



## Appendix C

### Consultation Log and Copies of Correspondence

### Lowell Hydroelectric Project (FERC No. 2790) Correspondence Log

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
April 26, 2017 (Accession Number 20170426-3025)	Letter	Federal Energy Regulatory Commission (FERC)	Tribes	Tribal consultation for the Lowell Hydroelectric Project.
March 6, 2018	Letter	Boott Hydropower, LLC (Boott)	Stakeholder distribution list <sup>1</sup>	Lowell Project Pre-Application Document (PAD) Questionnaire.
March 14, 2018	Email	Burlington Town Clerk	HDR	PAD Response
March 14, 2018	Email	Lower Merrimack River Local Advisory Committee (LMRLAC)	HDR	Additional Stakeholder
March 16, 2018	Questionnaire reply	Town of Action, Steven Ledoux, Town Manager	HDR	PAD Questionnaire Response
March 16, 2018	Questionnaire reply	Williamsburg 1 Condos, Dinell Clark, President	HDR	PAD Questionnaire Response
March 19, 2018	Questionnaire reply	Town of Hudson, Stephen Malizia, Town Administrator	HDR	PAD Questionnaire Response
March 19, 2018	Questionnaire reply	Massachusetts Division of Fisheries and Wildlife (MADFW) - Caleb Slater	HDR	PAD Questionnaire Response

<sup>1</sup> The stakeholder distribution list contains over 130 individuals representing federal and state agencies, municipalities, Indian tribes, and additional stakeholders.

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
March 19, 2018	Questionnaire reply	LMRLAC - Gene Porter, Chairman	HDR	PAD Questionnaire Response
March 19, 2018	Questionnaire reply	US Bureau of Indian Affairs Eastern Region, Harold Peterson, Natural Resources Officer	HDR	PAD Questionnaire Response
March 22, 2018	Questionnaire reply	Town of North Andover	HDR	PAD Questionnaire Response
March 22, 2018	Questionnaire reply and NGB Request for Database Check form	NH Natural Heritage Bureau	HDR	PAD Questionnaire Response
March 30, 2018	Questionnaire reply	Lowell Floodowners Group	HDR	PAD Questionnaire Response
April 3, 2018	Questionnaire reply	National Marine Fisheries Service (NMFS)	HDR	PAD Questionnaire Response
April 4, 2018	Email correspondence	National Park Service (NPS)	Enel/HDR	Lowell Hydro Project PAD National Park Response
April 4, 2018	Email attachment	NPS	Enel/HDR	PAD Questionnaire Response
April 4, 2018	Email attachment	NPS	Enel/HDR	Authorizing Legislation with reference to Lowell Canal System
April 4, 2018	Email attachment	NPS	Enel/HDR	Boundary Map referenced in authorizing law
April 4, 2018	Email attachment	NPS	Enel/HDR	Nomination for the Locks & Canals Historic District (1976)
April 4, 2018	Email attachment	NPS	Enel/HDR	Resource Management Report referencing the Lowell Canal System

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
April 6, 2018	Questionnaire reply	Massachusetts Department of Environmental Protection (MADEP)	HDR	PAD Questionnaire Response
April 6, 2018	Email correspondence	MADEP	HDR	Links to MA DEP info regarding the Lowell Project
April 16, 2018	Email correspondence	NH Natural Heritage Bureau	HDR	NHB datacheck results letter
April 30, 2018 (Accession Number 20190430-5234)	Letter/Document	Boott, HDR	FERC, Stakeholder distribution list	Boott Hydropower filed Notice of Intent and Pre-Application Document (PAD) for the Lowell Hydroelectric Project under P-2790.
May 14, 2018	Questionnaire reply	Merrimack River Watershed Council	HDR	PAD Questionnaire Response
June 14, 2018 (Accession Number 20180614-3015)	Letter	FERC	Boott, HDR	Scoping Document 1 for the Lowell Hydroelectric Project under P-2790.
July 24, 2018 (Accession Number 20180724-0478)	Letter	Lowell City Council	FERC	Clay Pit Brook Backwater Study Report
August 08, 2018 (Accession Number 20180808-5029)	Letter	AW	FERC	Comments on PAD, and study requests
August 10, 2018 (Accession Number 20180810-5079)	Letter	MADFW	FERC	Comments on PAD, and study requests
August 13, 2018 (Accession Number 20180813-5142)	Letter	New Hampshire Fish and Game Department (NHFGD)	FERC	Study Requests

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
August 14, 2018 (Accession Number 20180814-5106)	Letter	NMFS	FERC	Comments on Notice of Intent, PAD, and study requests
August 14, 2018 (Accession Number 20180814-5103)	Letter	Massachusetts Department of Conservation and Recreation (MADCR)	FERC	Comments on Scoping Document 1 and Study Requests
August 14, 2018 (Accession Number 20180814-5118)	Letter	U.S. Department of Interior – National Park Service (NPS)	FERC	Comments on Notice of Intent, SD1, and study requests
September 27, 2018 (Accession Number 20180927-5038)	Letter	FERC	Boott	Scoping Document 2
September 28, 2018 (Accession Number 20180928-5212)	Letter	Boott	FERC, Stakeholder distribution list	Proposed Study Plan
December 14, 2018 (Accession Number 20181214-5087)	Letter	NPS	FERC, Boott, HDR	Comments on Proposed Study Plan
December 19, 2018 (Accession Number 20181219-5243)	Letter	NPS	FERC, Boott, HDR	Submission of NPS Comprehensive Plans
December 20, 2018 (Accession Number 2081220-5164)	Letter	NMFS	FERC, Boott, HDR	Comments on Proposed Study Plan
December 21, 2018 (Accession Number 20181221-5324)	Letter	USFWS	FERC, Boott, HDR	Comments on Proposed Study Plan
December 21, 2018 (Accession Number 20181221-5243)	Letter	MADFW	FERC, Boott, HDR	Comments on Proposed Study Plan

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
December 21, 2018 (Accession Number 20181221-5359)	Letter	AW	FERC, Boott, HDR	Comments on Proposed Study Plan
December 27, 2018 (Accession Number 20181221-5205)	Letter	Massachusetts Division of Marine Fisheries	FERC, Boott, HDR	Comments on Proposed Study Plan
January 28, 2019 (Accession Number 20190128-5197)	Document	HDR and Boott	FERC, stakeholder distribution list	Filing of the Revised Study Plan (RSP)
February 1, 2019 (Accession Number 20190201-5060)	Letter	USFWS	FERC	USFWS Extension of Time Requests
February 8, 2019 (Accession Number 20190208-5073)	Letter	MADFW	FERC, Boott, HDR	Comments on the RSP
February 8, 2019 (Accession Number 20190208-5111)	Letter	USFWS	FERC	USFWS RSP Comment Letter for Lowell (FERC No. 2790)
March 13, 2019 (Accession Number 20190313-0151)	Letter	Lowell Flood Homeowners Group – Steve Masse	FERC	Comments on crest gate system
May 7, 2019 (Accession Number 20190507-5079)	Letter	HDR and Boott	AW, NPS, and MADCR	Consultation regarding Recreation and Aesthetics Study
May 7, 2019 (Accession Number 20190507-5079)	Letter	HDR and Boott	NPS	Consultation regarding Water Level and Flow Effects on Historical Resources
May 17, 2019	Letter	American Whitewater	Boott	Consultation regarding recreation study

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
May 24, 2019	Email	HDR	NPS	Consultation regarding Water Level and Flow Effects on Historical Resources
May 24, 2019	Email	NPS	HDR	Consultation regarding Water Level and Flow Effects on Historical Resources
May 28, 2019	Email	HDR	NPS	Coordination regarding Water Level and Flow Effects on Historical Resources
May 28, 2019	Email	NPS	HDR	Coordination regarding Water Level and Flow Effects on Historical Resources
June 3, 2019	Email	HDR	NPS	Schedule regarding trash mapping activities for the Lowell Recreation and Aesthetics Study
June 4, 2019	Email	NPS	HDR	Schedule regarding trash mapping activities for the Lowell Recreation and Aesthetics Study
June 12, 2019	Email	NPS	HDR	Schedule regarding trash mapping activities for the Lowell Recreation and Aesthetics Study
June 12, 2019	Email	HDR	NPS	Schedule regarding trash mapping activities for the Lowell Recreation and Aesthetics Study
June 14, 2019	Email	National Park Service	Boott	Consultation regarding timing of the Lowell Project Recreation and Aesthetics Study

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
July 2, 2019	Email	HDR	NPS	Lowell Recreation and Aesthetics Study
July 3, 2019	Email	NPS	HDR	Lowell Recreation and Aesthetics Study
July 24, 2019	Letter	HDR and Boott	American Whitewater, National Park Service, and Massachusetts Department of Conservation and Recreation	Consultation regarding Whitewater Boating Study
July 24, 2019	Email	American Whitewater	HDR and Boott	Consultation regarding Whitewater Boating Study
July 31, 2019	Email	American Whitewater	HDR and Boott	Logistics regarding Whitewater Boating Study
July 31, 2019	Email	HDR and Boott	American Whitewater	Logistics regarding Whitewater Boating Study
August 5, 2019	Email	Boott	NPS, Lowell Land Trust, Lowell Fire	Logistics regarding Whitewater Boating Study
September 9, 2019	Email	NPS	HDR	Logistical planning for Lowell Project Study Workshop
September 17, 2019	Email	HDR and Boott	NPS (Christine Bruins)	Agenda for the Lowell Project Study Workshop
September 23, 2019 (Accession Number 20190923-5006)	Letter	Matthew Doyle	FERC	Comments on the Lowell Relicensing
October 1, 2019 (Accession Number 20191001-5038)	Letter	NPS	FERC, Boott, HDR	Comments on Study Process and the Recreation and Aesthetics Study
October 1, 2019	Letter	HDR and Boott	FERC, Stakeholder distribution list	Quarterly study progress report



<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
(Accession Number 20191001-5208)				
October 28, 2019	Email	HDR and Boott	Whitewater Boating Study Working Group	Whitewater Study Plan
November 1, 2019	Email	HDR and Boott	Distribution List	Meeting logistics for the Workshop Study meetings
November 1, 2019	Email	NPS	HDR	Study Workshop Planning
November 4, 2019	Email	NPS	HDR and Boott	Meeting logistics for the Workshop Study meetings
November 4, 2019	Email	City of Lowell	HDR and Boott	Meeting logistics for the Workshop Study meetings
November 8, 2019	Email	HDR and Boott	Distribution List	Meeting logistics for the Workshop Study meetings
November 11, 2019	Email	HDR and Boott	Distribution List	Meeting logistics for the Workshop Study meetings
November 12, 2019	Email/Letter	AW (Bob Nasdor)	HDR and Boott	Comments on the Whitewater Boating Study
November 15, 2019	Email/Letter	NPS	AW, HDR and Boott	Comments on the Whitewater Boating Study
November 21, 2019	Email/Letter	HDR and Boott	Distribution List	Agenda and Meeting logistics for the Workshop Study meetings
November 21, 2019	Email/Letter	NPS	HDR and Boott	Agenda and Meeting logistics for the Workshop Study meetings
December 9, 2019	Email/Letter	HDR and Boott	Distribution List	Agenda and Meeting logistics for the Workshop Study meetings
December 19, 2019	Email	NPS	HDR	Vegetation Mapping Consultation

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
December 20, 2019	Email	MADCR	HDR	Lowell Recreation and Aesthetics Study
December 20, 2019	Email/Letter	MADCR	HDR and Boott	Follow-up information regarding the Workshop Study meetings
January 15, 2020	Email/Letter	HDR, Boott	AW, NPS, MADCR, City of Lowell	Whitewater Boating and Access Study
January 20, 2020	Email	LMRLAC – Gene Porter	HDR and Boott	Comments on the Lowell Relicensing
January 16, 2020 (Accession Number 20200410-5033)	Letter	HDR and Boott	FERC, Distribution List	Quarterly Study Progress Report
February 21, 2020	Email	HDR and Boott	NPS	Information regarding the Initial Study Report Meeting
February 24, 2020	Email	HDR and Boott	NPS	Information regarding the Initial Study Report Meeting
February 24, 2020	Email	NPS	HDR and Boott	Information regarding the Initial Study Report Meeting
February 24, 2020	Email	HDR and Boott	NPS	Information regarding the Initial Study Report Meeting
March 6, 2020	Email	HDR and Boott	Distribution List	Information regarding the Initial Study Report Meeting
March 11, 2020	Email	HDR and Boott	Distribution List	Information regarding the Initial Study Report Meeting
March 13, 2020	Email	HDR and Boott	NPS	Logistics Regarding the Waterborne Trash Mapping
March 18, 2020	Email	HDR and Boott	Distribution List	Followup with Distribution List regarding the Study Report Meeting
March 25, 2020	Email/Report	HDR and Boott	Distribution List	Filing of the Initial Study Report Meeting Summary

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
(Accession Number 20200410-5201)				
March 26, 2020	Email	HDR	Peter Severance (River Merrimack)	Comment on the Filing of the Initial Study Report Meeting
April 10, 2020 (Accession Number 20200410-5033)	Letter	NPS	FERC, Boott, HDR	Comments on the Recreation and Aesthetics Study
April 16, 2020 (Accession Number 20200410-5146)	Letter	USFWS	FERC, Boott, HDR	USFWS Comments on the Initial Study Report for the Lowell Project under P-2790.
April 17, 2020 (Accession Number 20200410-5229)	Letter	NOAA	FERC, Boott, HDR	NOAA Fisheries' comments on Boott Hydro's ISR for the Lowell Project, under P-2790
April 17, 2020 (Accession Number 20200417-5184)	Email/Report	HDR and Boott	Distribution List	Filing of the First Quarter Progress Report
April 21, 2020	Email	HDR	Jean Robinson (UMass)	Request of GIS Information
April 21, 2020	Email	HDR	Pamela Locke (UMass)	Request of GIS Information
April 22, 2020 (Accession Number 20200422-5027)	Letter	American Whitewater	FERC, Boott, HDR	Comments on the Recreation and Aesthetics Study
May 26, 2020 (Accession Number 20200526-5114)	Email/Letter	HDR and Boott	Distribution List	Response to Comments on the ISR Meeting Summary
June 10, 2020	Email	HDR and Boott	NPS	Historically Significant Waterpower Equipment Study
June 12, 2020 (Accession Number 20200612-3001)	Letter	FERC	HDR and Boott	Revised Process Plan and Schedule
June 15, 2020	Email/Letter	NPS	HDR and Boott	Historically Significant Waterpower Equipment Study

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
June 22, 2020	Email	HDR and Boott	NPS	Historically Significant Waterpower Equipment Study
June 29, 2020	Email	HDR and Boott	NPS	Historically Significant Waterpower Equipment Study
July 9, 2020	Email	HDR and Boott	NPS	Historically Significant Waterpower Equipment Study
July 13, 2020 (Accession Number 20200713-5084)	Email/Report	HDR and Boott	Distribution List and FERC	Filing of the Quarterly Progress Report
July 14, 2020	Email	HDR and Boott	NPS	Historically Significant Waterpower Equipment Study
July 27, 2020	Email	HDR and Boott	NPS	Historically Significant Waterpower Equipment Study
July 29, 2020	Email	AW (Bob Nasdor)	HDR, Boott	Whitewater Flow and Access Study
July 31, 2020	Email	AW (Bob Nasdor)	HDR, Boott	Whitewater Flow and Access Study
July 31, 2020	Email	Boott (Gray & Pape)	NPS	Historically Significant Waterpower Equipment Study
August 4, 2020	Email	AW (Bob Nasdor)	HDR, Boott	Whitewater Flow and Access Study
August 4, 2020	Email	HDR, Boott	AW (Bob Nasdor)	Whitewater Flow and Access Study
August 4, 2020	Email	NPS	HDR and Boott	Historically Significant Waterpower Equipment Study
August 5, 2020	Email	Boott (Gray & Pape)	NPS	Historically Significant Waterpower Equipment Study
September 28, 2020	Email	LMRLAC – Gene Porter	Boott	Comments on the Lowell Relicensing
September 29, 2020	Email	LMRLAC – Gene Porter	Boott	Comments on the Lowell Relicensing

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
September 29, 2020	Email	Boott	LMRLAC – Gene Porter	Comments on the Lowell Relicensing
September 29, 2020	Email	LMRLAC – Gene Porter	Boott	Comments on the Lowell Relicensing
September 29, 2020	Email	Boott	LMRLAC – Gene Porter	Comments on the Lowell Relicensing
September 29, 2020	Email	LMRLAC – Gene Porter	Boott	Comments on the Lowell Relicensing
September 30, 2020 (Accession Number 20200930-5137)	Email	Boott	Distribution List	Submission of Initial Study Report/Updated Study Report
October 16, 2020	Email	Boott (Gray & Pape)	NPS	Historically Significant Waterpower Equipment Study
October 16, 2020	Email	NPS	Boott (Gray & Pape)	Historically Significant Waterpower Equipment Study
October 21, 2020 (Accession Number 20200410-5109)	Email	HDR and Boott	Distribution List	Quarterly Progress Report to Distribution List
October 26, 2020	Email	HDR, Boott	AW (Bob Nasdor)	Whitewater Boating and Access Study consultation
October 26, 2020	Email	AW (Bob Nasdor)	HDR, Boott	Whitewater Boating and Access Study consultation
October 30, 2020 (Accession Number 20200410-5242)	Email/Letter	Boott	Distribution List	Lowell Revised ISR Meeting Summary Submission
November 2, 2020	Email	Boott (Gray & Pape)	NPS	Historically Significant Waterpower Equipment Study

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
November 3, 2020	Email	NPS	Boott (Gray & Pape)	Historically Significant Waterpower Equipment Study
November 5, 2020	Email	Boott (Gray & Pape)	NPS	Historically Significant Waterpower Equipment Study
November 5, 2020	Email	NPS	Boott (Gray & Pape)	Historically Significant Waterpower Equipment Study
November 5, 2020	Email	Boott (Gray & Pape)	NPS	Historically Significant Waterpower Equipment Study
November 16, 2020	Email	MADEP	HDR	Retirement of Rob Kubit and replacement with Derek Standish
November 23, 2020 (Accession Number 20201123-5132)	Email/Letter	City of Lowell	FERC; Distribution List	Comments on Revised ISR Meeting Summary Submission
November 25, 2020 (Accession Number 20201125-5060)	Email/Letter	MADFW	FERC; Distribution List	Comments on Revised ISR Meeting Summary Submission
November 30, 2020 (Accession Number 20201130-5028)	Email/Letter	NMFS	FERC; Distribution List	Comments on Revised ISR Meeting Summary Submission
November 30, 2020 (Accession Number 20201201-5045)	Email/Letter	MADMF	FERC; Distribution List	Comments on Revised ISR Meeting Summary Submission
December 2, 2020 (Accession Number 20201202-5154)	Email/Letter	Boott	FERC; Distribution List	Filed the Draft License Application
December 10, 2020 (Accession Number 20201210-5162)	Email/Letter	NPA	FERC; Distribution List	Comments on Revised ISR Meeting Summary Submission

