Analysis of the Lowell Canal Study

In accordance with 18 C.F.R. § 5.15, Boott initiated studies as provided in the study plan and schedule approved by the Commission. On February 25, 2020, Boott filed an Initial Study Report (ISR) with the Commission and distributed the ISR to stakeholders. The ISR described the Licensee's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule. In the ISR, Boott did not propose any modifications to ongoing studies approved in the Commission's March 13, 2019 SPD or any new studies.

Boott held an ISR Meeting on March 11, 2020 to discuss the overall progress in implementing the study plan, data collected to date, variances from the SPD, and an overview of results of the studies to date. Pursuant to the ILP, Boott filed an ISR Meeting Summary with the Commission on March 25, 2020. Stakeholders were provided a 30-day period to provide comments on the ISR Meeting Summary, recommend study modifications, or propose new studies.

By letters to the Commission, National Park Service (NPS), American Whitewater (AW), United States Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS) filed timely comments on the ISR and ISR Summary. In response, the Commission issued a Revised Process Plan and Schedule and Determination on Requests for Study Modifications for the Lowell Hydroelectric Project (Revised PPS) on June 12, 2020. The Revised PPS required Boott file a Revised ISR for studies 1, 2, 3, 7, and 8 by September 30, 2020.

In response to the Revised PPS letter from the Commission, on September 30 2020, Boott filed the results of the five individual study reports (studies 1, 2, 3, 7, and 8) that were not included in the February 25, 2020 ISR. Boott held a Revised ISR Meeting to

discuss the results of these studies on October 15, 2020. Pursuant to the ILP, Boott filed a Revised ISR Meeting Summary with the Commission on October 30, 2020.

Stakeholders were provided a 30-day period (ending on November 29, 2020) to provide comments on the Revised ISR Meeting Summary, recommend study modifications, or propose new studies.

By letters to the Commission, the City of Lowell, Massachusetts Division of Fisheries and Wildlife (MADFW), Massachusetts Division of Marine Fisheries (MADMF), NPS, and NMFS filed comments on the Revised ISR and Revised ISR Summary. Boott filed with the Commission a response to these comments on December 29, 2020, and New Hampshire Fish and Game (NHFG) filed a comment letter on January 8, 2021. On February 2, 2021, the Commission issued a Determination on Requests for Study Modifications for the Lowell Hydroelectric Project (DRS).

In accordance with the Revised PPS and DRS letters from the Commission, on February 25, 2021, Boott filed the individual study reports (studies 4, 5, 6, 7, 9, 10, 11, 13) and updated study reports (studies 1, 2, 3, 7 and 8). Boott held a Revised ISR Meeting to discuss the results of these studies on March 11, 2021. Pursuant to the ILP, Boott filed a Revised ISR Meeting Summary with the Commission on March 26, 2021. Stakeholders were provided a 30-day period (ending on April 25, 2021) to provide comments on the Revised ISR Meeting Summary, recommend study modifications, or propose new studies. By letters to the Commission, NMFS, MADFW, NPS, and USFWS provided comments on the February 2021 Revised ISR and Revised ISR Summary.

In accordance with 18 C.F.R. § 5.16(a), Boott filed the Draft License Application (DLA) with the Commission. FERC and stakeholders had 90 days to provide comments on the DLA (i.e., until March 2, 2021). Comments on the DLA were filed by the following: AW, Lowell Plan, Inc., City of Lowell, Massachusetts Department of Conservation and Recreation (MADCR), Lowell Parks & Conservation, Greater Lowell Community Foundation, NPS, USFWS, Massachusetts Senator Edward Kennedy, Lowell Historic Board, Massachusetts Historical Commission, and the University of Massachusetts. Boott has reviewed and considered all comments received, as evidenced through further development of the Licensee's measures proposed in this Final License Application.

## ES.4 Summary of Proposed Action and Enhancement Measures

Based on the studies conducted in support of this relicensing and consultation with stakeholders to date, Boott proposes the following measures to be included in the new Project license:

### **Project Facilities and Operations**

- Boott proposes to operate the Project in a ROR mode using automatic pond level control of the E.L. Field powerhouse units, for the purpose of protection of fish and wildlife resources downstream from the Project. ROR operation may be temporarily modified for short periods to allow flow management for other project and non-project needs, e.g., downtown canal water level management, raising the crest gates following a high-water event, or for recreational purposes.

- During the upstream fish passage season, which generally runs from late April through mid-July, Boott proposes to release a minimum flow of 500 cfs into the bypass reach via the existing fish ladder at the Pawtucket Dam. The operating period for the fish ladder will continue to be determined annually through consultation with the Merrimack River Technical Committee, consistent with current practice. At all other times, Boott proposes to release a minimum flow of 100 cfs or inflow, whichever is less, to the bypass reach downstream of the Pawtucket Dam, for the protection of aquatic habitat within the bypass reach.
- Boott proposes continued adherence to the requirements of the Project's existing Crest Gate Operation Plan (approved by FERC on March 30, 2015).
- Boott proposes to remove the four mill power stations and associated canal infrastructure from the new FERC license. Boott will continue to manage its canal structures and facilities, water levels and flows through the downtown canal system in line with the current agreements with NPS and other stakeholders.
- Boott understands that removal of the fifteen turbine-generator units and canal system from its license will require a decommissioning plan to define the final disposition of the canal system, turbine-generator units, water conveyance structures, and mechanical and electrical components. A decommissioning plan is also necessary to protect the public from any safety, dam safety, or environmental concerns. Boott will develop a decommissioning plan for each of the four downtown power stations and the canal system. In developing the decommissioning plan, Boott will consult with the NPS, MADCR, City of Lowell, and the Massachusetts Historical Commission (MHC). Boott will file a decommissioning plan for the Commission's approval within 18 months of issuance of a new license.

### **Fish Passage**

- Boott proposes to replace the existing fish lift with a short fish ladder to pass migratory fish from the E.L. Field powerhouse tailrace to the bypass reach, such that all fish would be passed upstream of the Project via the existing fish ladder at the Pawtucket Dam. The Licensee will consult with the Merrimack River Technical Committee (MRTC) member agencies<sup>7</sup> to determine the design and installation schedule for the proposed ladder.
- Following installation and operation of the fish ladder at the tailrace, Boott proposes to cease operations of the upstream fish elevator at the tailrace. The timing of cessation of operation of the upstream fish elevator will be determined based on consultation with the MRTC.

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<sup>7</sup> The Merrimack River Technical Committee is comprised of the following state and federal agencies: New Hampshire Department of Fish and Game (NHDFG), Massachusetts Division of Fisheries and Wildlife (MADFW), Massachusetts Division of Marine Fisheries (MADMF), United States Fish and Wildlife Service (USFWS), United States Forest Service (USFS), and National Marine Fisheries Service (NMFS).

- Boott proposes to continue to work with the MRTC to identify any necessary minor modifications to the existing upstream fish ladder located at the Pawtucket Dam, and/or to the existing weirs in the bypass reach to improve passage.
- Boott proposes the installation of new trashracks or other fish exclusion facility at the E.L. Field Powerhouse which will be consistent with current USFWS passage guidelines, to prevent entrainment of fish through the turbines. Downstream passage of fish will continue to be provided via the existing sluice gate in the left forebay wall of the E.L. Field Powerhouse. The Licensee will consult with the MRTC member agencies to determine the design and installation schedule for the proposed fish exclusion system. Boott reserves the right to seasonally deploy the new trashracks or other exclusion facility only during the downstream fish passage season (mid-May – November), and to use the existing trashracks outside of the fish migration season.
- Boott proposes to develop a Fishways Operation and Management Plan in consultation with the MRTC. The proposed plan would effectively replace the Project's existing Comprehensive Fish Passage Plan.

#### **Historic Properties**

- Within one year of license issuance, Boott will develop a Historic Properties Management Plan (HPMP) for the Project that will describe appropriate management measures to avoid, minimize, or mitigate Project-related adverse effects on historic and archaeological resources over the term of the new license issued for the Project. The measures provided in the HPMP will direct the Licensee's management of NRHP-listed or eligible historic properties within the proposed Project boundary. Boott will develop the HPMP in consultation with the NPS, MHC, New Hampshire Division of Historic Resources (NHDHR), and Indian tribes.
- Boott proposes to continue to adhere to existing Article 33, which requires that prior to the commencement of any construction activities inside the Project boundary, Boott will cooperate with the Massachusetts SHPO and the NPS to carry out a mitigation program for avoiding or minimizing adverse effects on the Locks and Canals Historic District and the Lowell National Historical Park.

#### **Recreation**

- Within one year of license issuance, Boott will develop a Recreation Access and Facilities Management Plan in consultation with the stakeholders to: a) evaluate opportunities for increasing pedestrian access to the Northern Canal Walkway under certain conditions; b) define flow management practices needed to enhance recreational opportunity in the project vicinity; and c) continue to manage the Project's recreation facility, the E.L. Field Powerhouse Visitor Center.

#### **License Term**

- In view of the substantial capital investment in new or improved fish passage facilities that Boott is committing to within this license application, Boott requests that the Commission issue the new license for a term of 50 years. This request is consistent with the Commission's 2017 Policy Statement on Establishing License Terms for

Hydroelectric Projects,<sup>8</sup> which recognizes “significant measures expected to be required under the new license” when considering extension of a license term beyond the 40-year default period.

Boott notes that certain studies required by the Commission are ongoing (the Three-Dimensional CFD Modeling Study and the Whitewater Boating and Access Study). Boott will consult with stakeholders regarding the results and recommendations of these studies and potential PM&E measures. As appropriate, Boott may propose additional PM&E measures in a supplement to this license application.

## ES.5 Final License Application Roadmap

This Final License Application is composed of three volumes.

### **VOLUME I OF III**

Volume I contains Public information and exhibits as follows:

- Table of Contents
- Executive Summary
- Initial Statement and Additional Information Required by 18 C.F.R. § 5.18(a)
- Exhibit A – Project Description: Describes the existing and proposed Project facilities.
- Exhibit B – Project Operation and Resource Utilization: Describes the existing and proposed operation of the Project and how the resource is utilized.
- Exhibit C – Construction History and Proposed Construction Schedule: Provides a construction history and schedule for proposed construction activities.
- Exhibit D – Cost and Financing: Provides information on the cost and financing of the Project.
- Exhibit F – Public list of General Design Drawings and Supporting Design Report.
- Exhibit G – Project Maps: Includes maps showing the Project boundary for the Lowell Hydroelectric Project. Electronic Project boundary files required by 18 C.F.R. 4.41(h) are being transmitted to the Commission on compact disk.
- Exhibit H – Description of Project Management and Need for Project Power: Describes the commitment and responsibility of Boott as a Licensee to continue to operate and maintain the Project and the needs and costs for power from the Project or alternate sources.

### **VOLUME II OF III**

Volume II contains Public information and includes Exhibit E, the Environmental Exhibit. Exhibit E is further divided into two parts as follows:

- Exhibit E - Part 1

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<sup>8</sup> PL17-3-000, October 19, 2017

Executive Summary  
Lowell Hydroelectric Project

- Table of Contents
- Introduction
- Cumulative Effects – Geographic and Temporal Scope
- Applicable Laws
- General Description of the River Basin
- Project Facilities and Operations
- Environmental Analysis - Affected Environment and Environmental Effects
- Economic Analysis
- Consistency with Comprehensive Plans
- Literature Cited
- Exhibit E – Part 2
  - Exhibit E Appendices

**VOLUME III OF III (Critical Energy Infrastructure Information (CEII))**

Volume III contains CEII materials associated with Exhibits F and H.

- Exhibit F – General Design Drawings and Supporting Design Report
- Exhibit H – Single-Line Diagram of the Project

## ES.6 References

Cleantech Analytics, LLC. 2017. Certification Application to the Low Impact Hydro Institute, Lowell Hydroelectric Facility. July 26, 2017.

Federal Energy Regulatory Commission (FERC). 2015. Order Approving Amended Crest Gate System Operation Plan. Issued March 30, 2015.

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**BEFORE THE  
UNITED STATES OF AMERICA  
FEDERAL ENERGY REGULATORY COMMISSION**

Application for a New License for a Major Waterpower Project – Existing Dam

**INITIAL STATEMENT**

(1) Boott Hydropower, LLC (Boott or Applicant) applies to the Federal Energy Regulatory Commission (FERC or Commission) for a new license for the Lowell Hydroelectric Project (Lowell Project or Project), FERC No. 2790, as described in the attached Exhibits.

(2) The location of the Project is:

State or Territory:	Massachusetts and New Hampshire
County:	Middlesex County, Massachusetts Hillsborough County, New Hampshire
Township or nearby town:	City of Lowell
Stream or other body of water:	Merrimack River

(3) The exact name, address, and telephone number of the applicant are:

Boott Hydropower, LLC  
670 N Commercial Street, Suite 204  
Manchester, NH 03101  
(978) 935-6039

The exact name, address, and telephone number of each person authorized to act as agent for the applicant in this application are:

Kevin Webb  
Licensing Manager  
670 N Commercial Street, Suite 204  
Manchester, NH 03101  
(978) 935-6039

Curt Mooney  
Manager, Regulatory Compliance  
59 Ayers Island Road  
Bristol, NH 03222  
(603) 744-0846

(4) The Applicant is a domestic corporation and is not claiming preference under Section 7(a) of the Federal Power Act.

(5)(i) The statutory or regulatory requirements of the State of Massachusetts and New Hampshire that affect the Project as proposed, with respect to bed and banks and to the appropriation, diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing, transmitting, and distributing power in any other business necessary to accomplish the purpose of the license under the Federal Power Act are:

*Massachusetts*

- a. Boott is a limited liability company organized under the laws of the Commonwealth of Massachusetts and registered to do business in Massachusetts, and, as such, can engage in the activities set forth in its organizational documents, which includes the generation, transmission, and distribution of electricity from the Project.
- b. Section 401 of the Federal Clean Water Act, 33 United States Code (USC) § 1341 (Section 401) requires that any applicant for a federal license or permit to conduct an activity that will or may discharge into waters of the United States (as defined in the Clean Water Act) must present the federal authority with a Water Quality Certification (WQC). Pursuant to Massachusetts General Law (M.G.L.) Chapter 27(3), the Massachusetts Department of Environmental Protection (MADEP) is the state agency designated to carry out the certification requirements prescribed in Section 401 of the Clean Water Act for waters of the Commonwealth of Massachusetts. The Massachusetts Clean Waters Act (M.G.L. Chapter 21 §§ 26-53) directs the MADEP to take all action necessary or appropriate to secure to the Commonwealth the benefits of the Clean Water Act, 33 USC § 1251 *et seq.* Regulations promulgated thereunder at 314 Code of Massachusetts Regulations (CMR) 9.00, establish procedures and criteria for the administration of Section 401 of the Federal Clean Water Act within the Commonwealth.
- c. Regulations promulgated under the Massachusetts Clean Waters Act, at 314 CMR 2.00 *et seq.* provide permitting procedures for the MADEP's administration of the National Pollutant Discharge Elimination System (NPDES) permit program under delegated authority from the U.S. Environmental Protection Agency (USEPA).
- d. M.G.L. Chapter 91 (Chapter 91) (Waterways Act) and regulations promulgated thereunder at 310 CMR 9.00 *et seq.*, protects the public's interest in and access to waterways of the Commonwealth, and is intended to ensure that public rights to fish,

fowl, and navigate are not unreasonably restricted and that unsafe or hazardous structures are repaired or removed. Chapter 91 requires a license from the MADEP for certain structures in tidelands, Great Ponds, and rivers and streams, as defined in 310 CMR 9.00 *et seq.*

*New Hampshire*

- a. NH Revised Statutes Annotated (RSA) Chapter 481. State Dams, Reservoirs and other Water Conservation Projects. Empowers the Department of Environmental Services to provide careful stewardship over all the waters of New Hampshire and to seek the maximum public benefit from the use of the State's water.
- b. NH RSA Chapter 482. Dams, Mills and Flowage. Empowers the Department of Environmental Services, Water Resources Division, to regulate the maintenance and operation of hydroelectric dams.
- c. NH RSA Chapter 482-A. Fill and Dredge in Wetlands. Empowers the Department of Environmental Services to preserve the state's submerged lands under tidal and fresh waters and its wetlands from despoliation and unregulated alteration.
- d. NH RSA Chapter 483. New Hampshire Rivers Management and Protection Program. Empowers the New Hampshire Department of Environmental Service to complement and reinforce existing state and federal water quality laws, to assure that instream flows are maintained along protected rivers and to restore and maintain the scenic beauty and recreational potential of such rivers while respecting riparian interests.
- e. NH RSA Chapter 483-B. Comprehensive Shoreland Protection Act. Empowers the Department of Environmental Services to establish standards for the subdivision, use and development of shorelands of the state's public waters.
- f. NH RSA Section 498:6. Water Rights. Allows a cause of action for riparian rights in equity regardless of available remedies at law.

(5)(ii) The steps that Applicant has taken, or plans to take, to comply with each of the laws cited above, are:

*Massachusetts*

- a. The Applicant has complied with the requirements of the laws of the Commonwealth of Massachusetts with respect to the right to engage in the business of developing and transmitting power.

- b. The Applicant believes that it has all approvals, licenses, permits, and exemptions that are necessary to continue operating the existing waterpower facility. A request for §401 Water Quality Certification will be submitted to the Massachusetts Department of Environmental Protection. Since this is an application for relicensing of an existing waterpower project and the Applicant does not propose any significant change in operation of the existing waterpower facility, the Applicant expects to continue to operate the facility pursuant to approvals, licenses, permits, and exemptions already in effect. The Applicant proposes to remove the four downtown powerhouses (Assets, Bridge Street, Hamilton, and John Street) and associated canals from the Project's new FERC license, retaining only that portion of the Northern Canal necessary to operate the E.L. Field powerhouse. Further details of Boott's proposal are provided in the following sections of this license application.
- c. Pursuant to the federal Clean Water Act and the Massachusetts Clean Waters Act, the Lowell Project has four NPDES permits issued under the Massachusetts General Permit no. MAG360000. These are: Permit No. MAG360024 for the Eldred L. Field Powerhouse; No. MAG360026 for the Hamilton powerhouse; No. MAG360025 for the John St. powerhouse; and No. MAG360027 for the Section 8 powerhouse.
- d. The Applicant currently holds four Waterways Licenses issued pursuant to M.G.L. Chapter 91 (Chapter 91) (Waterways Act). These include: License No. 1025 which allows Boott to construct and maintain the E.L. Field powerhouse and the fish passageway structures; License No. 1166 which allows Boott to construct and maintain the submarine power transmission line in the bed of the Concord River; and Licenses No. 1949 and 2200 which each allow Boott to construct and maintain three of the water control weirs in the bed of the Merrimack River within the Project bypass reach, for fish passage purposes. The Licensee anticipates that a new Waterways License may be required to construct a new fish ladder from the powerhouse tailrace to the bypassed reach of the Merrimack River, as described in the attached exhibits.

*New Hampshire*

- a-f. The Applicant has complied with the requirements of the laws of the New Hampshire Department of Environmental Services. Boott has and will continue to operate the Project pursuant to the regulations of the New Hampshire Department of

Initial Statement  
Lowell Hydroelectric Project

Environmental Services and is committed to making careful use of the waters of New Hampshire.

- (6) Boott owns and operates the Lowell Project and there are no federal facilities or land associated with the Project. Portions of the historic infrastructure and associated property are owned by the Commonwealth of Massachusetts, and administered by the Massachusetts Department of Conservation and Recreation.

**Additional Information Required by 18 CFR §5.18(a)**

- (1) *Identify every person, citizen, association of citizens, domestic corporation, municipality, or state that has or intends to obtain and will maintain any proprietary right necessary to construct, operate, or maintain the project:*

Boott presently holds, and will continue to hold, the proprietary rights necessary to operate and maintain the Project works.

- (2) *Identify (providing names and mailing addresses):*

- (i) *Every county in which any part of the project and any Federal facilities that would be used by the project would be located:*

County Name:	Middlesex County	Hillsborough County
Address:	375 Merrimack Street Lowell, MA 01852	19 Temple Street Nashua, NH 03060

There are no Federal lands or facilities used by the Project.

- (ii) *Every city, town, or similar local subdivision:*

- (A) *In which any part of the project, and any Federal facilities that would be used by the project, would be located:*

City/Town Name:		Tyngsborough, MA 01879
Address:	City of Lowell 375 Merrimack Street Lowell, MA 01852	City of Nashua 229 Main Street Nashua, NY 03060
	Town of Chelmsford 50 Billerica Road Chelmsford, MA 01824	Town of Litchfield 2 Liberty Way Litchfield, NH 03052
	Town of Hudson, NH 12 School Street Hudson, NH 03051	Town of Merrimack 6 Baboosic Lake Road Merrimack, NH 03054
	Town of Tyngsborough 25 Bryant Lane	

(B) *That has a population of 5,000 or more people and is located within 15 miles of the project dam:*

City/Town/Name:	City of Lowell	Town of Andover
Address:	John Leahy Mayor 375 Merrimack Street Lowell MA, 01852	Andrew P. Flanagan Town Manager 36 Bartlet Street Andover, MA 01810
	Town of Groton Mark Haddad Town Manager 173 Main Street Groton, MA 01450	Town of Atkinson David Cressman Town Administrator 19 Academy Avenue Atkinson, NH 03811
	Town of Ayer Town Manager Robert Pontbriand 1 Main Street Ayer, MA 01432	Town of Bedford Sarah Stanton Town Manager 10 Mudge Way Bedford, MA 01730
	Town of Littleton Anthony Ansaldi Town Administrator 37 Shattuck Street 3rd Floor, Room 306 Littleton, MA 01460	Town of Billerica John Curran Town Manager 365 Boston Road Billerica, MA 01821
	Town of Harvard Timothy P. Bragan Town Administrator 13 Ayer Road Harvard, MA 01451	Town of Boxford Alan J. Benson Town Administrator 7A Spofford Road Boxford, MA 01921
	Town of Acton John S. Mangiaratti Town Manager 472 Main Street Acton, MA 01720	Town of Burlington Paul F. Sagarino, Jr. Town Administrator 29 Center Street Burlington, MA 01803

Town of Chelmsford  
Paul E. Cohen  
Town Manager  
50 Billerica Road  
Chelmsford, MA 01824

Town of Concord  
Stephen Crane  
Town Manager  
P.O. Box 535  
Concord, MA 01742

Town of Derry  
David Caron  
Town Administrator  
14 Manning Street  
Derry, NH 03038

Town of Dracut  
Ann M. Vandal  
Town Manager  
62 Arlington Street  
Dracut, MA 01826

City of Haverhill  
James J. Fiorentini  
Mayor  
4 Summer Street  
Haverhill, MA 01830

Town of Hollis  
Lori Radke  
Town Administrator  
7 Monument Square  
Hollis, NH 03049

Town of Hudson  
Steve Malizia  
Administrator  
12 School Street  
Hudson, NH 03051

City of Lawrence  
Kendrys Vasquez  
Mayor  
200 Common Street  
3rd Floor Room 309  
Lawrence, MA 01840

Town of Lexington  
James J. Malloy  
Town Manager  
1625 Massachusetts Avenue  
2nd Floor, Town Office  
Building  
Lexington, MA 02420

Town of Lincoln  
Timothy S. Higgins  
Town Administrator  
16 Lincoln Road  
Lincoln, MA 01773

Town of Litchfield  
Troy Brown  
Town Administrator  
2 Liberty Way Suite 2  
Litchfield, NH 03052

Town of Londonderry  
Kevin H. Smith  
Town Manager  
268B Mammoth Road  
Londonderry, NH 03053

Town of Lynnfield  
Robert Dolan  
Town Administrator  
55 Summer Street  
Lynnfield, MA 01940

Town of Merrimack  
Eileen Cabanel  
Town Manager  
6 Baboosic Lake Road  
Merrimack, NH 03054

City of Methuen  
Neil Perry  
Mayor  
41 Pleasant Street  
Methuen, MA 01844

Town of Middleton  
Andrew Sheehan  
Town Administrator  
48 South Main Street  
Middleton, MA 01949

City of Nashua  
Jim W. Donchess  
Mayor  
229 Main Street  
Nashua, NH 03060

Town of North Andover  
Melissa Rodrigues  
Town Manager  
120 Main Street  
North Andover, MA 01845

Town of North Reading  
Michael P. Gilleberto  
Town Administrator  
235 North Street  
North Reading, MA 01864

Town of Pelham  
Brian McCarthy  
Town Administrator  
6 Village Green  
Pelham, NH 03076

Town of Pepperell  
Andrew MacLean  
Town Administrator  
One Main Street  
Pepperell, MA 01463



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Town of Reading  
Robert W. LeLacheur, Jr.  
Town Manager  
16 Lowell Street  
Reading, MA 01867

Town of Tewksbury  
Richard Montuori  
Town Manager  
1009 Main Street  
2nd Floor  
Tewksbury, MA 01876

Town of Wilmington  
Jeffrey M. Hull  
Town Manager  
121 Glen Road  
Room 11  
Wilmington, MA 01887

Town of Salem  
Christopher A. Dillon  
Town Manager  
33 Geremonty Drive  
Salem, NH 03079

Town of Tyngsborough  
Matt Hanson  
Town Administrator  
25 Bryant Lane  
Tyngsborough, MA 01879

Town of Windham  
David Sullivan  
Town Administrator  
4 North Lowell Street  
Windham, NH 03087

Town of Shirley  
Michael McGovern  
Town Administrator  
7 Keady Way  
Shirley, MA 01464

Town of Westford  
Jodi Ross  
Town Manager  
55 Main Street  
Westford, MA 01886

City of Woburn  
Scott Galvin  
Mayor  
10 Common Street  
Woburn, MA 01801

Town of Stoneham  
Dennis Sheehan  
35 Central Street  
2nd Floor  
Stoneham, MA 02180

(iii) *Every irrigation district, drainage district, or similar special purpose political subdivision:*

(A) *In which any part of the project, and any Federal facilities that would be used by the project, would be located:*

The Project is not located in any irrigation district, drainage district, or similar special purpose political subdivision and does not utilize any federal facilities.

(B) *That owns, operates, maintains, or uses any project facilities or any Federal facilities that would be used by the project:*

There are no irrigation districts, drainage districts, or similar special purpose political subdivisions that own, operate, maintain, or use any Project facilities. The Project does not use any federal facilities.

(iv) *Every other political subdivision in the general area of the project that there is reason to believe would likely be interested in, or affected by, the application:*

There are no political subdivisions in the general area of the Project that there is reason to believe would likely be interested in, or affected by, the application.

- (v) *All Indian tribes that may be affected by the project:*

Indian Tribes listed in the 2018 Notice of Intent and receiving copies of this application include the following Indian tribes:

Mashpee Wampanoag Tribe  
483 Great Neck Road South  
Mashpee, MA 02649

Narragansett Indian Tribe  
PO Box 268  
Charlestown, RI 02813

Wampanoag Tribe of Gay Head  
(Aquinnah)  
20 Black Brook Road  
Aquinnah, MA 02535

Stockbridge Munsee Tribe of Mohican  
Indians  
N8467 Moh He Con Nuck Road  
Bowler, WI 54416

Penobscot Nation  
23 Wabanaki Way  
Indian Island, Maine 04468

- (3) *For a license (other than a license under section 15 of the Federal Power Act) state that the applicant has made, either at the time of or before filing the application, a good faith effort to give notification by certified mail of the filing of the application.*

This section is not relevant because Boott is applying for a new license under section 15 of the Federal Power Act.

# VERIFICATION

This application is executed in the:

STATE OF: New Hampshire

COUNTY OF: Hillsborough

By: Matthew E. Stanley  
Vice President and General Manager  
Boott Hydropower, LLC  
Central Rivers Power US, LLC  
670 N Commercial Street, Suite 204  
Manchester, NH 03101

The undersigned being duly sworn, deposes and says that the contents of this application are true to the best of his knowledge or belief. The undersigned Applicant has signed this Application this 29 day of April 2021.

By:

  
\_\_\_\_\_

[name]

Subscribed and sworn to before me, a Notary Public of the State of New Hampshire, this 29 day of April 2021.

  
\_\_\_\_\_

Notary Public



My Commission expires: 4/8/2025

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## Exhibit A Project Description (18 C.F.R. §4.51(b))

### A.1 Project Location and Facilities

The Lowell Hydroelectric Project (Project) is located at the Pawtucket Dam on the Merrimack River in the City of Lowell in Middlesex County, Massachusetts. The Project is located approximately 11 miles upstream of the Lawrence Project (FERC No. 2800) and approximately 30 miles downstream of the Amoskeag Dam (a development of the Merrimack River Project, FERC No. 1893) in New Hampshire. This proposed impoundment extends approximately 16 miles upstream to the limit of the 92.2 feet National Geodetic Vertical Datum (NGVD) 29 contour located in Litchfield, New Hampshire. The 116-mile-long Merrimack River begins at the confluence of the Winnepesaukee and Pemigewasset Rivers in Franklin, New Hampshire; flows southward into Massachusetts; and then travels northeast until it discharges into the Atlantic Ocean. The Project includes a single powerhouse, the 15.0-megawatt (MW) Eldred L. Field (E.L. Field) powerhouse constructed in 1985-1986 during Project redevelopment. The total installed capacity of the project is 15,012 kW. A Project location map is presented as Figure A.1-1.

The E.L. Field powerhouse utilizes the existing Pawtucket Dam and the first 2,200 feet of the Northern Canal. The powerhouse is located close to the canal, downstream of the University Avenue Bridge (also called the Moody Street Bridge), with an intake structure drawing water from the Northern Canal. A 440-foot tailrace channel, surge gate and fish passage facilities comprise other major E.L. Field powerhouse features.