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
January 20, 2021	Email	HDR, Boott	NPS	Consultation regarding water level and flow effects on historic resources study
January 21, 2021	Email	NPS	HDR, Boott	Consultation regarding water level and flow effects on historic resources study
February 5, 2021	Email	NPS	HDR, Boott	Consultation regarding water level and flow effects on historic resources study
February 5, 2021	Email	HDR, Boott	NPS	Consultation regarding water level and flow effects on historic resources study
February 5, 2021	Email	NPS	HDR, Boott	Consultation regarding water level and flow effects on historic resources study
February 8, 2021	Email	HDR, Boott	NPS	Consultation regarding water level and flow effects on historic resources study
February 8, 2021	Email	NPS	HDR, Boott	Consultation regarding water level and flow effects on historic resources study
February 9, 2021	Email	Boott	NPS	Consultation regarding water level and flow effects on historic resources study
February 9, 2021	Email	NPS	HDR, Boott	Consultation regarding water level and flow effects on historic resources study
February 11, 2021	Email	Boott (Gray & Pape)	NPS	Historically Significant Waterpower Equipment Study

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
February 11, 2021	Email	NPS	HDR, Boott	Consultation regarding water level and flow effects on historic resources study
February 11, 2021	Email	Boott	NPS	Consultation regarding water level and flow effects on historic resources study
February 12, 2021	Email	NPS	Boott (Gray & Pape)	Historically Significant Waterpower Equipment Study
February 25, 2021 (Accession Number 20210302-5147)	Comment Letter	MADCR	FERC	Comments on Draft License Application
March 11, 2021	Email	NPS	HDR	ISR Meeting
March 02, 2021 (Accession Number 20210302-5170)	Comment Letter	Edward Kennedy	FERC	Comments on Draft License Application
March 02, 2021 (Accession Number 20210302-5163)	Comment Letter	Allison Lamey	FERC	Comments on Draft License Application
March 02, 2021 (Accession Number 20210302-5179)	Comment Letter	City of Lowell	FERC	Comments on Draft License Application
March 02, 2021 (Accession Number 20210302-5159)	Comment Letter	USFWS	FERC	Comments on Draft License Application
March 02, 2021 (Accession Number 20210302-5151)	Comment Letter	Lowell Historic Board	FERC	Comments on Draft License Application
March 02, 2021 (Accession Number 20210302-5147)	Comment Letter	MADCR	FERC	Comments on Draft License Application



<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
March 02, 2021 (Accession Number 20210302-5132)	Comment Letter	Jane Calvin	FERC	Comments on Draft License Application
March 02, 2021 (Accession Number 20210302-5058)	Comment Letter	Jay Linnehan	FERC	Comments on Draft License Application
March 02, 2021 (Accession Number 20210302-5054)	Comment Letter	NPS	FERC	Comments on Draft License Application
March 4, 2021	Email	FERC	HDR	Logistics regarding ISR meeting
March 15, 2021 (Accession Number 20210315-0034)	Comment Letter	Massachusetts Historical Commission	FERC	Comments on Draft License Application
March 19, 2021 (Accession Number 20210319-0006)	Comment Letter	University of Massachusetts	FERC	Comments on Draft License Application
March 26, 2021 (Accession Number 20210326-5139)	Comment letter	Boott	FERC	ISR Meeting Summary
April 09, 2021 (Accession Number 20210409-5151)	Progress Report	Boott	FERC	Study Progress Report
April 19, 2021	Email	AW	Boott, HDR	Whitewater Boating and Access Study
April 19, 2021	Email	Boott	AW	Whitewater Boating and Access Study
April 19, 2021	Email	AW	Boott, HDR	Whitewater Boating and Access Study

<b>Date</b>	<b>Type</b>	<b>From</b>	<b>To</b>	<b>Subject</b>
April 19, 2021	Email	Boott	AW	Whitewater Boating and Access Study
April 19, 2021	Email	HDR, Boott	AW	Whitewater Boating and Access Study
April 19, 2021	Email	AW	Boott, HDR	Whitewater Boating and Access Study
April 20, 2021	Email	AW	Boott, HDR	Whitewater Boating and Access Study
April 21, 2021	Email	AW	Boott	Whitewater Boating and Access Study
April 21, 2021	Email	Boott	AW	Whitewater Boating and Access Study
April 22, 2021 (Accession Number 20210422-5232)	Comment letter	NMFS	Boott	Comments on Technical Study Reports
April 26, 2021 (Accession Number 20210426-5094)	Comment letter	MADFW	Boott	Comments on Technical Study Reports
April 26, 2021 (Accession Number 20210426-5218)	Comment letter	NPS	Boott	Comments on Technical Study Reports
April 28, 2021 (Accession Number 20210428-5133)	Comment letter	USFWS	Boott	Comments on Technical Study Reports

## Lowell Hydroelectric Project (FERC Project No. 2790) Relicensing Pre-Application Document Information Questionnaire

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Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc. (Enel), is the Licensee and operator of the Lowell Hydroelectric Project (FERC No. 2790) (Project), with principal Project facilities located along the Merrimack River in Middlesex County, Massachusetts and a reservoir extending upstream to Hillsborough County, New Hampshire (see attached map). Boott, with assistance from HDR, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Project. Accordingly, Boott is preparing a Pre-Application Document (PAD) that will provide FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project that will be used to prepare documents related to analyzing the relicensing application to be prepared by Boott. To prepare the PAD, Boott will use information in its possession and information obtained from additional sources. This PAD Information Questionnaire will be used by Boott to help identify sources of existing, relevant, and reasonably available information that are not currently in Boott's possession.

1. Information about person completing the questionnaire:

Name & Title	
Organization	
Address	
Phone	
Email Address	

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

\_\_\_ Yes (*If yes, please complete 2a through 2c*)    \_\_\_ No (*If no, go to 3*)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>■ Geology and soils</li> <li>■ Water resources</li> <li>■ Fish and aquatic resources</li> <li>■ Wildlife and botanical resources</li> <li>■ Wetlands, riparian, and littoral habitat</li> <li>■ Rare, threatened &amp; endangered species</li> </ul> | <ul style="list-style-type: none"> <li>■ Recreation and land use</li> <li>■ Aesthetic resources</li> <li>■ Cultural resources</li> <li>■ Socio-economic resources</li> <li>■ Tribal resources</li> <li>■ Other resource information</li> </ul> |
|---|--|

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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b. Please briefly describe the information referenced above or list available documents (*additional information may be provided on pages 3 or 4 of this questionnaire*).

c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative (*additional information may be provided on pages 3 or 4 of this questionnaire*).

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes     No

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

Name	
Address	
Phone	
Email Address	

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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**Additional Representative Contact Information (Optional)**

Name	
Address	
Phone	
Email Address	

*Additional Information (additional space provided on the following page):*

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*Comments and/or questions may be sent via email to:*

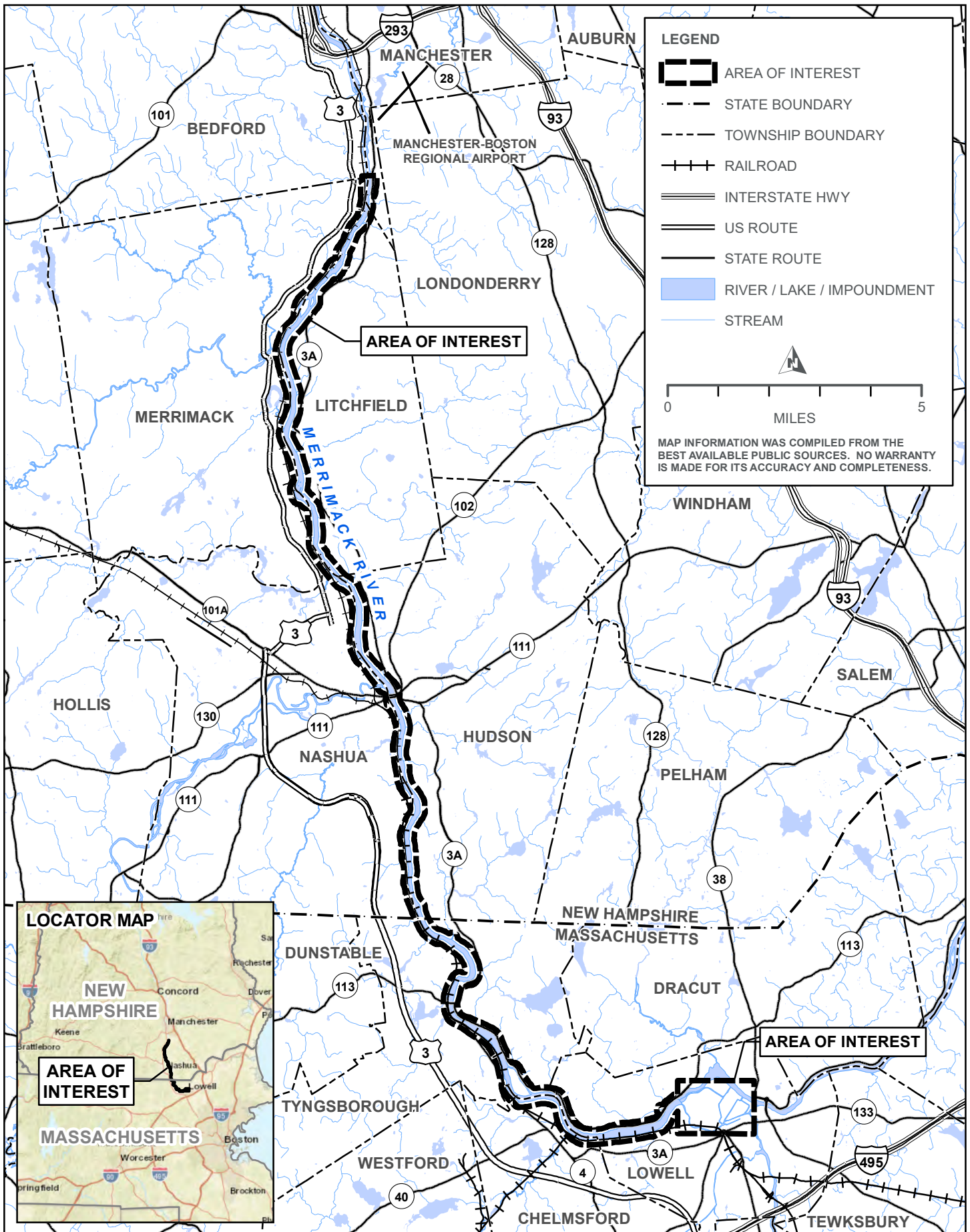
Jim Gibson, HDR, at [Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com) or  
Rob Quiggle, HDR, at [Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

If you have any questions about the Project, or the upcoming FERC licensing processes, please contact Mr. Kevin Webb, Enel Relicensing Manager for the Lowell Hydroelectric Project, at (978) 681-1900 ext. 809 or [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com); Jim Gibson at (315) 414-2202; or Rob Quiggle at (315) 414-2216.

**Please return this questionnaire in the enclosed, self-addressed, stamped envelope within 21 days of receipt to allow for any follow-up contact that may be necessary by a representative from Boott or HDR.** Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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# Lowell Hydroelectric Project (FERC No. 2790) Distribution List

## Federal and State Agencies

Charlene Dwin Vaughn  
Assistant Director  
Advisory Council on Historic Preservation  
401 F Street NW  
Suite 308  
Washington, DC 20001-2637

John Eddins  
Program Analyst  
Advisory Council on Historic Preservation  
401 F Street NW  
Suite 308  
Washington, DC 20001-2637

John Fowler  
Executive Director  
Advisory Council on Historic Preservation  
401 F Street NW  
Suite 308  
Washington, DC 20001-2637

Office of Dam Safety  
Massachusetts Department of Conservation  
and Recreation  
John Augustas Hall  
180 Beaman Street  
West Boylston, MA 01583-1109

Michael Judge  
Renewable Energy Division Director  
Massachusetts Department of Energy  
Resources  
100 Cambridge Street  
Suite 1020  
Boston, MA 02114-2533

Rachel Freed  
Northeast Region Section Chief  
Massachusetts Department of Environmental  
Protection  
205 Lowell Street  
Wilmington, MA 01887

Arthur Johnson  
DWM Environmental Monitoring Program  
Massachusetts Department of Environmental  
Protection  
8 Bond Street  
Worcester, MA 01606

Massachusetts Department of Fish and Game  
251 Causeway Street  
Suite 400  
Boston, MA 02114

Massachusetts Department of Public Utilities  
One South Station  
Boston, MA 02110

Matthew Ayer  
Massachusetts Division of Fisheries & Wildlife  
1 Rabbit Hill Road  
Westborough, MA 01581

Joseph Larson  
Chairman  
Massachusetts Division of Fisheries & Wildlife  
1 Rabbit Hill Road  
Westborough, MA 01581

Caleb Slater  
Anadromous Fish Project Leader  
Massachusetts Division of Fisheries & Wildlife  
1 Rabbit Hill Road  
Westborough, MA 01581

Ben Gahagan  
Diadromous Fisheries Biologist  
Massachusetts Division of Marine Fisheries  
251 Causeway Street  
Suite 400  
Boston, MA 02114

Bob Durand  
Massachusetts Executive Office of Energy &  
Environmental Affairs  
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Suite 900  
Boston, MA 02114

Jonathan Patton  
Preservation Planner  
Massachusetts Historical Commission  
220 Morrissey Boulevard  
Boston, MA 02125-3314

Brona Simon  
State Historic Preservation Officer  
Massachusetts Historical Commission  
220 Morrissey Boulevard  
Boston, MA 02125-3314



## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Secretary of the Commonwealth  
Massachusetts Historical Commission  
220 Morrissey Boulevard  
Boston, MA 02125-3314

Massachusetts Office of the Attorney General  
1 Ashburton Place  
Boston, MA 02108-1518

Bjorn Lake  
National Marine Fisheries Service  
55 Great Republic Drive  
Gloucester, MA 01930

Sue Tuxbury  
Fisheries Biologist  
National Marine Fisheries Service  
55 Great Republic Drive  
Gloucester, MA 01930

Misty Anne Marold  
Senior Review Biologist  
Natural Heritage Endangered Species  
Program  
Massachusetts Division of Fisheries & Wildlife  
1 Rabbit Hill Road  
Westborough, MA 01581

Owen David  
Water Quality Certification Program  
New Hampshire Department of Environmental  
Services  
29 Hazen Drive  
P.O. Box 95  
Concord, NH 03302

Jim Gallagher  
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New Hampshire Department of Environmental  
Services  
29 Hazen Drive  
P.O. Box 95  
Concord, NH 03302

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Director  
New Hampshire Division of Forests and Lands  
172 Pembroke Road  
Concord, NH 03301

Elizabeth Muzzey  
Director and State Historic Preservation  
Officer  
New Hampshire Division of Historical  
Resources  
19 Pillsbury Street  
Concord, NH 03301

Matt Carpenter  
Fisheries Biologist  
New Hampshire Fish and Game Department  
11 Hazen Drive  
Concord, NH 03301

Bill McDavitt  
Environmental Specialist  
NOAA Fisheries Service  
55 Great Republic Drive  
Gloucester, MA 01930

Sean McDermott  
Marine Habitat Resource Specialist,  
Hydropower Coordinator  
NOAA Fisheries Service  
55 Great Republic Drive  
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Harold Peterson  
Bureau of Indian Affairs  
US Department of the Interior  
545 Marriott Drive  
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Nashville, TN 37214

Andrew Tittler  
Attorney-Advisor  
US Department of the Interior  
One Gateway Center  
Suite 612  
Newton, MA 02458

Ed Reiner  
Region 1 - New England  
US Environmental Protection Agency  
5 Post Office Square  
Mail Code: OEP06-3  
Boston, MA 02109-3912

David Turin  
Region 1 - New England  
US Environmental Protection Agency  
5 Post Office Square  
Mail Code: OES04-3  
Boston, MA 02109-3912

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Michael Bailey  
Assistant Project Leader  
US Fish and Wildlife Service  
151 Broad Street  
Nashua, NH 03603

Tom Chapman  
Supervisor, New England Field Office  
US Fish and Wildlife Service  
70 Commercial Street  
Suite 300  
Concord, NH 03301-5094

Julianne Rosset  
Fish and Wildlife Biologist  
US Fish and Wildlife Service  
70 Commercial Street  
Suite 300  
Concord, NH 03301

Bryan Sojkowski  
Civil Engineer  
US Fish and Wildlife Service  
300 Westgate Center Drive  
Hadley, MA 01035

John Warner  
Assistant Supervisor Federal Activities  
US Fish and Wildlife Service  
70 Commercial Street  
Suite 300  
Concord, NH 03301

Keith Nislow  
Northern Research Station  
US Forest Service  
11 Campus Boulevard  
Suite 200  
Newton Square, PA 19073

Mark Prout  
Region 9 - Eastern Region (Midwest and  
Northeast)  
US Forest Service  
626 East Wisconsin Avenue  
Milwaukee, WI 53202

Celeste Bernardo  
Lowell National Historic Park  
US National Park Service  
67 Kirk Street  
Lowell, MA 01852

Kevin Mendik  
Hydro Program Manager  
US National Park Service  
15 State Street  
Boston, MA 02109

### Indian Tribes

Cedric Cromwell  
Chairman  
Mashpee Wampanoag Tribe  
483 Great Neck Road South  
Mashpee, MA 02649

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

John Brown  
Narragansett Indian Tribal Historic  
Preservation Office  
Narragansett Indian Tribe  
P.O. Box 268  
Charlestown, RI 02813

Bonney Hartley  
Tribal Historic Preservation Officer  
Stockbridge Munsee Community, Wisconsin  
65 1st Street  
Troy, NY 12180

Shannon Holsey  
Tribal President  
Stockbridge Munsee Community, Wisconsin  
N8476 MoHeConNuck Road  
Bowler, WI 54416

Cheryl Andrew-Maltais  
Chairwoman  
Wampanoag Tribe of Gay Head  
20 Black Brook Road  
Aquinnah, MA 02535

Bettina Washington  
Tribal Historic Preservation Officer  
Wampanoag Tribe of Gay Head  
20 Black Brook Road  
Aquinnah, MA 02535