The Project also includes the Guard Lock and Gates Facility (“Guard Locks”) and the approximately 1,600-foot-long portion of the Pawtucket Canal leading from the Project impoundment to the Guard Locks.

The Project as described herein, consisting of the 15.0 MW E.L. Field powerhouse and associated structures, is intended to fully develop, conserve, and utilize the water resource of the Merrimack River at the Pawtucket Dam.

Figure A.1-1. Lowell Hydroelectric Project Location Map

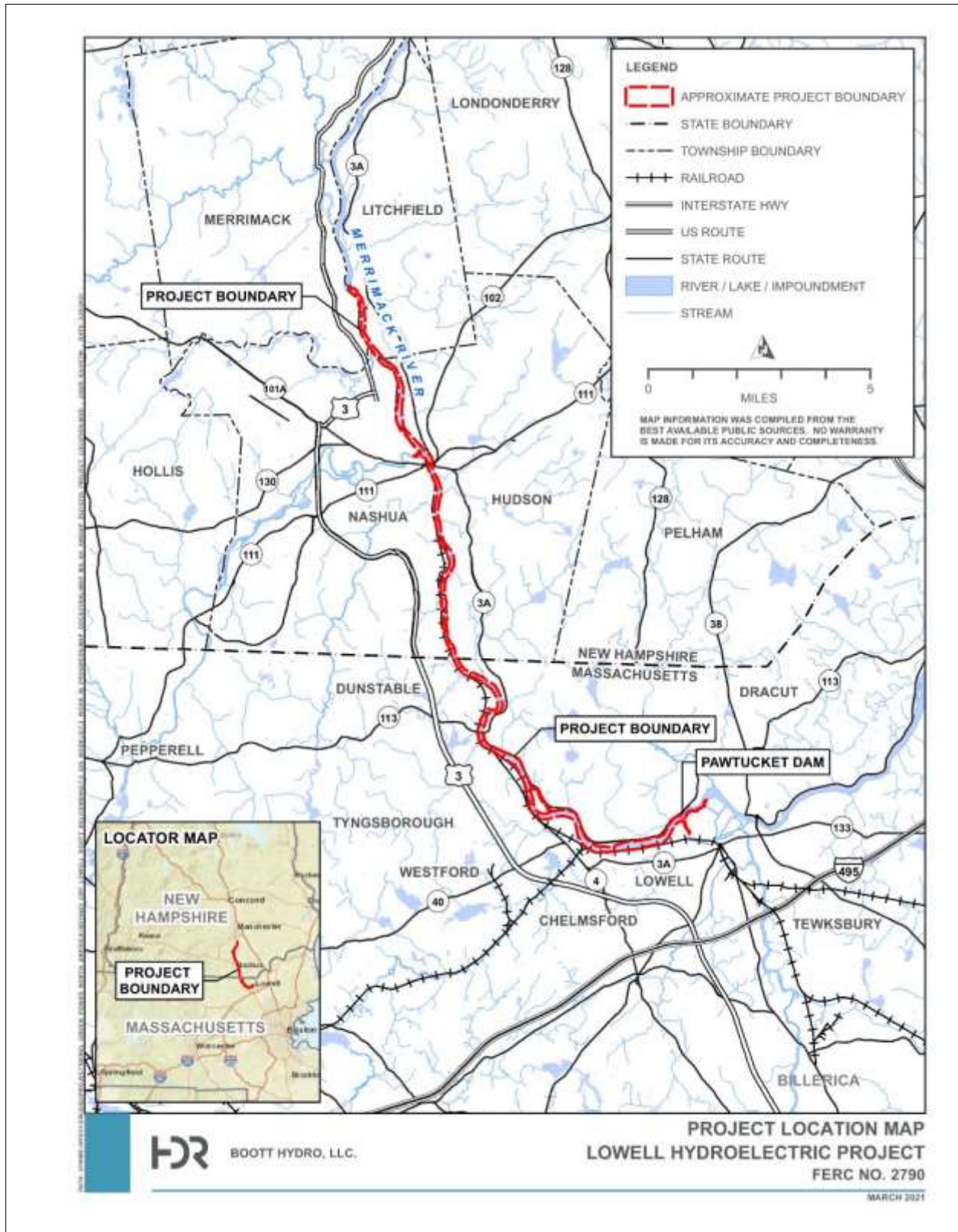
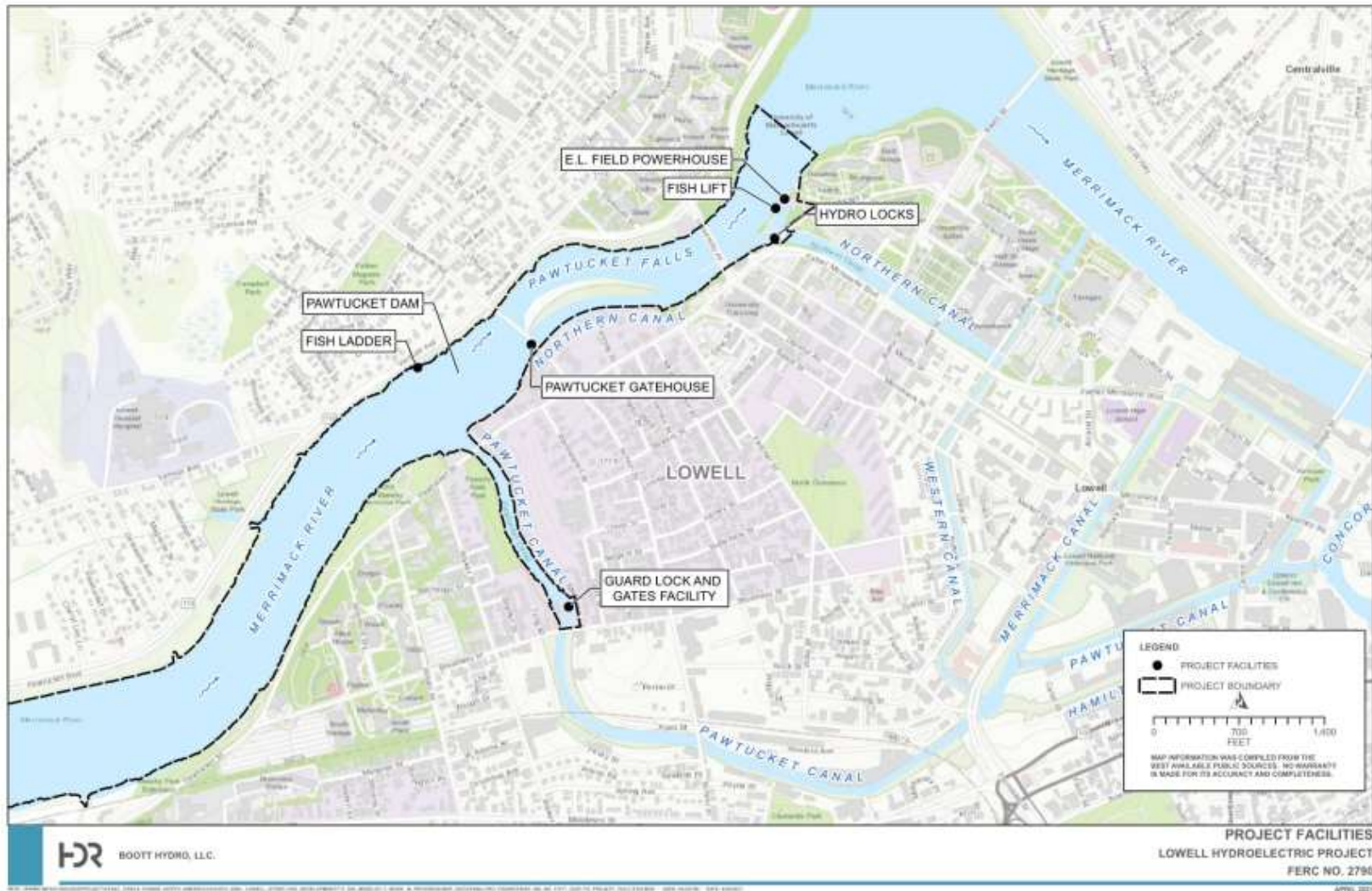


Figure A.1-2. Lowell Hydroelectric Project Facilities



## A.2 Physical Composition, Dimensions, and General Configuration (18 C.F.R. §4.51 (b)(1))

The site of the Lowell Project was historically used for hydromechanical and hydroelectric power for various mill operations. Much of the Project's civil works were constructed during the 19th and early 20th centuries, and existed prior to Project licensing and redevelopment in the 1980's. These structures are described below.

### A.2.1 The Pawtucket Dam

The Pawtucket Dam is of dressed masonry gravity construction with a length of 1,093 feet, a spillway crest length of 982.5 feet, a spillway crest elevation of 87.2 feet NGVD 29, and an average height of 15 feet. Original drawings show the masonry was ashlar, laid dry with a mortared masonry upstream face at a 1:1 slope, a two-foot-thick capstone, and the bed course laid in mortar. It was built in two sections in 1847 and 1875, the latter being grouted during construction. The dam foundation rests on bedrock, except for a short section on hardpan. A fishway is located at the left dam abutment, and the Pawtucket Gatehouse to the Northern Canal is at the right abutment.

A pneumatically operated crest gate system is mounted on the spillway crest to maintain the headpond at its normal level of 92.2 feet NGVD 29. The pneumatic crest gate system consists of 20 ft long hinged steel panels supported on their downstream side by tubular rubber air bladders. The crest gate system is installed in five independently controllable zones. Air compressors, which supply system inflation and deflation pressure, and the crest gate control system are housed in a building located near the fish ladder and the left (northerly) abutment of the dam.

### A.2.2 The Northern Canal

The portion of the Northern Canal contained within the project boundary is about 2,200 feet in length, with masonry or bedrock lining its complete length. The width of the Northern Canal varies along its length. At the head of the canal it is approximately 95-feet-wide, at the location of the University Bridge overpass it is its most narrow at approximately 78-feet-wide. The canal widens to approximately 80 feet as it discharges into the E.L. Field Powerhouse forebay. The Great River Wall is the left retaining wall of the Northern Canal. It runs from the Pawtucket Gatehouse to a natural rock outcrop upstream of the E.L. Field Powerhouse. The wall is a masonry structure that is 2,485 feet long and 32 feet in height. The first 1,000 feet combines masonry walls and an earth dike (with masonry core) as the river wall. The second length is a dressed masonry gravity structure to the site of the E.L. Field powerhouse. The crest of the Great River Wall is approximately 103.0 feet NGVD 29 adjacent to the Pawtucket Gatehouse and varies in elevation along its length. The lowest point of the wall is approximately 93.3 feet NGVD at the University Bridge overpass. The width of the wall varies from 8 feet upstream at the Pawtucket Gatehouse to 10 feet at the downstream end.



### A.2.3 Pawtucket Gatehouse

The Pawtucket Gatehouse (also known as the “Northern Canal Gatehouse”) is located at the southern abutment of the Pawtucket Dam and controls flow into the Northern Canal. It is principally constructed of dressed masonry with concrete over lintels and contains ten 8-foot-wide by 15-foot-high, motor-operated, timber sliding gates which feed the Northern Canal. Another small intake opening feeds a historic Francis-designed turbine, which formerly powered the gate mechanisms through a line shaft. The structure's water passages are nearly 80 feet in length. A small navigation lock is located on the located at the southerly end of the Pawtucket Gatehouse (Boott 2017).

### A.2.4 Eldred L. Field Powerhouse

The E.L. Field powerhouse is a reinforced concrete structure. The powerhouse is approximately 109-feet-long by 96-feet-wide and houses two generating units with a total authorized generation of 15.0 megawatts (MW). The powerhouse incorporates a separate conventional intake structure for each of the station's two identical units. Each intake is equipped with trashracks; intake and draft tube gate slots with permanent or bulkhead style gates for emergency shutdown and dewatering purposes are also provided. The powerhouse is equipped with a traversing trash rake to remove debris at the intake. Both mobile and on-site cranes are used for heavy equipment movement at the facility.

### A.2.5 Tailrace Channel

A 440-foot-long tailrace channel was excavated out of bedrock in the river. The channel excavation is approximately 60 feet wide by an average of 20 feet deep. The tailrace is protected from high river flows by a 10- to 16-foot-high concrete training wall, which directs bypassed river flows away from the tailrace.

### A.2.6 Control Structures

A concrete control structure known as “Hydro Locks” was constructed during project redevelopment in the 1980s, at the bend in the Northern Canal upstream of the E.L. Field intake and immediately underneath the Pawtucket Street Bridge. The control structure includes a navigation lock and was constructed to maintain the effective net head at the E.L. Field Powerhouse by isolating the powerhouse forebay from the remainder of the Lowell canal system.

Located just downstream of the Great River Wall is the canal surge gate, constructed in the bedrock in the left forebay wall just upstream of the E.L. Field Powerhouse. The steel gate is pneumatically operated and is 15-feet-high by 78-feet-wide set on a masonry weir with a crest elevation of 77.0 feet. This system is designed to attenuate the surge wave in the canal that occurs when there is a sudden plant shutdown. When flow is less than 3,500 cubic feet per second (cfs), the surge suppressor gate is manually disabled. Should the flow increase to over 3,500 cfs, the gate is returned to the automatic operating condition. A safety boom has been installed in the canal above the gate.

## A.2.7 Fish Passage and Protection Facilities

Upstream and downstream fish passage facilities at the Project include a fish elevator and downstream fish bypass at the E.L. Field powerhouse, and a vertical-slot fish ladder at the Pawtucket Dam. All fish passage facilities were designed in consultation with the U.S. Fish and Wildlife Service. Passage operations are supervised by the state and federal fishery agencies.

The reinforced concrete fish ladder at the Pawtucket Dam is designed to allow for controlled fish passage at river flows up to 25,000 cfs. The fishway operates at 200 cfs, including attraction flow, with an additional 300 cfs of supplemental attraction flow released from a slide gate adjacent to the passage facility. The fish ladder is a vertical slot design with 13-foot-wide by 10-foot-long pools. A counting station and fish trap area is provided. The Pawtucket Dam has been modified by removing ashlar masonry to allow the exit channel to penetrate the dam. Boott is proposing certain minor modifications and adjustments to the fish ladder based on consultation with relevant agencies.

The upstream fishway at the powerhouse is a fish elevator. The design discharge capacity is 200 cfs. A fish collection gallery with two openings spans the downstream wall of the powerhouse to collect fish migrating through the tailrace channel, however only the westerly "river side" entrance has been used since the 1990's, by agreement with the fishery agencies. The fish are attracted into the 30-foot crowding pool, trapped, and crowded. From the crowding pool, they enter the elevator and are lifted in a hopper to the exit channel. From the elevator area, the fish enter a holding pool 10 feet wide by 50 feet long. Fish next enter the fish trap area where they can be counted. A 10-foot by 12-foot fish counting station is provided. Passage of fish through the trap area allows fish to enter the exit channel, passing into the Northern Canal and then upriver.

Based on consultation with relicensing parties, Boott proposes to design and install an upstream fish passage structure in place of the current fish lift at the E. L. Field Powerhouse. The design of the new upstream passage facility has not been finalized, but based agency consultation to date, it is anticipated to consist of a fish ladder extending from the Project tailrace into the bypassed reach. It will be operated on a seasonal basis. The design and installation schedule of the upstream fish passage structure will be determined in consultation with the fishery agencies.

Following installation and operation of the proposed fish ladder at the tailrace, Boott proposes to cease operation of the fish elevator and associated operations described above. Cessation of the fish elevator operations will be determined based on consultation with relevant agencies.

The downstream fishway at the powerhouse consists of an adjustable-flow sluiceway and bypass adjacent to the intake headwall. Downstream migrants entering the bypass are quickly sluiced into an enlarged and deepened plunge pool located in the bypassed river reach next to the powerhouse. Natural channel braids in the riverbed allow emigrants to move downstream to the mainstem river, at the confluence of the river reach and tailrace.

Boott proposes to install new trashracks or other fish exclusion facility at the E.L. Field Powerhouse which will be consistent with current USFWS passage guidelines, to prevent entrainment of fish through the turbines. Downstream passage of fish will continue to be provided via the existing sluice gate in the left forebay wall of the E.L. Field Powerhouse. The

Licensee will consult with the Merrimack River Technical Committee member agencies to determine the design and installation schedule for the proposed fish exclusion system. Boott reserves the right to seasonally deploy the new trashracks or other exclusion facility only during the downstream fish passage season (mid-May – November), and to use the existing trashracks outside of the fish migration season.

## A.2.8 The Pawtucket Canal

The Pawtucket Canal branches off the Merrimack River about 950 feet upstream of the Pawtucket Gatehouse and feeds water into the downtown canal system. From its starting point, the 9,000-foot canal curves south and then east to meet the Concord River near its junction with the Merrimack River. Only the first 1,600-foot-long section of the Pawtucket Canal between the impoundment and the Guard Lock and Gates Facility is contained within the project boundary. Within this section, the Pawtucket Canal is an excavated channel through soil and ledge and varies from 80 to 100 feet in width.

## A.2.9 Guard Lock and Gates Facility

The historic Guard Lock and Gates facility consists of a five-bay gate house located on the left descending side the Pawtucket Canal and a series of three gate structures located within a boat lock on the right descending side of the canal. The substructure of the gate house on the Pawtucket Canal is of dressed masonry, and the superstructure is of brick masonry and wood frame. Adjacent to this structure is a boat lock consisting of the upper locking gate, Great Guard Gate or Francis Gate, and lower locking gate. The boat lock chamber is 24 feet wide with masonry walls. The upper locking gate and Great Guard Gate are housed in frame buildings.

The Great Guard Gate is a large portcullis gate located within the lock chamber between the upstream and downstream lock gates. This 25-foot-wide by 25-foot-high wooden gate is designed to be lowered into the lock chamber during extreme flood conditions on the Merrimack River, to prevent flooding of downtown Lowell via the Pawtucket Canal. A wood frame structure, the Francis Gatehouse, houses the Great Gate. When needed, the Great Gate can be dropped under its own weight to the bottom of the lock chamber, thereby closing off any flow through the boat lock channel at the Guard Locks, preventing flooding in downtown Lowell via the Pawtucket Canal. The original Great Gate has been used only twice during its history, the year following its construction in 1852 and again in 1936.

Due to the historic nature, public safety concerns and questionable functionality of the historic Great Guard Gate, in 2005 Boott designed and implemented a replacement gate in consultation with the FERC and National Park Service. The replacement gate is a segmented structural steel stoplog gate and frame which is stored on-site. The steel stoplog gate was designed and implemented to functionally replace the historic Great Guard Gate, which remains in place within the Francis Gate House. The steel stoplog gate fits immediately upstream of the Francis Gate House within existing stoplog slots in the granite masonry. When required, installation of the steel stoplog gate can be accomplished within a few hours by a local crane operator. The Project's Emergency Action Plan (EAP) provides that the stoplogs should be installed when the water level at the Pawtucket Dam rises above 98.0 ft NGVD 29. To date, the steel stoplogs have been installed twice, during flooding events in May 2006 and April 2007.

### **A.3 Impoundment Characteristics (18 C.F.R. §4.51 (b)(2))**

The Project operates in a run of river mode and has no usable storage capacity. In this license application, Boott is proposing to modify the impoundment to follow more accurately the 92.2 feet NGVD 29 contour. This proposed impoundment extends approximately 16 miles upstream to the limit of the 92.2 feet NGVD 29 contour located at Cromwell's Falls in Litchfield and Merrimack, New Hampshire, and is shown in Figure A.1-1. The surface area of the proposed Project impoundment is reported to encompass about 1,236 acres. The gross storage capacity between the normal surface elevation of 92.2 feet NGVD 29 and the minimum pond level of 87.2 feet NGVD 29 is approximately 6,180 acre-feet. See Exhibit G.

### **A.4 Generating Equipment (18 C.F.R. §4.51 (b)(3))**

Turbine and generator data for the E.L. Powerhouse are provided below in Table A.4-1 and Table A.4-2.

**Table A.4-1. Lowell Hydroelectric Project Turbine and Unit Capacity Data**

TURBINES									
Powerhouse	Unit #	Type	Diameter Inches	Speed RPM	Head Feet	Flow cfs	Power HP	Power kW	Unit Capacity
E. L. Field	1	Fuji Horizontal Full Kaplan	152.4	120	39	3,300	11,540	8,655	7,506
E. L. Field	2	Fuji Horizontal Full Kaplan	152.4	120	39	3,300	11,540	8,655	7,506

**Table A.4-2. Lowell Hydroelectric Project Generator Data**

GENERATORS					
Type	kVA	Power Factor	Power kW	Voltage Volts	Speed RPM
Fuji Electric	8,340	0.9	7,506	4,160	120
Fuji Electric	8,340	0.9	7,506	4,160	120

## A.5 Transmission Facilities (18 C.F.R. §4.51 (b)(4))

Generator leads connect the turbine-generating units at the E.L. Field Powerhouse to a transformer adjacent to the powerhouse. From the E.L. Field Powerhouse substation, a 13.8-kilovolt (kV) submarine cable in the canal beds carries electricity generated at the Project approximately 1.3 miles through the canal system in the City of Lowell and an additional 0.5 miles along the Concord River to National Grid’s Perry Street substation. From the Perry Street substation Project output is delivered to the regional utility grid at 115 kV. See Exhibit G.

## A.6 Ancillary Equipment (18 C.F.R. §4.51 (b)(5))

### A.6.1 Electrical and Transmission

The design of the electrical equipment and station protection equipment provides completely automatic E.L. Field station operation with load control on a float to measure water level at the dam.

This equipment controls the two synchronous generators connected via 4.16-kV circuit breakers to a common bus. One station transformer is connected directly to this bus and delivers power to the system. Protective relaying comprises one overall differential

relaying scheme (with harmonic and percent bias) enclosing within its protected zone the generators, 4.16-kV switchgear, and the transformer.

With the exception of the station transformer and the line circuit breaker, all electrical equipment is housed inside the powerhouse structure. The transformer is located within a fenced enclosure adjacent to the powerhouse. The station transformer has the normal protective devices, such as lightning surge, gas and winding temperature detectors.

Power for station metering is derived from 4.16-kV potential transformers connected to the station bus and current transformers installed in the low-voltage connections to the main transformer.

## A.6.2 Mechanical

On-site cranes and hoists can be used to operate the E. L. Field powerhouse head gate and draft tube gates for dewatering. Smaller hoists can be utilized for most other site needs. When required, mobile cranes sited in the facility driveway can be used to reach and operate within most locations of the powerhouse.

A shop and garage located next to the E. L. Field powerhouse provides the station with on-site equipment storage and maintenance capabilities.

## A.7 United States Lands within Project Boundary ((18 C.F.R. §4.51 (b)(6))

No lands of the United States are enclosed within the Project boundary. However, portions of the Project do fall within the boundaries of the Lowell National Historical Park. Certain historical structures are owned by the Commonwealth of Massachusetts, administered by Massachusetts Department of Conservation and Recreation.

## A.8 References

Boott Hydropower, LLC (Boott). 2017. Application for Amendment of License. Andover, MA. Filed with the Federal Energy Regulatory Commission.

## Exhibit B Project Operation and Resource Utilization

### B.1 Description of Plant Operations (18 C.F.R. §4.51(c)(1))

#### B.1.1 General Project Description and Overview

##### B.1.1.1 Drainage Basin Description

The Lowell Hydroelectric Project is located on the Merrimack River in Lowell, Massachusetts. The Merrimack River watershed has a total drainage area of approximately 5,010 square miles within the states of New Hampshire and Massachusetts (MEOEEA 2002). The drainage area of the Lowell Project is approximately 3,979 square miles.

There is a total of five<sup>9</sup> hydroelectric developments on the Merrimack River, comprising three separate Projects licensed by the Federal Energy Regulatory Commission (FERC or Commission). In New Hampshire, there are four U.S. Army Corps of Engineers (USACE) flood storage dams within the Merrimack River basin. Table B.1-1 presents information on the five hydroelectric developments on the Merrimack River. All the hydroelectric facilities on the Merrimack River operate in ROR mode.

**Table B.1-1. FERC-regulated Developments on the Merrimack River**

Facility	FERC Project #	Licensee	River Mile	Generation Capacity (MW)
Garvins Falls (Merrimack River Project)	1893	CRP NH Amoskeag, LLC	87	12.3
Hooksett (Merrimack River Project)	1893	CRP NH Amoskeag, LLC	81	1.6
Amoskeag (Merrimack River Project)	1893	CRP NH Amoskeag, LLC	73	16
Lowell	2790	Boott	40	15
Lawrence	2800	Essex Company, LLC	29	16.8

The existing license for the Lowell Project was issued by the FERC on April 13, 1983. In accordance with the existing license, the Lowell Project operates in a ROR mode using automatic pond level control of the E.L. Field generating units, with no useable storage

<sup>9</sup> The five hydroelectric developments on the Merrimack River do not include the four downtown mill power stations Boott is proposing to remove from the FERC license.

capacity, thereby meeting or exceeding the project minimum flow requirement of 1,990 cubic feet per second (cfs).

## B.1.2 Current License Requirements and Compliance History

The articles of the 1983 license (as modified by the 2013 Commission order amending the license) represent the applicable license terms under which Boott now operates the Project. A summary of the most applicable of these articles related to Project operations and environmental measures is provided below.

**Article 34 (approved September 24, 1984):** Requires the Licensee to design and construct upstream and downstream fish passage facilities at the Project, in consultation with the fishery agencies. Accordingly, in the late 1980s the Licensee constructed a fish lift and downstream fish passage facility at the E.L. Field powerhouse and a fish ladder at the Pawtucket Dam. These facilities are operated and managed under a Comprehensive Fish Passage Plan (CFPP) discussed below in Section B.1.2.1.

**Article 35 (approved November 28, 2000):** Requires the Licensee to conduct an operational study to determine the effectiveness of the fish passage facilities required under Article 34, in consultation with the fishery agencies. During the term of the license The Licensee has conducted numerous fish passage studies and has implemented operational and facility improvements based on the results of those studies. These studies and improvements have been carried out pursuant to the CFPP as discussed below in Section B.1.2.1.

**Article 36 (approved November 27, 1984; November 28, 2000; July 11, 2001):** Requires the Licensee to develop (1) an instream flow study plan to determine the relationship between Project discharges and downstream aquatic habitat, and (2) a fishery study plan to determine Project discharges necessary to provide for the migration of anadromous fish.

**Article 37 (ordered November 27, 1984):** Requires the Licensee to discharge an interim continuous minimum flow of 1,990 cfs or inflow, whichever is less, for the purpose of protection of fish and wildlife resources, as measured immediately downstream from the Project.

**Article 38 (ordered September 12, 1984):** Requires the Licensee to file a revised Report on Recreational Resources to include (1) functional plans for certain repairs and improvements to the Northern Canal and a visitor facility at the Eldred. L. Field (E.L. Field) Powerhouse, and (2) a canal system water level agreement with the National Park Service (NPS).

Boott is also required to adhere to the following operations-related plan:

**Crest Gate Operation Plan (approved March 30, 2015):** Requires the Licensee to adhere to the detailed plan for operation of the pneumatic crest gate system filed on July 16, 2013 and revised on July 30, 2014. The details of this plan are discussed further in Section B.1.2.1.



### B.1.2.1 Operations Compliance History

Boott has continued to operate the Project in compliance with the Project license except for one violation relating to the operation of the Project's only FERC-approved recreational facility (E. L. Field Powerhouse Visitor Center). FERC issued a letter on December 2, 1994, stating a violation of Article 38 had occurred. In accordance with the license, the Project visitor center was to open to the public by May 30, 1993; however, the opening was delayed by design changes to the powerhouse and development of display signage. The visitor center was opened to the public on July 21, 1994. FERC did not issue any penalties related to this violation.

Following record flooding events on the Merrimack River in May 2006 and April 2007, FERC initiated an investigation of the performance of the Project's wooden flashboards during these events. The investigation was initiated in response to complaints from residents in low-lying areas upstream of the Pawtucket Dam. While it did not designate the issue as a violation or non-compliance, FERC staff concluded that the flashboards had not performed as designed, and on May 28, 2008, ordered the Licensee to remove the flashboards, and to submit a new design for the flashboards that would fail as originally designed. FERC approved Boott's updated flashboard design on June 4, 2008, and the flashboards were fully reinstalled per the approved design on June 20, 2008. On September 25, 2008, FERC issued a letter ordering Boott to work with the NPS and other stakeholders to determine options for a flashboard system that "can be ensured to be completely down during high flows in the Merrimack River." Accordingly, Boott held several meetings with the stakeholders and on March 26, 2010, submitted a letter to FERC indicating that a pneumatic crest gate system had been selected as the best option. On July 6, 2010, Boott submitted an application to amend the Project license to replace the existing five-foot wooden flashboards with a pneumatic crest gate system of equal height. FERC issued an amendment order authorizing the crest gate system on April 18, 2013.

### B.1.3 Project Operation

The Project is operated in a ROR mode using the automatic pond level control capability of the E.L. Field Powerhouse. Boott is proposing to continue to operate the Project in the same manner as it is currently operated.

Boott also proposes to release a minimum flow of 100 cfs or inflow, whichever is less, to the bypass reach downstream of the Pawtucket Dam during the period outside of the fish passage season. The minimum flow would be provided as spillage over one or more of the crest gate zones. During the fish passage season, which generally runs from late April through mid-July, the Licensee proposes to release a minimum flow of 500 cfs into the bypass reach via the existing fish ladder at the Pawtucket Dam. The operating period for the fish ladder will continue to be determined annually through consultation with the fishery agencies, consistent with current practice.

### B.1.3.1 General Operations

In accordance with the existing license, the Lowell Project operates in a ROR mode using automatic pond level control of the E.L. Field generating units, with no useable storage capacity, thereby meeting or exceeding the project minimum flow requirement of 1,990 cubic feet per second (cfs) (Boott 2017).

### B.1.3.2 Pneumatic Crest Gate Operations

On April 18, 2013, FERC authorized Boott to replace the existing wooden flashboard system on the Project’s Pawtucket Dam with a pneumatic crest gate system. FERC approved the amended crest gate system operation plan on March 30, 2015, as discussed in Section B.1.2.1. The plan describes the operation of the pneumatic crest gate system under normal and high-water operations.

The pneumatic crest gate system works in conjunction with the automatic pond level control system at the E.L. Field Powerhouse to maintain consistent headpond level conditions.

Below (Table B.1-2) is a tabular description of the operating curve used for existing crest gate operations.

**Table B.1-2. Pneumatic Crest Gate System Operational Scheme**

Approximate Spillway Flow (cfs) †	Crest Gate Status	Target Pond Level (ft NGVD 1929)	Unit Operation
0	Full elevation	92.2 ft (Normal pond)	Pond level control maintained at E.L. Field Powerhouse; additional flow passed through downtown canal system as necessary.
0 – 3,250	Full elevation	Rising to ± 93.2 ft	Full available output
3,250 - ± 23,000 (est.)	Automatic pond level control	± 93.2 ft	Full available output
± 23,000 (est.) – 35,000 <sup>††</sup>	Automatic pond level control if High Water Operations Protocol is not triggered.	± 93.2 ft	Full available output
	Fully lowered if High Water Operations Protocol is triggered	Pond level follows spillway rating curve based on spillway flow.	Full available output
>35,000	Fully lowered	Rises above 93.2 ft as spillway discharge increases.	Full available output

Source: FERC 2015.

† Flow over the spillway is the inflow to the headpond minus any flow through the turbines at the E.L. Field Powerhouse, through the downtown canal system or through the fish ladder. The maximum combined hydraulic

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capacity of E.L. Field Powerhouse is approximately 6,600 cfs, but may be restricted by unit availability, debris accumulation at the Northern Canal Gatehouse, high tailwater conditions, and other factors.

†† The potential range of spillway flows over which the crest gate may be fully lowered per the High-Water Operations Protocol. The estimated flow over the spillway is the flow at the Merrimack River (U.S. Geological Survey [USGS] gage No. 01100000) minus the flow at the Concord River (USGS gage No. 01099500) and minus any flow released through Boott's turbines.

### B.1.3.2.1 Normal Operation

Under normal operations, the crest gate is maintained at full elevation, and the E.L. Field Powerhouse control system adjusts the main units' output to match inflow and maintain the impoundment water level at the normal, authorized pond elevation of 92.2 feet National Geodetic Vertical Datum (NGVD) 29.

### B.1.3.3 Operations During Low Water and Adverse Conditions

During low inflow conditions, Boott operates the Project to maintain the impoundment level of 92.2 feet NGVD 29, and provides the required minimum downstream releases and flows necessary for operation of the fish passage structures in accordance with Articles 36 and 37 of the Project's license. Boott is proposing to continue this operational strategy through a new FERC license for the Project.

### B.1.3.4 Operations During High Water and Adverse Conditions

When river flows exceed the hydraulic capacity of the E.L. Field Powerhouse units (approximately 3,300 cfs per unit or 6,600 cfs for both units), excess flows are passed over the Pawtucket Dam spillway.

During these high-water conditions, the crest gate control system automatically adjusts the gates to maintain the impoundment elevation no higher than 93.2 feet NGVD 29, or one foot above the normal pond elevation. When under automatic control, the crest gates would all be fully lowered at spillway flows of approximately 35,000 cfs. In addition, the approved crest gate operations plan requires Boott to fully lower the crest gate panels in anticipation of potential flood events. This minimizes the upstream backwater effect of the Pawtucket Dam to the extent possible. (FERC 2015).

### B.1.3.5 Canal System Operations

The Lowell Hydroelectric Project includes a two-tiered network of man-made canals, totaling 5.5 miles in length. Flow enters the canal system upstream of the Pawtucket Dam via the Pawtucket Canal and is controlled by the Guard Lock and Gates Facility.

The Lowell Hydroelectric Project currently includes four power stations located within mill buildings along the downtown canal system: Hamilton Power Station, Assets Power Station, and Bridge Street and John Street Power Stations. As stated elsewhere in this application for license, Boott proposes to remove the four mill power stations and associated canal infrastructure from the new FERC license. Boott will continue to manage the canal structures, water levels and flows using best practices and consistent with current agreements with the National Park Service and other stakeholders.

#### B.1.3.5.1 Minimum Flow Management

Although there is no formal flow requirement for the canal system, Boott maintains an operating agreement with the NPS to allow tour boat operations to navigate the canal system. Boott maintains canal water levels within appropriate limits during the May 15 to October 15 tour boat operating season. Operations are maintained through a series of locks and gatehouses along the Canal System (Cleantech Analytics 2017).

#### B.1.3.5.2 Normal Operation

The nominal flow capacity of the downtown canal system via the Pawtucket Canal and the Guard Lock and Gates Facility is approximately 2,000 cfs. Future normal operations will consist of providing sufficient flow through the Guard Gates structure necessary to maintain and manage water levels in the downtown canal system, consistent with current practices and agreements.

#### B.1.3.5.3 Operation During High Water

When river flows exceed the hydraulic capacity of the E.L. Field Powerhouse units (6,600 cfs for both units), excess flows up to approximately 2,000 cfs can be routed through the downtown canal system and to the canal units. Any flows in excess of these capacities are passed over the Pawtucket Dam spillway. Under proposed future operations Boott does not anticipate any need to pass excess flow through the canal system, since the Pawtucket Dam spillway has ample capacity and the crest gates would be fully lowered during high flow events.

The Guard Lock and Gates facility includes the Great Guard Gate, a large portcullis gate constructed in 1851 to prevent flooding in downtown Lowell via the Pawtucket Canal. In 2005 Boott designed and implemented a replacement for the historic Great Guard Gate. The replacement gate is a segmented structural steel stoplog gate and frame which is stored on-site, and was designed and implemented in consultation with the FERC and National Park Service. It is intended to functionally replace the historic Great Guard Gate, which remains in place within the Francis Gate House. The steel stoplog gate fits immediately upstream of the Francis Gate House within existing stoplog slots in the granite masonry. When required, installation of the steel stoplog gate can be accomplished within a few hours by a local crane operator. The Project's Emergency Action Plan (EAP) provides that the stoplogs should be installed when the water level at the Pawtucket Dam rises above 98.0 ft NGVD 29. Boott proposes to retain the Great Guard Lock and Gates facility in the Project license, and to continue implementation of the existing Emergency Action Plan associated with the facility.

#### B.1.3.6 Fish Passage Operations

The Comprehensive Fish Passage Plan, approved by FERC on November 28, 2000, required operation of a fish ladder at the Pawtucket Dam. The fish ladder has a total operating flow of 500 cfs including attraction flow. The 500 cfs is the primary source of flow in the bypass reach, other than spillage over the Pawtucket Dam spillway. The fish lift system at E.L Field Powerhouse has a total flow capacity of 200 cfs, designed to be

released through two entrance weirs on either side of the E.L. Field powerhouse. However, since the 1990's only the northern "riverside" entrance operated as 100-120 cfs has been used, by agreement with the fishery agencies. Presently, Boott operates both the fish ladder and the fish lift daily during spring of each year when a cumulative total of 50 American shad (*Alosa sapidissima*) or 200 river herring (alewives, *A. pseudoharengus*, and blueback herring, *A. aestivalis*) are passed at the downstream Lawrence Hydroelectric Project (FERC No. 2800). Additionally, Boott is required to operate the downstream bypass facility from April 1 through July 15 and from September 1 through November 15 (Cleantech Analytics 2017). Since 2013, Boott has worked cooperatively with the U.S. Fish and Wildlife Service (USFWS) and other fishery agencies as part of the Merrimack River Technical Committee to assess and provide passage for eels moving upstream in the mainstem Merrimack. The efforts have occurred primarily at the fish ladder at the Pawtucket Dam, from mid-July through September, annually. Fish passage operations are coordinated with the Merrimack River Technical Committee. All fish passage facilities were designed in consultation with the USFWS.

Under the new Project license, Boott proposes to replace the existing fish lift with a short fish ladder to pass migratory fish from the tailrace to the bypass reach, such that all fish would be passed upstream of the Project via the existing fish ladder at the Pawtucket Dam. The Licensee will work with the Merrimack River Technical Committee member agencies to determine the design and installation schedule for the proposed ladder.

Boott also proposes to install new trashracks or other fish exclusion facility at the E.L. Field Powerhouse to prevent entrainment of fish through the turbines and consistent with current USFWS passage guidelines. Downstream passage of fish will continue to be provided via the existing sluice gate in the left forebay wall of the E.L. Field Powerhouse. The Licensee will consult with the Merrimack River Technical Committee member agencies to determine the design and installation schedule for the proposed fish exclusion system. Boott reserves the right to seasonally deploy the new trashracks or other exclusion facility only during the downstream fish passage season (mid-May – November), and to use the existing trashracks outside of the fish migration season.

#### B.1.4 Plant Factor

Based on the average annual gross energy produced during calendar years 2008 through 2017 and the rated plant capacity of 15.0 megawatt (MW), the estimated annual plant factor for the Lowell Hydroelectric Project is 0.643.

### B.2 Estimated Energy Production and Dependable Capacity (18 C.F.R. §4.51(c)(2))

#### B.2.1 Estimated Average Annual Energy Production

The average annual energy generation of the Lowell Hydroelectric Project for the period of 2008 through 2017 was 84,501 megawatt-hours (MWh). The Project operates in a

ROR mode and, therefore, experiences seasonal and annual variations in generation based on natural hydrologic conditions in the Merrimack River Watershed. Table B.2-1 provides a summary of monthly Project generation for a 10-year period from 2008 through 2017 in MWh.

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**Table B.2-1. Lowell Hydroelectric Project Monthly and Annual Generation (MWh)**

Month	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
January	10,610	2,574	6,403	7,163	10,272	8,064	10,422	6,624	9,258	9,325
February	10,955	3,851	6,672	5,228	8,928	8,304	5,232	3,216	9,312	6,335
March	11,727	5,088	8,555	10,176	12,432	12,784	10,536	5,820	10,042	9,395
April	10,876	7,341	8,061	11,088	7,872	13,392	10,959	10,128	8,427	8,387
May	7,690	10,147	8,094	11,472	11,712	9,600	9,264	5,219	7,244	8,181
June	4,512	10,464	4,752	8,304	9,792	11,551	3,075	6,563	2,577	9,716
July	5,615	11,252	2,963	3,552	3,216	11,520	4,608	6,432	1,010	6,635
August	4,810	8,026	2,072	4,416	4,560	6,144	5,472	2,412	1,044	2,959
September	4,962	4,012	1,677	10,128	3,696	6,214	4,428	1,898	498	3,462
October	5,287	5,703	8,457	11,136	7,344	3,894	4,314	5,297	1,059	3,332
November	4,726	4,404	10,216	10,272	6,384	5,376	6,880	6,367	3,649	7,380
December	4,656	4,747	9,687	10,272	8,880	7,772	10,700	8,395	9,025	7,946
Annual	86,425	77,609	77,608	103,207	95,088	104,614	85,890	68,371	63,146	83,053

## B.2.2 Estimated Dependable Capacity

Dependable capacity is generally defined as the amount of load a hydroelectric plant can carry under adverse hydrologic conditions during a period of peak demand; for example, during the hot, dry conditions typical of August in the Project area. The estimated dependable capacity is also determined by the minimum flow requirements included in the existing license. Under the current license, the Project's estimated dependable capacity is approximately 4.9 MW, based on the August median flow of 1,940 cfs at the Project site. The estimated dependable capacity is not expected to change with removal of the four power stations along the downtown canal system given they were only operated during flow conditions over 6,600 cfs.

## B.2.3 Hydraulic Capacity of Powerhouses

The maximum hydraulic capacity of E.L. Field Powerhouse is approximately 6,600 cfs, but may be restricted by unit availability, debris accumulation at the Northern Canal Gatehouse, high tailwater conditions, and other factors.

**Table B.2-2. Lowell Hydroelectric Project Hydraulic Capacity**

TURBINES				
			Runner Diameter	Hydraulic Capacity
Powerhouse	Unit #	Type	Inches	cfs
E. L. Field	1	Fuji Horizontal Full Kaplan	152.4	3,300
E. L. Field	2	Fuji Horizontal Full Kaplan	152.4	3,300

## B.2.4 Project Flows

The Pawtucket Dam is the main impounding structure that provides head and flow for all the Lowell Hydroelectric Project's generating stations and the canal system. The normal operating pool level behind the dam is 92.2 ft NGVD 29. Flow passes from the Pawtucket Dam reservoir into the Pawtucket Canal and the Northern Canal. The Northern Canal Gatehouse controls flow into the Northern Canal, which leads to the E.L. Field Powerhouse; normally all flow in the Northern Canal pass through the turbines at E.L. Field and is discharged back to the Merrimack River. A lock control structure controls flow into the lower portion of the Northern Canal downstream of the E.L. Field Powerhouse. The Guard Lock and Gates Facility controls flow into the Pawtucket Canal.

Flow over the spillway is the inflow to the headpond less any flow through the turbines at the E.L. Field Powerhouse, through the downtown canal system, or through the fish ladder.

The majority of flows through the Lowell Project are a direct result of the annual hydrologic cycle. The river receives higher inflows during the annual spring runoff and in the wetter fall and winter months. There are several U.S. Army Corps of Engineers flood



Exhibit B Project Operation and Resource Utilization  
 Lowell Hydroelectric Project

control reservoirs in the Merrimack River basin upstream of the Lowell Project. Boott and other licensees in the Merrimack River basin pay Headwater Benefits annual charges to offset the costs of operation and maintenance of these flood control facilities.

Two USGS Gages were reviewed to establish Project hydrology:

- USGS Gage No. 01100000 Merrimack River Below Concord River at Lowell, MA; and,
- USGS Gage No. 01099500 Concord River Below River Meadow Brook, at Lowell, MA.

Flows from USGS Gage No. 01099500 *Concord River Below River Meadow Brook, at Lowell, MA* were subtracted from flows at USGS Gage No. 01100000 *Merrimack River Below Concord River at Lowell, MA, MA* to calculate the hydrologic data tabulated in Table B.2-3, presenting data at the Project from the past 30 years (water years 1987-2016).

**Table B.2-3. Lowell Hydroelectric Project Hydrologic Data (1987-2016)**

Month	Minimum (cfs)	90% Exceedance (cfs)	Average (cfs)	10% Exceedance (cfs)	Maximum (cfs)
January	916	3,462	7,651	12,834	39,710
February	1,478	3,272	6,813	11,415	39,180
March	1,914	4,508	11,484	21,355	50,220
April	2,765	6,558	17,901	31,178	78,890
May	2,034	4,112	10,749	18,657	88,410
June	874	2,279	6,768	13,286	44,660
July	670	1,325	4,207	9,270	29,820
August	569	1,121	3,526	6,852	30,030
September	460	1,008	3,162	6,025	32,264
October	787	1,676	5,938	12,706	50,150
November	1,345	2,888	7,978	14,747	30,990
December	1,839	3,472	9,141	17,243	34,810
Annual	460	1,723	7,941	17,059	88,410

Source: USGS 2018.

Monthly flow duration curves have been developed for the Lowell Project using water years 1987-2016 are shown below in Figure B.2-1 through Figure B.2-4

### B.2.5 Area-Capacity and Rule Curves

The Project operates in ROR mode and has no useable storage capacity. The gross storage capacity between the normal surface elevation of 92.2 feet NGVD 29 and the minimum pond level of 87.2 feet is approximately 6,180 acre-feet. Given the Project's current and proposed ROR operations, the minimal fluctuations in the reservoir level

cause very little change in the surface area of the impoundment. Consequently, a site-specific area-capacity curve and impoundment rule curve for the E.L. Field Powerhouse have not been developed, nor are they necessary to the current and future operation of the Project.

Figure B.2-1. Monthly Flow Duration Curves at Pawtucket Dam (January – March)

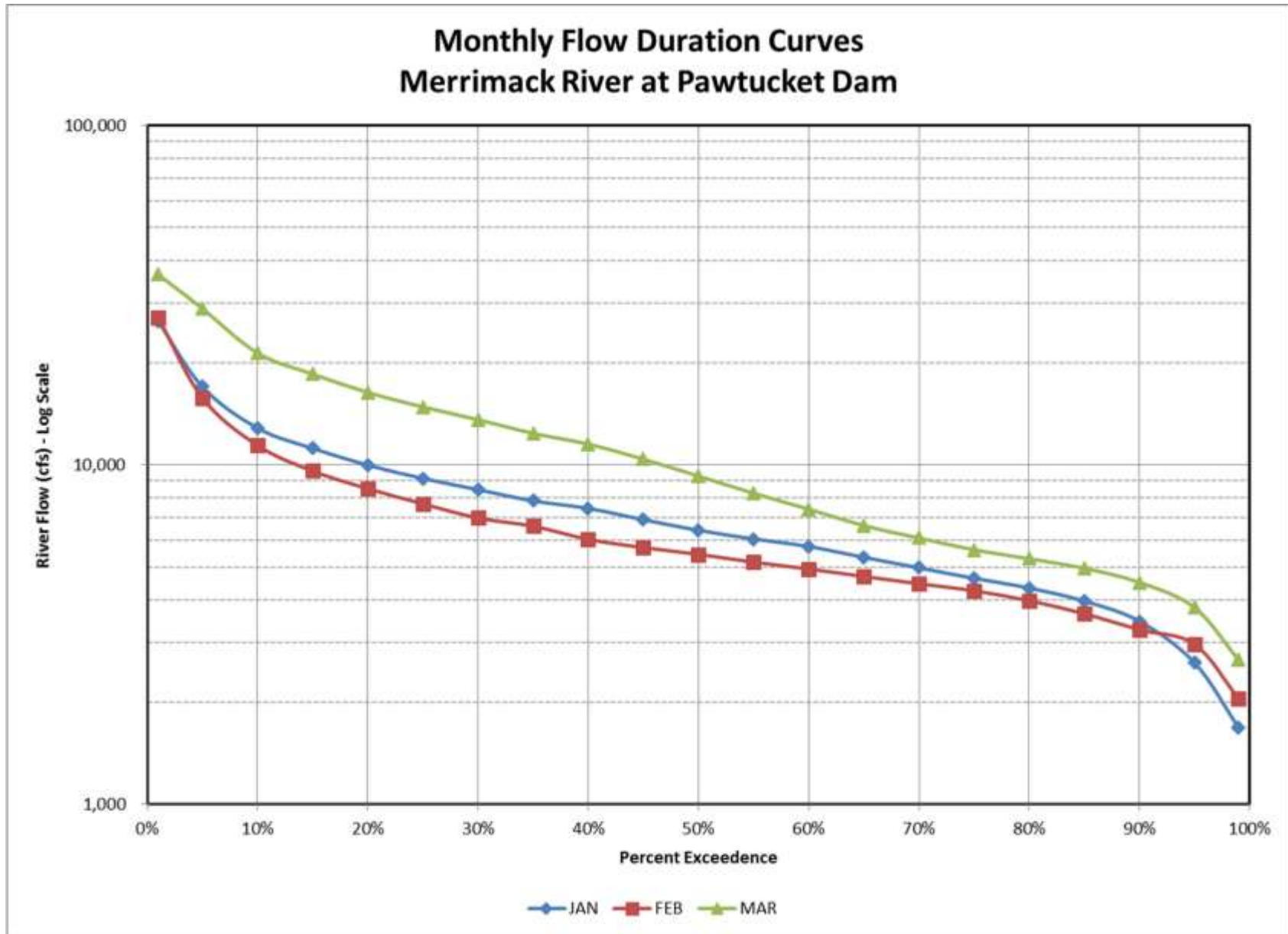


Figure B.2-2. Monthly Flow Duration Curves at Pawtucket Dam (April – June)

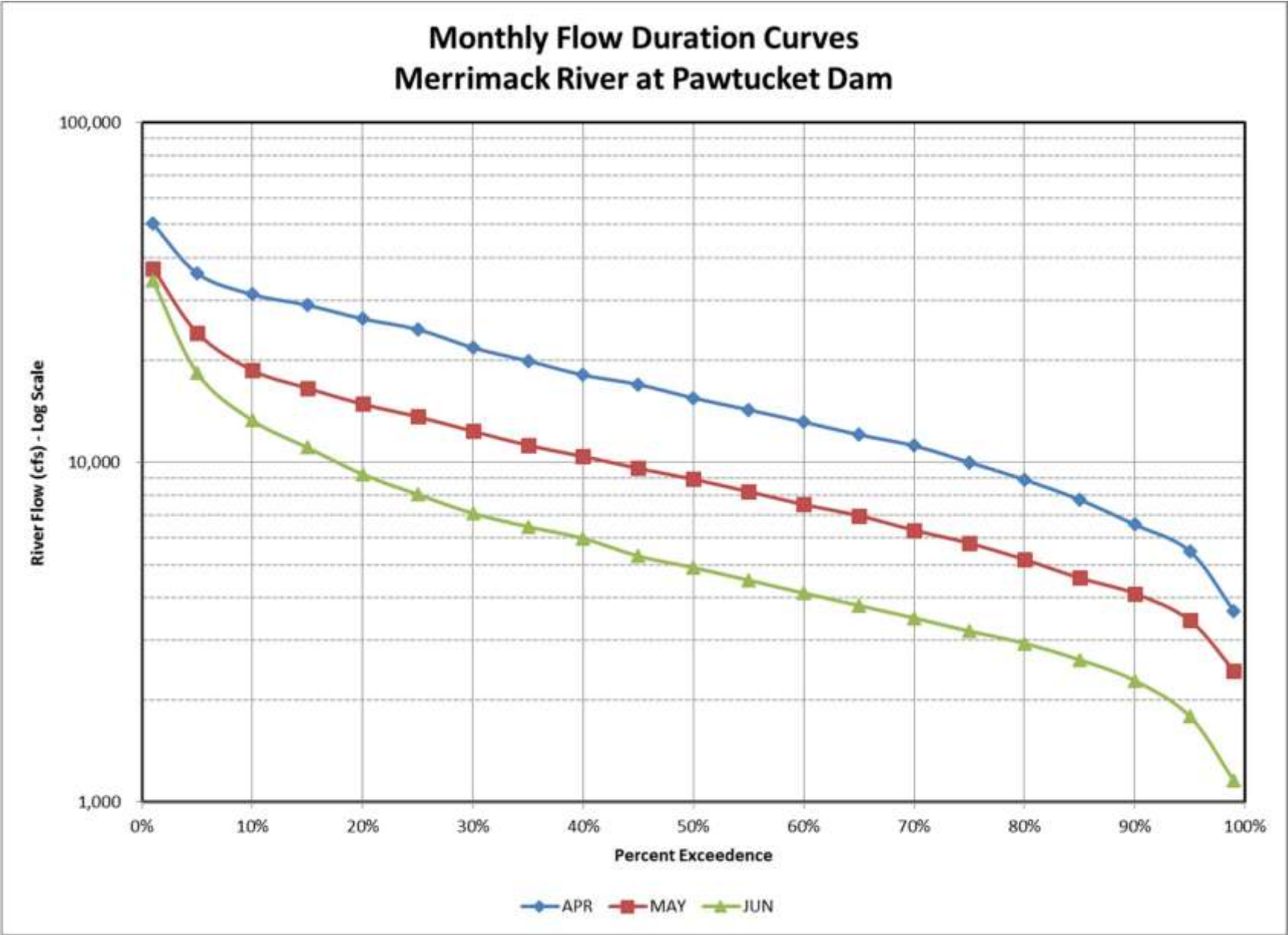


Figure B.2-3. Monthly Flow Duration Curves at Pawtucket Dam (July – September)

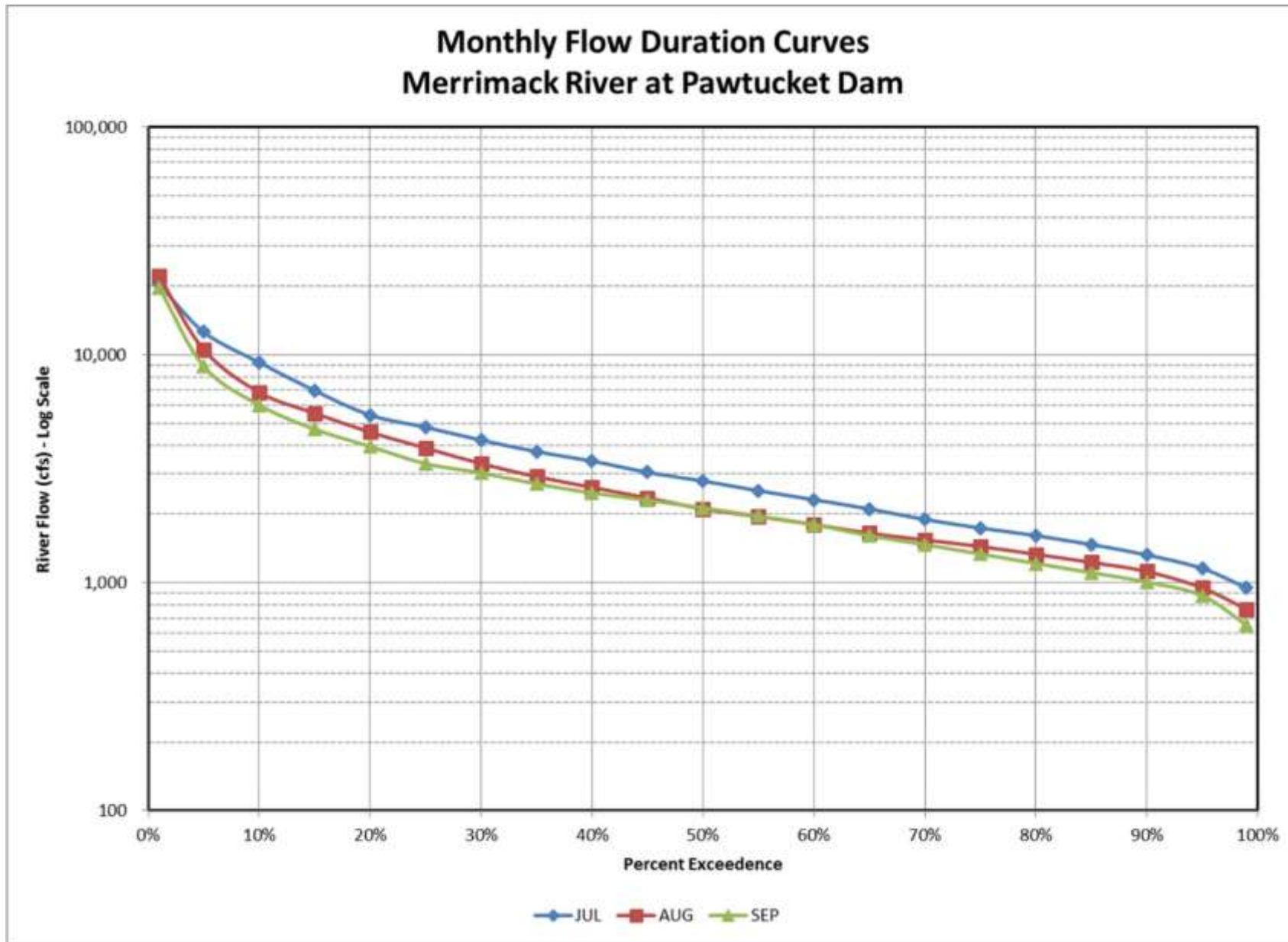
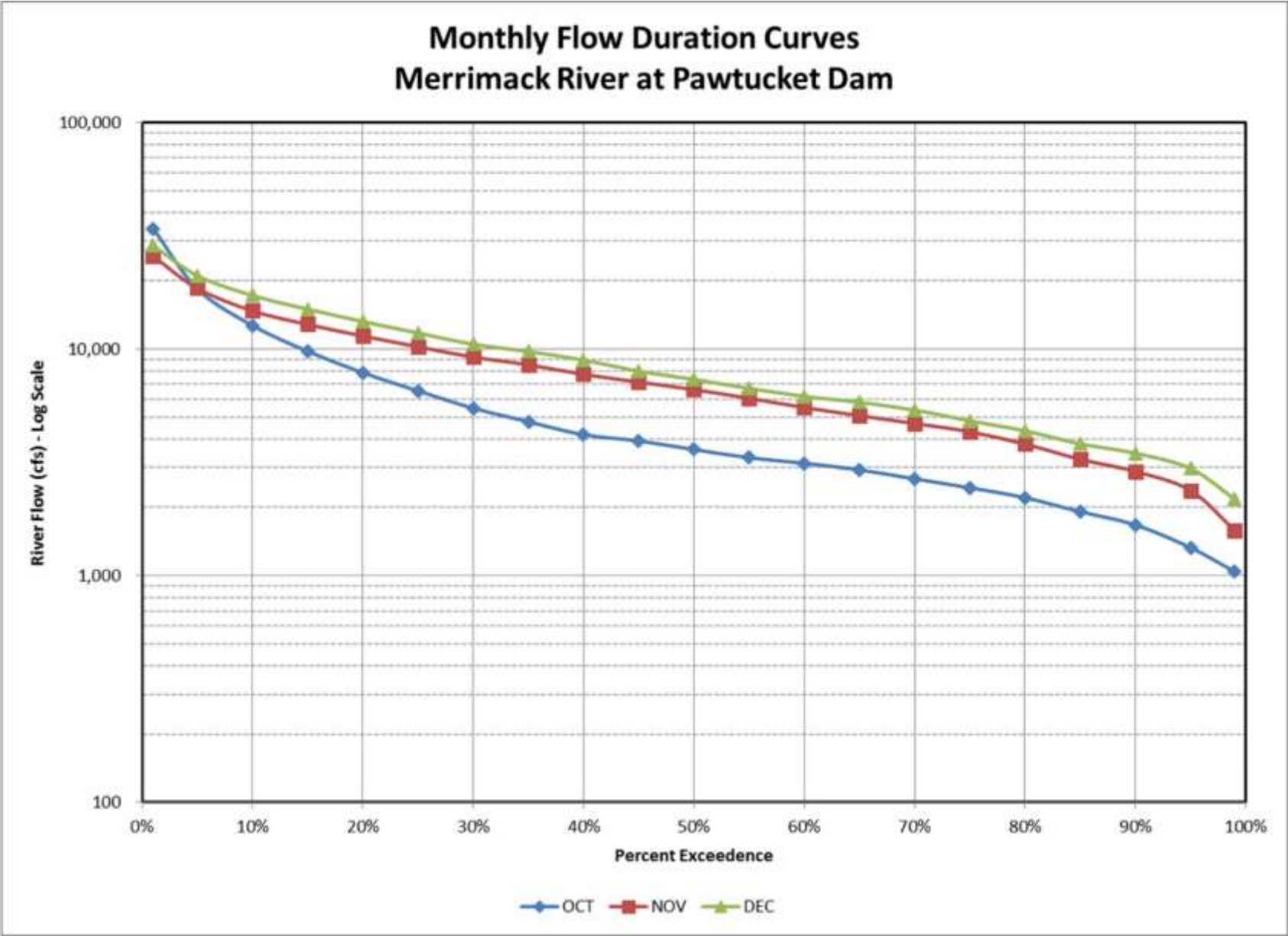