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

### Municipalities

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

Daniel Rivera  
Mayor  
City of Lawrence, MA  
200 Common Street  
3rd Floor Room 309  
Lawrence, MA 01840

Nicolas Bosonetto  
Interim City Engineer  
City of Lowell, MA  
375 Merrimack Street  
3rd Floor, Room 61  
Lowell, MA 01852

Edward Kennedy  
Mayor  
City of Lowell, MA  
375 Merrimack Street  
2nd Floor, Room 50  
Lowell, MA 01852

Christine O'Connor  
City Solicitor  
City of Lowell, MA  
375 Merrimack Street  
3rd Floor, Room 64  
Lowell, MA 01852

Joyce Craig  
Mayor  
City of Manchester, NH  
One City Hall Plaza  
Manchester, NH 03101

James Jajuga  
Mayor  
City of Methuen, MA  
41 Pleasant Street  
Methuen, MA 01844

Jim Donchess  
City of Nashua, NH  
229 Main Street  
Nashua, NH 03060

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

Paul Bergeron  
District #2  
Hillsborough County, NH  
329 Mast Road  
Suite 120  
Goffstown, NH 03045

Toni Pappas  
District #1  
Hillsborough County, NH  
329 Mast Road  
Suite 120  
Goffstown, NH 03045

Robert Rowe  
District #3  
Hillsborough County, NH  
329 Mast Road  
Suite 120  
Goffstown, NH 03045

Steven Ledoux  
Town Manager  
Town of Acton, MA  
472 Main Street  
Acton, MA 01720

Andrew Flanagan  
Town Manager  
Town of Andover, MA  
36 Bartlet Street  
Andover, MA 01810

Jason Grosky  
Chairman  
Town of Atkinson, NH  
21 Academy Avenue  
Atkinson, NH 03811

Robert Pontbriand  
Town Administrator  
Town of Ayer, MA  
1 Main Street  
Ayer, MA 01432

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Richard Reed  
Town Manager  
Town of Bedford, MA  
10 Mudge Way  
Bedford, MA 01730

John Curran  
Town Manager  
Town of Billerica, MA  
365 Boston Road  
Billerica, MA 01821

Alan Benson  
Town Administrator  
Town of Boxford, MA  
7A Spofford Road  
Boxford, MA 01921

Amy Warfield  
Town Clerk  
Town of Burlington, MA  
29 Center Street  
Burlington, MA 01803

Jon Kurland  
Town Moderator  
Town of Chelmsford, MA  
50 Billerica Road  
Chelmsford, MA 01824

Jane Hotchkiss  
Chair, Select Board  
Town of Concord, MA  
P.O. Box 535  
Concord, MA 01742

James Morgan  
Councilor  
Town of Derry, NH  
14 Manning Street  
Derry, NH 03038

Alison Hughes  
Chairman  
Town of Dracut, MA  
62 Arlington Street  
Dracut, MA 01826

Town Manager  
Town of Groton, MA  
173 Main Street  
Groton, MA 01450

Timothy Bragan  
Town Administrator  
Town of Harvard, MA  
13 Ayer Road  
Harvard, MA 01451

Kim Galipeau  
Town Administrator  
Town of Hollis, NH  
7 Monument Square  
Hollis, NH 03049

Thaddeus Luszey  
Chairman  
Town of Hudson, NH  
12 School Street  
Hudson, NH 03051

Suzanne Barry  
Chairman  
Town of Lexington, MA  
1625 Massachusetts Avenue  
2nd Floor, Town Office Building  
Lexington, MA 02420

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

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

Keith Bergman  
Town Administrator  
Town of Littleton, MA  
37 Shattuck Street  
3rd Floor, Room 306  
Littleton, MA 01460

Tom Dolan  
Chairman  
Town of Londonderry, NH  
268B Mammoth Road  
Londonderry, NH 03053

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

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

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

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

Andrew Maylor  
Town Manager  
Town of North Andover, MA  
120 Main Street  
North Andover, MA 01845

John Murphy  
Town Moderator  
Town of North Reading, MA  
235 North Street  
North Reading, MA 01864

Douglas Viger  
Chairman  
Town of Pelham, NH  
6 Village Green  
Pelham, NH 03076

Mark Andrews  
Town Administrator  
Town of Pepperell, MA  
One Main Street  
Pepperell, MA 01463

John Arena  
Chair, Board of Selectmen  
Town of Reading, MA  
16 Lowell Street  
Reading, MA 01867

Michael Lyons  
Chairman  
Town of Salem, NH  
33 Geremonty Drive  
Salem, NH 03079

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

George Seibold  
Chairman  
Town of Stoneham, MA  
35 Central Street  
2nd Floor  
Stoneham, MA 02180

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

Robert Jackson  
Chair, Board of Selectmen  
Town of Tyngsborough, MA  
25 Bryants Lane  
Tyngsborough, MA 01879

Board of Selectmen  
Town of Westford, MA  
55 Main Street  
Westford, MA 01886

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

Ross Mcleod  
Chairman  
Town of Windham, NH  
3 North Lowell Street  
Windham, NH 03087

### **Additional Parties**

Robert Nasdor  
NE Stewardship Director  
American Whitewater  
65 Blueberry Hill Lane  
Sudbury, MA 01776

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Norman Sims  
Appalachian Mountain Club  
77 Back Ashuelot Road  
Winchester, NH 03470

Ross Holland  
Enel Green Power North America, Inc.  
One Tech Drive  
Andover, MA 01810

Kevin Webb  
Hydro Licensing Manager  
Enel Green Power North America, Inc.  
One Tech Drive  
Andover, MA 01810

Robert Bersak  
780 North Commercial Street  
Eversource Energy  
P.O. Box 330  
Manchester, NH 03015

Jay Mason  
President  
Friends of Tyler Park  
77 Tyler Park  
Lowell, MA 01851

David Meeker  
4920 Elm Street  
Hull Street Energy, LLC  
Suite 205  
Bethesda, MD 20814

Dinell Clark  
Lowell Flood Owner's Group  
197 Wellman Avenue  
North Chelmsford, MA 01863

Bob Gagnon  
Lowell Flood Owner's Group  
136 Townsend Avenue  
Lowell, MA 01854

Lynda Ignacio  
Lowell Flood Owner's Group  
66 Shirley Avenue  
Lowell, MA 01854

Steve Masse  
Lowell Flood Owner's Group  
186 Humphrey Street  
Lowell, MA 01850

John Nappi  
Lowell Flood Owner's Group  
279 Pawtucket Boulevard  
Tyngsborough, MA 01879

Gene Porter  
Lower Merrimack River Local Advisory  
77 Concord Street  
Nashua, NH 03064

Thomas Golden, Jr.  
Massachusetts House of Representatives  
24 Beacon Street  
Room 473B  
Boston, MA 02133

Rady Mom  
Massachusetts House of Representatives  
24 Beacon Street  
Room 43  
Boston, MA 02133

David Nangle  
Massachusetts House of Representatives  
24 Beacon Street  
Room 479  
Boston, MA 02133

Eileen Donoghue  
Massachusetts Senate  
24 Beacon Street  
Room 405  
Boston, MA 02133

Kim Goddu  
Merrimack River Watershed Council  
60 Island Street  
Suite 211-E  
Lawrence, MA 01840

Rusty Russell  
Executive Director  
Merrimack River Watershed Council  
60 Island Street  
Suite 211-E  
Lawrence, MA 01840

Fred Britton  
Associate President  
Thoreau's Landing Condominium Association  
32 Walden Pond Drive  
Nashua, NH 03064

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Fred Jennings  
President, Nor'East Chapter  
Trout Unlimited  
P.O. Box 946  
Ipswich, MA 01938

Arthur Faneros  
Universal Apartment Rental  
114 University Avenue  
Lowell, MA 01854

Michele Tremblay  
Upper Merrimack River Local Advisory  
Committee  
P.O. Box 3019  
Penacook, NH 03303

Ann Kuster  
US House of Representatives  
137 Cannon House Office Building  
2nd District  
Washington, DC 20515

Seth Moulton  
6th District  
US House of Representatives  
21 Front Street  
Salem, MA 01970

Carol Shea-Porter  
US House of Representatives  
1530 Longworth House Office Building  
1st District  
Washington, DC 20515

Niki Tsongas  
3rd District  
US House of Representatives  
126 John Street  
Suite 12  
Lowell, MA 01852

Margaret Hassan  
US Senate  
330 Hart Senate Office Building  
Washington, DC 20510

Edward Markey  
US Senate  
218 Russell Senate Office Building  
Washington, DC 20510

Jeanne Shaheen  
US Senate  
506 Hart Senate Office Building  
Washington, DC 20510

Elizabeth Warren  
US Senate  
317 Hart Senate Office Building  
Washington, DC 20510

Dinell Clark  
President  
Williamsburg Condominium I  
197 Wellman Avenue  
North Chelmsford, MA 01863

Richard Howe  
Register of Deeds - Middlesex County North  
360 Gorham Street  
Lowell, MA 01852

**From:** Amy Warfield [mailto:awarfield@burlington.org]  
**Sent:** Wednesday, March 14, 2018 10:25 AM  
**To:** Gibson, Jim <Jim.Gibson@hdrinc.com>  
**Subject:** Lowell Hydro Project (FERC Project No. 2790)

Dear Sir,

We have no information regarding this project.

Regards,

--

Amy E. Warfield , CMC, CMMC  
Town Clerk, Burlington  
Webmaster  
Records Access Officer  
29 Center St  
Burlington, MA 01803  
781-270-1660

**Remember to be involved!!!**

**Town Election - April 7th - 8 AM to 8 PM, Burlington High School**

~~~~~  
Please remember when writing or responding, the Massachusetts Secretary of State has determined that e-mail is a public record.



All email messages and attached content sent from and to this email account are public records unless qualified as an exemption under the [Massachusetts Public Records Law](#).

**From:** gene porter [mailto:gporter77@gmail.com]  
**Sent:** Thursday, March 15, 2018 12:40 PM  
**To:** Gibson, Jim <Jim.Gibson@hdrinc.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>  
**Cc:** Madeline Mineau <mineaum@nashuanh.gov>  
**Subject:** Relicensing FERC 2709

Greetings

Thanks for sending me the Information Questionnaire, which I have mailed back today.

You will note that I have identified the Nashua Waterways Manager, Dr Madeleine Mineau, as an important stakeholder that should be afforded an opportunity to comment on your preparations for this relicensing process. One obvious near term matter of joint interest is the interaction between your future management of headpond water levels and the City's contracting process for the design and construction of a new boat launch facility in Greeley Park.

I have copied her on this note

--  
Best  
Gene Porter  
Chair, LMRLAC

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc. (Enel), is the Licensee and operator of the Lowell Hydroelectric Project (FERC No. 2790) (Project), with principal Project facilities located along the Merrimack River in Middlesex County, Massachusetts and a reservoir extending upstream to Hillsborough County, New Hampshire (see attached map). Boott, with assistance from HDR, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Project. Accordingly, Boott is preparing a Pre-Application Document (PAD) that will provide FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project that will be used to prepare documents related to analyzing the relicensing application to be prepared by Boott. To prepare the PAD, Boott will use information in its possession and information obtained from additional sources. This PAD Information Questionnaire will be used by Boott to help identify sources of existing, relevant, and reasonably available information that are not currently in Boott's possession.

1. Information about person completing the questionnaire:

|               |                             |
|---------------|-----------------------------|
| Name & Title  | Steven Ledoux, Town Manager |
| Organization  | Town of Acton               |
| Address       | 472 Main St                 |
| Phone         | 978-929-6611                |
| Email Address | Manager@acton-ma.gov        |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)     No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                   |                                                     |
|-------------------------------------------------------------------|-----------------------------------------------------|
| <input type="checkbox"/> Geology and soils                        | <input type="checkbox"/> Recreation and land use    |
| <input type="checkbox"/> Water resources                          | <input type="checkbox"/> Aesthetic resources        |
| <input type="checkbox"/> Fish and aquatic resources               | <input type="checkbox"/> Cultural resources         |
| <input type="checkbox"/> Wildlife and botanical resources         | <input type="checkbox"/> Socio-economic resources   |
| <input type="checkbox"/> Wetlands, riparian, and littoral habitat | <input type="checkbox"/> Tribal resources           |
| <input type="checkbox"/> Rare, threatened & endangered species    | <input type="checkbox"/> Other resource information |

10/01/14

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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b. Please briefly describe the information referenced above or list available documents (*additional information may be provided on pages 3 or 4 of this questionnaire*).

c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative (*additional information may be provided on pages 3 or 4 of this questionnaire*).

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes     No

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

|               |  |
|---------------|--|
| Name          |  |
| Address       |  |
| Phone         |  |
| Email Address |  |

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

---

**Additional Representative Contact Information (Optional)**

|               |  |
|---------------|--|
| Name          |  |
| Address       |  |
| Phone         |  |
| Email Address |  |

*Additional Information (additional space provided on the following page):*

---

*Comments and/or questions may be sent via email to:*

Jim Gibson, HDR, at [Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com) or  
Rob Quiggle, HDR, at [Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

If you have any questions about the Project, or the upcoming FERC licensing processes, please contact Mr. Kevin Webb, Enel Relicensing Manager for the Lowell Hydroelectric Project, at (978) 681-1900 ext. 809 or [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com); Jim Gibson at (315) 414-2202; or Rob Quiggle at (315) 414-2216.

**Please return this questionnaire in the enclosed, self-addressed, stamped envelope within 21 days of receipt to allow for any follow-up contact that may be necessary by a representative from Boott or HDR.** Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

---

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc. (Enel), is the Licensee and operator of the Lowell Hydroelectric Project (FERC No. 2790) (Project), with principal Project facilities located along the Merrimack River in Middlesex County, Massachusetts and a reservoir extending upstream to Hillsborough County, New Hampshire (see attached map). Boott, with assistance from HDR, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Project. Accordingly, Boott is preparing a Pre-Application Document (PAD) that will provide FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project that will be used to prepare documents related to analyzing the relicensing application to be prepared by Boott. To prepare the PAD, Boott will use information in its possession and information obtained from additional sources. This PAD Information Questionnaire will be used by Boott to help identify sources of existing, relevant, and reasonably available information that are not currently in Boott's possession.

1. Information about person completing the questionnaire:

|               |                                           |
|---------------|-------------------------------------------|
| Name & Title  | Dinell Clark President                    |
| Organization  | Williamsburg 1 Condos                     |
| Address       | 197 Wellman Ave<br>No Chelmsford MA 01803 |
| Phone         | 978-806-2580                              |
| Email Address | dinellclark@verizon.net                   |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)  No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                   |                                                     |
|-------------------------------------------------------------------|-----------------------------------------------------|
| <input type="checkbox"/> Geology and soils                        | <input type="checkbox"/> Recreation and land use    |
| <input type="checkbox"/> Water resources                          | <input type="checkbox"/> Aesthetic resources        |
| <input type="checkbox"/> Fish and aquatic resources               | <input type="checkbox"/> Cultural resources         |
| <input type="checkbox"/> Wildlife and botanical resources         | <input type="checkbox"/> Socio-economic resources   |
| <input type="checkbox"/> Wetlands, riparian, and littoral habitat | <input type="checkbox"/> Tribal resources           |
| <input type="checkbox"/> Rare, threatened & endangered species    | <input type="checkbox"/> Other resource information |

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

---

b. Please briefly describe the information referenced above or list available documents *(additional information may be provided on pages 3 or 4 of this questionnaire)*.

c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative *(additional information may be provided on pages 3 or 4 of this questionnaire)*.

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes     No

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

|               |                                           |
|---------------|-------------------------------------------|
| Name          | Direll Clark                              |
| Address       | 197 Wellman Ave<br>No Chelmsford MA 01803 |
| Phone         | 978.866-2580                              |
| Email Address | direllclark@verizon.net                   |



**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

---

**Additional Representative Contact Information (Optional)**

|               |  |
|---------------|--|
| Name          |  |
| Address       |  |
| Phone         |  |
| Email Address |  |

*Additional Information (additional space provided on the following page):*

---

*Comments and/or questions may be sent via email to:*

Jim Gibson, HDR, at [Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com) or  
Rob Quiggle, HDR, at [Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

If you have any questions about the Project, or the upcoming FERC licensing processes, please contact Mr. Kevin Webb, Enel Relicensing Manager for the Lowell Hydroelectric Project, at (978) 681-1900 ext. 809 or [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com); Jim Gibson at (315) 414-2202; or Rob Quiggle at (315) 414-2216.

**Please return this questionnaire in the enclosed, self-addressed, stamped envelope within 21 days of receipt to allow for any follow-up contact that may be necessary by a representative from Boott or HDR.** Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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1. Information about person completing the questionnaire:

|               |                                                       |
|---------------|-------------------------------------------------------|
| Name & Title  | Gene Porter, Chairman                                 |
| Organization  | Lowell Merrimack River<br>Local Advisory Ctr (LMRLAC) |
| Address       | 77 Concord St<br>Nashua, NH 03064                     |
| Phone         | 603 966 0015 (Mob)                                    |
| Email Address | gporter77@gmail.com                                   |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)     No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                   |                                                             |
|-------------------------------------------------------------------|-------------------------------------------------------------|
| <input type="checkbox"/> Geology and soils                        | <input checked="" type="checkbox"/> Recreation and land use |
| <input type="checkbox"/> Water resources                          | <input type="checkbox"/> Aesthetic resources                |
| <input type="checkbox"/> Fish and aquatic resources               | <input type="checkbox"/> Cultural resources                 |
| <input type="checkbox"/> Wildlife and botanical resources         | <input type="checkbox"/> Socio-economic resources           |
| <input type="checkbox"/> Wetlands, riparian, and littoral habitat | <input type="checkbox"/> Tribal resources                   |
| <input type="checkbox"/> Rare, threatened & endangered species    | <input type="checkbox"/> Other resource information         |

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

b. Please briefly describe the information referenced above or list available documents (additional information may be provided on pages 3 or 4 of this questionnaire).

The Project headpond in NH is a major recreational asset. The NH state IDWAA identified this water body as the highest priority for a new public access boat ramp, now

c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative (additional information may be provided on pages 3 or 4 of this questionnaire).

See next page

Dr. Minnow  
Nashua Waterways Mgt

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes     No

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

|               |                                   |
|---------------|-----------------------------------|
| Name          | Gene Porter                       |
| Address       | 77 Concord St<br>Nashua, NH 03062 |
| Phone         | 603 966-0015                      |
| Email Address | gporter77@gmail.com               |

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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**Additional Representative Contact Information (Optional)**

|               |                                        |
|---------------|----------------------------------------|
| Name          | Dr. Madeline Mineau                    |
| Address       | Waterways Manager<br>Nashua City Hall, |
| Phone         |                                        |
| Email Address | mineau m @ nashua.nh.gov               |

*Additional Information (additional space provided on the following page):*

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*Comments and/or questions may be sent via email to:*

Jim Gibson, HDR, at [Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com) or  
Rob Quiggle, HDR, at [Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

If you have any questions about the Project, or the upcoming FERC licensing processes, please contact Mr. Kevin Webb, Enel Relicensing Manager for the Lowell Hydroelectric Project, at (978) 681-1900 ext. 809 or [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com); Jim Gibson at (315) 414-2202; or Rob Quiggle at (315) 414-2216.

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**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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**Lowell Hydroelectric Project (FERC Project No. 2790)  
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1. Information about person completing the questionnaire:

|               |                                      |
|---------------|--------------------------------------|
| Name & Title  | Caleb Slator, PhD                    |
| Organization  | Mass Wildlife                        |
| Address       | 1 Rabbit Hill Rd, Westbury, MA 01581 |
| Phone         | 509 389 6331                         |
| Email Address | Caleb.slator@slator.com.us           |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)     No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li><input type="checkbox"/> Geology and soils</li> <li><input checked="" type="checkbox"/> Water resources</li> <li><input checked="" type="checkbox"/> Fish and aquatic resources</li> <li><input checked="" type="checkbox"/> Wildlife and botanical resources</li> <li><input checked="" type="checkbox"/> Wetlands, riparian, and littoral habitat</li> <li><input checked="" type="checkbox"/> Rare, threatened &amp; endangered species</li> </ul> | <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Recreation and land use</li> <li><input checked="" type="checkbox"/> Aesthetic resources</li> <li><input type="checkbox"/> Cultural resources</li> <li><input type="checkbox"/> Socio-economic resources</li> <li><input type="checkbox"/> Tribal resources</li> <li><input type="checkbox"/> Other resource information</li> </ul> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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b. Please briefly describe the information referenced above or list available documents (*additional information may be provided on pages 3 or 4 of this questionnaire*).

- fish surveys
- T+E species maps
- fish lift counts

c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative (*additional information may be provided on pages 3 or 4 of this questionnaire*).

none

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes  No

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

|               |                                       |
|---------------|---------------------------------------|
| Name          | Caleb Slater, PhD                     |
| Address       | 1 Rabbit Hill Rd Westborough MA 01581 |
| Phone         | 508 399 6331                          |
| Email Address | Caleb.Slater@state.ma.us              |



**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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**Additional Representative Contact Information (Optional)**

|               |  |
|---------------|--|
| Name          |  |
| Address       |  |
| Phone         |  |
| Email Address |  |

*Additional Information (additional space provided on the following page):*

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Jim Gibson, HDR, at [Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com) or  
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**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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RECEIVED  
MAR 14 2018  
TOWN OF HUDSON  
SELECTMEN'S OFFICE

**Lowell Hydroelectric Project (FERC Project No. 2790)  
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1. Information about person completing the questionnaire:

|               |                                              |
|---------------|----------------------------------------------|
| Name & Title  | <i>Stephen Malizia, Town Administrator</i>   |
| Organization  | <i>Town of Hudson, NH</i>                    |
| Address       | <i>12 School Street<br/>Hudson, NH 03051</i> |
| Phone         | <i>(603) 886-6024</i>                        |
| Email Address | <i>smalizia@hudsonnh.gov</i>                 |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)  No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- Geology and soils
- Water resources
- Fish and aquatic resources
- Wildlife and botanical resources
- Wetlands, riparian, and littoral habitat
- Rare, threatened & endangered species
- Recreation and land use
- Aesthetic resources
- Cultural resources
- Socio-economic resources
- Tribal resources
- Other resource information

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
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b. Please briefly describe the information referenced above or list available documents *(additional information may be provided on pages 3 or 4 of this questionnaire)*.

c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative *(additional information may be provided on pages 3 or 4 of this questionnaire)*.

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes     No

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

|               |                                      |
|---------------|--------------------------------------|
| Name          | Stephen Malizia                      |
| Address       | 12 School Street<br>Hudson, NH 03051 |
| Phone         | (603) 886-6024                       |
| Email Address | smalizia@hudsonnh.gov                |

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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**Additional Representative Contact Information (Optional)**

|               |                                              |
|---------------|----------------------------------------------|
| Name          | <i>Elvis Dhima, P.E. Town Engineer</i>       |
| Address       | <i>12 School Street<br/>Hudson, NH 03051</i> |
| Phone         | <i>(603) 886-6008</i>                        |
| Email Address | <i>edhima@hudsonnh.gov</i>                   |

*Additional Information (additional space provided on the following page):*

---

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1. Information about person completing the questionnaire:

|               |                                                |
|---------------|------------------------------------------------|
| Name & Title  | Harold Peterson, Natural Resources Officer     |
| Organization  | U.S. Bureau of Indian Affairs - Eastern Region |
| Address       | 545 Marriott Dr Ste 700<br>Nashville, TN 37214 |
| Phone         | 615-564-6838                                   |
| Email Address | harold.peterson@bia.gov                        |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)     No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                   |                                                      |
|-------------------------------------------------------------------|------------------------------------------------------|
| <input type="checkbox"/> Geology and soils                        | <input type="checkbox"/> Recreation and land use     |
| <input type="checkbox"/> Water resources                          | <input type="checkbox"/> Aesthetic resources         |
| <input type="checkbox"/> Fish and aquatic resources               | <input type="checkbox"/> Cultural resources          |
| <input type="checkbox"/> Wildlife and botanical resources         | <input type="checkbox"/> Socio-economic resources    |
| <input type="checkbox"/> Wetlands, riparian, and littoral habitat | <input checked="" type="checkbox"/> Tribal resources |
| <input type="checkbox"/> Rare, threatened & endangered species    | <input type="checkbox"/> Other resource information  |

**Lowell Hydroelectric Project (FERC Project No. 2790)  
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b. Please briefly describe the information referenced above or list available documents *(additional information may be provided on pages 3 or 4 of this questionnaire)*.

The following Tribes have historic interests in the area and should be consulted:

Mashpee Wampanoag Tribe  
Wampanoag Tribe of Gay Head  
Penobscot Nation

c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative *(additional information may be provided on pages 3 or 4 of this questionnaire)*.

tribal leaders directory or www.bia.gov

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes     No

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

|               |                 |
|---------------|-----------------|
| Name          | Harold Peterson |
| Address       | same            |
| Phone         |                 |
| Email Address |                 |



**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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**Additional Representative Contact Information (Optional)**

|               |  |
|---------------|--|
| Name          |  |
| Address       |  |
| Phone         |  |
| Email Address |  |

*Additional Information (additional space provided on the following page):*

---

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Jim Gibson, HDR, at [Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com) or  
Rob Quiggle, HDR, at [Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

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HDR  
1304 Buckley Rd Ste 202  
Syracuse, NY 13212

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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1. Information about person completing the questionnaire:

|               |                                             |
|---------------|---------------------------------------------|
| Name & Title  | Amy Lamb, Ecological Information Specialist |
| Organization  | NH Natural Heritage Bureau                  |
| Address       | 172 Pembroke Rd, Concord, NH 03301          |
| Phone         | 603-271-2834                                |
| Email Address | amy.lamb@dncr.nh.gov                        |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)     No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                           |                                                     |
|---------------------------------------------------------------------------|-----------------------------------------------------|
| <input type="checkbox"/> Geology and soils                                | <input type="checkbox"/> Recreation and land use    |
| <input type="checkbox"/> Water resources                                  | <input type="checkbox"/> Aesthetic resources        |
| <input type="checkbox"/> Fish and aquatic resources                       | <input type="checkbox"/> Cultural resources         |
| <input checked="" type="checkbox"/> Wildlife and botanical resources      | <input type="checkbox"/> Socio-economic resources   |
| <input type="checkbox"/> Wetlands, riparian, and littoral habitat         | <input type="checkbox"/> Tribal resources           |
| <input checked="" type="checkbox"/> Rare, threatened & endangered species | <input type="checkbox"/> Other resource information |

**Lowell Hydroelectric Project (FERC Project No. 2790)  
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- b. Please briefly describe the information referenced above or list available documents *(additional information may be provided on pages 3 or 4 of this questionnaire)*.

The NH Natural Heritage Bureau <sup>(NHB)</sup> maintains a database of known occurrences of Threatened - Endangered plant species, and exemplary natural communities. NHB routinely provides this information for various permitting processes, through an online tool called the "NHB Datacheck tool".

SEE PAGE 3

- c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative *(additional information may be provided on pages 3 or 4 of this questionnaire)*.

NHB Datacheck Tool: <https://www2.des.state.nh.us/nhb-datacheck/>

Contact: Amy Lamb (general/main contact)

Data Sharing Agreement contact: Sara Cairns, 603-271-2823  
(if interested, see pg. 3) [sara.cairns@dnr.nh.gov](mailto:sara.cairns@dnr.nh.gov)

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes     No

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

|               |                                    |
|---------------|------------------------------------|
| Name          | Amy Lamb                           |
| Address       | 172 Pembroke Rd, Concord, NH 03301 |
| Phone         | 603-271-2834                       |
| Email Address | amy.lamb@dnr.nh.gov                |

**Lowell Hydroelectric Project (FERC Project No. 2790)  
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**Additional Representative Contact Information (Optional)**

|               |                                      |                                          |
|---------------|--------------------------------------|------------------------------------------|
| Name          | Sara Cairns<br>data manager          | Sabrina Stanwood<br>Bureau administrator |
| Address       | 172 Pembroke Rd<br>Concord, NH 03301 | (Same)                                   |