Figure B.2-4. Monthly Flow Duration Curves at Pawtucket Dam (October – December)

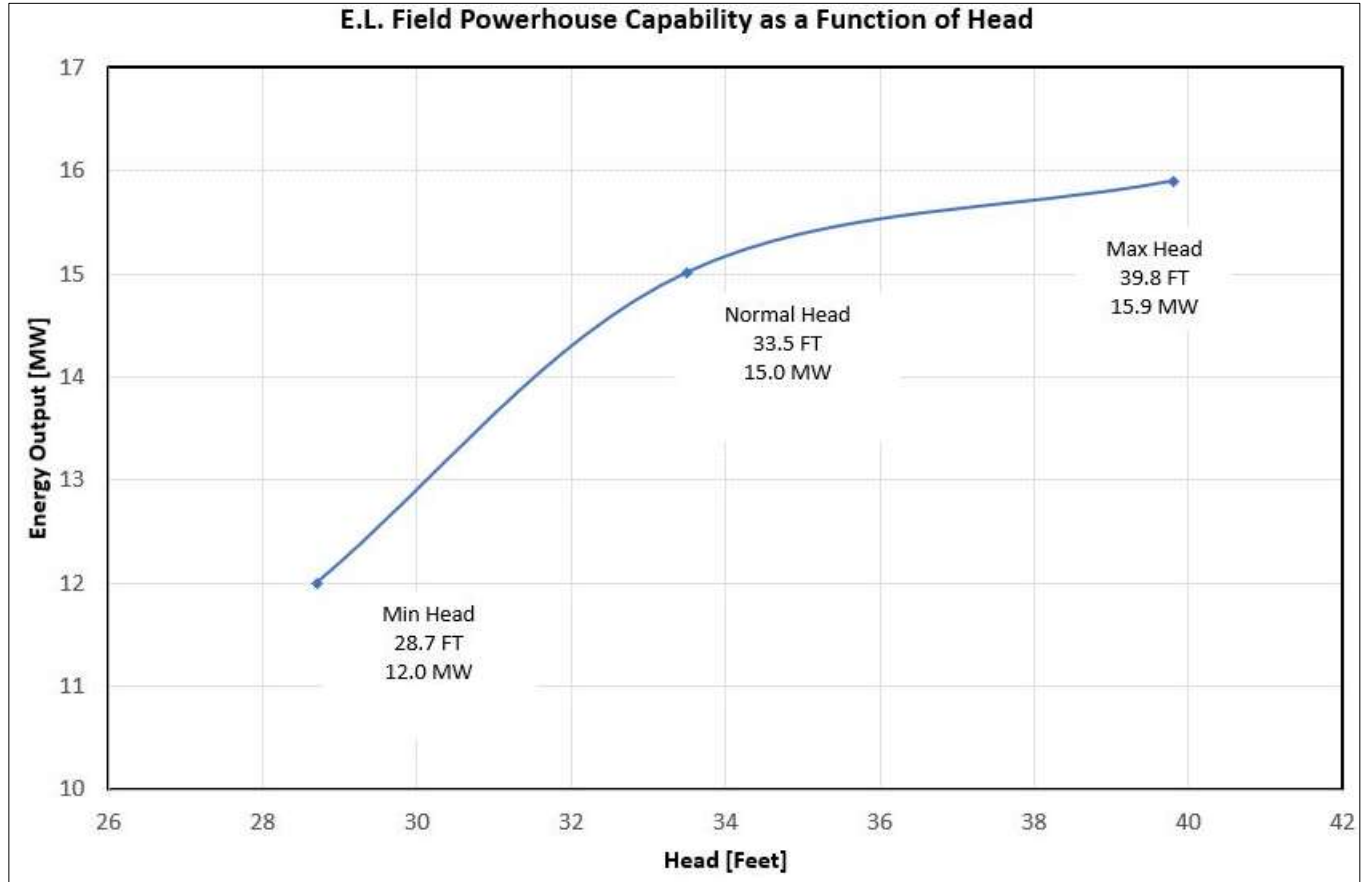




## B.2.7 Powerplant Capacity versus Head

Curves indicating powerplant capability versus head for the E.L. Field Powerhouse are presented below.

**Figure B.2-6. Powerplant Capacity versus Head**





### B.3 Statement of Power Utilization (18 C.F.R. §4.51(c)(3))

Boott proposes to continue to operate the Project in a ROR mode while maintaining minimum flow requirements and reservoir elevations pursuant to the new license. Power generated at the Project is sold to meet the demands of the regional grid.

13.8-kilovolt (kV) submarine cable in the canal beds carries electricity generated at the Project approximately 1.3 miles through the canal system in the City of Lowell and an additional 0.5 miles along the Concord River to National Grid's Perry Street substation. From the Perry Street substation Project output is delivered to the regional utility grid at 115 kV.

A single-line diagram for the Project and its interconnection to the grid are provided in Volume III of the FLA and filed as Critical Energy Infrastructure Information (CEII).

### B.4 Future Development (18 C.F.R. §4.51(c)(4))

Boott is not proposing any new Project facilities or modifications to Project operations currently. However, as economic conditions continue to change, Boott periodically performs evaluations of Project facilities for potential upgrades and will continue to do so in the future.

### B.5 References

- Boott Hydropower, LLC (Boott). 2017. Application for Amendment of License. Andover, MA.
- Cleantech Analytics, LLC. 2017. Certification Application to the Low Impact Hydro Institute, Lowell Hydroelectric Facility. July 26, 2017.
- Federal Energy Regulatory Commission (FERC). 2015. Order Approving Amended Crest Gate System Operation Plan. Issued March 30, 2015.
- Massachusetts Executive Office of Energy and Environmental Affairs (MEOEEA). 2002. Merrimack River A Comprehensive Watershed Assessment Report 2001. [Online] URL: <http://www.mass.gov/eea/docs/eea/water/assess-rpt-merrimack-2000.pdf> (October 1, 2020).
- U.S. Geological Survey (USGS). 2018. National Water Information System: Web Interface. [Online] URL: [https://waterdata.usgs.gov/ma/nwis/uv/?site\\_no=01100000&PARAMeter\\_cd=00065,00060](https://waterdata.usgs.gov/ma/nwis/uv/?site_no=01100000&PARAMeter_cd=00065,00060) (Accessed March 23, 2018).

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# Exhibit C Construction History (18 C.F.R. § 4.51 (d))

## C.1 Introduction

The site of the Lowell Project was historically used for hydromechanical and hydroelectric power for various mill operations. Much of the Project's civil works were constructed during the 19th and early 20th centuries and existed prior to initial Project licensing. In 1796, construction of the Pawtucket Canal was complete. The Pawtucket Canal had to be deepened and its locks rebuilt or repaired several times during its first decade of operation. By 1821, three single locks were constructed along the canal, the Guard Locks, Swamp Locks, and a flight of three locks in a row known as the Lower Locks. By 1836 the canal system comprised of a two-level system, with the Western, Merrimack, and Hamilton canals, all of which took their water from above Swamp Lock Dam, comprising the upper portion of the system, and the Lower Pawtucket and Eastern Canals, fed from below Swamp Locks Dam, comprising the lower portions. The second great phase of construction was completed by 1848 with construction of the Northern Canal and the Pawtucket Gatehouse.

The four additional power stations included under the original Project license were in operation prior to being licensed by the Federal Energy Regulatory Commission (FERC) in 1983. The Assets Power Station was constructed in 1911. The Bridge Street Power Station was constructed in 1910. The Hamilton Power Station was constructed in 1918. The John Street Power Station was constructed in 1919. Boott proposes to remove these power stations and associated canal infrastructure from the new license. On April 13, 1983, FERC issued an original license for the Lowell Hydroelectric Project in accordance with the FERC's delegated authority under the Federal Power Act. Construction of new Project features, including the E.L. Field Powerhouse, Hydro Locks and fishway facilities, was initiated in 1983 and the Project was commissioned and placed into service on November 21, 1985.

Since the license was transferred to Boott in 1983<sup>10</sup>, Boott has engaged in a series of operations and maintenance and life extension activities to maintain the reliability of the Project.

## C.2 Project Schedule of New Development

Boott is not proposing any increase in capacity as part of this relicensing, and instead proposes to reduce the currently authorized capacity by removing the four mill powerhouses and associated canal infrastructure from the license. Boott has examined the potential for Project life extension, unit upgrade, and capacity addition (outside of, or beyond current authorizations), and has determined that life extension of the existing

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<sup>10</sup> Order Approving Transfer of License, 23 FERC ¶ 62,043 (1983).

canal facilities is not economically feasible. Therefore, Boott is only considering life extension of the remaining Project facilities, namely the Pawtucket Dam and fish ladder, the E.L. Field powerhouse, the Northern Canal and associated structures leading up to E.L. Field, and the Guard Lock and Gates facility. There is no fixed schedule for Boott's life-extension program, and no proposed new development at this time. This program consists of an ongoing program to maintain, repair, modify, or replace the civil, mechanical, or electrical components of the Project on an as-needed basis. Boott reserves the right to reevaluate the potential for unit upgrades or capacity additions in the future.

Based on consultation with relicensing parties, Boott proposes to design and install a short fish ladder to pass migratory fish from the E.L. Field powerhouse tailrace to the bypass reach, such that all fish would be passed upstream of the Project via the existing fish ladder at the Pawtucket Dam. Following installation and operation of the proposed fish ladder at the tailrace, Boott proposes to cease operation of the fish elevator and associated operations described above. The Licensee will consult with the Merrimack River Technical Committee member agencies to determine the design and installation schedule for the proposed ladder.

Boott proposes the installation of new trashracks or other fish exclusion facility at the E.L. Field Powerhouse which will be consistent with current USFWS passage guidelines, to prevent entrainment of fish through the turbines. Downstream passage of fish will continue to be provided via the existing sluice gate in the left forebay wall of the E.L. Field Powerhouse. The Licensee will consult with the Merrimack River Technical Committee member agencies to determine the design and installation schedule for the proposed fish exclusion system. Boott reserves the right to seasonally deploy the new trashracks or other exclusion facility only during the downstream fish passage season (mid-May – November), and to use the existing trashracks outside of the fish migration season.

## Exhibit D Costs and Financing (18 C.F.R. §4.51(e))

### D.1 Original Cost of Existing Unlicensed Facilities

This section is only applicable to initial license applications and not applicable to this current relicensing application of Lowell Hydroelectric Project.

### D.2 Project Takeover Cost Pursuant to Section 14 of the FPA

Under Section 14(a) of the Federal Power Act (FPA), the Federal government may take over any project licensed by the Commission upon the expiration of the original license. The Commission may also issue a new license in accordance with Section 15(a) of the FPA. If such a takeover were to occur upon expiration of the current license, the Licensee would have to be reimbursed for the net investment, not to exceed fair value, of the property taken, plus severance damages. To date, no agency or interested party has recommended a federal takeover of the Project pursuant to Section 14 of the Federal Power Act.

#### D.2.1 Fair Market Value

Fair market value is not defined in the FPA or its implementing regulations. The fair value of the Project depends on prevailing power values and license conditions, both of which are currently subject to change. The best approximation of fair value is likely to be the cost to construct and operate a comparable power generating facility. Because of the high capital costs involved with constructing new facilities and the increase in fuel costs associated with operating such new facilities (assuming a fossil-fueled replacement), the fair value would be considerably higher than the net investment amount.

The fair market value of the Project is currently estimated at \$33,475,000. If a takeover were to be proposed, the Licensee would calculate fair value based on then-current conditions.

#### D.2.2 Net Investment

The FPA defines “net investment” as the original cost, plus additions, minus the sum of the following items (to the extent that such items have been accumulated during the period of the license from earnings in excess of a fair return on such investment): (a) unappropriated surplus; (b) aggregate credit balances of current depreciated accounts; and (c) aggregate appropriations of surplus or income held in amortization, sinking fund, or similar reserves.

The Licensee’s current net investment in the Project is approximately \$28,870,669.

## D.2.3 Severance Damages

Severance damages are determined either by the cost of replacing (retiring) equipment that is “dependent for its usefulness upon the continuance of the License” (Section 14, FPA), or the cost of obtaining an amount of power equivalent to that generated by the Project from the least expensive alternative source, plus the capital cost of constructing any facilities that would be needed to transmit the power to the grid, minus the cost savings that would be realized by not operating the Project. These values would need to be calculated based on power values and license conditions at the time of Project takeover.

## D.3 Estimated Cost of New Development

### D.3.1 Land and Water Rights

The Licensee currently holds all land and water rights necessary to construct, operate and maintain the Project, and is not proposing expansion of its land or water rights as a consequence of this license application.

### D.3.2 Cost of New Facilities

The Licensee is not proposing any capacity-related developments at the Project. The Licensee proposes to install upstream and downstream fish passage measures at the Project subsequent to the issuance of a new license. The cost to construct and maintain these facilities are provided in Exhibit E – Section E.8.

## D.4 Estimated Average Annual Cost of the Project

This section describes the annual costs of the Project as proposed. The Licensee’s estimated average cost of the total Project is approximately \$1,962,037. This estimate includes costs associated with existing and projected project operations and maintenance, as well as property and real estate taxes, but excludes income taxes, depreciation, and costs of financing.

### D.4.1 Capital Costs

Actual capital costs are based on a combination of funding mechanisms that includes stock issues, equity, debt issues, revolving credit lines, and cash from operations. Boot does not have any capital costs.

### D.4.2 Taxes

Property taxes for the 2019 fiscal year were approximately \$635,666. Income taxes for the Project are incorporated into costs of the Licensee’s consolidated business and are not separated out for the Project.

### D.4.3 Depreciation and Amortization

The annualized composite rate of depreciation for the Project is approximately 6.19 percent.

### D.4.4 Operation and Maintenance Expenses

The estimated annual operation and maintenance expense at the Project was approximately \$222,686, including corporate support costs, but excludes property and real estate taxes.

## D.5 Estimated Annual Value of Project Power

The Licensee sells all the electricity generated at the Project into the regional grid under a Power Purchase Agreement (PPA). The projected future average annual gross energy production for the Project is 78,125 MWh, which has been adjusted for the removal of the downtown mill units and for generation lost due to increased bypass minimum flows.

The estimated annual value of Project power is approximately \$7,031,250 based on the Project's current PPA. However, following the expiration of the PPA in 2023 the project will likely sell energy under ISO-NE market conditions, which will likely reduce power sales revenues by 40% under current market conditions.

## D.6 Sources and Extent of Financing

Boott's current financing needs are met from internal funds. Boott is likely to finance major enhancements through earnings retention, equity contributions, third-party loans, and loans made by the corporate parent or some combination of those mechanisms.

## D.7 Cost to Develop the License Application

The approximate cost to prepare the application for new license for the Project was approximately \$1,780,000.

## D.8 On-Peak and Off-Peak Values of Project Power

The Lowell Hydroelectric project essentially operates in run of river mode. As per 18 C.F.R. § 4.51(e)(8), this section is not applicable to hydroelectric projects operating in run of river mode.

## D.9 Estimated Average Annual Increase or Decrease in Generation

Boott proposes to remove the four mill power stations from the new license. The resulting annual decrease in generation is estimated at 5,300 MWh. Boott also proposes to release a minimum flow of 100 cfs or inflow, whichever is less, to the bypass reach

below the Project dam during the period outside of fish passage season (typically July 15 to April 30). The minimum flow release will result in an estimated loss of approximately 1,100 MWh of generation annually. Boott does not propose any change to the existing fish ladder and bypass reach flow of 500 cfs currently released during the fish passage season.



## Exhibit F Project Description (18 C.F.R. §4.51(g))

### F.1 Design Drawings

The General Design Drawings showing overall plan views, elevations, and sections of the principal Project works are described in Table F-1.

In accordance with FERC's regulations and guidelines,<sup>11</sup> Boott is requesting that the General Design Drawings for the Lowell Hydroelectric Project be treated as containing Controlled Unclassified Information (CUI) and Critical Energy Infrastructure Information (CEII). This request for privileged treatment is being made to the Commission in accordance with the Final Rule (Order No. 630-A) issued by the Commission on July 23, 2003 (revised August 8, 2003).

Therefore, in conjunction with filing this License Application, the Exhibit F General Design Drawings listed in Table F-1 are being filed with the Federal Energy Regulatory Commission ("FERC or "Commission") in Volume III of this application as CUI/CEII.

**Table F.1-1. Lowell Hydroelectric Project Exhibit F Project Boundary Drawings**

Exhibit No.	Drawing Title
F-1	Key Plan
F-2	Powerhouse and Tailrace Detailed Layout
F-3	Powerhouse Longitudinal Section
F-4	Powerhouse Floor Plans
F-5	Powerhouse and Tailrace Layout Plan
F-6	Pawtucket Dam Plan, Elevation and Sections
F-7	Fish Ladder Layout Plan
F-8	Northern Canal Gatehouse Plans, Sections and Elevations
F-9	Northern Canal Wastegates, Old Guard Locks and Gate Plans, Sections and Elevation
F-10	Control Structure and Lock General Layout
F-11	Canal Sections

<sup>11</sup> "Designation of Incoming Dam Safety Documents" <https://www.ferc.gov/enforcement-legal/ceii/designation-incoming-dam-safety-documents>

## F.2 Supporting Design Report

Pursuant to 18 C.F.R. §4.41(g)(3) and (4), Pursuant to 18 CFR §4.41(g)(3), an applicant for a new license is required to file with the Commission two copies of a Supporting Design Report (SDR) when the applicant files a license application. An SDR summarizes the studies that have been performed to date and the assumptions that have been made related to the development of the existing Project. The information contained within the SDR demonstrates that the existing structures are safe and adequate to fulfill their stated functions. In accordance with 18 CFR Part 388, Boott is requesting that the SDR for the Project be given privileged treatment because the drawings contain CUI/CEII material. Therefore, in conjunction with filing this License Application, the SDR is being filed with the Commission in Volume III of this application.

## Exhibit G Project Maps (18 C.F.R. §4.51(h))

### G.1 Project Boundary Maps

The current Project Boundary Maps for the Lowell Hydroelectric Project were prepared in accordance with the requirements of 18 C.F.R. §4.39 and 4.51(h) and show the Project vicinity, location, and boundary to provide an understanding of the Project's location. The electronic files associated with the Project Boundary Map are being filed on CDs with the Commission.

The preparation of this boundary map in support of obtaining a subsequent license for the Project has provided Boott the opportunity to make corrections and modifications consistent with the Project's operations. Boott is proposing to remove approximately 480 acres of the Project impoundment, or about 7.4 miles from the upper limit of the current Project boundary. This removal more accurately follows the 92.2 National Geodetic Vertical Datum (NGVD) 29 contour located at Cromwell's Falls in Litchfield and Merrimack, New Hampshire. This decision is supported by LiDAR (light detection and ranging) data downloaded from the New Hampshire Statewide GIS Clearinghouse GRANIT LiDAR Distribution Site, as well as aerial imagery indicating a hydraulic change in the Merrimack River. Accordingly, Boott is proposing to remove those lands from the Project boundary as they are not needed for Project purposes.