| Phone         | 603-271-2823                         | 271-2861                                 |
| Email Address | sara.cairns@dncr.<br>nh.gov          | sabrina.stanwood@<br>dncr.nh.gov         |

Additional Information (additional space provided on the following page):

Note: NHB's database also contains data on occurrences of protected wildlife species (Threatened, Endangered, special concern, or otherwise rare/protected), which is maintained in conjunction with the NH Fish & Game Department. NHFG has jurisdiction over wildlife.

Data for both rare plants/exemplary natural communities AND NH Fish & Game rare species data is available through NHB. Preliminary data may be obtained through the NHB Datacheck Tool or via the enclosed hard copy form. However, for large projects we may also be able to share our digital data, if needed, through a Data Sharing Agreement.

*Comments and/or questions may be sent via email to:*

Jim Gibson, HDR, at [Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com) or  
Rob Quiggle, HDR, at [Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

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1. Information about person completing the questionnaire:

|               |                                      |
|---------------|--------------------------------------|
| Name & Title  | Andrew W. Maylor, Town Manager       |
| Organization  | Town of North Andover                |
| Address       | 120 MAIN ST. NORTH ANDOVER, MA 01845 |
| Phone         | 978-688-9510                         |
| Email Address | amaylor@northandoverma.gov           |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

\_\_\_ Yes (If yes, please complete 2a through 2c)     No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                   |                                                     |
|-------------------------------------------------------------------|-----------------------------------------------------|
| <input type="checkbox"/> Geology and soils                        | <input type="checkbox"/> Recreation and land use    |
| <input type="checkbox"/> Water resources                          | <input type="checkbox"/> Aesthetic resources        |
| <input type="checkbox"/> Fish and aquatic resources               | <input type="checkbox"/> Cultural resources         |
| <input type="checkbox"/> Wildlife and botanical resources         | <input type="checkbox"/> Socio-economic resources   |
| <input type="checkbox"/> Wetlands, riparian, and littoral habitat | <input type="checkbox"/> Tribal resources           |
| <input type="checkbox"/> Rare, threatened & endangered species    | <input type="checkbox"/> Other resource information |

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc. (Enel), is the Licensee and operator of the Lowell Hydroelectric Project (FERC No. 2790) (Project), with principal Project facilities located along the Merrimack River in Middlesex County, Massachusetts and a reservoir extending upstream to Hillsborough County, New Hampshire (see attached map). Boott, with assistance from HDR, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Project. Accordingly, Boott is preparing a Pre-Application Document (PAD) that will provide FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project that will be used to prepare documents related to analyzing the relicensing application to be prepared by Boott. To prepare the PAD, Boott will use information in its possession and information obtained from additional sources. This PAD Information Questionnaire will be used by Boott to help identify sources of existing, relevant, and reasonably available information that are not currently in Boott's possession.

1. Information about person completing the questionnaire:

|               |                                  |
|---------------|----------------------------------|
| Name & Title  | Stephen Morse                    |
| Organization  | Lowell Flood Owners Group        |
| Address       | 186 Humphrey St Lowell, MA 01850 |
| Phone         | 978-397-4180                     |
| Email Address | SMORSE64@yahoo.com               |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)     No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                   |                                                                |
|-------------------------------------------------------------------|----------------------------------------------------------------|
| <input checked="" type="checkbox"/> Geology and soils             | <input checked="" type="checkbox"/> Recreation and land use    |
| <input checked="" type="checkbox"/> Water resources               | <input type="checkbox"/> Aesthetic resources                   |
| <input type="checkbox"/> Fish and aquatic resources               | <input type="checkbox"/> Cultural resources                    |
| <input type="checkbox"/> Wildlife and botanical resources         | <input type="checkbox"/> Socio-economic resources              |
| <input type="checkbox"/> Wetlands, riparian, and littoral habitat | <input type="checkbox"/> Tribal resources                      |
| <input type="checkbox"/> Rare, threatened & endangered species    | <input checked="" type="checkbox"/> Other resource information |

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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b. Please briefly describe the information referenced above or list available documents (additional information may be provided on pages 3 or 4 of this questionnaire).

The Lowell Boott Hydro Project has increased the level of the Historic Granite Dam from its original 3 ft to its current height without payments for increased flood occurrences in terms of costs to home owners for flood insurance, damages to private property and increased use of dewatering/ground water control in private residences, all un-compensated as the FERC has continually allowed taller Granite Dams, wooden floodboards and now, higher bladder-type floodboard structures on said Granite Dam.

c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative (additional information may be provided on pages 3 or 4 of this questionnaire).

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes     No

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

|               |                                 |
|---------------|---------------------------------|
| Name          | Stephen Mass, LFOG              |
| Address       | 186 Humphrey St Lowell MA 01850 |
| Phone         | 978 397-4180                    |
| Email Address | smass@w4shod.com                |

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

---

**Additional Representative Contact Information (Optional)**

|               |  |
|---------------|--|
| Name          |  |
| Address       |  |
| Phone         |  |
| Email Address |  |

*Additional Information (additional space provided on the following page):*

*LFLOG will oppose Relicensing of this Project until  
Compensation is offered to all Landowners for the taking of  
their Private Property (Flood Costs, Ground De-watering Costs of Insurance  
Costs) for a "Public" use by a "For Profit" Corporate interest.*

---

*Comments and/or questions may be sent via email to:*

Jim Gibson, HDR, at [Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com) or  
Rob Quiggle, HDR, at [Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

If you have any questions about the Project, or the upcoming FERC licensing processes, please contact Mr. Kevin Webb, Enel Relicensing Manager for the Lowell Hydroelectric Project, at (978) 681-1900 ext. 809 or [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com); Jim Gibson at (315) 414-2202; or Rob Quiggle at (315) 414-2216.

**Please return this questionnaire in the enclosed, self-addressed, stamped envelope within 21 days of receipt to allow for any follow-up contact that may be necessary by a representative from Boott or HDR.** Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

---

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1. Information about person completing the questionnaire:

|               |                                               |
|---------------|-----------------------------------------------|
| Name & Title  | Sue Tuxbury<br>Fishery Biologist              |
| Organization  | NOAA Fisheries                                |
| Address       | 55 Great Republic Dr.<br>Gloucester, MA 01930 |
| Phone         | 978-281-9176                                  |
| Email Address | susan.tuxbury@noaa.gov                        |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)     No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                   |                                                     |
|-------------------------------------------------------------------|-----------------------------------------------------|
| <input type="checkbox"/> Geology and soils                        | <input type="checkbox"/> Recreation and land use    |
| <input type="checkbox"/> Water resources                          | <input type="checkbox"/> Aesthetic resources        |
| <input checked="" type="checkbox"/> Fish and aquatic resources    | <input type="checkbox"/> Cultural resources         |
| <input type="checkbox"/> Wildlife and botanical resources         | <input type="checkbox"/> Socio-economic resources   |
| <input type="checkbox"/> Wetlands, riparian, and littoral habitat | <input type="checkbox"/> Tribal resources           |
| <input type="checkbox"/> Rare, threatened & endangered species    | <input type="checkbox"/> Other resource information |

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

---

- b. Please briefly describe the information referenced above or list available documents (additional information may be provided on pages 3 or 4 of this questionnaire).

Passage of Radio-tagged American Shad Through the Northern Canal Headgate Structure, Lowell Hydroelectric Project. Nov 1988  
Prepared by RMC Environmental Services

- c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative (additional information may be provided on pages 3 or 4 of this questionnaire).

We can provide a PDF upon request

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes  No

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

|               |                                               |
|---------------|-----------------------------------------------|
| Name          | Sue Tuxbury                                   |
| Address       | 55 Great Republic Dr.<br>Gloucester, MA 01930 |
| Phone         | 978-281-9176                                  |
| Email Address | susan.tuxbury@noaa.gov                        |

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

---

**Additional Representative Contact Information (Optional)**

|               |                                           |
|---------------|-------------------------------------------|
| Name          | Sean McDermott                            |
| Address       | 55 Great Republic Dr.<br>Lowell, MA 01930 |
| Phone         | 978-281-9113                              |
| Email Address | sean.mcdermott@usaa.gov                   |

Additional Information (additional space provided on the following page):

The PAD should discuss the gatehouse and operation/condition of the boat lock system adjacent to the gatehouse

---

*Comments and/or questions may be sent via email to:*

Jim Gibson, HDR, at [Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com) or  
Rob Quiggle, HDR, at [Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

If you have any questions about the Project, or the upcoming FERC licensing processes, please contact Mr. Kevin Webb, Enel Relicensing Manager for the Lowell Hydroelectric Project, at (978) 681-1900 ext. 809 or [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com); Jim Gibson at (315) 414-2202; or Rob Quiggle at (315) 414-2216.

**Please return this questionnaire in the enclosed, self-addressed, stamped envelope within 21 days of receipt to allow for any follow-up contact that may be necessary by a representative from Boott or HDR.** Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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## Scida, Rebecca

---

**From:** MacVane, Kelly  
**Sent:** Wednesday, April 04, 2018 5:26 PM  
**To:** Scida, Rebecca  
**Subject:** FW: Lowell Hydroelectric Project (FERC 2790) Relicensing Pre-Application Questionnaire - Lowell National Park Response  
**Attachments:** Slingshot.txt  
**Follow Up Flag:** Follow up  
**Flag Status:** Flagged

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Returning users click here to [Download](#) (files: Lowell NHP Response to Lowell Hydro Project Questionnaire.pdf; National Register Nomination Lowell 8-13-76.pdf; Lowell NHP P.L.95-290 as amended.pdf; DCR lowell-gbfm-rmp.pdf; Boundary Map 1978 LOWE\_475\_80008A\_[id3686].pdf;)

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---

Becky-

Can you please update the consultation log? Thanks!

### Kelly MacVane

**D** 207-239-3828 **M** 207-775-4495

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

---

**From:** Gibson, Jim  
**Sent:** Wednesday, April 4, 2018 5:12 PM  
**To:** MacVane, Kelly <[Kelly.MacVane@hdrinc.com](mailto:Kelly.MacVane@hdrinc.com)>  
**Cc:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Subject:** FW: Lowell Hydroelectric Project (FERC 2790) Relicensing Pre-Application Questionnaire - Lowell National Park Response

FYI

**Jim Gibson**, MPA, MSES  
*Vice President*

### HDR

1304 Buckley Road, Suite 202  
Syracuse, NY 13212

D 315.414.2202 M 315.415.2729  
jim.gibson@hdrinc.com

hdrinc.com/follow-us

**From:** Aucella, Peter [[mailto:peter\\_aucella@nps.gov](mailto:peter_aucella@nps.gov)]

**Sent:** Wednesday, April 4, 2018 5:08 PM

**To:** Kevin Webb <[kevin.webb@enel.com](mailto:kevin.webb@enel.com)>; Gibson, Jim <[Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com)>; Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>

**Subject:** Lowell Hydroelectric Project (FERC 2790) Relicensing Pre-Application Questionnaire - Lowell National Park Response

Hello:

On behalf of Lowell National Historical Park, this is to reply to your survey seeking document related to the Lowell Project relicensing.

I have attached the questionnaire responses plus the following documents:

- 1) Lowell National Historical Park Authorizing Legislation with reference to Lowell Canal System.
- 2) Lowell National Historical Park Boundary Map referenced in authorizing law.
- 3) National Register Nomination for the Locks & Canals Historic District (1976).
- 4) The Lowell Heritage State Park Resource Management Report referencing the Lowell Canal System.

Please let me know if you have any questions.

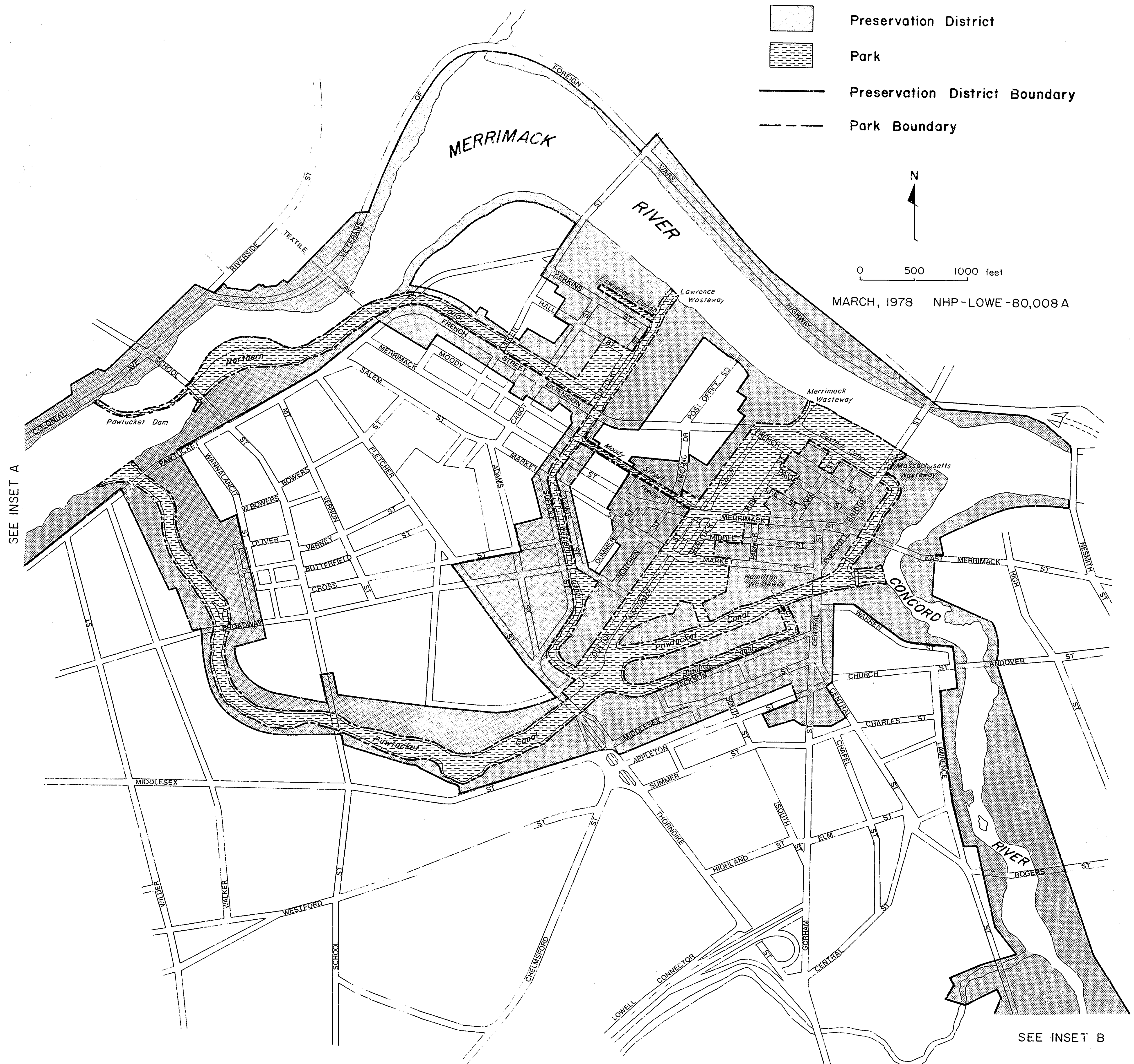
Thanks,

Peter Aucella  
Assistant Superintendent  
Lowell National Historical Park  
67 Kirk Street  
Lowell, MA 01852  
978-275-1722

# LOWELL NATIONAL HISTORICAL PARK

## BOUNDARY MAP

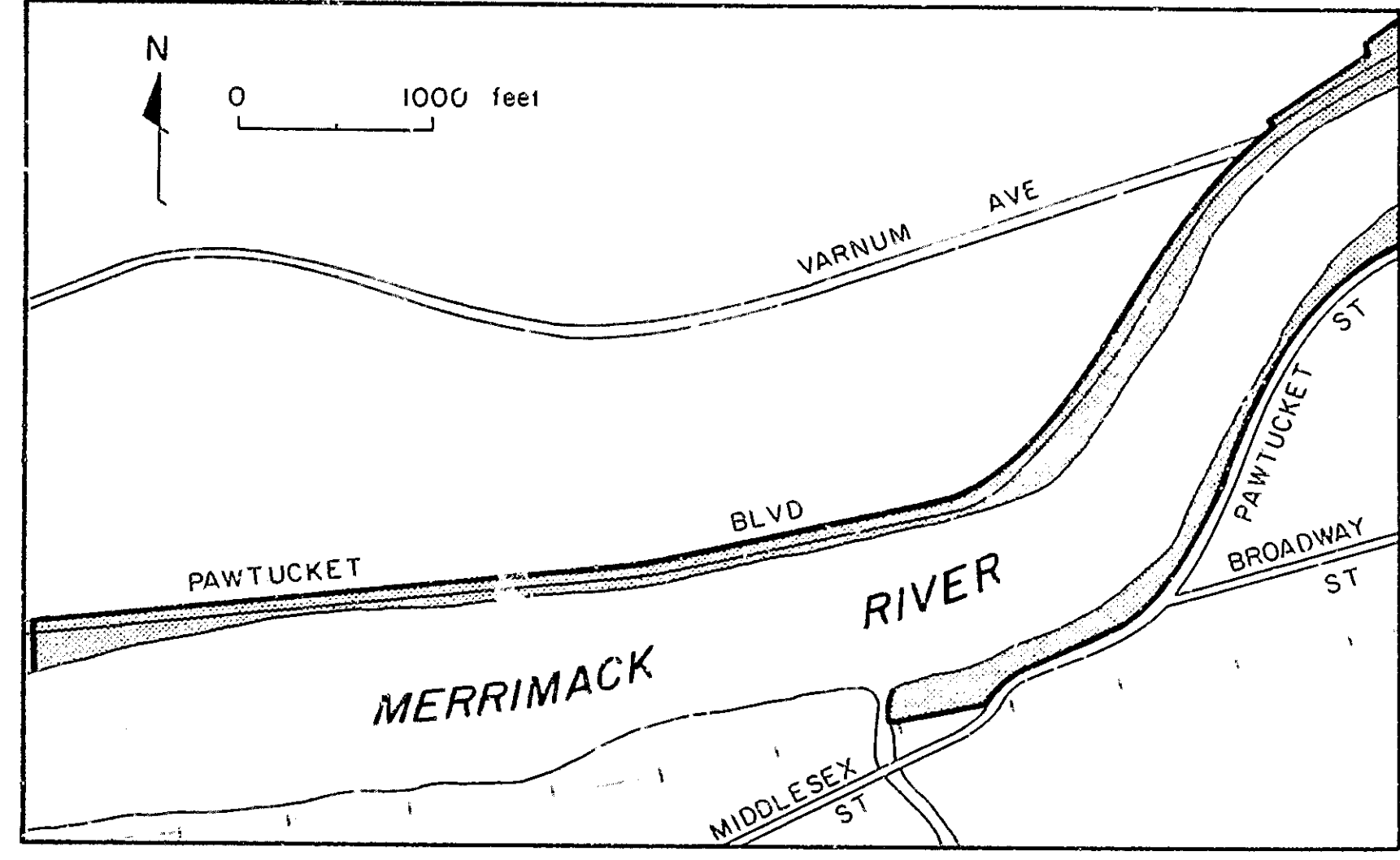
LOWELL, MASSACHUSETTS



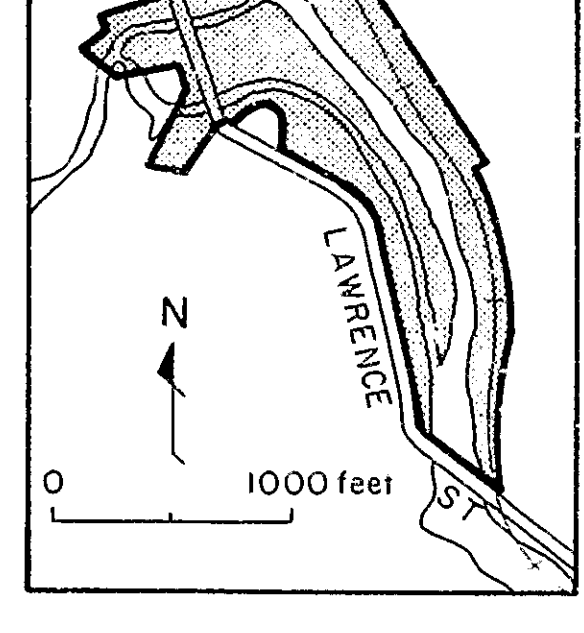
SEE INSET A

SEE INSET B

INSET A



INSET B





Massachusetts Department of Conservation and Recreation  
Bureau of Planning and Resource Protection  
Resource Management Planning Program

## RESOURCE MANAGEMENT PLAN

# Lowell/Great Brook Planning Unit

*Including Lowell-Dracut-Tyngsborough State Forest, Lowell Heritage State Park, Great Brook Farm State Park, Carlisle State Forest, Warren H. Manning State Forest, Billerica State Forest, and Governor Thomas Dudley State Park*







# Lowell/Great Brook Planning Unit

*Including Lowell-Dracut-Tyngsborough State Forest, Lowell Heritage State Park, Great Brook Farm State Park, Carlisle State Forest, Warren H. Manning State Forest, Billerica State Forest, and Governor Thomas Dudley State Park*

## RESOURCE MANAGEMENT PLAN

# 2014

Deval L. Patrick, Governor  
Maeve Vallely Bartlett, Secretary  
John P. Murray, Commissioner  
Kevin J. Whalen, Deputy Commissioner for Park Operations

Resource Management Plans provide guidance for managing properties under the stewardship of the Department of Conservation and Recreation (DCR). They are intended to be working documents for setting priorities, enabling the DCR to adapt to changing fiscal, social, and environmental conditions. The planning process provides a forum for communication and cooperation with park visitors and the surrounding communities to ensure transparency in the DCR's stewardship efforts.

The Lowell/Great Brook Planning Unit is as diverse as the DCR's park system as a whole. From the collection of highly significant cultural resources and urban green spaces that make up Lowell Heritage State Park, to the historic working agricultural landscape of Great Brook Farm State Park, to the roughly 1,500 acres that encompass five other heavily wooded properties in the planning unit, visitors can enjoy a range of urban, rural, and backwoods experiences all within a seven mile radius. It is really pretty remarkable.

There are also many educational and recreational opportunities available within the planning unit, from learning about the 19<sup>th</sup> century textile industry and the inner workings of a dairy farm, to hiking, biking, and cross-country skiing by moonlight, the properties provide a little bit of everything for everyone. In several cases, the DCR has partnered with private and public entities to further enhance these opportunities, and ensure that the planning unit is able to be enjoyed today, and for years to come.

This Resource Management Plan provides recommendations that protect the natural and cultural resources of each property, while providing for compatible recreation, so that they are available for future generations.

John P. Murray  
Commissioner

The Massachusetts Department of Conservation and Recreation (DCR), an agency of the Executive Office of Energy and Environmental Affairs, oversees 450,000 acres of parks and forests, beaches, bike trails, watersheds, dams and parkways. Led by Commissioner John P. Murray, the agency's mission is to protect, promote and enhance our common wealth of natural, cultural and recreational resources. To learn more about the DCR, our facilities and our programs, please visit us at [www.mass.gov/dcr](http://www.mass.gov/dcr). Contact us at [mass.parks@state.ma.us](mailto:mass.parks@state.ma.us).



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# EXECUTIVE SUMMARY

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## INTRODUCTION

The Department of Conservation and Recreation is directed by a legislative mandate (M.G.L. Chapter 21, Section 2F) to prepare management plans for every reservation, park and forest, to provide guidelines for the management and stewardship of natural and cultural resources and ensure consistency between recreation, resource protection and sustainable forest management. The legislative mandate also requires the incorporation of public review and input into the development of management plans, and review and adoption by the DCR Stewardship Council.

Resource Management Plans (RMPs) consider the past, present and future of a reservation, park or forest. Through an assessment of resources and their existing conditions, clear management goals and objectives are developed, and short and long-term implementation action plans are identified for the management of properties under the stewardship of the DCR. RMPs are written to meet the information needs of a diverse audience: from the decision-makers directly involved in the operation and management of a property, to a variety of outside stakeholders. RMPs are intended to be working documents for setting priorities, budgeting and resource allocation, and establishing guidelines for balancing sustainable recreation with the stewardship of natural and cultural resources. Finally, RMPs are of value to users that are interested in learning more about specific properties, the challenges the DCR faces and how decisions affecting the properties are made.

This plan covers the Lowell/Great Brook Planning Unit in the municipalities of Lowell, Dracut, Tyngsborough, Carlisle, Chelmsford, and Billerica, Massachusetts.

## THE LOWELL/GREAT BROOK PLANNING UNIT

The Lowell/Great Brook Planning Unit is very diverse and can be viewed as a microcosmic representation of the DCR state park system as a whole. From the collection of highly significant cultural resources and urban greenspaces that make up Lowell Heritage State Park, to the historic

working agricultural landscape of Great Brook Farm State Park, to the roughly 1,500 acres encompassing the five other heavily wooded properties in this planning unit, and a range of recreational uses in between, there are few characteristics that can be applied to the planning unit as a whole. In addition, there are several complex partnerships and co-management relationships to balance at many of these facilities. The defining characteristics for the individual properties are as follows:

### Lowell-Dracut-Tyngsborough State Forest

A large swath of protected open space that is predominantly wooded, with many low wet areas and little park infrastructure, Lowell-Dracut-Tyngsborough provides miles of trails and recreational access for the nearby urban population, along with habitat protection that is regionally important. There are also three Conservation Restrictions associated with the forest, totaling approximately 73 acres.

### Lowell Heritage State Park

An urban park encompassing a variety of parcels within the City of Lowell and operated through multiple and complex shared management systems, this property was established to help showcase the history of the city. The DCR owns numerous historic and a few more recently constructed buildings, including four gatehouses that are a part of canal operations and the Mack building; greenspaces ranging from a small Victorian garden to the one-mile-long Vandenberg esplanade along the river; and some unusual resources, including air rights over many of the city's canals. Lowell Heritage State Park provides both interpretive opportunities and recreational access in a dense urban environment.

### Great Brook Farm State Park

A working dairy farm connected to miles of trails that are used for a variety of recreational activities, Great Brook Farm includes historic buildings and resources alongside a new "smart" barn with a robotic milking system, interpretive programming and a cross-country ski concession.

### Carlisle State Forest

A small wooded property protected from forestry activities at the turn of the 20<sup>th</sup> century to conserve an older stand of exceptionally large white pines. Undeveloped and used primarily by local residents, this small gem provides recreational access and habitat protection.

### Warren H. Manning State Forest

A largely wooded property with a small recreation area, complete with a spray deck, picnic area and fitness trail. Named for the preeminent landscape architect that advocated (and donated land for) the establishment of a town forest, this property provides recreational opportunities and habitat protection in a suburban environment.

### Billerica State Forest

An undeveloped and largely wooded property bordering Route 3, this property provides recreational access and habitat protection.

### Governor Thomas Dudley State Park

The smallest facility within the planning unit, this 11-acre park is a small wooded parcel that provides access to the Concord River and links to other protected open space.

## **MANAGEMENT PRINCIPLE AND GOALS**

Through the Resource Management Planning process, a principle for managing the Lowell/Great Brook Planning Unit was established and four associated goals developed.

### **Management Principle**

*Protect the natural and cultural resources of the planning unit and provide enhanced recreational and educational opportunities for visitors through the creative use of state resources and partnerships.*

### **Management Goals**

The following four management goals have been developed to achieve the management principle. These goals are of equal importance, and are not presented in order of priority.

**Goal 1.** Preserve natural and cultural resources through appropriate stewardship strategies.

**Goal 2.** Offer diverse recreational opportunities and facilities to ensure visitor safety and access.

**Goal 3.** Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.

**Goal 4.** Improve engagement with partners, stakeholders, visitors and volunteers.

## **PRIORITY RECOMMENDATIONS**

Recommendations are characterized on the basis of priority (i.e., High, Medium, or Low) and resource availability. High priority recommendations are those that address regulatory compliance or public health and safety; prevent immediate damage to, or loss of, resources; or repair or replace damaged equipment or systems critical to park operations. They are typically time sensitive. Medium priority recommendations maintain existing resources and visitor experiences. Low priority recommendations enhance resources or visitor experiences; they are not time sensitive.

Resource availability considers both funding and labor. A resource availability of one indicates that funding and/or labor are available to implement the recommendation. A resource availability of two indicates that funding and/or labor are not currently available, but may become so in the near future (i.e., the next five years). A resource availability of three indicates that funding and/or labor are not anticipated in the next five years. Resources to implement these recommendations may, or may not, become available after five years.

This RMP identifies 150 management recommendations; 69 are classified as high priorities. Resources are currently available to implement 46 of these high priority recommendations. It is anticipated that resources will be available within the next five years to implement 19 additional high priority recommendations. These recommendations, and the lead DCR unit responsible for their implementation, are identified in the Action Plan that accompanies this Executive Summary.

**Table ES.1. Summary of management recommendations.**

| Priority     | Resource Availability |    |    | Total |
|--------------|-----------------------|----|----|-------|
|              | 1                     | 2  | 3  |       |
| High         | 41                    | 24 | 4  | 69    |
| Medium       | 14                    | 30 | 7  | 51    |
| Low          | 7                     | 12 | 11 | 30    |
| <i>Total</i> | 62                    | 66 | 22 |       |

**PUBLIC PARTICIPATION IN DEVELOPING THIS RMP**

Notice of a public meeting and the DCR’s intent to prepare a Resource Management Plan for the Lowell/Great Brook Planning Unit appeared in the July 11, 2012 issue of the Environmental Monitor. Additional announcements were posted on the DCR website and press releases were provided to the local media. Announcements were also distributed to individuals, statewide, regional and local stakeholder organizations and local officials. An initial public meeting occurred on July 23, 2012 in the Hart Barn at Great Brook Farm State Park in Carlisle. Approximately 20 people attended this initial meeting. Public input was received at the meeting

and through e-mail received during a 30-day public comment period after the meeting.

A public meeting to present an overview of the draft RMP held on July 21, 2014 in Alumni Hall at the University of Massachusetts Lowell; it was attended by [#] people. Notice of the meeting was published in the July 9, 2014 issue of the Environmental Monitor and posted on the DCR website. Press releases were provided to local media and notices were sent directly to individuals, stakeholder organizations and local officials. The draft RMP was made available on the DCR website, at the Powell Memorial Library in Lowell, Gleason Public Library in Carlisle, Billerica Public Library, Parker Memorial Library in Dracut, and Tyngsborough Public Library, as well as at the Great Brook Farm State Park headquarters on [DATE].

The public comment period on the draft RMP ran from July 22, 2014 to August 29, 2014. [#] sets of comments were received and incorporated into the final RMP (see Appendix B). This Resource Management Plan was submitted to the DCR’s Stewardship Council on [DATE] and was adopted by the Council on [DATE].

## Action Plan 2014-2019

| Priority Action                                                                                                                                                                                              | DCR Lead Unit(s)                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>Goal 1. Preserve natural and cultural resources through appropriate stewardship strategies.</b>                                                                                                           |                                     |
| Remove the debris at the former headquarters site that poses a threat to significant resources (i.e., the pump house cellar hole) and public safety (i.e., glass bottles). [LDT SF]                          | Mass Parks                          |
| Address the culverts within the forest that are blocked and/or collapsing. [LDT SF]                                                                                                                          | MassParks, Planning and Engineering |
| Remove the graffiti from Sheep Rock and work with the Environmental Police to curb the illegal activities that take place at the site. [LDT SF]                                                              | MassParks and Planning              |
| Assess the condition of the interior and exterior of the Rynne bathhouse and make repairs, where necessary. [Lowell Heritage SP]                                                                             | MassParks, Planning and Engineering |
| Meet with the National Park Service to develop and implement a preservation plan for the Hamilton Wasteway Gatehouse. [Lowell Heritage SP]                                                                   | MassParks, Planning and Engineering |
| Revisit the draft Comprehensive Interpretive Plan; revise and update as necessary and finalize. [Great Brook Farm SP]                                                                                        | MassParks                           |
| Develop interpretive programs, opportunities, and products as identified in the Comprehensive Interpretive Plan, working to expand interpretive offerings beyond the smart barn tours. [Great Brook Farm SP] | MassParks                           |
| Clear the debris currently built up around the beaver deceivers to maintain water flow and keep them operational. [Great Brook Farm SP]                                                                      | MassParks                           |
| Routinely monitor “The City,” particularly the Garrison House site, for stability and potential disturbances. [Great Brook Farm SP]                                                                          | MassParks and Planning              |
| Remove the broken sign at the Garrison House site. [Great Brook Farm SP]                                                                                                                                     | MassParks                           |
| North Schoolhouse: Carefully remove the English ivy from the walls, with guidance from DCR’s Office of Cultural Resources. [Great Brook Farm SP]                                                             | MassParks and Planning              |
| Main Farm House: Install an appropriate gutter, with guidance from DCR’s Office of Cultural Resources. [Great Brook Farm SP]                                                                                 | Planning                            |
| Main Farm House: Complete minor repairs to the siding and the front door sill, with guidance from DCR’s Office of Cultural Resources. [Great Brook Farm SP]                                                  | Planning                            |
| Tie Stall Barn: Assess the stability of the foundation in areas where it has visibly been compromised, and repair as necessary, with guidance from DCR’s Office of Cultural Resources. [Great Brook Farm SP] | Planning and Engineering            |
| Litchfield House: Complete repairs to the barn. [Great Brook Farm SP]                                                                                                                                        | Planning                            |
| Update the inventory of the large eastern white pine trees, last done in 1980. [Carlisle SF]                                                                                                                 | Forestry                            |
| After completion of tree inventory update, revisit the Land Stewardship Zoning to determine if any changes are applicable. [Carlisle SF]                                                                     | Planning and Forestry               |
| Monitor for invasive pests, especially hemlock wooly adelgid. Propose biological or chemical controls if warranted on the specimen trees. [Carlisle SF]                                                      | Forestry                            |
| Clean up the dumping debris located off of Rangeway Road, and continue to monitor the area for illegal dumping. [Manning SF]                                                                                 | MassParks                           |
| Dismantle the fire ring located at the top of Gilson Hill, to discourage use. [Billerica SF]                                                                                                                 | MassParks                           |
| Clean up the dumping debris located adjacent to Winning Street, and continue to monitor the area for illegal dumping. [Billerica SF]                                                                         | MassParks                           |

*Continued on next page.*

## Action Plan 2014-2019 (Continued)

| Priority Action                                                                                                                                                                                                                     | DCR Lead Unit(s)                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>Goal 2. Offer diverse recreational opportunities and facilities to ensure visitor safety and access.</b>                                                                                                                         |                                     |
| Review and update or create, where appropriate, a trail map for each of the properties in the planning unit, and make the maps available through multiple outlets. [Planning Unit]                                                  | MassParks and External Affairs      |
| Work with the Environmental Police to curb the illegal recreation activities (e.g., off-highway vehicle use and paintball games) taking place at the forest. [LDT SF]                                                               | MassParks                           |
| Post signs that clearly indicate the boundary of the forest’s “No Hunting Areas.” [LDT SF]                                                                                                                                          | MassParks and Forestry              |
| Improve the trail signage within the forest, adding trail names and intersection numbers where appropriate. [LDT SF]                                                                                                                | MassParks and Forestry              |
| Post fish consumption advisory signs in multiple, locally spoken languages at popular fishing spots along the Merrimack River and Lowell Canal System. [Lowell Heritage SP]                                                         | MassParks and External Affairs      |
| Ensure that all of the violations noted in the most recent inspection of the Lord pool are addressed in the upcoming modernization project. [Lowell Heritage SP]                                                                    | Engineering                         |
| Develop a trails plan, assessing existing density and incorporating critical information developed through the hydrological study to better address areas that have trail washout problems. [Great Brook Farm SP]                   | Planning                            |
| Securely cover the open well located southeast of the Litchfield House. [Great Brook Farm SP]                                                                                                                                       | MassParks                           |
| Reassess all boardwalk crossings to identify older ones in need of replacement, including those on the Acorn Trail. [Great Brook Farm SP]                                                                                           | MassParks                           |
| Establish designated handicapped accessible parking spaces in the parking lot, total number to be determined in consultation with DCR’s Universal Access Program. [Manning SF]                                                      | Engineering                         |
| <b>Goal 3. Address vacant infrastructure to improve visitor experiences and DCR operational responsibilities.</b>                                                                                                                   |                                     |
| Former Regional HQ site: remove former sign holder and pavement to let the site return to a natural state. [Great Brook Farm SP]                                                                                                    | MassParks and Engineering           |
| Tie Stall Barn: Address the outstanding permit issues for the event space and renew discussions about future use. [Great Brook Farm SP]                                                                                             | MassParks and Engineering           |
| Farnham Smith’s Cabin: Undertake a structural assessment and reuse feasibility study to determine if reuse is possible and develop some potential options. [Great Brook Farm SP]                                                    | Planning, MassParks and Engineering |
| Cabin Shed: Access and clean out the interior of the shed, so that it does not become a potential nuisance. [Great Brook Farm SP]                                                                                                   | MassParks                           |
| Boat House: Complete and submit MHC Inventory form. [Great Brook Farm SP]                                                                                                                                                           | Planning                            |
| Boat House: Undertake demolition. [Great Brook Farm SP]                                                                                                                                                                             | Engineering                         |
| South House/District 6 Fire Control: Assess for any reuse possibilities by the park and/or the region, such as accommodating the storage needs currently being met by the Hadley House and the Anderson Barn. [Great Brook Farm SP] | Planning, MassParks and Forestry    |
| Hadley House: Investigate alternative uses of the property and possibly making it available to be moved. If not possible, identify a funding source for demolition before it becomes an attractive nuisance. [Great Brook Farm SP]  | Planning, MassParks and Engineering |
| West Farm/Manseau House: Assess for inclusion in the Historic Curatorship Program. If not a good candidate, identify a funding source for demolition, before it becomes an attractive nuisance. [Great Brook Farm SP]               | Planning, MassParks and Engineering |
| North Farm House and Barn: Make sure the buildings are secure, and routinely monitor to ensure they aren’t damaged or broken into. [Great Brook Farm SP]                                                                            | MassParks                           |

*Continued on next page.*



## Action Plan 2014-2019 (Continued)

| Priority Action                                                                                                                                                                                                                                  | DCR Lead Unit(s)                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| <b>Goal 3. Address vacant infrastructure to improve visitor experiences and DCR operational responsibilities.</b>                                                                                                                                |                                          |
| North Farm House and Barn: Work with current long term leaseholders of other facilities within the park to identify any potential complementary reuses for this property, and explore putting out a Request for Proposals. [Great Brook Farm SP] | Planning, MassParks and External Affairs |
| Anderson Barn: Explore any potential interest in, and options for, permitting use of the barn by others, and relocate current storage closer to the Park HQ. [Great Brook Farm SP]                                                               | MassParks and Planning                   |
| <b>Goal 4. Improve engagement with partners, stakeholders, visitors and volunteers.</b>                                                                                                                                                          |                                          |
| Establish webpages on the DCR website for the properties in the planning unit that currently do not have a webpage. [Planning Unit]                                                                                                              | MassParks and External Affairs           |
| Renew the agreement with the Greater Lowell Indian Cultural Association (GLICA). [LDT SF]                                                                                                                                                        | MassParks and Legal                      |
| Arrange a meeting between the Dracut Water Supply District and appropriate DCR staff to discuss their need to replace the reservoir at the forest. [LDT SF]                                                                                      | MassParks and Legal                      |
| Work with the Merrimack Valley Chapter of the New England Mountain Bike Association to review and approve, where appropriate, the existing technical features in the forest. [LDT SF]                                                            | Planning, MassParks and Legal            |
| Develop a formal agreement with the Merrimack Valley Chapter of the New England Mountain Bike Association regarding the review and approval of their trail maintenance, repair and construction projects within the forest. [LDT SF]             | Planning, MassParks and Legal            |
| Determine the owner of the Hadley House and establish an agreement that guides the management and use of the building. [Lowell Heritage SP]                                                                                                      | Planning, MassParks and Legal            |
| Install DCR signs at the parking areas along the Vandenberg esplanade, next to the Lord pool and on Broadway Street. [Lowell Heritage SP]                                                                                                        | MassParks                                |
| Renew the agreements with the City of Lowell related to their management of the regatta field and Rynne beach, as well as their use of the Rynne bathhouse. [Lowell Heritage SP]                                                                 | MassParks and Legal                      |
| Renew the agreement with the stakeholders in the Lowell Canal System. [Lowell Heritage SP]                                                                                                                                                       | MassParks and Legal                      |
| Renew the agreement with the New England Electric Railway Historical Society / Seashore Trolley Museum. [Lowell Heritage SP]                                                                                                                     | MassParks and Legal                      |
| Establish an agreement with the Boston & Maine Railroad Historical Society regarding their maintenance of the B&M 410. [Lowell Heritage SP]                                                                                                      | MassParks and Legal                      |
| Finalize the transfer of the Bellegarde boathouse, obtaining a copy of the items listed in Section 4.4. and executing the care, custody, management and control agreement. [Lowell Heritage SP]                                                  | Legal                                    |
| Conduct annual meetings with lease holders and annual property inspections of leased property as specified in lease agreements and permits. [Great Brook Farm SP]                                                                                | MassParks and Legal                      |
| Woods House: Update and renew the expired lease agreement for the Woods House with the old North Bridge Hounds. [Great Brook Farm SP]                                                                                                            | Legal                                    |
| Clear the vegetation from around the former DEM sign stanchion, and hang a new DCR entrance sign from the existing sign stanchion. [Carlisle SF]                                                                                                 | MassParks                                |
| Work with the Town of Billerica to get a Special Use Permit in place, to formalize their operation of the recreational area. [Manning SF]                                                                                                        | MassParks and Legal                      |
| Hold bi-annual meetings with the Town of Billerica Recreation Department to discuss programs, events, and maintenance and operation of the recreational area. [Manning SF]                                                                       | MassParks and External Affairs           |
| Provide DCR information on the informational kiosk. [Manning SF]                                                                                                                                                                                 | External Affairs                         |
| Install a DCR entrance sign for the forest. [Billerica SF]                                                                                                                                                                                       | MassParks                                |

*Continued on next page.*

## Action Plan 2014-2019 (Continued)

| Priority Action                                                                                                                                                          | DCR Lead Unit(s)    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Goal 4. Improve engagement with partners, stakeholders, visitors and volunteers.</b>                                                                                  |                     |
| Hold an annual meeting with the MA Department of Fish & Game and the Town of Billerica Conservation Commission to discuss any issues, plans or projects. [Dudley SP]     | MassParks           |
| With the MA Department of Fish & Game and the Town of Billerica Conservation Commission, conduct the stipulated 5 year review of the Management Agreement. [Dudley SP]   | MassParks and Legal |
| Working with the Town of Billerica and the MA Department of Fish & Game, identify an appropriate location for an entrance sign that recognizes the partners. [Dudley SP] | MassParks           |

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Great Brook Farm State Park ([Peter E. Lee; CC BY-NC 2.0](#); cropped from original)

## SECTION 1. INTRODUCTION

### 1.1. MISSION OF THE DEPARTMENT OF CONSERVATION AND RECREATION

The Department of Conservation and Recreation (DCR) is responsible for the stewardship of approximately 450,000 acres of Massachusetts' forests, parks, reservations, greenways, historic sites and landscapes, seashores, lakes, ponds, reservoirs and watersheds. The mission of the DCR is:

*“To protect, promote and enhance our common wealth of natural, cultural and recreational resources for the well-being of all.”*

In meeting today's responsibilities and planning for tomorrow, the DCR's focus is on:

- Improving outdoor recreational opportunities and natural resource conservation;
- Restoring and improving our facilities;
- Expanding public involvement in carrying out our mission; and
- Establishing first-rate management systems and practices.

The DCR was created pursuant to state legislation that in 2003 merged the former Metropolitan District

Commission and the former Department of Environmental Management. The DCR manages over 300,000 acres of the state's forests, parks, beaches, mountains, ponds, rivers and trails. The Department has broad management responsibilities for the preservation, maintenance and enhancement of the natural, scenic, historic and aesthetic qualities within these areas.

The health and happiness of people across Massachusetts depend on the accessibility and quality of our green spaces, natural and cultural resources, recreation facilities and great historic landscapes. The DCR continues to improve this vital connection between people and their environment.

### 1.2. INTRODUCTION TO RESOURCE MANAGEMENT PLANS

The Department of Conservation and Recreation is directed by a legislative mandate (M.G.L. Chapter 21, Section 2F) to prepare management plans for every reservation, park and forest, to provide guidelines for the management and stewardship of natural and cultural resources and ensure consistency between recreation, resource protection and sustainable forest management. The legislative

mandate also requires the incorporation of public review and input into the development of management plans, and review and adoption by the DCR Stewardship Council.

Resource Management Plans (RMPs) consider the past, present and future of a reservation, park or forest. Through an assessment of resources and their existing conditions, clear management goals and objectives are developed, and short and long-term implementation action plans are identified for the management of properties under the stewardship of the DCR. RMPs are written to meet the information needs of a diverse audience: from the decision-makers directly involved in the operation and management of a property, to a variety of outside stakeholders. RMPs are intended to be working documents for setting priorities, budgeting and resource allocation, and establishing guidelines for balancing sustainable recreation with the stewardship of natural and cultural resources. Finally, RMPs are of value to users that are interested in learning more about specific properties, the challenges the DCR faces and how decisions affecting the properties are made.

DCR staff undertook a statewide survey in 2008–2009 to assess the level of existing resource and planning data available, and correlate that with operations and management considerations. This assessment was used to identify groupings of properties that should be included together in a single RMP, i.e. planning units. The statewide survey was also used to develop a tiered sequence for preparing RMPs. The Lowell/Great Brook Planning Unit is ranked 6<sup>th</sup> out of the 80 planning units identified statewide.

### **1.3. THE PLANNING PROCESS**

Resource Management Plans are developed by the DCR's Resource Management Planning Program through an iterative process of data gathering and analyses, public input, review and revision. Administrative, cultural, ecological, recreation, social and spatial information is gathered. Sources of information include interviews with DCR staff, site visits, administrative files and reports, legal documents, map data and municipal and regional plans. An initial public meeting is convened to provide an opportunity to discuss the properties included in the RMP and to solicit public input for

the plan. The public meeting is announced in the Environmental Monitor and advertised electronically and through local media outlets.

An inventory of available information on natural, cultural, recreation and operational resources and an assessment of their existing conditions is the foundation of an RMP, from which recommendations for stewardship can be made. The draft is distributed within the DCR for internal review, and is repeatedly reviewed and revised to produce a draft RMP for public review and comment.

A second public meeting is convened to present an overview of the draft RMP's findings and recommendations and solicit input. Once again, the public meeting is announced in the Environmental Monitor and advertised electronically and through local media outlets. After the second public meeting, the draft RMP is made available to the public via the DCR website and local libraries. The meeting is followed by a 30-day public comment period. Comments made during the meeting and written comments received during the public comment period are taken into consideration and used to further develop the RMP.