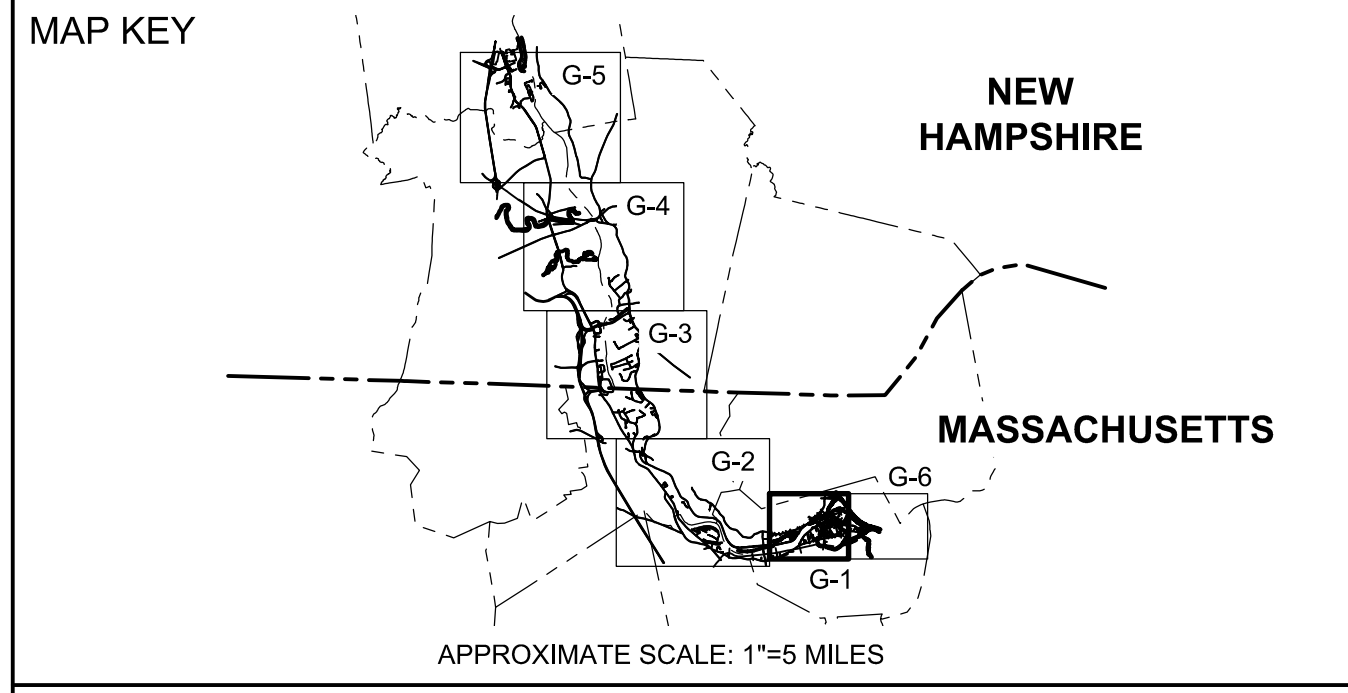
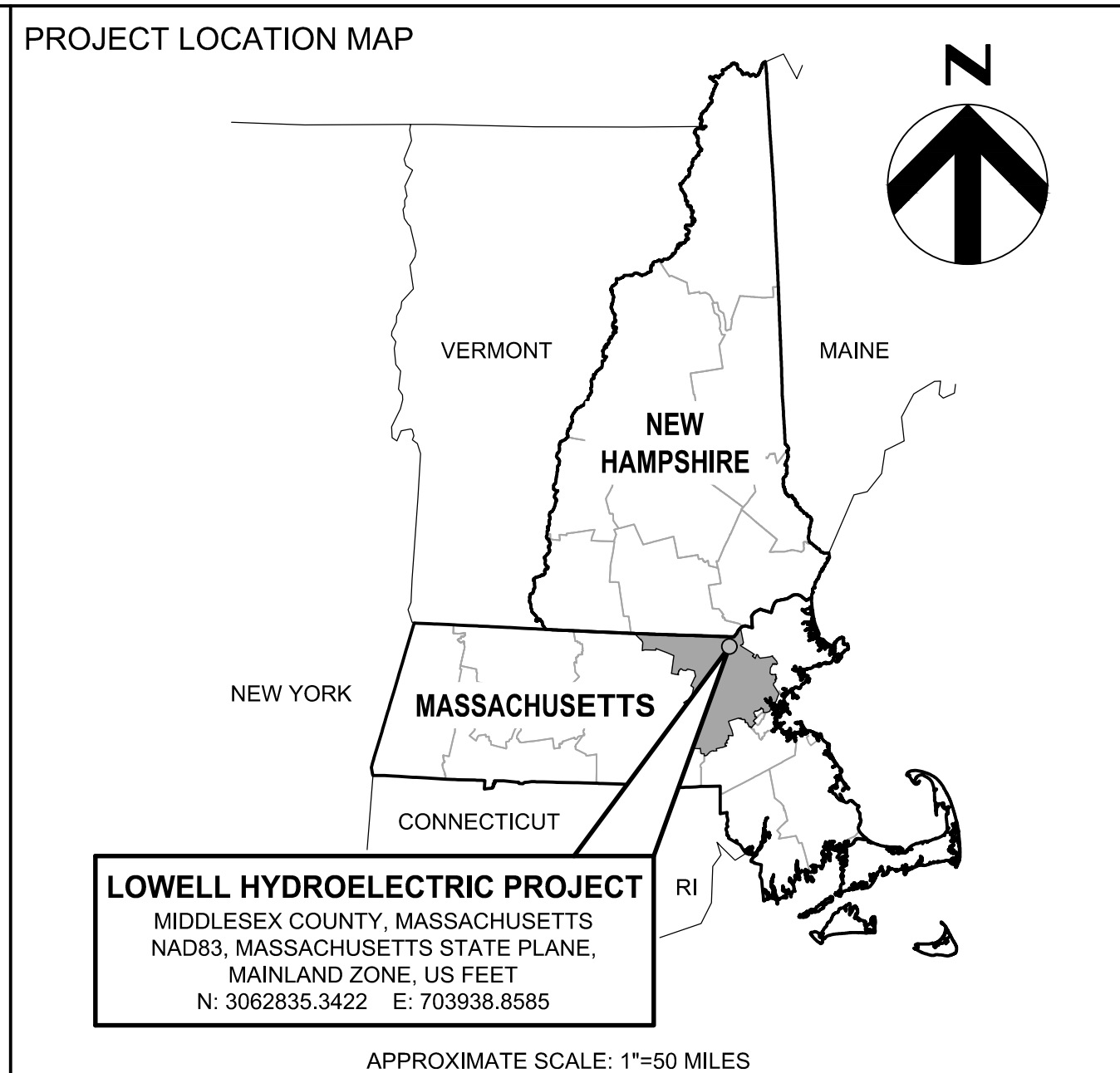
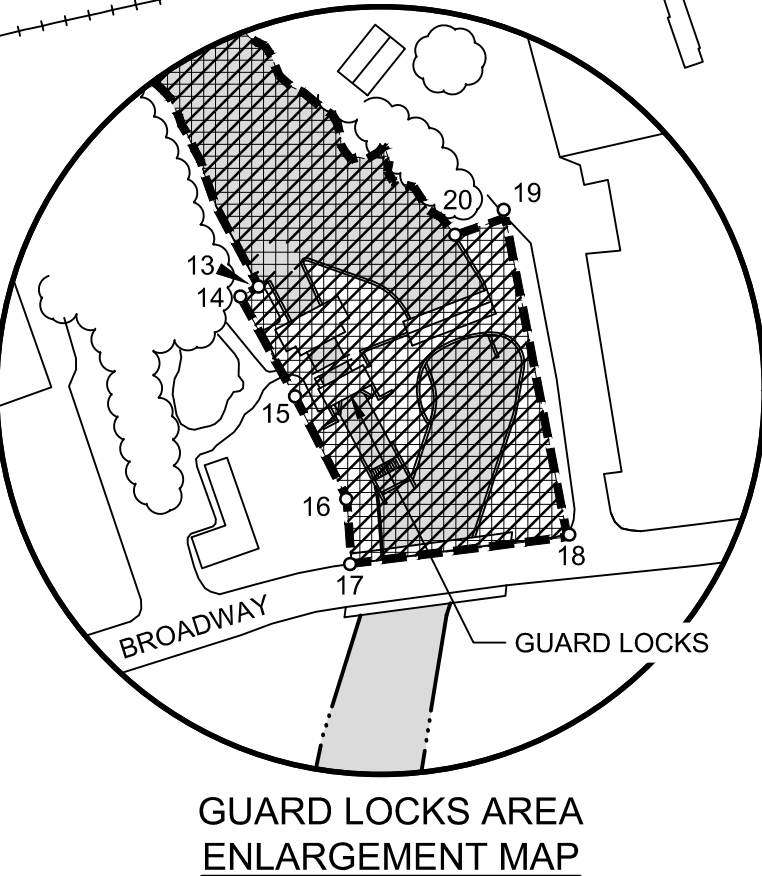
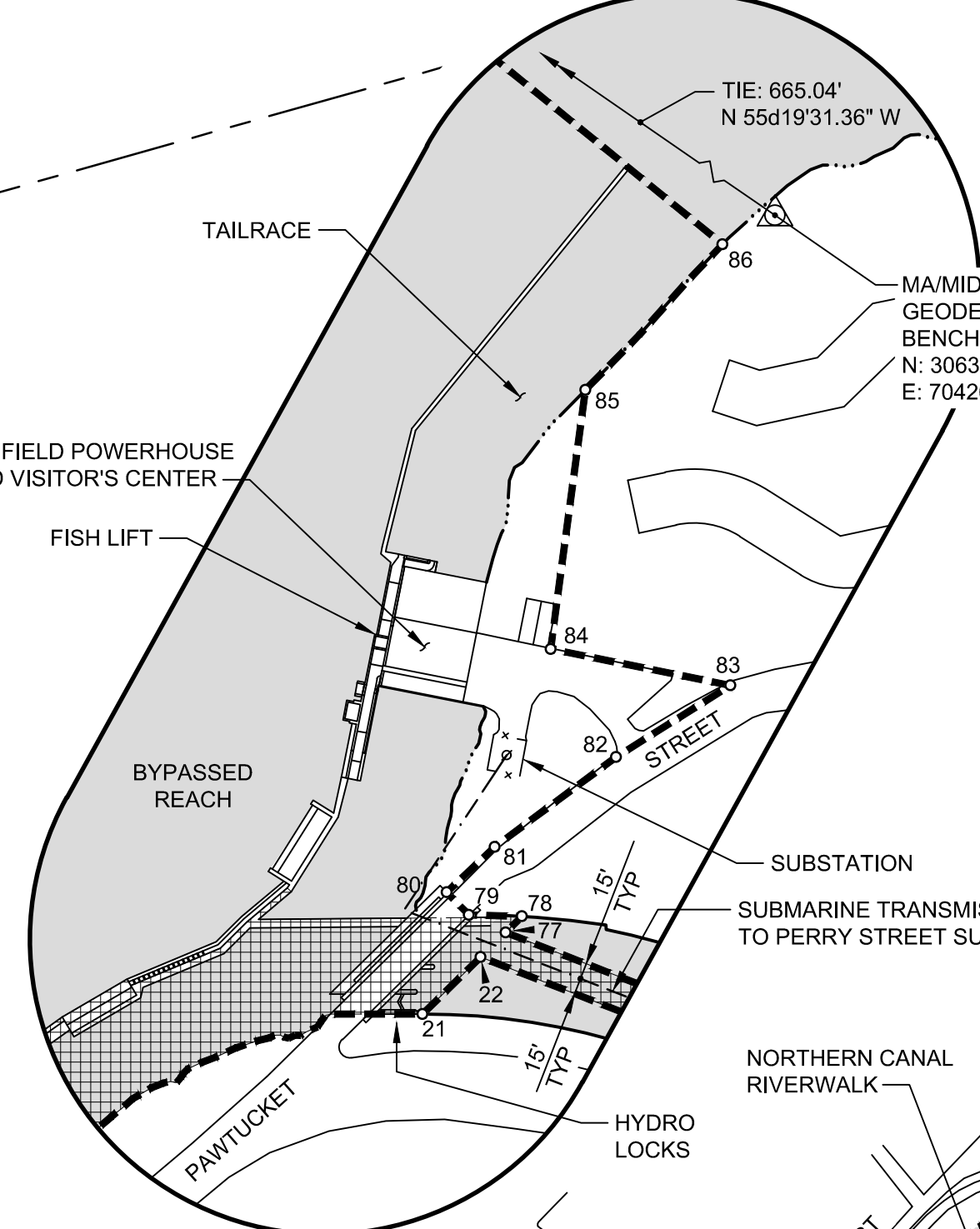
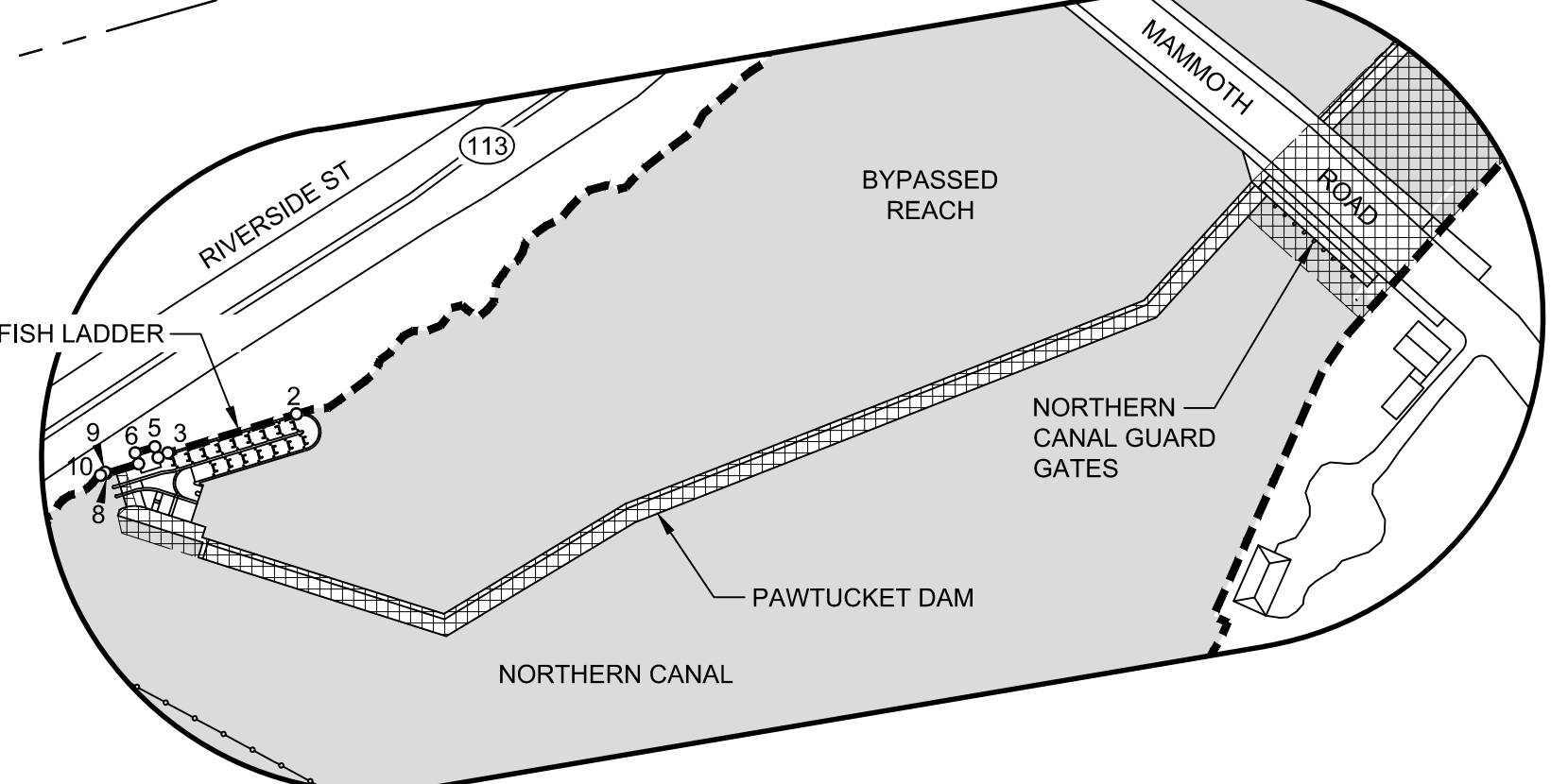
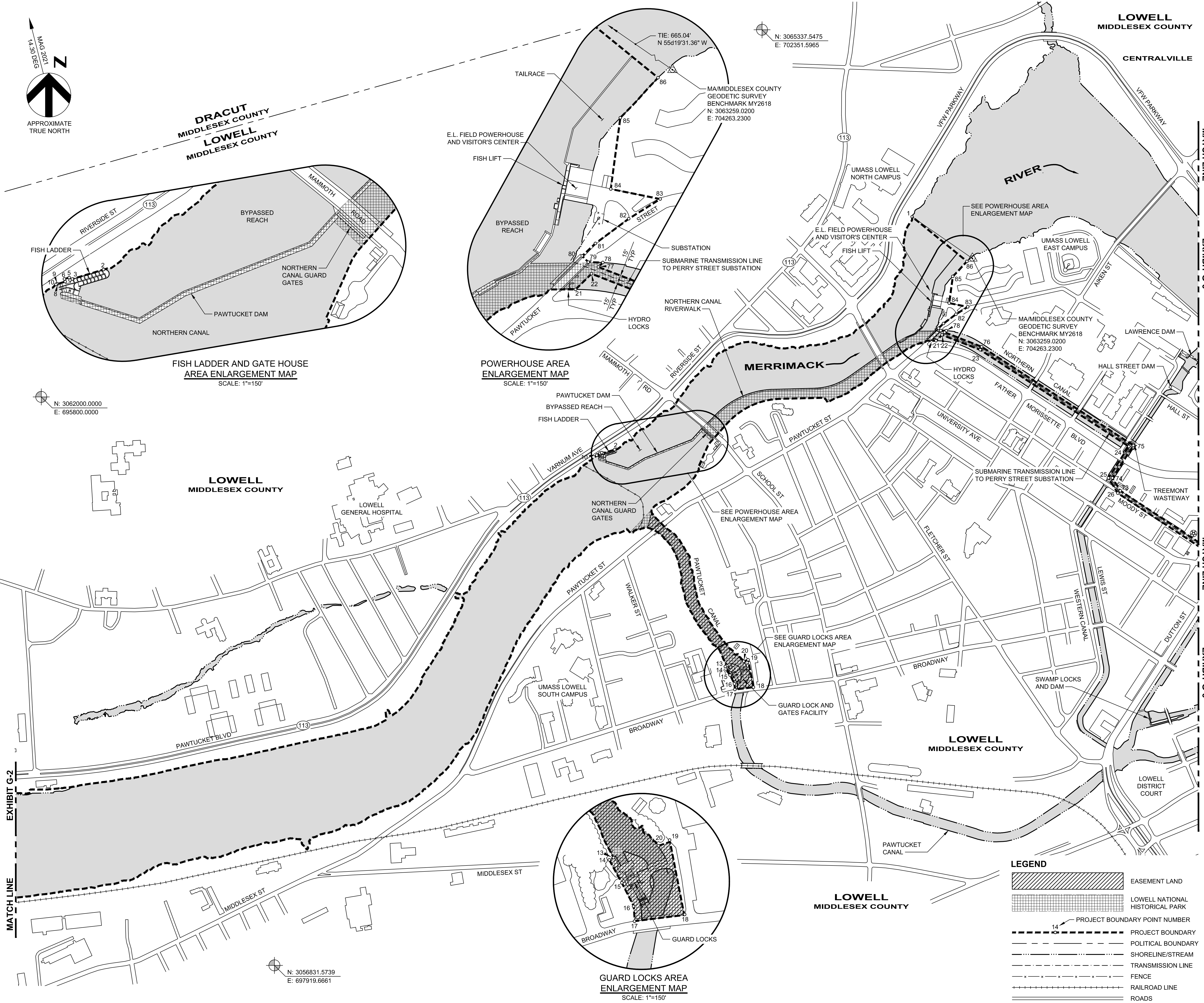
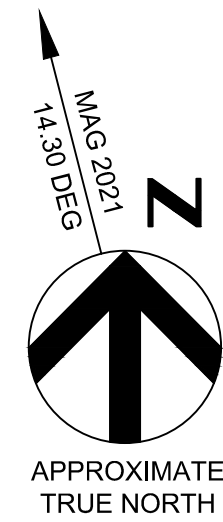
Additionally, the Project Boundary Maps presented with this license are updated to reflect Boott's proposal to remove the four mill power stations and associated canal infrastructure from the new FERC license.

Boott possesses the property and/or easement rights associated with all minor corrections and modifications, as well as all areas associated within the defined Project Boundary.

**Table G.1-1. Lowell Hydroelectric Project Exhibit G Project Boundary Drawings**

Exhibit No.	FERC Drawing No.
G-1	Project Boundary Map
G-2	Project Boundary Map
G-3	Project Boundary Map
G-4	Project Boundary Map
G-5	Project Boundary Map
G-6	Project Boundary Map

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**PROJECT BOUNDARY TIE DATA**  
 THE PROJECT BOUNDARY IS TIED TO MA/MIDDLESEX COUNTY GEODETIC SURVEY BENCHMARK PID MY2619: N: 3063259.0200 E: 704268.2800  
 TIE POINT 1: 665.04±, N 55d19'31.36" W  
 TYPINGS ISLAND - EXCEPTION A (SHEET G-2) IS TIED TO MA/MIDDLESEX COUNTY GEODETIC SURVEY BENCHMARK PID MY6227: N: 3059748.9700 E: 678786.3900  
 TIE POINT 54: 5662.4±, N 61d3'19.01" E

**REFERENCE COORDINATE METADATA**  
 PROJECTION - MASSACHUSETTS STATE PLANE  
 DATUM - NAD83, MAINLAND ZONE  
 UNITS - U.S. SURVEY FEET

**GEOREFERENCE SOURCE DATA**  
 DIGITIZED DATA: PICTOMETRY HIGH ACCURACY ORTHOIMAGERY <https://www.pictometry.com>  
 REPORTED ACCURACY EXCEEDING NMAS (12.3FT) 1:4800  
 LIDAR ELEVATION DATA:  
 • U.S. GEOLOGICAL SURVEY, 20140916, USGS LIDAR POINT CLOUD (LPC) ARRA-LFTNE, MASSACHUSETTS, 2011\_000107 2014-09-15 LAS: U.S. GEOLOGICAL SURVEY 2011 - 2012 FEMA RISKMAP LIDAR: MERRIMACK RIVER WATERSHED (NH, MA)  
 PROPERTY DATA: ATLANTIC ENGINEERING AND SURVEY CONSULTANTS, LOWELL CANAL SYSTEM, DATED MAY 23, 1983, ADDITIONAL DATA MASSGIS, LEVEL 3 PARCEL DATA, NATIONAL PARK SERVICE U.S. DEPT OF THE INTERIOR, NPS BOUNDARY, APRIL 2021, <https://public-nps.opendata.arcgis.com>  
 BOUNDARY DATA: FERC EXHIBIT G, BOOTT MILLS, DETAILED MAPS OF PROJECT AREAS, MAY 1980 INTERNATIONAL ENGINEERING CO., INC., TRANSMISSION CABLE LAYOUT DETAILS, APRIL 1983

**NOTES**  
 1. THE LICENSEE EITHER OWNS IN SIMPLE FEE OR POSSESSES FLOWAGE EASEMENTS OVER ALL LANDS WITHIN THE PROJECT BOUNDARY REQUIRED TO OPERATE THE FACILITY.  
 2. SEE EXHIBIT G-2 FOR PROJECT BOUNDARY TABLES.

**SURVEYORS STATEMENT**  
 I HEREBY CERTIFY TO THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) THAT THIS PLAN MEETS THE CONDITIONS SET FORTH BY FERC FOR ITS EXPRESSED PURPOSE. THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND DIGITAL REFERENCE SOURCES INCORPORATED INTO THE GEOGRAPHIC INFORMATION SYSTEM (GIS). LOCATIONS HAVE NOT BEEN VERIFIED BY PHYSICAL FIELD SURVEYS AND THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

**EXHIBIT G-1 SHEET 1 OF 6**

**LOWELL HYDROELECTRIC PROJECT  
 BOOTT MILLS  
 PROJECT BOUNDARY MAP**

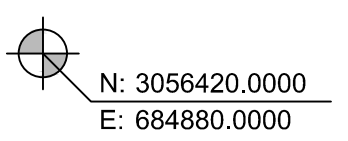
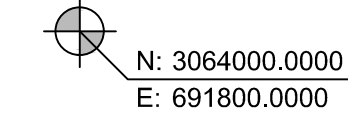
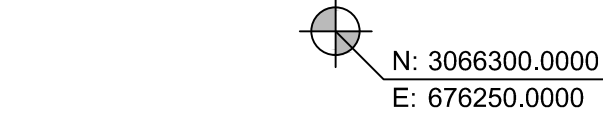
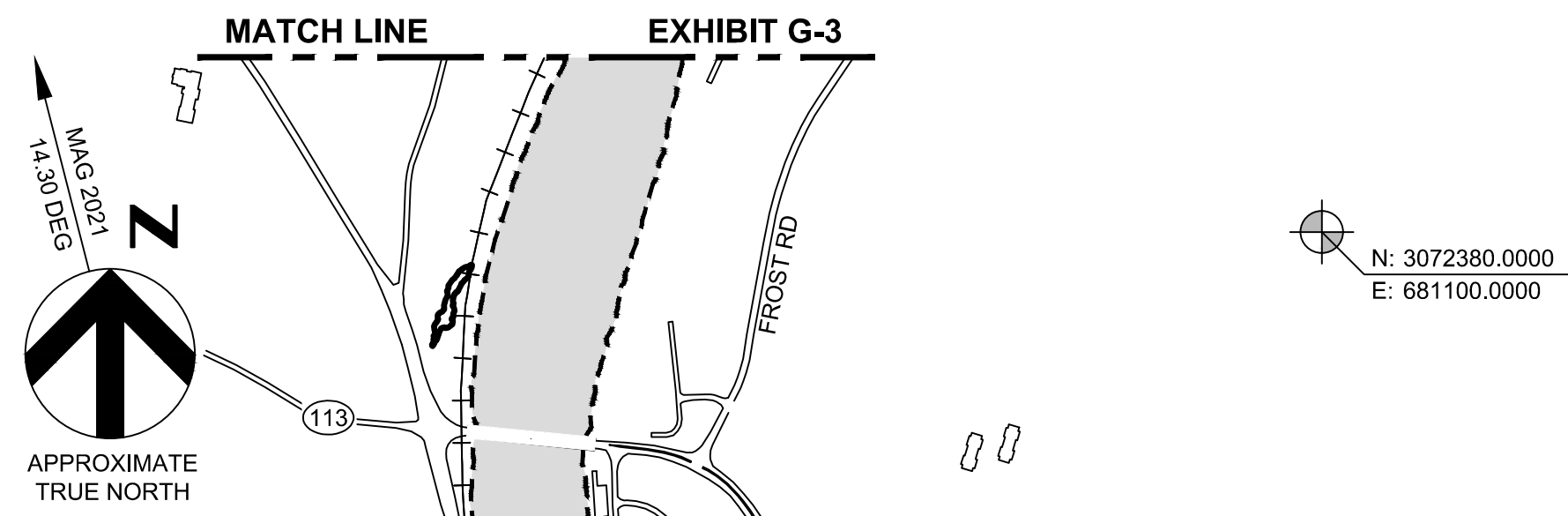
**BOOTT HYDROPOWER, LLC FERC No. 2790**

DATE: MAY 2021 SCALE: 1"=400' APPROVED: PENDING

**LEGEND**

	EASEMENT LAND
	LOWELL NATIONAL HISTORICAL PARK
	PROJECT BOUNDARY POINT NUMBER
	PROJECT BOUNDARY
	POLITICAL BOUNDARY
	SHORELINE/STREAM
	TRANSMISSION LINE
	FENCE
	RAILROAD LINE
	ROADS

CAD FILENAME: P-2790-XXXX-G-1-PROJECT BOUNDARY MAP-XX-XX-XXXX.DWG

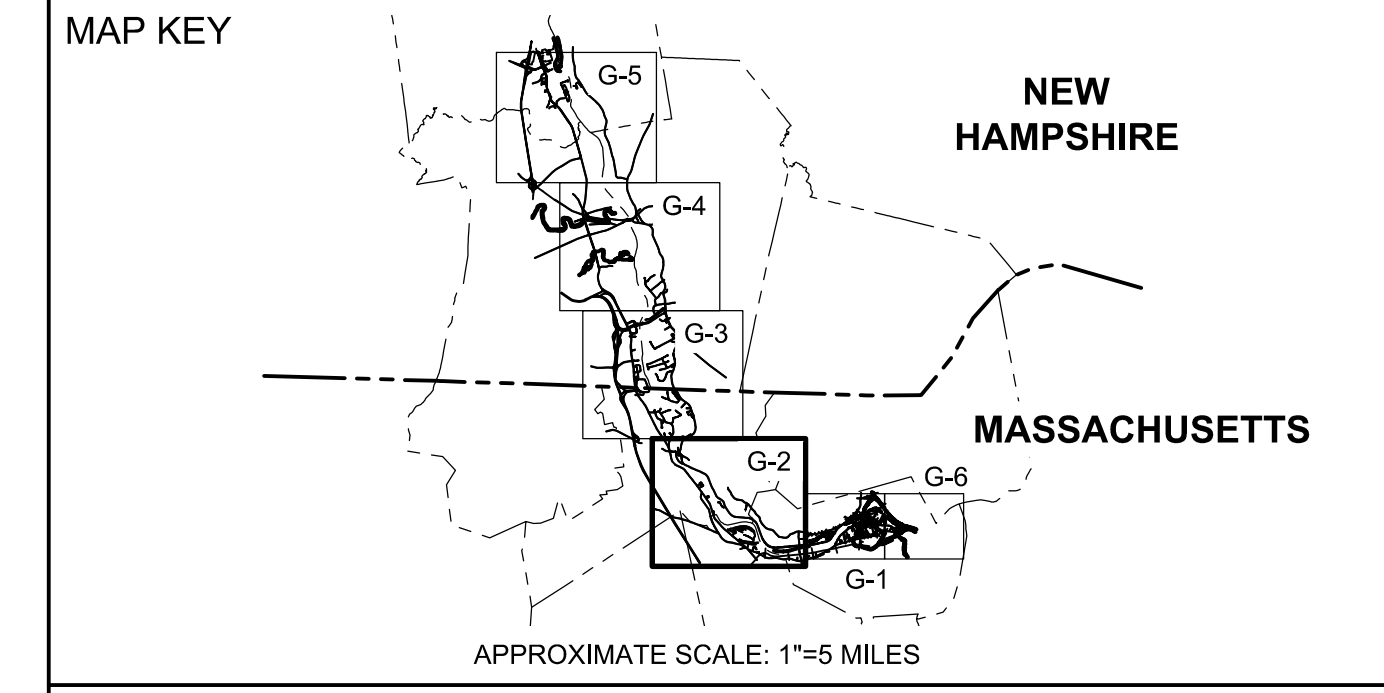
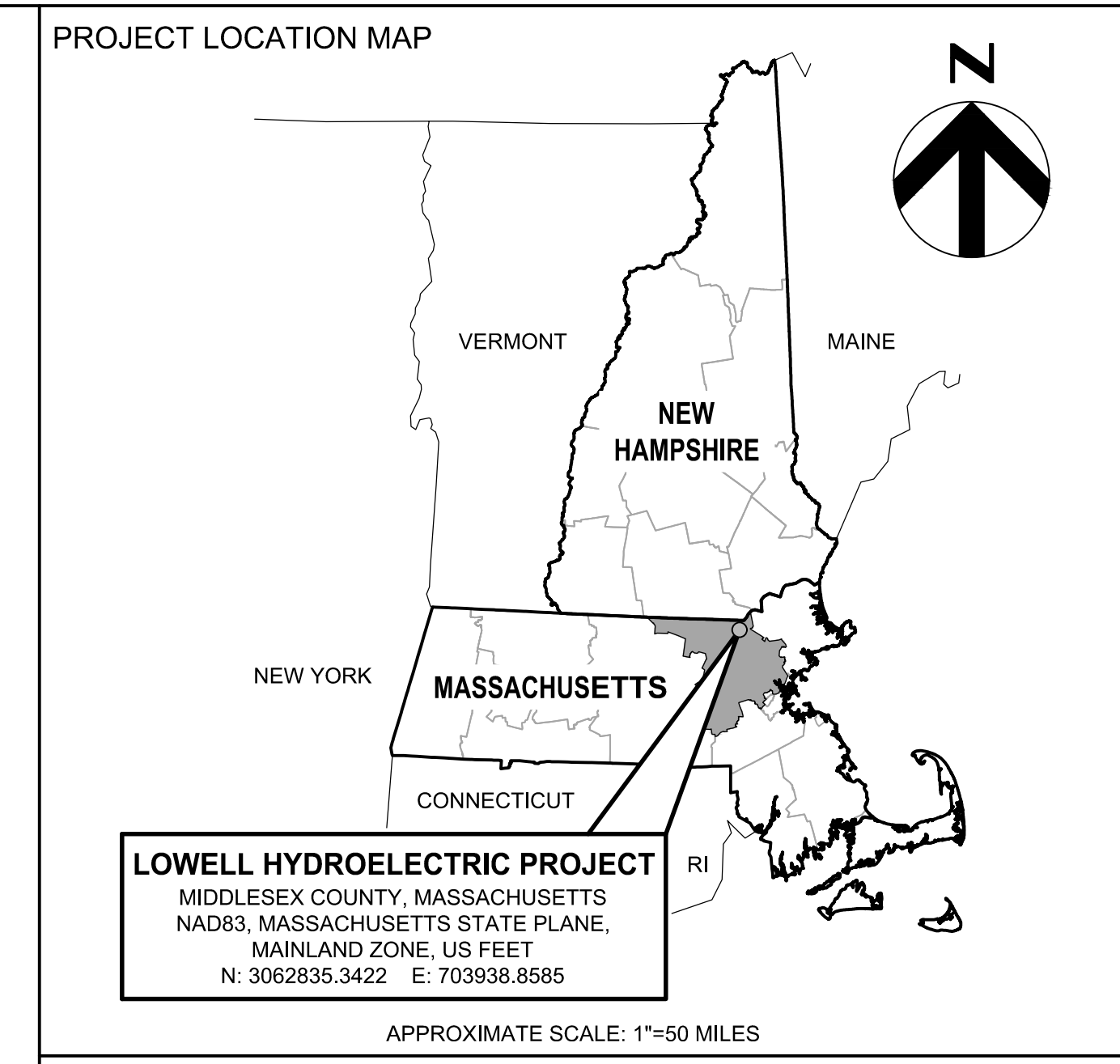


PROJECT BOUNDARY		
POINT	COURSE	DISTANCE (FT)
1-2	ALONG 92.2 CONTOUR	4032.96
2-3	S 73d10'14.95" W	111.12
3-4	S 64d11'53.49" W	8.77
4-5	N 16d49'45.05" W	9.22
5-6	S 73d10'14.95" W	16.96
6-7	S 16d49'45.05" E	9.35
7-8	S 73d10'14.95" W	28.26
8-9	N 32d49'45.05" W	1.28
9-10	S 57d10'14.95" W	4.48
10-11	ALONG 92.2 CONTOUR	101841.5
11-12	S 9d4'19.56" W	621.5
12-13	ALONG 92.2 CONTOUR	107226.5
13-14	S 61d30'46.66" W	16.45
14-15	S 28d42'32.00" E	88.79
15-16	S 27d6'12.00" E	88.85
16-17	S 3d54'52.00" E	51.47
17-18	N 82d56'5.00" E	170.02
18-19	N 11d0'40.00" W	253.76
19-20	S 71d8'11.20" W	41.38
20-21	ALONG 92.2 CONTOUR	4980.1
21-22	N 45d27'26.07" E	76.26
22-23	S 68d42'46.25" E	372.58
23-24	S 56d56'26.87" E	1611.66
24-25	S 32d53'28.91" W	340.58
25-26	S 31d40'47.34" E	162.69
26-27	S 56d40'47.34" E	1141.09
27-28	E	148.64
28-29	N 33d24'14.13" E	949.69
29-30	N 77d53'17.64" E	30.56

CONTINUED		
POINT	COURSE	DISTANCE (FT)
30-31	S 57d38'48.43" E	201.61
31-32	N 82d21'11.57" E	236.91
32-33	S 56d57'50.36" E	853.0
33-34	S 34d27'50.36" E	42.29
34-35	S 0d32'9.64" W	120.22
35-36	S 32d54'8.36" W	244.32
36-37	S 57d11'5.56" E	302.82
37-38	S 32d48'54.44" W	158.24
38-39	S 24d11'53.68" W	114.46
39-40	S 0d48'6.32" E	116.24
40-41	S 22d48'27.68" E	125.90
41-42	S 43d57'4.02" E	681.32
42-43	S 88d57'4.02" E	120.0
43-44	S 43d57'4.02" E	238.33
44-45	S 3d57'4.02" E	293.23
45-46	S 6d2'55.98" W	458.47
46-47	S 0d6'25.54" W	469.25
47-48	S 29d53'34.46" E	100.23
48-49	S 74d53'34.46" E	189.89
49-50	N 15d6'25.54" E	30.0
50-51	N 74d53'34.46" W	177.47
51-52	N 29d53'34.46" W	79.77
52-53	N 0d6'25.54" E	459.65
53-54	N 6d2'55.98" E	459.53
54-55	N 3d57'4.02" W	306.77
55-56	N 43d57'4.02" W	261.67
56-57	N 88d57'4.02" W	120.0
57-58	N 43d57'4.02" W	663.30
58-59	N 22d48'27.68" W	114.47

CONTINUED		
POINT	COURSE	DISTANCE (FT)
59-60	N 0d48'6.32" W	103.76
60-61	N 24d11'53.68" E	105.54
61-62	N 32d48'54.44" E	185.98
62-63	N 57d11'5.56" W	302.77
63-64	N 32d54'8.36" E	222.98
64-65	N 0d32'9.64" E	138.39
65-66	N 34d27'50.36" W	57.71
66-67	N 56d57'50.36" W	870.09
67-68	S 82d21'11.57" W	237.11
68-69	N 57d38'48.43" W	202.95
69-70	S 77d53'17.64" W	55.09
70-71	S 33d24'14.13" W	945.81
71-72	W	123.51
72-73	N 56d40'47.34" W	1125.47
73-74	N 31d40'47.34" W	137.08
74-75	N 32d53'28.91" E	351.54
75-76	N 56d56'26.87" W	1644.66
76-77	N 68d42'46.25" W	362.21
77-78	N 45d27'26.07" E	21.57
78-79	N 88d26'58.32" W	49.8
79-80	N 44d32'33.93" W	29.7
80-81	N 46d39'46.74" E	62.0
81-82	N 53d27'32.88" E	141.5
82-83	N 57d54'37.25" E	126.3
83-84	N 78d31'29.94" W	171.8
84-85	N 7d38'38.63" E	245.1
85-86	N 43d16'16.32" E	187.4
86-1	N 50d50'10.78" W	641.97

EXCEPTION A		
POINT	COURSE	DISTANCE (FT)
87-87	ALONG SHORELINE	8883.8



**PROJECT BOUNDARY TIE DATA**  
 THE PROJECT BOUNDARY IS TIED TO MA/MIDDLESEX COUNTY GEODETIC SURVEY BENCHMARK PID MY2619: N: 3063259.0200 E: 704268.2800  
 TIE POINT 1: 665.04±, N 55d19'31.36" W  
 TYNGS ISLAND - EXCEPTION A (SHEET G-2) IS TIED TO MA/MIDDLESEX COUNTY GEODETIC SURVEY BENCHMARK PID MY6227: N: 3059748.9700 E: 678786.3900  
 TIE POINT 54: 5662.4±, N 61d3'19.01" E

**REFERENCE COORDINATE METADATA**  
 PROJECTION - MASSACHUSETTS STATE PLANE  
 DATUM - NAD83, MAINLAND ZONE  
 UNITS - U.S. SURVEY FEET

**GEOREFERENCE SOURCE DATA**  
 DIGITIZED DATA: PICTOMETRY HIGH ACCURACY ORTHOIMAGERY <https://www.pictometry.com>  
 REPORTED ACCURACY EXCEEDING NMAS (12.3FT) 1:4800  
 LIDAR ELEVATION DATA:  
 • U.S. GEOLOGICAL SURVEY, 20140916, USGS LIDAR POINT CLOUD (LPC) ARRA-LFTNE, MASSACHUSETTS, 2011\_000107 2014-09-15 LAS: U.S. GEOLOGICAL SURVEY 2011 - 2012 FEMA RISKMAP LIDAR: MERRIMACK RIVER WATERSHED (NH, MA)  
 PROPERTY DATA: ATLANTIC ENGINEERING AND SURVEY CONSULTANTS, LOWELL CANAL SYSTEM, DATED MAY 23, 1983, ADDITIONAL DATA MASSGIS, LEVEL 3 PARCEL DATA, NATIONAL PARK SERVICE  
 U.S. DEPT OF THE INTERIOR, NPS BOUNDARY, APRIL 2021, <https://public-nps.opendata.arcgis.com>  
 BOUNDARY DATA: FERC EXHIBIT G, BOOTT MILLS, DETAILED MAPS OF PROJECT AREAS, MAY 1980  
 INTERNATIONAL ENGINEERING CO. INC., TRANSMISSION CABLE LAYOUT DETAILS, APRIL 1983

**NOTES**  
 1. THE LICENSEE EITHER OWNS IN SIMPLE FEE OR POSSESSES FLOWAGE EASEMENTS OVER ALL LANDS WITHIN THE PROJECT BOUNDARY REQUIRED TO OPERATE THE FACILITY.  
 2. SEE EXHIBIT G-2 FOR PROJECT BOUNDARY TABLES.

**SURVEYORS STATEMENT**  
 I HEREBY CERTIFY TO THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) THAT THIS PLAN MEETS THE CONDITIONS SET FORTH BY FERC FOR ITS EXPRESSED PURPOSE. THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND DIGITAL REFERENCE SOURCES INCORPORATED INTO THE GEOGRAPHIC INFORMATION SYSTEM (GIS). LOCATIONS HAVE NOT BEEN VERIFIED BY PHYSICAL FIELD SURVEYS AND THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

**EXHIBIT G-2 SHEET 2 OF 6**

**LOWELL HYDROELECTRIC PROJECT PROJECT BOUNDARY MAP**

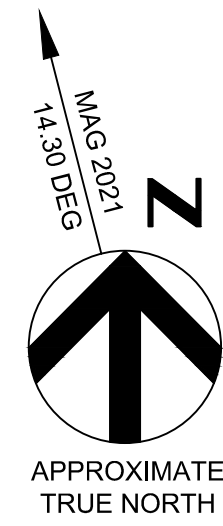
**BOOTT HYDROPOWER, LLC FERC No. 2790**

DATE: MAY 2021 SCALE: 1"=800' APPROVED: PENDING

**LEGEND**

	EASEMENT LAND
	LOWELL NATIONAL HISTORICAL PARK
	PROJECT BOUNDARY POINT NUMBER
	PROJECT BOUNDARY
	POLITICAL BOUNDARY
	SHORELINE/STREAM
	TRANSMISSION LINE
	FENCE
	RAILROAD LINE
	ROADS

CAD FILENAME: P-2790-XXXX\_G-2\_PROJECT BOUNDARY MAP\_XX-XX-XXXX.DWG



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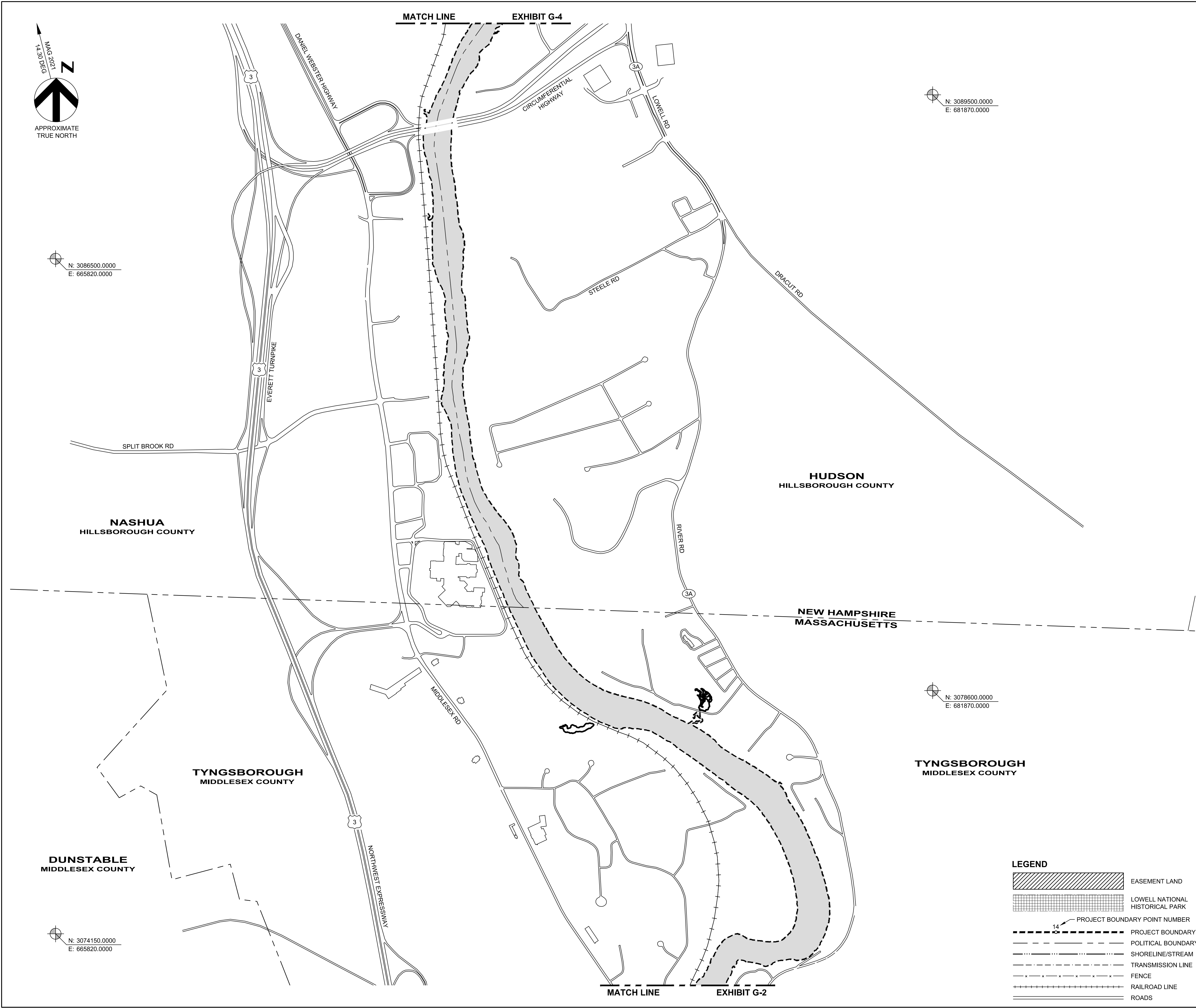
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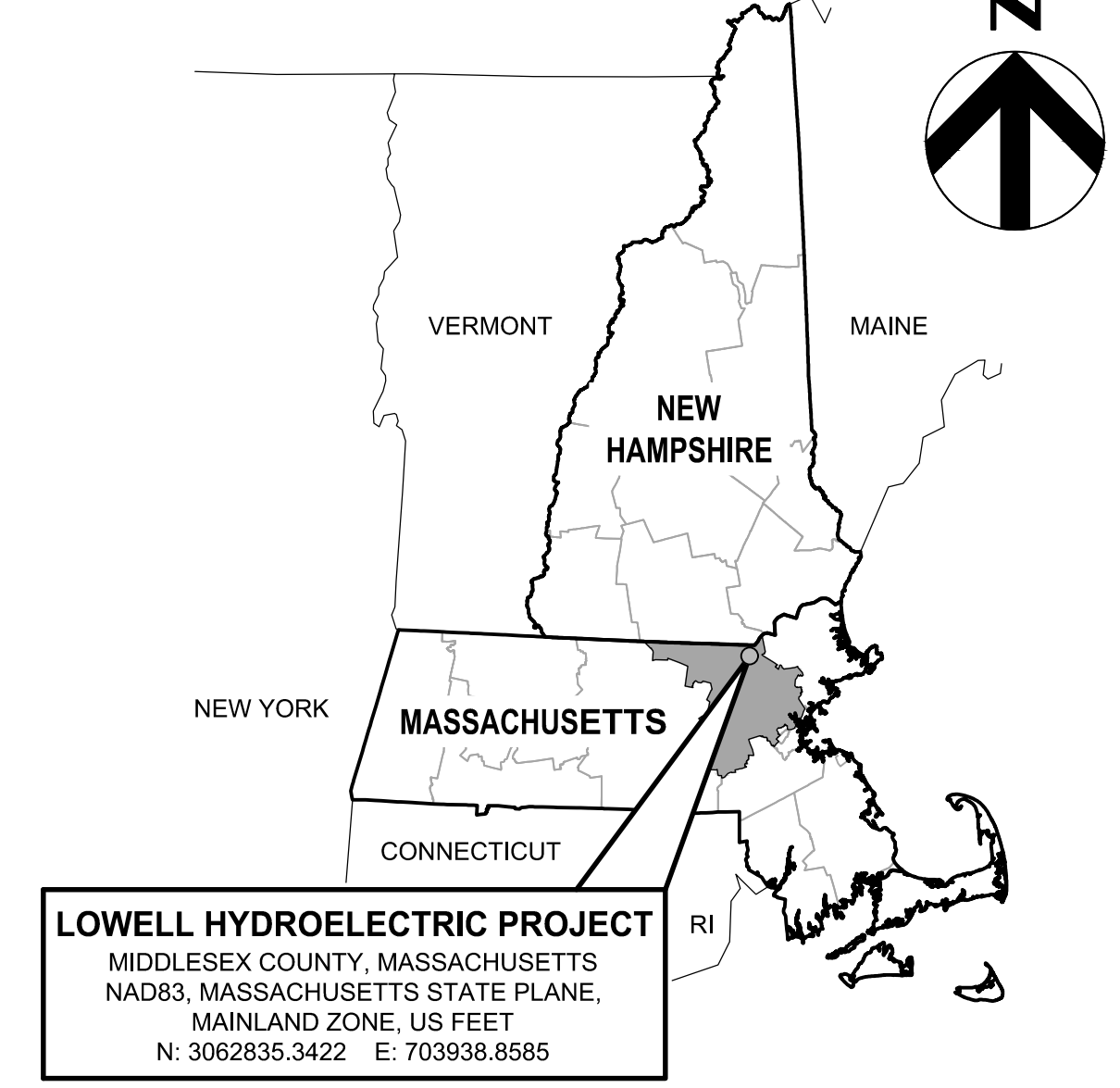
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MATCH LINE EXHIBIT G-4

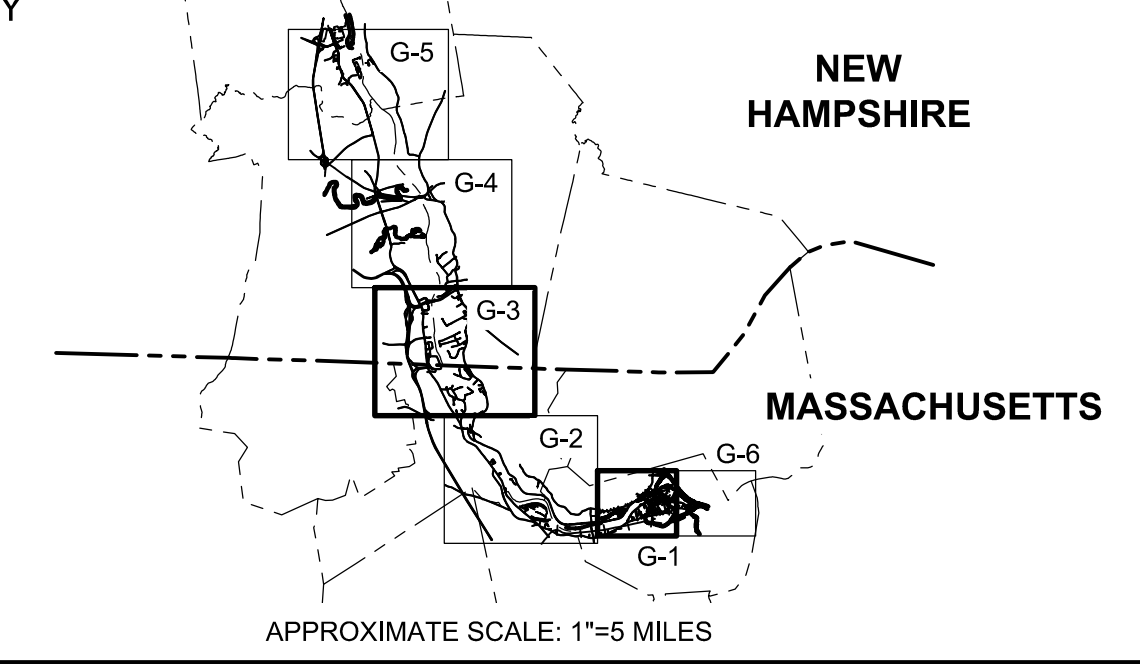
MATCH LINE EXHIBIT G-2



PROJECT LOCATION MAP



MAP KEY



**PROJECT BOUNDARY TIE DATA**  
THE PROJECT BOUNDARY IS TIED TO MA/MIDDLESEX COUNTY GEODETIC SURVEY  
BENCHMARK PID MY2619: N: 3063259.0200 E: 704268.2800  
TIE POINT 1: 665.04±, N 55°19'31.36\" W  
TYNGS ISLAND - EXCEPTION A (SHEET G-2) IS TIED TO MA/MIDDLESEX COUNTY GEODETIC SURVEY  
BENCHMARK PID MY6227: N: 3059748.9700 E: 678786.3900  
TIE POINT 54: 5662.4±, N 61°43'19.01\" E

**REFERENCE COORDINATE METADATA**  
PROJECTION - MASSACHUSETTS STATE PLANE  
DATUM - NAD83, MAINLAND ZONE  
UNITS - U.S. SURVEY FEET

**GEOREFERENCE SOURCE DATA**  
DIGITIZED DATA: PICTOMETRY HIGH ACCURACY ORTHOIMAGERY <https://www.pictometry.com>  
REPORTED ACCURACY EXCEEDING NMAS (12.3FT) 1:4800  
LIDAR ELEVATION DATA:  
• U.S. GEOLOGICAL SURVEY, 20140916, USGS LIDAR POINT CLOUD (LPC) ARRA-LFTNE, MASSACHUSETTS, 2011\_000107 2014-09-15 LAS: U.S. GEOLOGICAL SURVEY 2011 - 2012 FEMA RISKMAP LIDAR: MERRIMACK RIVER WATERSHED (NH, MA)  
PROPERTY DATA: ATLANTIC ENGINEERING AND SURVEY CONSULTANTS, LOWELL CANAL SYSTEM, DATED MAY 23, 1983, ADDITIONAL DATA MASSGIS, LEVEL 3 PARCEL DATA, NATIONAL PARK SERVICE U.S. DEPT OF THE INTERIOR, NPS BOUNDARY, APRIL 2021, <https://public-nps.opendata.arcgis.com>  
BOUNDARY DATA: FERC EXHIBIT G, BOOTT MILLS, DETAILED MAPS OF PROJECT AREAS, MAY 1980 INTERNATIONAL ENGINEERING CO. INC., TRANSMISSION CABLE LAYOUT DETAILS, APRIL 1983

**NOTES**  
1. THE LICENSEE EITHER OWNS IN SIMPLE FEE OR POSSESSES FLOWAGE EASEMENTS OVER ALL LANDS WITHIN THE PROJECT BOUNDARY REQUIRED TO OPERATE THE FACILITY.  
2. SEE EXHIBIT G-2 FOR PROJECT BOUNDARY TABLES.

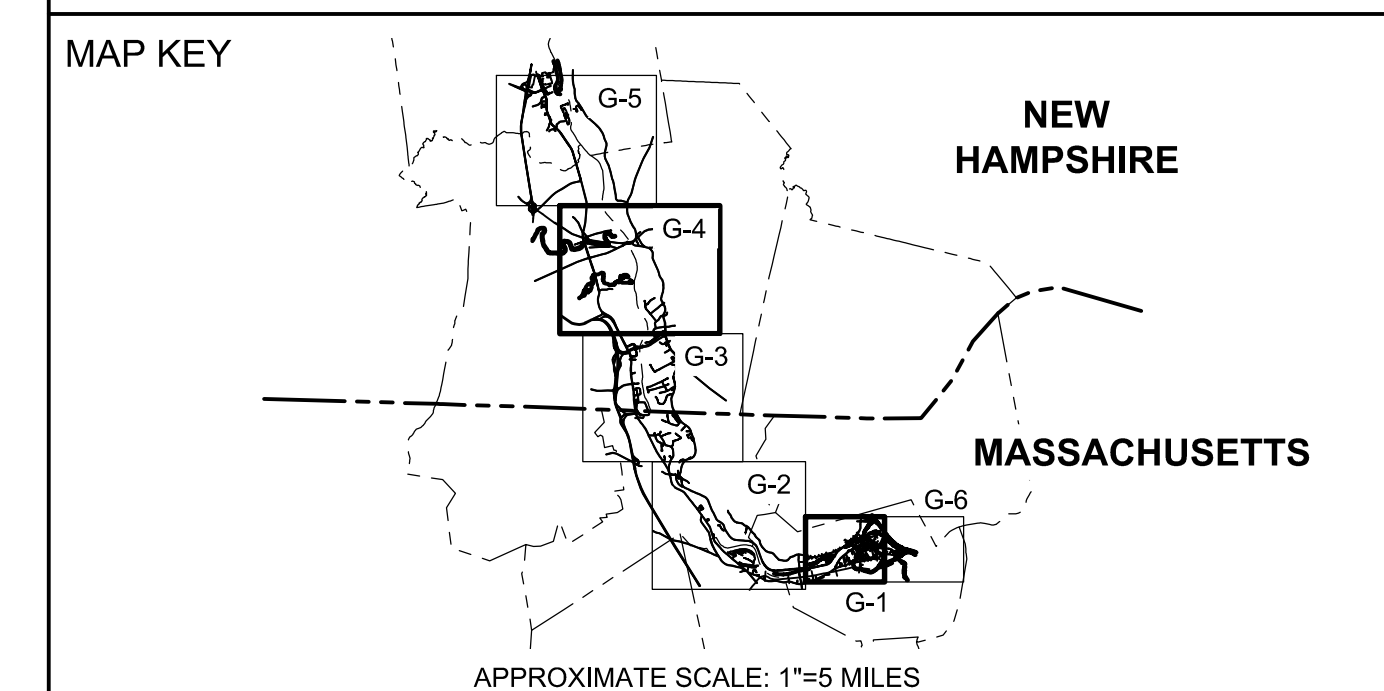
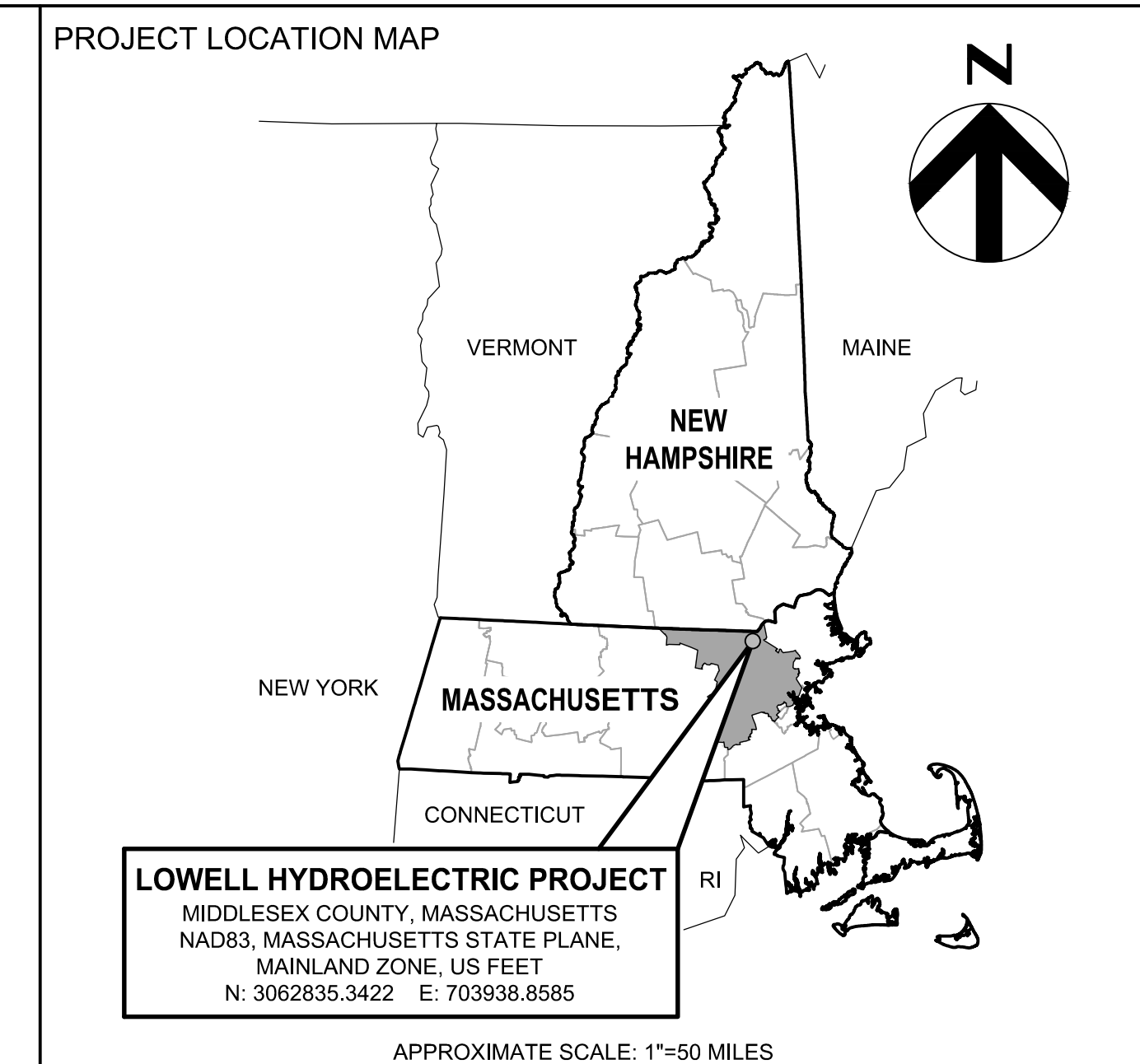
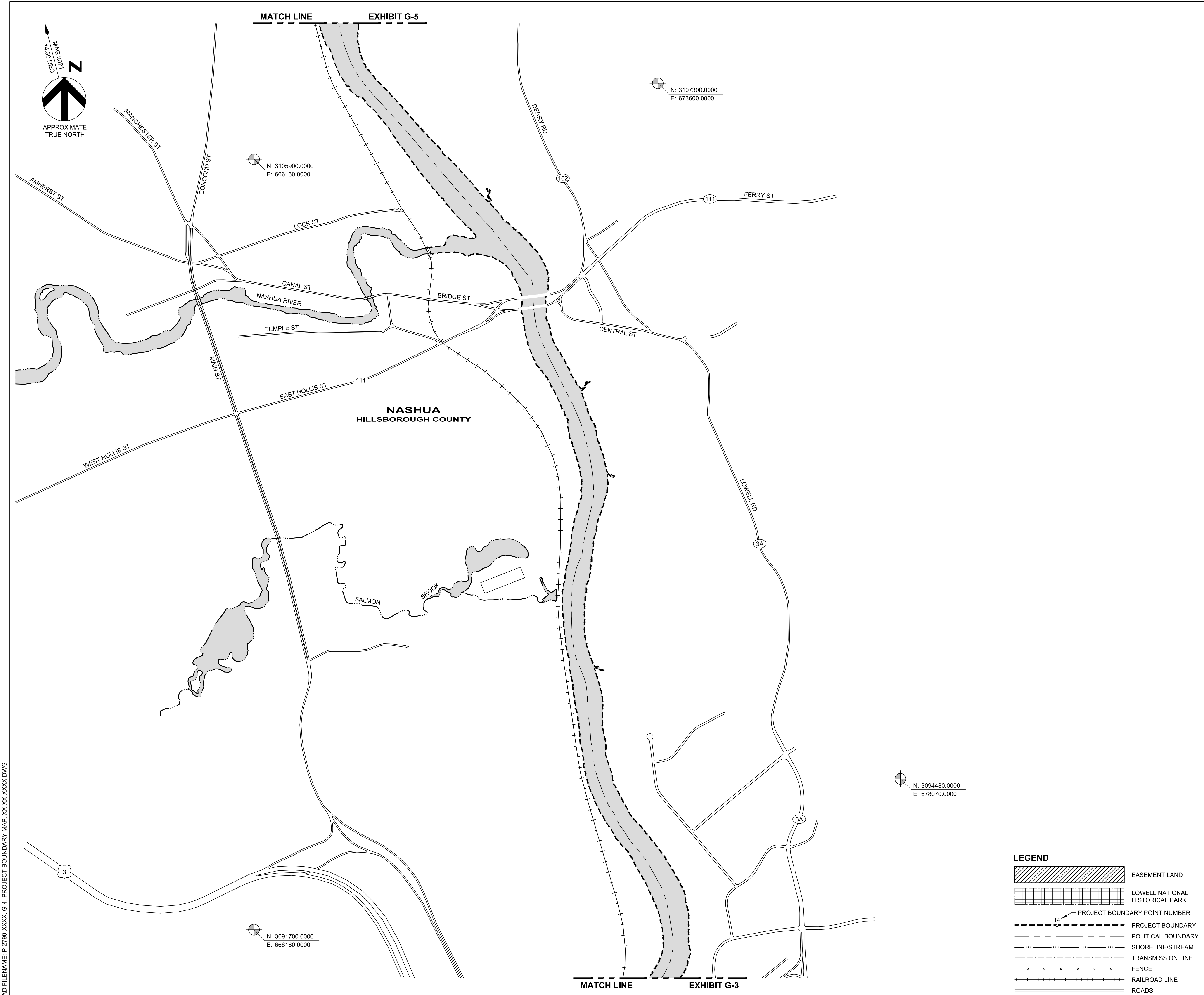
**SURVEYORS STATEMENT**  
I HEREBY CERTIFY TO THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) THAT THIS PLAN MEETS THE CONDITIONS SET FORTH BY FERC FOR ITS EXPRESSED PURPOSE. THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND DIGITAL REFERENCE SOURCES INCORPORATED INTO THE GEOGRAPHIC INFORMATION SYSTEM (GIS). LOCATIONS HAVE NOT BEEN VERIFIED BY PHYSICAL FIELD SURVEYS AND THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

**EXHIBIT G-3 SHEET 3 OF 6**  
**LOWELL HYDROELECTRIC PROJECT PROJECT BOUNDARY MAP**  
800 400 0 800 1600 2400 3200  
**BOOTT HYDROPOWER, LLC FERC No. 2790**  
DATE: MAY 2021 SCALE: 1"=800' APPROVED: PENDING

**LEGEND**

	EASEMENT LAND
	LOWELL NATIONAL HISTORICAL PARK
	PROJECT BOUNDARY POINT NUMBER
	PROJECT BOUNDARY
	POLITICAL BOUNDARY
	SHORELINE/STREAM
	TRANSMISSION LINE
	FENCE
	RAILROAD LINE
	ROADS

CAD FILENAME: P-2790-XXXX\_G-3\_PROJECT BOUNDARY MAP\_XX-XX-XXXX.DWG



**PROJECT BOUNDARY TIE DATA**

THE PROJECT BOUNDARY IS TIED TO MA/MIDDLESEX COUNTY GEODETIC SURVEY

BENCHMARK PID MY2619: N: 3063259.0200 E: 704268.2800

TIE POINT 1: 665.04±, N 55d19'31.36" W

TYNGS ISLAND - EXCEPTION A (SHEET G-2) IS TIED TO MA/MIDDLESEX COUNTY GEODETIC SURVEY

BENCHMARK PID MY6227: N: 3059748.9700 E: 678786.3900

TIE POINT 54: 5662.4±, N 61d3'19.01" E

**REFERENCE COORDINATE METADATA**

PROJECTION - MASSACHUSETTS STATE PLANE

DATUM - NAD83, MAINLAND ZONE

UNITS - U.S. SURVEY FEET

**GEOREFERENCE SOURCE DATA**

DIGITIZED DATA: PICTOMETRY HIGH ACCURACY ORTHOIMAGERY <https://www.pictometry.com>

REPORTED ACCURACY EXCEEDING NMAS (12.3FT) 1:4800

LIDAR ELEVATION DATA:

- U.S. GEOLOGICAL SURVEY, 20140916, USGS LIDAR POINT CLOUD (LPC) ARRA-LFTNE, MASSACHUSETTS, 2011\_000107 2014-09-15 LAS: U.S. GEOLOGICAL SURVEY 2011 - 2012 FEMA RISKMAP LIDAR: MERRIMACK RIVER WATERSHED (NH, MA)

PROPERTY DATA: ATLANTIC ENGINEERING AND SURVEY CONSULTANTS, LOWELL CANAL SYSTEM, DATED MAY 23, 1983, ADDITIONAL DATA MASSGIS, LEVEL 3 PARCEL DATA, NATIONAL PARK SERVICE U.S. DEPT OF THE INTERIOR, NPS BOUNDARY, APRIL 2021, <https://public-nps.opendata.arcgis.com>

BOUNDARY DATA: FERC EXHIBIT G, BOOTT MILLS, DETAILED MAPS OF PROJECT AREAS, MAY 1980

INTERNATIONAL ENGINEERING CO. INC., TRANSMISSION CABLE LAYOUT DETAILS, APRIL 1983

**NOTES**

- THE LICENSEE EITHER OWNS IN SIMPLE FEE OR POSSESSES FLOWAGE EASEMENTS OVER ALL LANDS WITHIN THE PROJECT BOUNDARY REQUIRED TO OPERATE THE FACILITY.
- SEE EXHIBIT G-2 FOR PROJECT BOUNDARY TABLES.