Once revised, a final draft RMP is submitted to the DCR Stewardship Council for review and adoption. The Stewardship Council is a 13-member citizen advisory board (appointed by the Governor) that works with the Department to provide a safe, accessible, well-maintained and well-managed system of open spaces and recreation facilities that are managed and maintained on behalf of the public.

Once adopted, the Commissioner of the Department of Conservation and Recreation files copies with the Secretary of State and the Joint Committee on Environment, Natural Resources and Agriculture of the Massachusetts General Court and posts the adopted RMP on the DCR website for use. The adopted RMP provides structure and guidance for the operation and management of properties included in the plan.

### **1.4. PUBLIC PARTICIPATION**

Notice of a public meeting and the DCR's intent to prepare a Resource Management Plan for the Lowell/Great Brook Planning Unit appeared in the July 11, 2012 issue of the Environmental Monitor. Additional announcements were posted on the DCR

website and press releases were provided to the local media. Announcements were also directly distributed to individuals, statewide, regional and local stakeholder organizations and local officials. An initial public meeting occurred on July 23, 2012 in the Hart Barn at Great Brook Farm State Park in Carlisle. Approximately 20 people attended this initial meeting. Public input was received at the meeting and through e-mail received during a 30-day public comment period after the meeting.

To promote greater citizen participation and obtain additional information about visitor use, an online survey was created using Survey Monkey. Announcements of this survey were distributed electronically to stakeholders and signs were posted at individual properties. Surveys were created and made available in English and Spanish, in an effort to reach out to a broad constituency. One hundred and sixty one (161) surveys were submitted, nearly all of which were related to Great Brook Farm State Park and Lowell-Dracut-Tyngsborough State Forest.

A public meeting to present an overview of the draft RMP held on July 21, 2014 in Alumni Hall at the University of Massachusetts Lowell; it was attended by [#] people. Notice of the meeting was published in the July 9, 2014 issue of the Environmental Monitor and posted on the DCR website. Press releases were provided to local media and notices were sent directly to individuals, stakeholder organizations and local officials. The draft RMP was made available on the DCR website, at the Powell Memorial Library in Lowell, Gleason Public Library in Carlisle, Billerica Public Library, Parker Memorial Library in Dracut, and Tyngsborough Public Library, as well as at the Great Brook Farm State Park headquarters on [DATE].

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## 1.5. PROPERTIES INCLUDED IN THIS RMP

This plan covers the Lowell/Great Brook Planning Unit, which includes:

- Lowell-Dracut-Tyngsborough State Forest

- Three Conservation Restrictions abutting Lowell-Dracut-Tyngsborough State Forest
- Lowell Heritage State Park
- Great Brook Farm State Park
- Carlisle State Forest
- Warren H. Manning State Forest
- Billerica State Forest
- Governor Thomas Dudley State Park

A Conservation Restriction is a legal document that limits the uses of a property to protect specific open space values of that land. Locations of these properties are indicated on Figure 1. Although these properties are not owned in fee by the DCR, they are included in the plan because of their physical proximity to Lowell-Dracut-Tyngsborough State Forest and the DCR's responsibility for overseeing the stipulations of the restrictions.

## 1.6. DEFINING CHARACTERISTICS

The Lowell/Great Brook Planning Unit is very diverse and can be viewed as a microcosmic representation of the DCR state park system as a whole. From the collection of highly significant cultural resources and urban greenspaces that make up Lowell Heritage State Park, to the historic working agricultural landscape of Great Brook Farm State Park, to the roughly 1,500 acres encompassing the five other heavily wooded properties in this planning unit, and a range of recreational uses in between, there are few characteristics that can be applied to the planning unit as a whole. In addition, there are several complex partnerships and co-management relationships to balance at many of these facilities. The defining characteristics for the individual properties are as follows:

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A large swath of protected open space that is predominantly wooded, with many low wet areas and little park infrastructure, Lowell-Dracut-Tyngsborough provides miles of trails and recreational access for the nearby urban population, along with habitat protection that is regionally important. There are also three Conservation Restrictions associated with the forest, totaling approximately 73 acres.

Placeholder for Figure 1.

### Lowell Heritage State Park

An urban park encompassing a variety of parcels within the City of Lowell and operated through multiple and complex shared management systems, this property was established to help showcase the history of the city. The DCR owns numerous historic and a few more recently constructed buildings, including four gatehouses that are a part of canal operations and the Mack building; greenspaces ranging from a small Victorian garden to the one-mile-long Vandenberg esplanade along the river; and some unusual resources, including air rights over many of the city's canals. Lowell Heritage State Park provides both interpretive opportunities and recreational access in a dense urban environment.

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A largely wooded property with a small recreation area, complete with a spray deck, picnic area and fitness trail. Named for the preeminent landscape architect that advocated (and donated land for) the protection of public woodlands in the Town of Billerica, this property provides recreational opportunities and habitat protection in a suburban environment.

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access to the Concord River and links to other protected open space.

## **1.7. MANAGEMENT PRINCIPLE AND GOALS**

Through the Resource Management Planning process, a principle for managing the Lowell/Great Brook Planning Unit was established and four associated goals developed.

### **Management Principle**

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### **Management Goals**

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**Goal 2.** Offer diverse recreational opportunities and facilities to ensure visitor safety and access.

**Goal 3.** Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.

**Goal 4.** Improve engagement with partners, stakeholders, visitors and volunteers.

## **1.8. REGIONAL CONTEXT**

The Lowell/Great Brook Planning Unit is located within Middlesex County; the towns of Billerica, Chelmsford, Dracut and Tyngsborough and the City of Lowell are all in the northern section of Middlesex County, while the Town of Carlisle is in the southern portion of the county. Lowell is the urban focus for this region, while Carlisle provides a rural respite. The towns of Billerica, Chelmsford, Dracut and Tyngsborough are all suburban in character.

Rivers have indelibly influenced the settlement, land use and development of the communities in this region from pre-historic times through today. The City of Lowell is located at the confluence of the Merrimack River and the Concord River. The mighty Merrimack River, flowing from Franklin,



New Hampshire to the Atlantic Ocean is the engine that drove the industrial development of the City of Lowell. Flowing through Tyngsborough and Lowell, the river also serves as the southern boundary of Dracut. The smaller Concord River, a tributary of the Merrimack, flows through Lowell and Billerica, and is the southeast boundary for Carlisle.

The pre-contact Native American population in this region utilized these rivers for travel and subsistence, with major anadromous fish runs on the Concord and Merrimack. The region's landscape provided additional resources for subsistence through freshwater ponds and fertile soils ideal for agricultural use, particularly along the rivers. Traditional hunting and gathering likely occurred in the upland areas, and supported other subsistence activities.

Pawtucket Falls on the Merrimack River served as a regional focus of settlement (MHC 1980a). The falls became a regionally important fishing ground and the Merrimack River served as a trade corridor. The area appears to have been extensively settled by native peoples and may have served as a population core area.

The Merrimack River was first visited by the French explorer Samuel de Champlain in 1605 as he explored the New England coast. A Praying Indian town, Wamesit, was established by John Eliot by the 1640s in what is now Lowell in an effort to Christianize native peoples. European settlement in this region started in earnest in the mid 17<sup>th</sup> century. Settlement through the second half of 17<sup>th</sup> century was dispersed, with small clusters of colonists in frontier communities relying primarily on subsistence farming, fishing and small mills set up on the rivers and streams in the region.

Population in the region began to uptick in the early to mid 18<sup>th</sup> century, as villages began to take shape in town centers and near mills, and transportation improvements made in the region helped facilitate travel and trade. By the turn of the 19<sup>th</sup> century, small scale granite quarrying and early manufacturing started to develop. Construction began on the Middlesex Canal in 1794, connecting Lowell and the Merrimack Valley to Boston, opening for use in 1804. Twenty-seven miles in length, running through several communities including Billerica, Chelmsford, Tyngsborough and

current day Lowell, the Middlesex Canal provided a transportation connection to haul goods and passengers from Boston to New Hampshire (Middlesex Canal Association 1993).

A range of small industries began to develop and take advantage of both the local water power and the proximity to the Middlesex Canal, and the textile industry in Lowell began in the 1820s with the establishment of the first major textile mill, the Merrimack Manufacturing Company. Others quickly followed over the course of the next dozen years, building off the early success and the application of the innovative system of manufacturing utilized here and the development of a system of power canals to run large mills. Additional industrial development also began in Chelmsford and to a smaller degree in Dracut.

The City of Lowell was established in 1826, from parts of Chelmsford, Dracut, and Tewksbury (MHC 1980a). Rapid growth ensued in Lowell, with the manufacturing base downtown and a series of suburban outlying neighborhoods. Railroads were introduced to the region, providing a more effective (and non-seasonal) form of transportation, and the Middlesex Canal was closed in 1853 (Middlesex Canal Commission n.d.).

Many nearby communities also experienced population growth and new immigrant populations headed to the region to work in manufacturing in Lowell (facilitated by streetcar lines providing access) and nearby towns. Carlisle however remained very rural throughout the 19<sup>th</sup> century, with agriculture remaining as the dominant focus of the local economy.

The Great Depression impacted the textile industry and the region saw a big decline in manufacturing. New highways provided enhanced regional access and with the exception of a population decline in Lowell, the nearby communities continued to grow. Post WWII suburban expansion impacted much of the region, however the City of Lowell struggled and the Town of Carlisle maintained its rural economy and character. The 1970s saw the establishment of Lowell Heritage State Park and brought the National Park Service to Lowell, as well as renovated mills, new immigrant communities and a growing interest in urban areas, which brought revitalization to downtown Lowell.

**Table 1.1. Physical, Ecological and Political Settings of the Lowell/Great Brook Planning Unit**

|                                                |                                                                                      |                                                                                |                                                                                                                                                                       |                                      |
|------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| <b>Planning Unit:</b> Lowell/Great Brook       |                                                                                      |                                                                                |                                                                                                                                                                       |                                      |
| <b>Location:</b>                               | City of Lowell                                                                       | Middlesex County                                                               |                                                                                                                                                                       |                                      |
|                                                | Town of Dracut                                                                       | Middlesex County                                                               |                                                                                                                                                                       |                                      |
|                                                | Town of Tyngsborough                                                                 | Middlesex County                                                               |                                                                                                                                                                       |                                      |
|                                                | Town of Carlisle                                                                     | Middlesex County                                                               |                                                                                                                                                                       |                                      |
|                                                | Town of Chelmsford                                                                   | Middlesex County                                                               |                                                                                                                                                                       |                                      |
|                                                | Town of Billerica                                                                    | Middlesex County                                                               |                                                                                                                                                                       |                                      |
| <b>DCR Management Structure:</b>               | Walden Complex<br>Metro West District<br>North Region                                |                                                                                |                                                                                                                                                                       |                                      |
| <b>Properties:</b>                             | <i>Landscape Designation</i>                                                         | <i>City/Town</i>                                                               | <i>Area (acres)<sup>a</sup></i>                                                                                                                                       | <i>Perimeter (miles)<sup>a</sup></i> |
| <i>Lowell-Dracut-Tyngsborough State Forest</i> | Parkland                                                                             | Lowell<br>Dracut<br>Tyngsborough                                               | 320<br>554<br>236                                                                                                                                                     | 15                                   |
| <i>Lowell Heritage State Park</i>              | Parkland                                                                             | Lowell                                                                         | 87                                                                                                                                                                    | 18                                   |
| <i>Great Brook Farm State Park</i>             | Parkland                                                                             | Carlisle<br>Chelmsford                                                         | 907<br>23                                                                                                                                                             | 16                                   |
| <i>Carlisle State Forest</i>                   | Parkland                                                                             | Carlisle                                                                       | 25                                                                                                                                                                    | 1                                    |
| <i>Warren H. Manning State Forest</i>          | Parkland                                                                             | Billerica                                                                      | 183                                                                                                                                                                   | 5                                    |
| <i>Billerica State Forest</i>                  | Parkland                                                                             | Billerica                                                                      | 141                                                                                                                                                                   | 3                                    |
| <i>Governor Thomas Dudley State Park</i>       | Parkland                                                                             | Billerica                                                                      | 11                                                                                                                                                                    | 1                                    |
| <b>Ecoregion:</b>                              | Southern New England Coastal Plains and Hills                                        |                                                                                |                                                                                                                                                                       |                                      |
| <b>Watersheds:</b>                             | Sudbury-Assabet-Concord (SuAsCo)<br>Merrimack River                                  |                                                                                |                                                                                                                                                                       |                                      |
| <b>Legislative Districts:</b>                  |                                                                                      |                                                                                |                                                                                                                                                                       |                                      |
| <i>Senate District</i>                         | First Middlesex<br>Second Essex and Middlesex<br>Third Middlesex<br>Fourth Middlesex | <i>House District</i>                                                          | Second Middlesex<br>Fourteenth Middlesex<br>Sixteenth Middlesex<br>Seventeenth Middlesex<br>Eighteenth Middlesex<br>Twenty-second Middlesex<br>Thirty-sixth Middlesex |                                      |
| <b>Conservation Restrictions:</b>              | <i>Property</i>                                                                      | <i>City/Town</i>                                                               | <i>Area (acres)<sup>a</sup></i>                                                                                                                                       | <i>Fee Interest</i>                  |
|                                                | Lowell-Dracut-Tyngsborough State Forest                                              | Lowell                                                                         | 17                                                                                                                                                                    | Northeast Radio, Inc.                |
|                                                | Lowell-Dracut-Tyngsborough State Forest                                              | Dracut                                                                         | 9                                                                                                                                                                     | Boisvert Family                      |
|                                                | Lowell-Dracut-Tyngsborough State Forest                                              | Tyngsborough                                                                   | 47                                                                                                                                                                    | Town of Tyngsborough                 |
| <b>Designations:</b>                           | <i>Property</i>                                                                      | <b>Designations</b>                                                            |                                                                                                                                                                       |                                      |
|                                                | <i>Lowell-Dracut-Tyngsborough State Forest</i>                                       | Priority Habitat<br>BioMap2 Core Habitat<br>BioMap2 Critical Natural Landscape |                                                                                                                                                                       |                                      |

Continued on next page.

**Table 1.1. Physical, Ecological and Political Settings of the Lowell/Great Brook Planning Unit (Continued)**

| <b>Designations:</b> | <b>Property</b>                          | <b>Designations</b>                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | <i>Lowell Heritage State Park</i>        | Priority Habitat<br>BioMap2 Core Habitat<br>BioMap2 Critical Natural Landscape<br>Downtown Lowell Local Historic District<br>City Hall District<br>Locks and Canals National Register Historic District<br>Locks and Canals National Historic Landmark<br>Lowell National Historical Park and Preservation District<br>Historic Civil Engineering Landmark<br>Historic Mechanical Engineering Landmark<br>Environmental Justice Population |
|                      | <i>Great Brook Farm State Park</i>       | Priority Habitat<br>BioMap2 Core Habitat                                                                                                                                                                                                                                                                                                                                                                                                   |
|                      | <i>Carlisle State Forest</i>             | National Wild & Scenic River                                                                                                                                                                                                                                                                                                                                                                                                               |
|                      | <i>Warren H. Manning State Forest</i>    | Priority Habitat<br>BioMap2 Core Habitat                                                                                                                                                                                                                                                                                                                                                                                                   |
|                      | <i>Billerica State Forest</i>            | Priority Habitat<br>BioMap2 Core Habitat                                                                                                                                                                                                                                                                                                                                                                                                   |
|                      | <i>Governor Thomas Dudley State Park</i> | BioMap2 Core Habitat<br>BioMap2 Critical Natural Landscape                                                                                                                                                                                                                                                                                                                                                                                 |