**SURVEYORS STATEMENT**

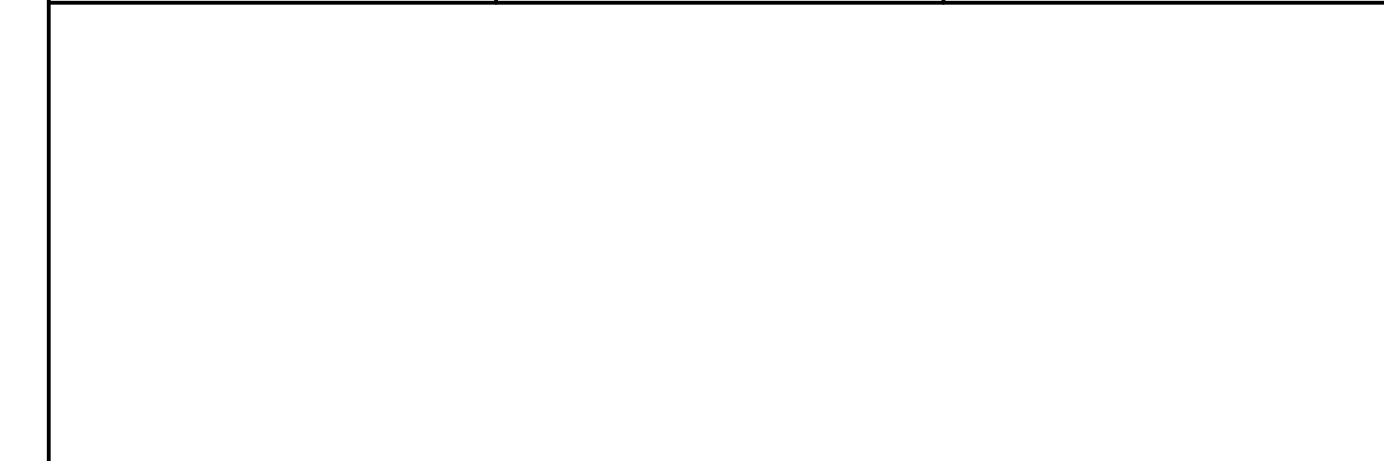
I HEREBY CERTIFY TO THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) THAT THIS PLAN MEETS THE CONDITIONS SET FORTH BY FERC FOR ITS EXPRESSED PURPOSE. THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND DIGITAL REFERENCE SOURCES INCORPORATED INTO THE GEOGRAPHIC INFORMATION SYSTEM (GIS). LOCATIONS HAVE NOT BEEN VERIFIED BY PHYSICAL FIELD SURVEYS AND THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

**EXHIBIT G-4 SHEET 4 OF 6**

**LOWELL HYDROELECTRIC PROJECT PROJECT BOUNDARY MAP**

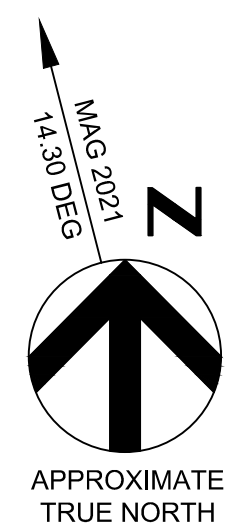
**BOOTT HYDROPOWER, LLC FERC No. 2790**

DATE: MAY 2021 SCALE: 1"=800' APPROVED: PENDING



CAD FILENAME: P-2790-XXXX-G4 - PROJECT BOUNDARY MAP-XX-XX-XXXX.DWG





MERRIMACK  
HILLSBOROUGH COUNTY

BUDWEISER  
BREWERY

LITCHFIELD  
HILLSBOROUGH COUNTY

N: 3123800.0000  
E: 665100.0000

N: 3123000.0000  
E: 655000.0000

MERRIMACK  
TECHNOLOGY  
PARK

EVERETT TURNPIKE

INDUSTRIAL DR

DANIEL WEBSTER HIGHWAY

CHARLES BAMCROFT HIGHWAY

LITCHFIELD  
HILLSBOROUGH COUNTY

PROJECT BOUNDARY  
92.2 CONTOUR

MERRIMACK  
HILLSBOROUGH COUNTY

HUDSON  
HILLSBOROUGH COUNTY


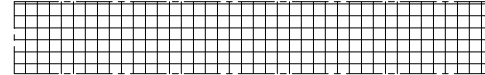

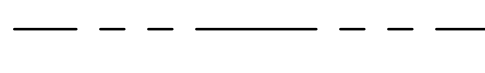
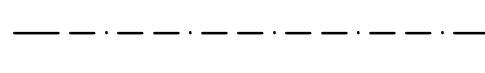
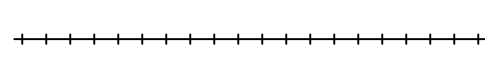
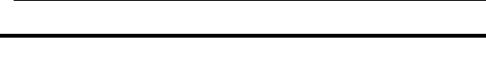

NASHUA  
HILLSBOROUGH COUNTY

DERRY RD

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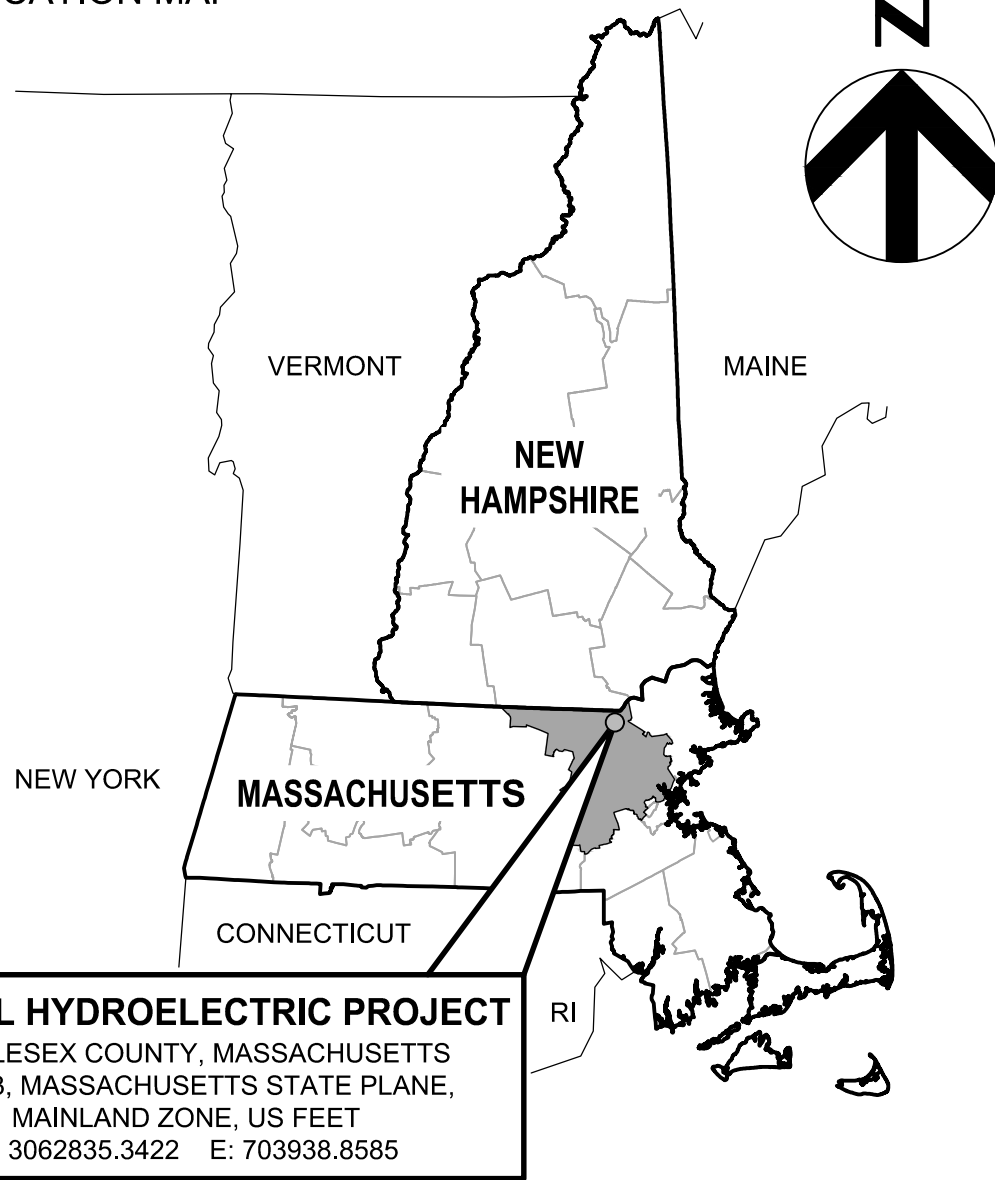
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**LEGEND**

-  EASEMENT LAND
-  LOWELL NATIONAL HISTORICAL PARK
-  PROJECT BOUNDARY POINT NUMBER
-  PROJECT BOUNDARY
-  POLITICAL BOUNDARY
-  SHORELINE/STREAM
-  TRANSMISSION LINE
-  FENCE
-  RAILROAD LINE
-  ROADS

MATCH LINE EXHIBIT G-4

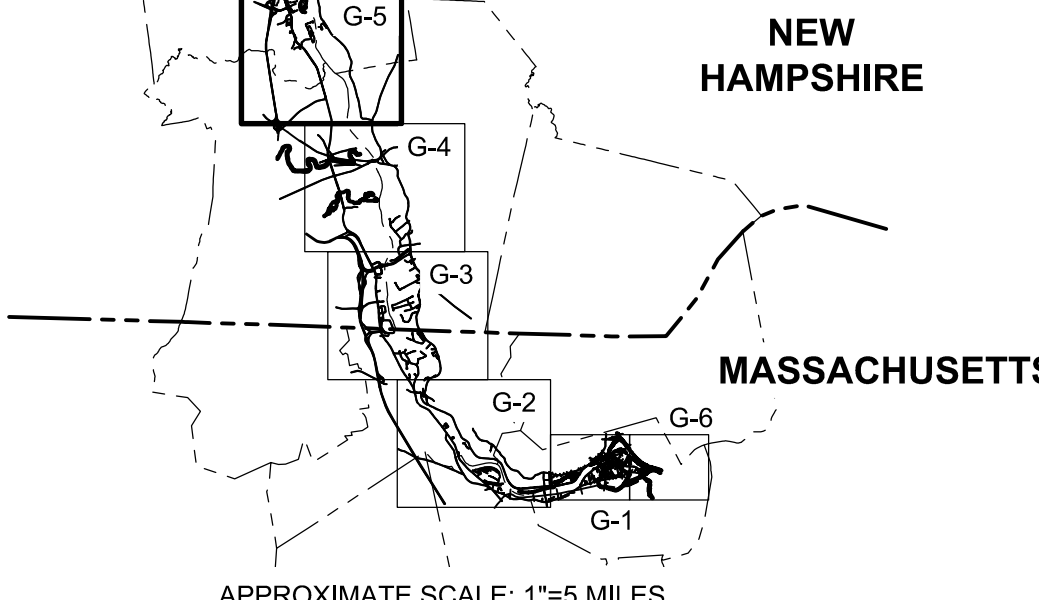
**PROJECT LOCATION MAP**



**LOWELL HYDROELECTRIC PROJECT**  
MIDDLESEX COUNTY, MASSACHUSETTS  
NAD83, MASSACHUSETTS STATE PLANE,  
MAINLAND ZONE, US FEET  
N: 3062835.3422 E: 703938.8585

APPROXIMATE SCALE: 1"=50 MILES

**MAP KEY**



APPROXIMATE SCALE: 1"=5 MILES

**PROJECT BOUNDARY TIE DATA**

THE PROJECT BOUNDARY IS TIED TO MA/MIDDLESEX COUNTY GEODETIC SURVEY  
BENCHMARK PID MY2619: N: 3063259.0200 E: 704268.2800  
TIE POINT 1: 665.04±, N 55d19'31.36" W  
TYNGS ISLAND - EXCEPTION A (SHEET G-2) IS TIED TO MA/MIDDLESEX COUNTY GEODETIC SURVEY  
BENCHMARK PID MY6227: N: 3059748.9700 E: 678786.3900  
TIE POINT 54: 5662.4±, N 61d3'19.01" E

**REFERENCE COORDINATE METADATA**

PROJECTION - MASSACHUSETTS STATE PLANE  
DATUM - NAD83, MAINLAND ZONE  
UNITS - U.S. SURVEY FEET

**GEOREFERENCE SOURCE DATA**

DIGITIZED DATA: PICTOMETRY HIGH ACCURACY ORTHOIMAGERY <https://www.pictometry.com>  
REPORTED ACCURACY EXCEEDING NMAS (12.3FT) 1:4800  
LIDAR ELEVATION DATA:  
• U.S. GEOLOGICAL SURVEY, 20140916, USGS LIDAR POINT CLOUD (LPC)  
ARRA-LFTNE, MASSACHUSETTS, 2011\_000107 2014-09-15 LAS: U.S. GEOLOGICAL SURVEY  
2011 - 2012 FEMA RISKMAP LIDAR: MERRIMACK RIVER WATERSHED (NH, MA)  
PROPERTY DATA: ATLANTIC ENGINEERING AND SURVEY CONSULTANTS, LOWELL CANAL SYSTEM,  
DATED MAY 23, 1983, ADDITIONAL DATA MASSGIS, LEVEL 3 PARCEL DATA, NATIONAL PARK SERVICE  
U.S. DEPT OF THE INTERIOR, NPS BOUNDARY, APRIL 2021, <https://public-nps.opendata.arcgis.com>  
BOUNDARY DATA: FERC EXHIBIT G, BOOTT MILLS, DETAILED MAPS OF PROJECT AREAS, MAY 1980  
INTERNATIONAL ENGINEERING CO. INC., TRANSMISSION CABLE LAYOUT DETAILS, APRIL 1983

**NOTES**

1. THE LICENSEE EITHER OWNS IN SIMPLE FEE OR POSSESSES FLOWAGE EASEMENTS OVER ALL LANDS WITHIN THE PROJECT BOUNDARY REQUIRED TO OPERATE THE FACILITY.
2. SEE EXHIBIT G-2 FOR PROJECT BOUNDARY TABLES.

**SURVEYORS STATEMENT**

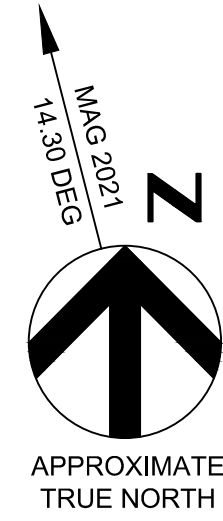
I HEREBY CERTIFY TO THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) THAT THIS PLAN MEETS THE CONDITIONS SET FORTH BY FERC FOR ITS EXPRESSED PURPOSE. THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND DIGITAL REFERENCE SOURCES INCORPORATED INTO THE GEOGRAPHIC INFORMATION SYSTEM (GIS). LOCATIONS HAVE NOT BEEN VERIFIED BY PHYSICAL FIELD SURVEYS AND THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

**EXHIBIT G-5 SHEET 5 OF 6**

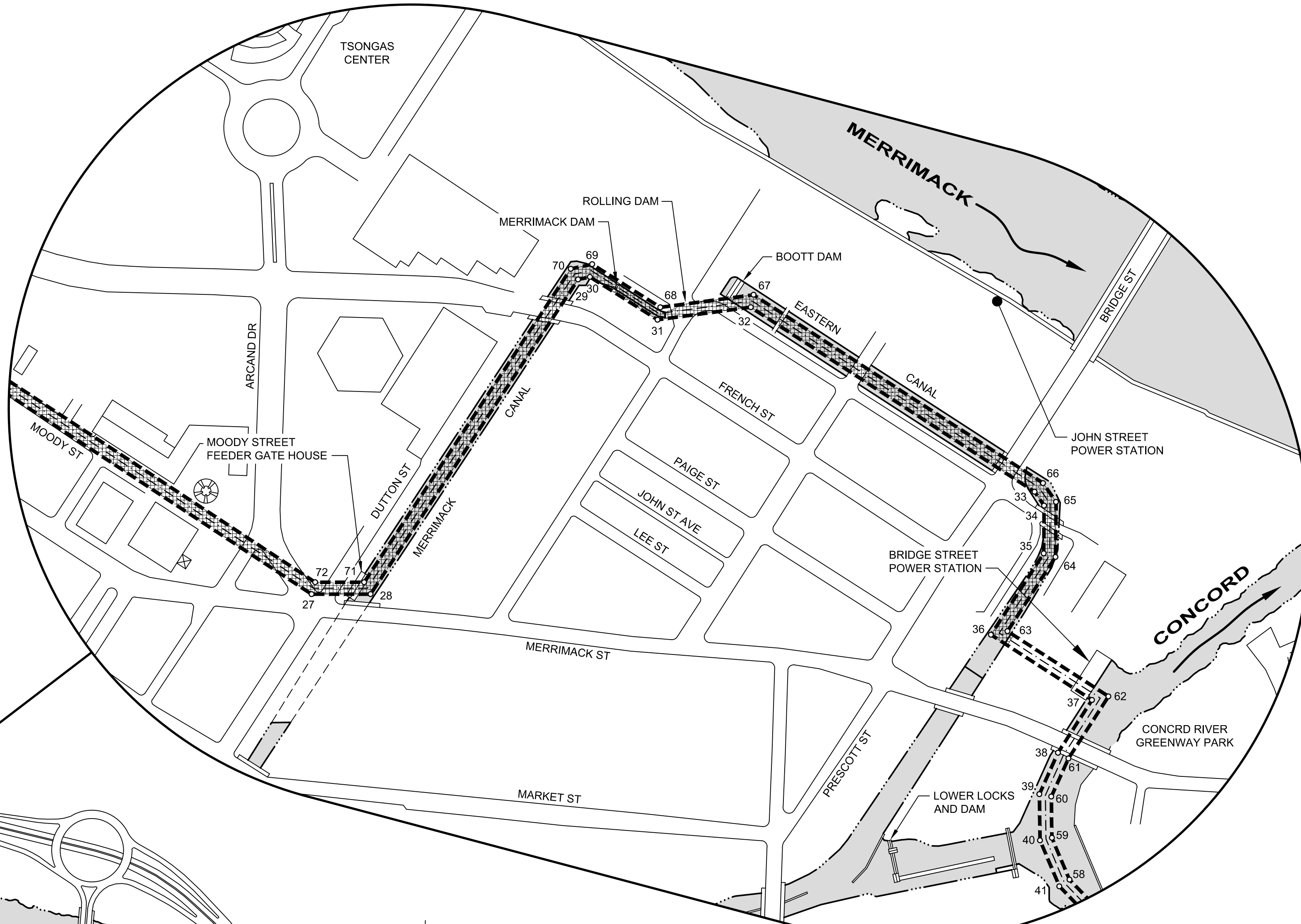
**LOWELL HYDROELECTRIC PROJECT  
PROJECT BOUNDARY MAP**

BOOTT HYDROPOWER, LLC FERC No. 2790

DATE: MAY 2021 SCALE: 1"=800' APPROVED: PENDING

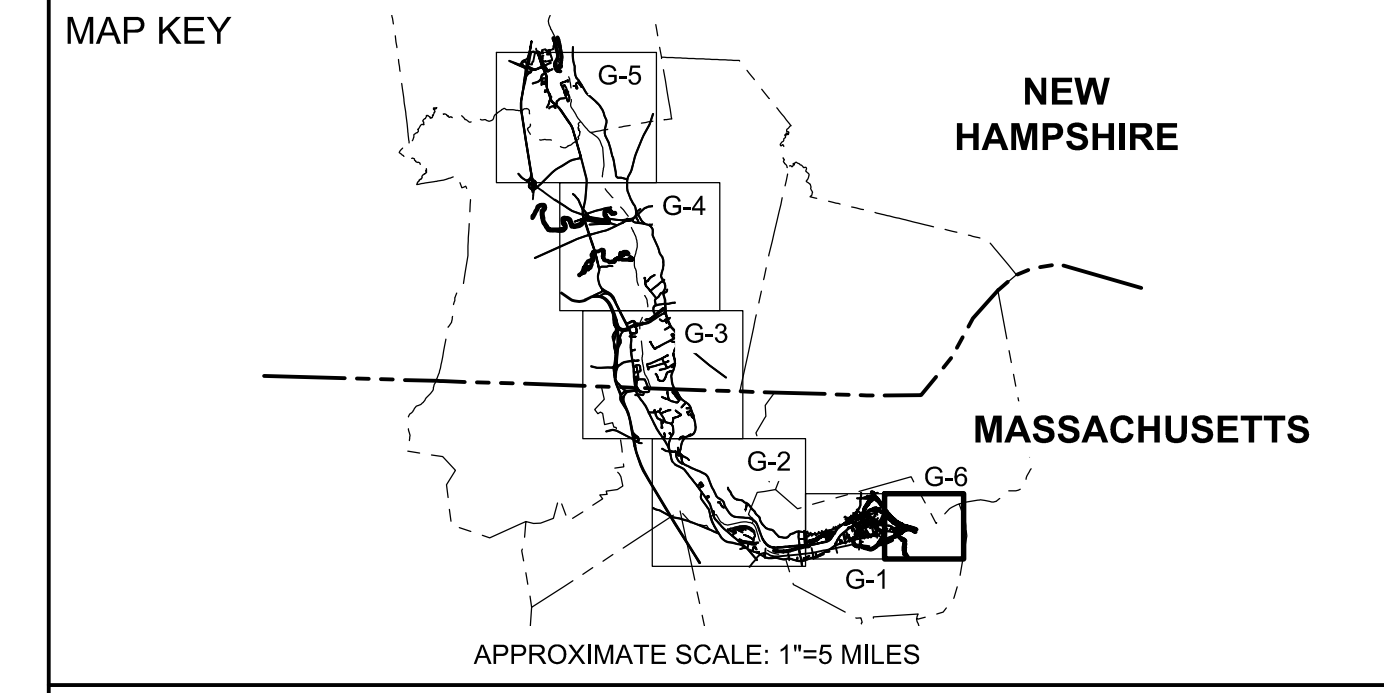
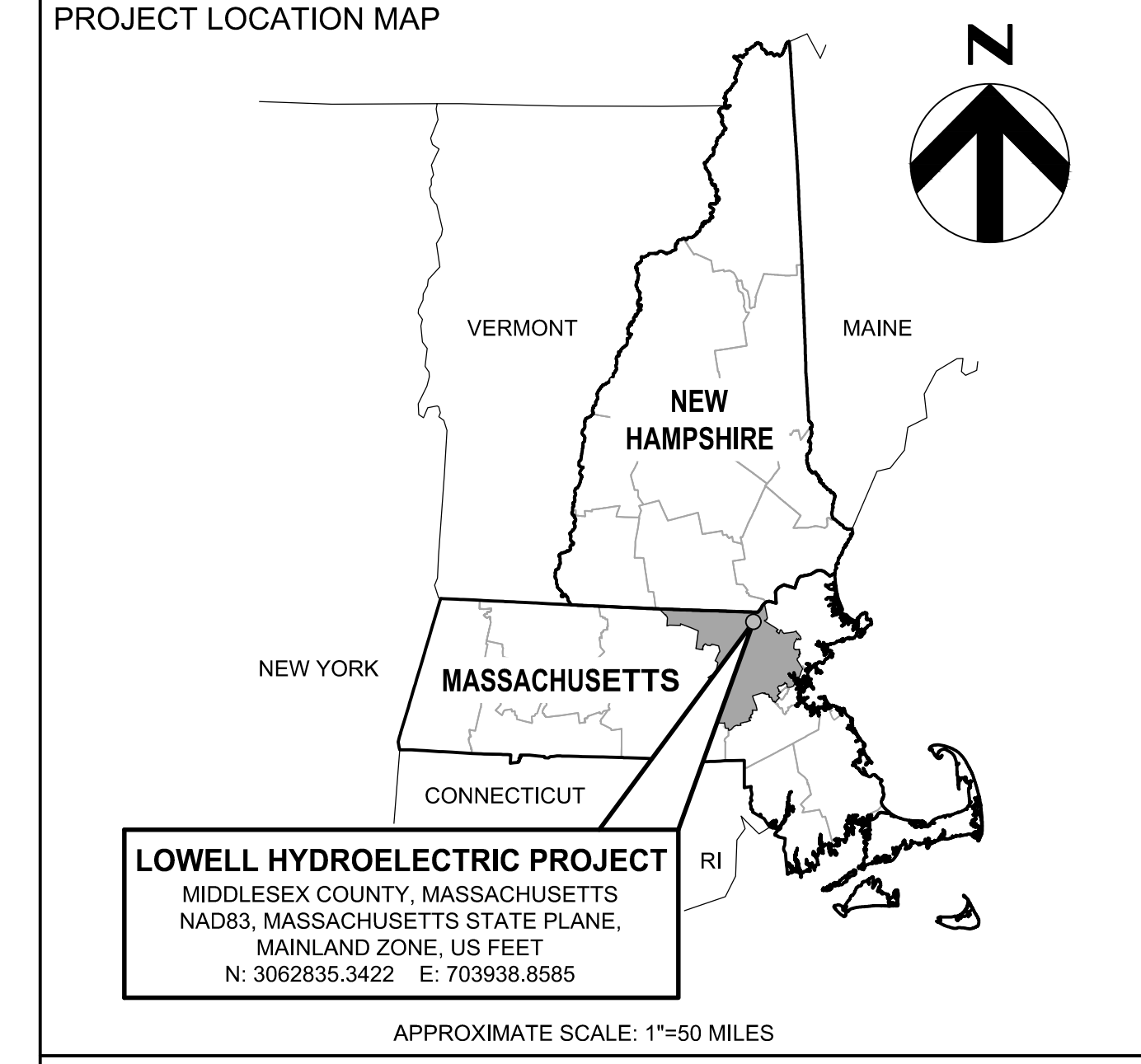


N: 3064350.0000  
E: 706980.0000



N: 3060880.0000  
E: 711900.0000

**ENLARGEMENT MAP**  
SCALE: 1"=200'



**PROJECT BOUNDARY TIE DATA**  
THE PROJECT BOUNDARY IS TIED TO MA MIDDLESEX COUNTY GEODETIC SURVEY  
BENCHMARK PID MY2619: N: 3063259.0200 E: 704268.2800  
TIE POINT 1: 665.04±, N 55°19'31.36" W  
TYNGS ISLAND - EXCEPTION A (SHEET G-2) IS TIED TO MA MIDDLESEX COUNTY GEODETIC SURVEY  
BENCHMARK PID MY6227: N: 3059748.9700 E: 678786.3900  
TIE POINT 54: 5662.4±, N 61°3'19.01" E

**REFERENCE COORDINATE METADATA**  
PROJECTION - MASSACHUSETTS STATE PLANE  
DATUM - NAD83, MAINLAND ZONE  
UNITS - U.S. SURVEY FEET

**GEOREFERENCE SOURCE DATA**  
DIGITIZED DATA: PICTOMETRY HIGH ACCURACY ORTHOIMAGERY <https://www.pictometry.com>  
REPORTED ACCURACY EXCEEDING NMAS (12.3FT) 1:4800  
LIDAR ELEVATION DATA:  
• U.S. GEOLOGICAL SURVEY, 20140916, USGS LIDAR POINT CLOUD (LPC) ARRA-LFTNE, MASSACHUSETTS, 2011\_000107 2014-09-15 LAS: U.S. GEOLOGICAL SURVEY 2011 - 2012 FEMA RISKMAP LIDAR: MERRIMACK RIVER WATERSHED (NH, MA)  
PROPERTY DATA: ATLANTIC ENGINEERING AND SURVEY CONSULTANTS, LOWELL CANAL SYSTEM, DATED MAY 23, 1983, ADDITIONAL DATA MASSGIS, LEVEL 3 PARCEL DATA, NATIONAL PARK SERVICE U.S. DEPT OF THE INTERIOR, NPS BOUNDARY, APRIL 2021, <https://public-nps.opendata.arcgis.com>  
BOUNDARY DATA: FERC EXHIBIT G, BOOTT MILLS, DETAILED MAPS OF PROJECT AREAS, MAY 1980 INTERNATIONAL ENGINEERING CO. INC., TRANSMISSION CABLE LAYOUT DETAILS, APRIL 1983

**NOTES**  
1. THE LICENSEE EITHER OWNS IN SIMPLE FEE OR POSSESSES FLOWAGE EASEMENTS OVER ALL LANDS WITHIN THE PROJECT BOUNDARY REQUIRED TO OPERATE THE FACILITY.  
2. SEE EXHIBIT G-2 FOR PROJECT BOUNDARY TABLES.

**SURVEYORS STATEMENT**  
I HEREBY CERTIFY TO THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) THAT THIS PLAN MEETS THE CONDITIONS SET FORTH BY FERC FOR ITS EXPRESSED PURPOSE. THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND DIGITAL REFERENCE SOURCES INCORPORATED INTO THE GEOGRAPHIC INFORMATION SYSTEM (GIS). LOCATIONS HAVE NOT BEEN VERIFIED BY PHYSICAL FIELD SURVEYS AND THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

**EXHIBIT G-6 SHEET 6 OF 6**

**LOWELL HYDROELECTRIC PROJECT  
BOOTT MILLS  
PROJECT BOUNDARY MAP**

**BOOTT HYDROPOWER, LLC FERC No. 2790**

DATE: MAY 2021 SCALE: 1"=400' APPROVED: PENDING



## Exhibit H Ability to Operate (18 C.F.R. §5.18(c))

### H.1 Licensee's Ability to Provide Efficient and Reliable Electric Service (18 C.F.R. §5.18(c)(1)(i)(A))

#### H.1.1 Increase in Capacity or Generation

As discussed in Exhibit A, Boott currently has no plans to increase the capacity or generation of the Project as part of this relicensing. The Licensee expects to maintain the high degree of process and controls to maintain the efficient use of the water supply to maximize the generation output and provide a reliable and environmentally sound source of generation.

#### H.1.2 Coordination of Operation with Upstream and Downstream Projects

As a run-of-river facility, Boott does not normally need coordinate the operation of the Project with other Projects located either upstream or downstream. However, all hydroelectric projects on the Merrimack River are under the common ownership of Central Rivers Power, LLC, which enhances and ensures any necessary coordination of operations on the Merrimack River.

#### H.1.3 Coordination of Operation with Electrical Systems to Minimize Cost of Production

Boott does not coordinate the operation of the Project with other Projects or electric systems in order to minimize the cost of production.

### H.2 Need for Project Power (18 C.F.R. §5.18(c)(1)(i)(B))

#### H.2.1 Cost and Availability of Alternative Sources of Power

Boott is not a utility with retail load obligations. However, the Project generates renewable power, without the emissions of air pollutants or greenhouse gases that the marginal fossil fuel plants produce. This is an increasingly important fact in New England where all six New England states have enacted legislation to reduce the dependence on fossil fired generation through the introduction of Renewable Portfolio Standards (RPS), or similar legislation, that encourages and requires the use of renewable power sources in the state's total resource output.

If Boott is not granted a license, the replacement of energy and capacity provided by the Project would be met through other sources, likely to be fossil-fired generating units,

whose fuel and other variable costs would be significantly higher than those of the Project. The equivalent amount of power would be provided through the Independent System Operator (ISO) and the costs are based on market pricing. Therefore, it is difficult for the Licensee to speculate about the cost and availability of such alternative sources of power since the price and source can vary hourly.

## H.2.2 Increase in Fuel, Capital, and Other Costs to Purchase or Generate Replacement Power

If Boott is not granted a new license, this Project would cease to provide clean and renewable energy. Costs to the market of replacing services that the Project provides would include reduced efficiency of other generation sources, such as coal, gas-fired and diesel generation, as they would need to modify operations to meet demand. Replacement of the Project would also likely result in additional carbon emissions within Massachusetts and/or the Northeast.

## H.2.3 Effect of Alternative Power Sources on Licensee's Customers, Operating and Load Characteristics, and Communities Served

### H.2.3.1 Effects on Licensee's Customers

This section is not relevant as the Licensee does not sell its electricity directly to customers. However, as a hydropower facility, the Project provides an important source of renewable electricity. Alternative sources of power would need to be used to generate electricity, many of which would most likely be sourced by fossil fuel generation such as coal, gas-fired and diesel generation. Energy production costs, environmental costs, and construction costs would be higher than the utilization of hydropower used by the Project. None of these increased costs would be beneficial to a consumer base.

### H.2.3.2 Effects on Operating and Load Characteristics

The Licensee is an independent power producer and, as such, does not maintain a separate transmission system which could be affected by replacement or alternative power sources.

### H.2.3.3 Effect on Communities Served by the Project

Because the Licensee cannot predict with any certainty the actual type or location of a potential alternative facility providing replacement power, Boott cannot specifically discuss potential effects on any particular community.

## H.3 Need, Reasonable Cost, and Availability of Alternative Sources of Power (18 C.F.R. §5.18(c)(1)(i)(C))

### H.3.1 Average Annual Cost of Power

The estimated annual costs for the Lowell Project are presented in Table H.3-1. The average annual cost of the power produced by the Project includes capital costs, operating costs, and costs associated with Project relicensing, including the proposed recreation enhancements. The Licensee has performed an analysis of the costs of producing Project power. The total average annual cost of power produced by the Project is approximately \$1,859,540 based on the Project's average annual generation of 78,125 MWh of energy, a license term of 50 years and a discount rate of 10%.

**Table H.3-1. Lowell Project Current Average Annual Cost**

	Capital Cost	Annual Cost	Levelized Cost
Cost of capital (debt and equity)	\$0	\$0	\$0
Annual operations and maintenance	\$0	\$222,686	\$202,442
Annual insurance, taxes, and administrative costs	\$0	\$999,666	\$908,787
Cost of Relicensing	\$1,780,000	\$0	\$148,256
Downstream fish protection	\$5,200,000	\$10,000	\$302,573
Upstream fish passage - tailrace ladder	\$2,600,000	\$10,000	\$186,849
Decommission fish lift	\$75,000	\$0	\$4,693
Existing fish ladder and weir improvements	\$100,000	\$5,000	\$11,701
Decommissioning Mill Units	\$1,000,000	\$0	\$72,605
Historic Properties Management Plan	\$75,000	\$5,000	\$9,619
Recreation Plan	\$50,000	\$10,000	\$12,422
<b>Total</b>			<b>\$1,864,262</b>

### H.3.2 Projected Resources to Meet Licensee's Capacity and Energy Requirements over the Short and Long Term

Boott is an independent electric generator; as such, this section is not applicable.

#### **H.4 Use of Power for Applicant-owned Industrial Facility (18 C.F.R. §5.18(c)(1)(i)(D))**

Boott does not own any industrial facilities; therefore, this section is not applicable.

#### **H.5 Native American Tribe as Applicant (C.F.R. §5.18(c)(1)(i)(E))**

Boott is not a Native American tribe; therefore, this section is not applicable.

#### **H.6 Impacts of Receiving or not Receiving a License on Licensee's Operations of the Transmission Facility (18§5.18(c)(1)(i)(F))**

The Licensee is an independent power producer and, as such, does not maintain a separate transmission system that could be affected by power flow redistribution. A one-line diagram for the Project is provided in Volume III of this License Application filed as Critical Energy Infrastructure Information (CEII).

#### **H.7 Modifications to Project Facilities and Consistency with Comprehensive Plans (18 C.F.R. §5.18(c)(1)(i)(G) and (H))**

Section 10(a)(1) and (2) of the Federal Power Act (FPA) 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 a project. The Commission's Scoping Document 2 (SD2) identified twenty-eight comprehensive plans that are potentially relevant to the Project. On December 19, 2018, the National Park Service filed five additional comprehensive plans, and by letter dated March 20, 2019, the Commission accepted four of the five plans. The Licensee has reviewed the Commission's list of comprehensive plans, which are listed below. For the reasons noted in this application, Boott has determined that the continued operation of the Project, as proposed in this Final License Application, is consistent with these plans.

1. Atlantic States Marine Fisheries Commission. 1998. Amendment 1 to the Interstate Fishery Management Plan for Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). (Report No. 31). July 1998.
2. Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. (Report No. 35). April 1999.
3. Atlantic States Marine Fisheries Commission. 2000. Interstate Fishery Management Plan for American eel (*Anguilla rostrata*). (Report No. 36). April 2000.

Exhibit H Ability to Operate (18 C.F.R. §5.18(c))  
Lowell Hydroelectric Project

4. Atlantic States Marine Fisheries Commission. 2000. Technical Addendum 1 to Amendment 1 of the Interstate Fishery Management Plan for shad and river herring. February 9, 2000.
5. Atlantic States Marine Fisheries Commission. 2008. Amendment 2 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. October 2008.
6. Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. May 2009.
7. Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.
8. Atlantic States Marine Fisheries Commission. 2013. Amendment 3 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. August 2013.
9. Atlantic States Marine Fisheries Commission. 2014. Amendment 4 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. October 2014.
10. Massachusetts Department of Environmental Management. Commonwealth connections: A greenway vision for Massachusetts. Boston, Massachusetts.
11. Massachusetts Department of Fish and Game. 2006. Comprehensive wildlife conservation strategy. West Boylston, Massachusetts. September 2006.
12. Massachusetts Executive Office of Energy and Environmental Affairs. Statewide Comprehensive Outdoor Recreation Plan (SCORP): Massachusetts Outdoor 2006. Boston, Massachusetts.
13. Merrimack River Policy and Technical Committees. 1990. Strategic plan for the restoration of Atlantic salmon to the Merrimack River, 1990 through 2004. Concord, New Hampshire. April 1990.
14. National Marine Fisheries Service. 1998. Final Amendment #11 to the Northeast Multispecies Fishery Management Plan; Amendment #9 to the Atlantic sea scallop Fishery Management Plan; Amendment #1 to the monkfish Fishery Management Plan; Amendment #1 to the Atlantic salmon Fishery Management Plan; and Components of the Proposed Atlantic herring Fishery Management Plan for Essential Fish Habitat. Volume 1. October 7, 1998.
15. National Marine Fisheries Service. 1998. Final Recovery Plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. December 1998.
16. National Park Service. 1981. Lowell National Historical Park General Management Plan. Lowell, Massachusetts.
17. National Park Service. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.
18. National Park Service. 2002. General Management Plan Addendum for Lowell National Historical Park. Lowell, Massachusetts.

19. National Park Service. 1980. Details of the Preservation Plan. Lowell National Historical Park. Lowell, Massachusetts.
20. National Park Service. 1990. Preservation Plan Amendment. Lowell National Historical Park. Lowell, Massachusetts.
21. New Hampshire Office of State Planning. 1977. Wild, scenic, & recreational rivers for New Hampshire. Concord, New Hampshire. June 1977.
22. New Hampshire Office of State Planning. 1989. New Hampshire wetlands priority conservation plan. Concord, New Hampshire.
23. New Hampshire Office of Energy and Planning. New Hampshire SCORP: 2008-2013. Concord, New Hampshire. December 2007.
24. New Hampshire Office of State Planning. 1991. Public access plan for New Hampshire's lakes, ponds, and rivers. Concord, New Hampshire. November 1991.
25. New Hampshire Office of State Planning. 1991. Upper Merrimack River corridor plan-volume 2: management plan. Concord, New Hampshire. March 1991.
26. Policy Committee for Anadromous Fishery Management of the Merrimack River Basin. 1985. A strategic plan for the restoration of Atlantic salmon to the Merrimack River Basin, 1985 through 1999. Laconia, New Hampshire. May 1985.
27. State of New Hampshire. 1991. New Hampshire rivers management and protection program [as compiled from NH RSA Ch. 483, HB 1432-FN (1990) and HB 674-FN (1991)]. Concord, New Hampshire.
28. State of New Hampshire. 1991. New Hampshire rivers management and protection program, including rivers in the Merrimack River basin:
  - (1) 1994 Contoocook and North Branch Rivers, river corridor management plan;
  - (3) 1999 Piscataquog River management plan;
  - (6) 2008 Lower Merrimack River corridor management plan;
  - (7) 2009 Cold River watershed management plan;
  - (10) 2001 Pemigewasset River corridor management plan;
  - (11) 2006 Souhegan River watershed management plan; and
  - (12) 2007 Upper Merrimack River management and implementation plan
29. U.S. Fish and Wildlife Service (USFWS). n.d. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.
30. USFWS. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.
31. USFWS. 1989. Atlantic salmon restoration in New England: Final environmental impact statement 1989-2021. Department of the Interior, Newton Corner, Massachusetts. May 1989.
32. USFWS. 2010. A Plan for the Restoration of American Shad: Merrimack River Watershed. Concord, New Hampshire. 2010.



## H.8 Financial and Personnel Resources (18 C.F.R. §5.18(c)(1)(i)(I))

### H.8.1 Financial Resources

Boott is dedicated to operating the Project in a safe and reliable manner to provide clean renewable electric energy to the electricity grid. As demonstrated under the existing license, Boott has the financial resources to meet the operation, maintenance, and capital requirements of the Project. All hydroelectric projects on the Merrimack River are under the common ownership of Central Rivers Power, LLC, which enhances and ensures any necessary coordination of operations on the Merrimack River.

### H.8.2 Personnel Resources

Operations, maintenance, environmental and license compliance, modification, technical and administrative activities required for the Project are performed and supported by employees and contractors of Boott.

## H.9 Expansion of Project Lands (18 C.F.R. §5.18(c)(1)(i)(J))

At this time, Boott does not anticipate a proposed expansion of Project boundaries at the Project.

## H.10 Electricity Consumption Efficiency Improvement Program (18 C.F.R. §5.18(c)(1)(i)(K))

Boott is an independent electric generator; as such, this section is not applicable.

## H.11 Names and Addresses of Native American Tribes with land on Which the Project is located or Tribes that May Be Affected by the Project as Proposed (18 C.F.R. §5.18(c)(1)(i)(L))

The Project is not located on Native American lands. Boott and the Commission consulted with the following federally recognized Native American tribes that may be affected by the Project throughout the relicensing process and in support of cultural resource studies. Points of contact (names) associated with each of these Native American Tribes is presented in the Initial Statement of this application and the associated distribution list.

Mashpee Wampanoag Tribe  
483 Great Neck Road South  
Mashpee, MA 02649

Narragansett Indian Tribe  
PO Box 268  
Charlestown, RI 02813

Wampanoag Tribe of Gay Head  
(Aquinnah)  
20 Black Brook Road  
Aquinnah, MA 02535

Stockbridge Munsee Tribe of  
Mohican Indians  
N8467 Moh He Con Nuck Road  
Bowler, WI 54416

Penobscot Nation  
23 Wabanaki Way  
Indian Island, Maine 04468

## H.12 Safe Management, Operation, and Maintenance of the Project (18 C.F.R. §5.18(c)(1)(ii)(B))

### H.12.1 Operating During Flood Conditions

Under past and current operations, when river flows exceed the hydraulic capacity of the E.L. Field Powerhouse units (approximately 3,300 cfs per unit or 6,600 cfs for both units), excess flows up to approximately 2,000 cfs can be routed through the downtown canal system and to the canal units (as described below). Any flows in excess of these flows are passed over the Pawtucket Dam spillway.

During these high-water conditions, the crest gate control system will automatically adjust the gates to maintain the impoundment elevation no higher than 93.2 feet National Geodetic Vertical Datum (NGVD), or one foot above the normal pond elevation. When under automatic control, the crest gates would all be fully lowered at spillway flows of approximately 35,000 cfs. In addition, the approved crest gate operations plan requires Boott to fully lower the crest gate panels in anticipation of potential flood events. This minimizes the upstream backwater effect of the Pawtucket Dam to the extent possible. (FERC 2015).

Under very high flow conditions when the water level at the Pawtucket Dam reaches 98.0 feet NGVD 29, Boott initiates the installation of the steel stoplogs upstream of the Great Guard Gate, per the provisions of the Emergency Action Plan (EAP). These stoplogs are designed to functionally replace the historic Great Guard Gate, to prevent the potential flooding of downtown Lowell via the Pawtucket Canal.

## H.12.2 Proposed Project Operation and Emergency Action Plan

Boott proposes operations of the Project very similar to current operations with no proposed modifications that would affect the EAP maintained for the Project.

## H.12.3 Warning Devices for Downstream Public Safety

Boott maintains public safety measures at the Project for public safety upstream, in the vicinity of, and downstream of the Project pursuant to the Commission-approved Public Safety Plan. Warning devices for public safety include an audible alarm, visual alarm, signage in multiple locations at the Project, seasonal upstream boat barriers, and additional measures.

## H.12.4 Monitoring Devices

The Project is maintained by Boott in accordance with manufacturers' instructions and industry best practices and monitored as described in the Dam Safety Surveillance and Monitoring Plan (DSSMPs) that are maintained for the Project and is on file with the Commission's Division of Dam Safety and Inspections – New York Regional Office.

As described in the DSSMP for the Project, instrumentation at the Project includes water level transducers located in the impoundment, the Northern Canal and in the tailrace. Boott also regularly monitors USGS Gage No. 1100000, Merrimack River below Concord River, Lowell, MA which is located immediately downstream of the Project, as well as the National Weather Service's Advanced Hydrologic Prediction Service web page associated with this gage.<sup>12</sup> (Gage No. 1100000).

## H.12.5 Employee Safety and Public Safety Record

The Licensee manages the Project consistent with their long-standing commitment to employee safety. This commitment begins with compliance with applicable local, state, and federal regulations regarding the safe operation of industrial and electrical facilities. As the Licensee operates the Project's generation facilities, this commitment is implemented primarily through a rigorous safety program. Detailed inspection and maintenance programs ensure employee and contractor safety relative to operating equipment and facilities. The safety program involves employee and contractor training sessions, as well as making safety information available to employees.

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<sup>12</sup> <https://water.weather.gov/ahps2/hydrograph.php?wfo=box&gage=lowm3>

The Licensee places a high priority on public safety at the Project, and maintains public safety measures (signage, markers, fencing, boat barriers, etc.) consistent with plans filed with the FERC's Regional Office.

### H.13 Current Operation of the Project (18 C.F.R. §5.18(c)(1)(ii)(C))

The Project has been operated in a manner consistent with the requirements of the current license. Details regarding operation and constraints of the Project are discussed in Exhibit B of this application. The Project will continue to operate in a manner consistent with the requirements of the current license until the new license is issued, after which time the Project will be operated in accordance with the requirements and conditions of the new license.

### H.14 Project History (18 C.F.R. §5.18(c)(1)(ii)(D))

A summary of the history of the Project, including recent operation and maintenance upgrades, are provided in Exhibit C of this application.

### H.15 Summary of Generation Lost at the Project Due to Unscheduled Outages (18 C.F.R. §5.18(c)(1)(ii)(E))

Table H.15-1 presents the unscheduled outages for the Project over the last 5 years (2016-2021).<sup>13</sup> In order to maximize energy production from the facility, Boott has a consistent record of addressing outages immediately and preventative measures taken in order to prevent future occurrences.

**Table H.15-1. Summary of Unscheduled Outages**

Date /Time Off	Date/Time On	Duration (hrs)	Unit(s) Affected	Description
2/19/2016 12:00	2/24/2016 16:00	124:00	John St. 6	Broken head gate / winch cables
2/27/2016 10:00	4/7/2017 16:00	1 year 2 months	John St. 6	Penstock water leak
3/6/2016 12:00	3/11/2016 18:30	126:30	John St. 4	Electrical issues
3/12/2016 12:00	3/16/2016 12:00	96:00	John St. 4	Exciter issues
3/21/2016 9:45	3/22/2016 13:30	27:45	Hamilton 4	No remote gate control

<sup>13</sup> Boott was owned by Enel Green Power North America, Inc. (Enel) until January 2020 before becoming acquired by Central Rivers Power US, LLC. The unscheduled outages provided in this table from 2016 through January 2020 were obtained from Enel's outage tracking system. The information provided by Enel to generate this table did not include any unplanned outages for 2019.

Exhibit H Ability to Operate (18 C.F.R. §5.18(c))  
 Lowell Hydroelectric Project

Date /Time Off	Date/Time On	Duration (hrs)	Unit(s) Affected	Description
4/3/2016 12:00	4/6/2016 12:00	72:00	John St. 4	Loss of gate operator control
4/9/2016 21:00	4/10/2016 12:08	15:08	John St. 5	Loss of DC / Breaker not functioning properly
4/15/2016 14:30	4/18/2016 11:00	68:30	John St. 5	Loss of DC
4/28/2016 6:35	4/28/2016 9:18	2:43	ELF 1	Low carbon seal / loss of permissives at start up/ low headtank level
9/20/2016 19:14	9/21/2016 0:47	5:33	ELF 2	Loss of permissives
10/25/2016 13:55	10/25/2016 15:31	1:36	ELF 1	Loss of station service
10/25/2016 13:59	10/25/2016 15:16	1:17	ELF 2	Loss of station service
12/17/2016 22:28	12/18/2016 8:24	9:56	ELF 1	Gland seal pressure low
12/24/2016 4:30	12/24/2016 12:05	7:35	ELF 1	Blown fuse
12/24/2016 4:30	12/24/2016 12:07	7:37	ELF 2	Blown fuse
2/27/2017 10:00	3/3/2017 13:00	99:00	Hamilton 5	HPU pump failed
4/5/2017 12:00	7/7/2017 8:00	93 days	John St. 6	Penstock repairs
9/8/2017 10:00	10/23/2017 16:00	1086:00	Hamilton 2	Wicket gate control issues
9/10/2017 8:00	9/10/2017 10:15	2:15	ELF 1	Utility trip
1/12/2018 8:00	1/25/2018 14:00	318:00	All mill units	Canals frozen over
6/30/2018 3:30	6/30/2018 23:45	20:15	ELF 1	Burned wire on CT connection
6/30/2018 18:15	6/30/2018 23:55	5:40	ELF 2	Unit 2 taken offline to ensure Bus is deenergized in order to perform repairs on ELF Unit 1
4/7/2020 9:47	4/7/2020 9:56	0:09	ELF 1	High vibration caused by debris in unit
4/17/2020 1:22	4/17/2020 2:20	0:58	ELF 1	High vibration caused by debris in unit
5/1/2020 13:46	5/1/2020 14:33	0:47	ELF 1&2	Low seal pressure, possibly caused by low municipal water pressure.

Exhibit H Ability to Operate (18 C.F.R. §5.18(c))  
Lowell Hydroelectric Project

Date /Time Off	Date/Time On	Duration (hrs)	Unit(s) Affected	Description
5/15/2020 20:30	5/16/2020 7:00	10:30	ELF 1&2	Output reduced from 13.5 MW to 1.2 MW due to faulty transducer, possibly caused by thunderstorm.
6/11/2020 11:25	6/11/2020 14:50	3:25	ELF 1	Moose swimming in Northern Canal; Unit 1 shut down to facilitate rescue.
7/2/2020 13:20	7/2/2020 13:39	0:19	ELF 1	Low water pressure during filter change on Unit 2.
7/12/2020 3:45	7/12/2020 10:24	6:39	ELF 1	High bearing temperature.
7/18/2020 20:23	7/18/2020 21:56	1:33	ELF 1	High vibration caused by debris in unit
8/11/2020 21:00	8/13/2020 15:32	42:32	ELF 2	Utility power outage, followed by station service breaker issues.
8/11/2020 21:00	9/2/2020 14:00	21 days	ELF 1	Damage to proportional valve caused by utility outage
9/13/2020 6:58	9/13/2020 10:20	3:22	ELF 2	Utility trip caused by squirrel in transformer.
9/15/2020 0:00	9/15/2020 8:55	1:36	ELF 2	Utility trip caused by "wildlife" in transformer.
10/7/2020 23:32	10/8/2020 0:45	1:13	ELF 1	Low seal pressure due to low municipal water pressure.
10/26/2020 6:24	10/26/2020 7:15	0:51	ELF 1&2	High vibration caused by debris in unit
11/20/2020 8:18	11/20/2020 13:02	4:44	ELF 2	Trash rack transducer and PLC issues
11/30/2020 18:11	11/30/2020 20:24	2:13	ELF 1&2	Utility outage caused by storm
12/4/2020 15:46	12/5/2020 5:12	13:34	ELF 1&2	Bad bus connection, possibly exacerbated by rodent.
12/5/2020 9:55	12/5/2020 10:22	0:27	ELF 2	Low turbine oil return flow, possibly related to outage on previous day.
12/17/2020 10:07	12/18/2020 12:54	13:32	ELF 2	Several outages totaling 13:32 caused by low turbine oil return flow, cold oil and possibly a bad flow switch.
12/18/2020 10:02	12/18/2020 12:54	2:52	ELF 1	Loss of flow to gland seal
1/25/2021 9:40	1/25/2021 10:20	0:40	ELF 1	Frozen trash rack transducer
2/2/2021 9:50	2/2/2021 10:11	0:21	ELF 2	Lube oil pump accidentally turned off

Date /Time Off	Date/Time On	Duration (hrs)	Unit(s) Affected	Description
2/26/2021 9:55	2/26/2021 10:37	0:42	ELF 1&2	GSU lockout trip overunder freq trip
3/28/2021 13:19	3/28/2021 13:25	0:06	ELF 1	High vibration caused by debris in unit
4/1/2021 0:00	Ongoing	--	All mill units	All downtown mill units curtailed due to multiple operational safety issues.
4/10/2021 0:39	4/10/2021 7:01	6:22	ELF 1	GOV PLC comms fail

## H.16 Record of Compliance (18 C.F.R. §5.18(c)(1)(ii)(F))

Boott has continued to operate the Project in compliance with the Project license except for one violation relating to the operation of the Project’s only FERC-approved recreational facility (E. L. Field Powerhouse Visitor Center). FERC issued a letter on December 2, 1994, stating a violation of Article 38 had occurred. In accordance with the license, the Project visitor center was to open to the public by May 30, 1993; however, the opening was delayed by design changes to the powerhouse and development of display signage. The visitor center was opened to the public on July 21, 1994. FERC did not issue any penalties related to this violation.

Following record flooding events on the Merrimack River in May 2006 and April 2007, FERC initiated an investigation of the performance of the Project’s wooden flashboards during these events. The investigation was initiated in response to complaints from residents in low-lying areas upstream of the Pawtucket Dam. While it did not designate the issue as a violation or non-compliance, FERC staff concluded that the flashboards had not performed as designed, and on May 28, 2008, ordered the Licensee to remove the flashboards, and to submit a new design for the flashboards that would fail as originally designed. FERC approved Boott’s updated flashboard design on June 4, 2008, and the flashboards were fully reinstalled per the approved design on June 20, 2008. On September 25, 2008, FERC issued a letter ordering Boott to work with the NPS and other stakeholders to determine options for a flashboard system that “can be ensured to be completely down during high flows in the Merrimack River.” Accordingly, Boott held several meetings with the stakeholders and on March 26, 2010, submitted a letter to FERC indicating that a pneumatic crest gate system had been selected as the best option. On July 6, 2010, Boott submitted an application to amend the Project license to replace the existing five-foot wooden flashboards with a pneumatic crest gate system of equal height. FERC issued an amendment order authorizing the crest gate system on April 18, 2013.

## H.17 Actions that Affect the Public (18 C.F.R. §5.18(c)(1)(ii)(G))

Boott holds that past actions and future actions related to the Project will not adversely affect the public. To the contrary, Boott believes that actions by the Licensee are favorable to the public in that the Project provides clean, renewable electric energy as well as other non-power benefits associated with the Project.

## H.18 Ownership and Operating Expenses Affected by Transfer of License (18 C.F.R. §5.18(c)(1)(ii)(H))

There is presently no proposal or application to transfer the Project license from the existing Licensee; therefore, this section is not applicable.

## H.19 Annual Fees Under Part I of the Federal Power Act (FPA) (18 C.F.R. §5.18(c)(1)(ii)(I))

Given that there are no federal or Native American lands associated with the Project, Boott does not pay annual fees under Part 1 of the FPA.