a. These values were calculated in GIS and rounded to the nearest whole number.

## 1.9. VISITATION

Visitation information for the planning unit is negligible, due in part to reduced DCR staffing and established management agreements with other entities, as well as physical constraints that make it difficult to capture the information (e.g., little or no infrastructure at a property, multiple entry points for a property, etc.).

The online survey that was undertaken as part of this RMP (see Section 1.4. Public Participation) did not provide a lot of information that could objectively be drawn from in order to get a sense of the complete visitor profile and experience for individual properties, or the planning unit as a whole. While there was a high response rate for both Lowell-Dracut-Tyngsborough State Forest and Great Brook Farm State Park, 78 responses for each, the remaining properties had minimal response rates, ranging from zero to three. This is due to the fact that the survey was very well publicized within the mountain biking community, and many members of that community responded to the survey for the two properties in the planning unit that are utilized the most for mountain biking. Despite promoting the survey to a wide variety of stakeholders, without active park friends groups for these properties to

help promote the survey within other user communities, responses from outside the mountain biking community were low.

### Lowell-Dracut-Tyngsborough State Forest

The state forest is not staffed and, as a result, there are no visitor estimates; however, the property is well-known as a popular mountain biking destination. Respondents to the online survey, most of whom were part of the mountain biking community, identified the state forest's convenient location and trail network as characteristics of the property that they liked the best. Among the ways that the state forest could be improved, respondents indicated enforcing regulations related to off-highway vehicle (OHV) use, adding more parking and trail signage, naming more trails and updating the trail map.

### Lowell Heritage State Park

Although Lowell Heritage State Park is staffed, as an urban property with individual parcels spread across the city, visitor data is especially difficult to capture. Fortunately, the National Park Service (NPS), a partner in Lowell through their Lowell National Historical Park, collects and publicizes annual visitation data based on the number of visitors that enter their visitor center and exhibits,

and attend special events on park property. While these estimates do not provide any insight into the level of visitorship on the DCR's Vandenberg esplanade, they do highlight the number of people who view, and in some cases tour, DCR property in downtown Lowell (see Section 4 for more information).

Since 1982, annual visitation rates at Lowell National Historical Park have exceeded 400,000 (NPS 2014a). In 2013, over 500,000 visitors enjoyed the park (NPS 2014a). Half of those individuals visited the park in July and August, with July being the most popular month (174,530 visitors; NPS 2014a). The majority of July visitors were "Special Event Visitors," and likely participated in the Lowell Folk Festival, a very popular event held in downtown Lowell each year (NPS 2014a). Peak visitation for the DCR's Francis Gate Park and Pawtucket Gatehouse were in August (2,022 visitors) and September (1,292 visitors), respectively (NPS 2014a).

#### Great Brook Farm State Park

Visitation increased ten-fold at Great Brook Farm State Park between the establishment of the park (1974) and mid-1990s, but it is now on a downward slope. In the early 1980s, the annual visitation rate was approximately 20,000 – 25,000, while in 1996 car counters recorded approximately 205,000 visitors enjoying the park. In the late 1990s staffing and programming began to decrease and in the early 2000s a parking fee was established, collectively leading to a decline in visitation. By 2010, annual visitation decreased to roughly 120,000. Although the completion of the Smart Barn in 2011 seems to have generated a small spike in visitation, recent estimates are steadily decreasing, and are now at approximately 100,000 visitors per year.

Due to the wide range of activities available, unlike some of the other properties in this planning unit, Great Brook Farm State Park has high year-round visitation. The online survey indicated little seasonal variation in park use by regular visitors. Mid-week visitation includes a fair amount of older visitors, primarily active retirees who like to walk the trails. Through the online survey, park users provided high praise for the variety and quality of trails, as well as the appeal of the active farm and ice cream stand for visiting with children.

#### Carlisle State Forest

In the absence of a formal parking lot and on site staff, visitation estimates are not available for Carlisle State Forest. Visitation is believed to be quite low, and primarily by local residents.

#### Warren H. Manning State Forest

The DCR does not have estimates on visitation for this property. The spray deck area is very popular with young families during the summer, and the Town of Billerica, who manages the spray deck area, reports that on hot days, the parking lot often reaches capacity (Hannon-Rizza 2013).

#### Billerica State Forest

Without a formal parking lot and the presence of on site staff, visitation estimates are not available for Billerica State Forest.

#### Governor Thomas Dudley State Park

As a facility that is managed by the Town of Billerica and not staffed, the DCR does not have estimates of visitation levels at Governor Thomas Dudley State Park.

In a survey conducted during the preparation of the 2008 update to the Billerica Open Space and Recreation Plan, only three of the 68 respondents included Dudley Park, as it is locally known, as one of the open space or recreation properties that their family utilized in town (Northern Middlesex Council of Governments 2008).

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Park Serve Day at Lowell-Dracut-Tyngsborough State Forest (DCR)

## SECTION 2. MANAGEMENT RESOURCES AND PRACTICES

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### 2.1. INTRODUCTION

The Lowell/Great Brook Planning Unit contains a diverse set of natural, cultural and recreation resources. Managing these resources can be challenging, due to the competing demands of resource protection and providing public access to recreational opportunities. Effective management of this two-pronged goal requires an understanding of various laws, regulations, policies and legal agreements, while working with limited operational resources.

This section describes the resources available to the planning unit, as well as relevant management practices, regulations, policies and legal considerations. Variations to these resources and practices, which occur at the property-level, are addressed in Section 3 through Section 9.

### 2.2. NATURAL RESOURCES

Research Permits are required for all ecological research on DCR property. Additional state (e.g., Scientific Collecting) and federal (e.g., Bird Banding and Marking) permits may be required, depending on the nature of research. Research within wetland and river jurisdictional areas may also require

regulatory review and approval from the local conservation commission.

#### **Water Resources**

##### Storm Water Management

Activities on DCR properties that affect the quantity or quality of storm water are regulated by a National Pollutant Discharge Elimination System (NPDES) storm water management plan (DCR 2007a). The plan describes control measures that the DCR uses to satisfy NPDES Phase II permit requirements for transportation and non-traditional Municipal Separate Storm Sewer Systems (MS4s). Best Management Practices (BMPs) are also identified in the plan, some of which are implemented at the agency-level (e.g., the detection and elimination of illicit discharges, catch basin cleaning), while others are implemented at the facility-level (e.g., the stenciling of catch basins).

##### Wetlands Protection

Activities within a wetland resource area or buffer are regulated by the Massachusetts Wetland Protection Act. (See Appendix F for additional information.)

## Rare Species

The Massachusetts Endangered Species Act (MESA) protects rare species and their habitats by prohibiting the “take” of any plant or animal listed as Endangered, Threatened or Special Concern. Projects within Priority Habitat of Rare Species must undergo review by the Natural Heritage & Endangered Species Program (NHESP), unless otherwise exempted under the law.

The term “project” refers not only to the construction of buildings and infrastructure, but also to activities that involve grading or the destruction of plant life. (See 321 CMR 10.00 for the full definition of “project.”) Many staff and volunteer activities that take place within the planning unit (e.g., invasive species removal, trail construction and maintenance, and habitat improvement activities) meet the definition of “project” and must go through regulatory review, if they occur in Priority Habitat.

State agencies, such as the DCR, have special obligations under MESA. First, agencies are directed to use their authorities in furtherance of the purposes of MESA and “use all practicable means and measures to avoid or minimize damage.” Next, they are required to submit draft management plans, such as RMPs, to the NHESP for review. Finally, state-owned lands “that provide habitat for state-listed species shall be managed for the benefit of such listed species;” agencies “shall give management priority to the protection, conservation, and restoration of” state-listed species on state-owned lands. All “practicable means and measures shall be taken to resolve conflicts between the protection, conservation, and restoration of state-listed species...and other uses of such lands in favor of the listed species.”

Additional information on MESA and its implementing regulations is available on the NHESP’s website:

<http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/regulatory-review/mass-endangered-species-act-mesa>.

## Vegetation

There is no single management plan for the planning unit’s vegetation. The *de facto* management policy is to permit populations of most species of plants to increase or decrease without human intervention.

Exceptions include the maintenance of lawns and other turf areas, removal of hazardous trees and vegetation cutting associated with the management of plant or wildlife habitat.

Continuous Forest Inventory (CFI) monitoring plots are located throughout the planning unit. The number of these one-fifth acre, circular plots varies by property. A series of forestry related metrics, including the number of trees five or more inches in diameter, tree regeneration, amount of coarse woody debris and presence of invasive plants and tree diseases, are collected at each plot. On average, each plot is visited, and data collected, once every ten years.

## Wildlife

There is no single wildlife management plan for the planning unit. The *de facto* management policy is to permit most wildlife populations to increase or decrease without human intervention. Exceptions to this include the hunting of game species and fishing at select properties. Hunting, trapping, and fishing are managed through a variety of regulations (see Section 2.4, below).

## 2.3. CULTURAL RESOURCES

The DCR’s Office of Cultural Resources (OCR) provides technical assistance on issues relating to archaeology and the preservation of landscapes, buildings, structures and objects. It also conducts a coordinated program of basic and applied research to support planning for, and management of, cultural resources on DCR properties through project management and resource management planning. The OCR also nominates properties for inclusion on the State and National Registers. A copy of the DCR Cultural Resources Policy has been included as Appendix D.

The OCR is also responsible for overseeing the historic preservation regulatory compliance responsibilities of the agency. It assesses regulatory needs and, when applicable, notifies the Massachusetts Historical Commission (MHC) through the filing of a Project Notification Form or Environmental Notification Form for any proposed projects undertaken, funded, permitted or licensed, in whole or in part, by the agency. This is done so that the MHC may make a Determination of Effect of the project on historic and archaeological

resources. Finally, the OCR coordinates all archaeological survey, testing and excavation with the State Archaeologist at the MHC through an archaeological permit.

Buildings, structures, landscapes, sites and objects that are a minimum of 50 years old, retain historic integrity and are of significance on the local, statewide or national level may be listed on the National Register of Historic Places. Repairs, rehabilitation and other preservation activities on listed and eligible resources follow guidelines in the *Secretary of the Interior's Standards for the Treatment of Historic Properties* (Weeks and Grimmer 1995).

Massachusetts law requires the review of all subsurface disturbances on state property. The DCR's Archaeologist holds an archaeological permit from the MHC that allows them to provide initial review of activities that result in subsurface disturbance. They are the primary reviewer of such projects and activities in the Lowell/Great Brook Planning Unit.

The inspection, investigation or removal of underwater archaeological resources is also regulated under Massachusetts law (M.G.L. 6:179–180). No person may remove, displace, damage or destroy any underwater archaeological resource, except in conformity with permits issued by the Massachusetts Board of Underwater Archaeological Resources. This applies to both inland and coastal waters. All archaeological resources in the waters of the planning unit are subject to this law.

Two of the properties within this planning unit are part of the OCR's Historic Curatorship Program, a program in which curators are selected through a competitive process to rehabilitate and maintain historic buildings in exchange for long term leases. The Historic Curatorship Program Manager is responsible for ensuring compliance with work and maintenance plans; maintaining investment accounting totals from curator reports; ensuring up to date insurance coverage; scheduling annual or bi-annual inspections; coordinating public benefit activities; and enforcing compliance with other lease terms and responsibilities.

## **2.4. RECREATION RESOURCES**

Regulations guiding the recreational use of forests and parks may be found in 304 CMR 12.00. (See

Appendix F for a summary of these regulations.) In general, all public use of DCR property must take place from dawn through dusk.

### **Permits**

Special Use Permits are required for “any commercial or special activity or event upon the lands or waters” of all DCR properties (304 CMR 12.17; Appendix F). Non-commercial activities requiring a Special Use Permit include, but are not limited to: concerts, charity walks, road races, cultural festivals, community service projects, small weddings and gatherings with amplified sound. Research on recreation and recreationists requires a Research Permit. Commercial filming, photography, and videography are regulated through Filming and Photography Permits. Additional information on these permits, and how they may be obtained, is available on the DCR's website: <http://www.mass.gov/eea/agencies/dcr/massparks/permits-rentals/dcr-permits.html>.

### **Camping**

Camping on DCR property is restricted to designated campsites or cabins; there are no permanent camping areas in the planning unit.

### **Geocaching**

There is no Massachusetts regulation or agency policy on the placement of geocaches on DCR property. In their absence, geocaches may be placed at any location not identified as closed to the public.

### **Hunting and Fishing**

Hunting and freshwater fishing are addressed in Massachusetts regulations 304 CMR 12.00, 321 CMR 3.00 and 321 CMR 4.00, and the official Massachusetts hunting, freshwater fishing and trapping regulations that are published annually. In general, all DCR properties are open to hunting, fishing and trapping unless otherwise specified in the Forests and Park Rules (304 CMR 12.00). Summaries of these and other applicable regulations are presented in Appendix F.

Officers from the Executive Office of Energy and Environmental Affairs' Office of Law Enforcement (i.e., Massachusetts Environmental Police officers) enforce hunting, fishing and off-highway vehicle (OHV) use.



## Trail Use

Dogs may accompany trail users provided the animals are kept under control and do not interfere with any other visitor's enjoyment of DCR property (304 CMR 12.00; Appendix F).

With the exception of DCR, public safety and utility company vehicles, motor vehicles are generally not permitted on the trails in the planning unit.

A March 15, 2011 Department of Justice ruling allows individuals with mobility disabilities to use "other power-driven mobility devices" on trails. Such devices include any device powered by batteries, fuel or other engines that are used by individuals with mobility disabilities for the purpose of locomotion. Use of such devices may be restricted on trails due to factors such as: the type, size, weight and speed of the device; the volume of pedestrian traffic; the design and operational characteristics of the device; whether or not the device may be operated safely; and the potential for substantial risk of serious harm to the environment or natural and cultural resources. None of the trails within the planning unit have been assessed for their compatibility with these devices.

## 2.5. INFRASTRUCTURE

### Property Boundary

The Management Forester or Assistant Management Forester attempts to locate and mark property boundaries in association with forest inventory activities. They also mark the boundaries of new properties as they are acquired. Boundary marking typically involves locating and painting cement bounds or pipes, and posting boundary signs.

### Buildings and Structures

The management of DCR-owned buildings is performed by DCR employees or contractors. Minor maintenance and repair is performed by on-site staff. More technical repairs (e.g., plumbing and electrical) are performed by DCR in-house trades staff or by trade or engineering contractors (e.g., well repair) whose activities are coordinated through the agency's Parks Support Operation Program. Major repairs are performed solely by licensed contractors.

## Roads

The DCR maintains and repairs forest and park roads, and parkways. Management of traffic and related systems is supervised by the Parkways Section of the DCR's Division of Engineering and guided by American Association of State Highway and Transportation Officials standards, the *Manual on Uniform Traffic Control Devices* (FHA 2012) and the *Historic Parkway Preservation Treatment Guidelines* (DCR 2007b), if applicable. Public roads adjacent to DCR properties are maintained and repaired by either local municipalities or the Massachusetts Department of Transportation (MassDOT).

Snow removal is performed by the DCR, MassDOT and local municipalities. In general, the municipalities or MassDOT plow the public roads adjacent to forests and parks, and the DCR is responsible for plowing internal roads.

## Parking

The DCR is responsible for maintaining and repairing its parking areas. Most snow removal is performed by the DCR.

## Trails

A variety of regulations and policies guide the management of trails. The design, management and marking of trails are guided by the DCR *Trails Guidelines and Best Practices Manual* (DCR 2012a). Additional regulations, such as the Massachusetts Endangered Species Act and Wetlands Protection Act, and the DCR Cultural Resources Policy may also apply, depending on location. These regulations and policies apply to DCR employee, partner and volunteer activities.

In accordance with DCR practices, trail maintenance and construction activities should be implemented in the following order, in accordance with the regulations, policies and guidance identified above:

1. Maintain appropriate existing trails and fire roads.
2. Close or improve existing trails with known public safety hazards.
3. Close or relocate existing trails that adversely impact documented state-listed species, in consultation with the DCR's Bureau of

Planning, Design and Resource Protection and NHESP staff.

4. Close, relocate or improve existing trails that impact vernal pools.
5. Close, relocate or improve wetland crossings on existing trails that impact wetlands, streams or ponds.
6. Close redundant, dead end and unauthorized trails.
7. Close, relocate or improve existing eroded and poor condition trail segments.
8. Construct new trail connections to enhance desired, authorized recreational experiences; create additional loop opportunities; and form new connections between access points and important features.

### **Signs and Kiosks**

The format and placement of regulatory and informational signs are governed by the *Manual of Uniform Traffic Control Devices* (FHA 2012) and guided by the DCR *Graphics Standards Manual* (DCR n.d.). The design and construction of kiosks are solely governed by the graphics manual.

Informational kiosks are managed by park staff as new information becomes available; they also perform kiosk installation and repair.

### **Memorials and Markers**

The placement of markers or plaques is not explicitly addressed in the Forests and Park Rules (see 304 CMR 12.00; Appendix F).

## **2.6. INTERPRETIVE SERVICES**

Regional interpretive staff provides programming in the planning unit. There is no Comprehensive Interpretive Plan (CIP) for the entire planning unit, nor are there programs offered at every property in the planning unit.

## **2.7. OPERATIONAL RESOURCES**

### **DCR Staffing**

The DCR manages its forests, parks and reservations through the Division of State Parks and Recreation, otherwise known as the MassParks Division. Resources within the MassParks Division, including finances, staffing and physical equipment, are

organized by regions, districts and complexes. Under this organizational structure, the Lowell/Great Brook Planning Unit is within the North Region, Metro West District and Walden Complex.

### **North Region**

The North Region is comprised of three districts: Metro West, Middlesex Essex and Coastal. Specialized staffing resources assigned to the North Region are available on an as needed basis to the planning unit. This includes services related to interpretation, public outreach and safety, and engineering. The region is headed by a North Region Director who reports to the Deputy Director of MassParks.

### **Metro West District**

The Metro West District is comprised of two complexes: Walden and Hopkinton. The district includes a functionally and geographically varied set of properties in the DCR system. Management is provided by a Metro West District Manager who reports to the North Region Director.

### **Walden Complex**

The Walden Complex includes Walden Pond State Reservation in Concord and Lincoln; Carlisle State Forest and Great Brook Farm State Park in Carlisle; Billerica State Forest, Warren H. Manning State Forest and Governor Thomas Dudley State Park in Billerica; Lowell Heritage State Park, the John J. Janas Skating Rink and Raymond J. Lord Memorial Swimming Pool in Lowell; and Lowell-Dracut-Tyngsborough State Forest.

The Forest and Park Supervisor at Walden Pond State Reservation also serves as the Walden Complex Field Operation Team (FOT) Leader. The team leader is responsible for coordinating the operational needs for each facility in the Walden Complex, through the use of Field Operation Teams. The Walden Complex FOT Leader reports to the Metro West District Manager.

**Table 2.1. DCR Staffing Resources in the Walden Complex, by Reporting Location<sup>a</sup>**

| <b>Job Title<sup>b</sup></b>                  | <b>Type<sup>c</sup></b> | <b>Reporting Location</b> |
|-----------------------------------------------|-------------------------|---------------------------|
| <i>Walden Pond State Reservation</i>          |                         |                           |
| Walden Complex FOT Leader                     | Y                       | Concord                   |
| Forest and Parks Supervisor II                | Y                       | Concord                   |
| Clerk I                                       | Y                       | Concord                   |
| Visitor Services Supervisor I                 | Y                       | Concord                   |
| Park Interpreter (2)                          | S                       | Concord                   |
| Forest and Parks Supervisor I (3)             | S                       | Concord                   |
| Summer Worker (4)                             | S                       | Concord                   |
| Laborer I (8)                                 | S                       | Concord                   |
| Recreation Facility Supervisor I              | S                       | Concord                   |
| Park Ranger                                   | S                       | Concord                   |
| Lifeguard II                                  | S                       | Concord                   |
| Lifeguard I (12)                              | S                       | Concord                   |
| <i>Great Brook Farm State Park</i>            |                         |                           |
| Forest and Parks Supervisor III               | Y                       | Carlisle                  |
| Laborer II                                    | Y                       | Carlisle                  |
| Laborer I (3)                                 | S                       | Carlisle                  |
| Park Interpreter                              | S                       | Carlisle                  |
| Park Ranger                                   | S                       | Carlisle                  |
| <i>Lowell Heritage State Park</i>             |                         |                           |
| Forest and Parks Supervisor I                 | Y                       | Lowell                    |
| Laborer I (2)                                 | S                       | Lowell                    |
| <i>Raymond J. Lord Memorial Swimming Pool</i> |                         |                           |
| Recreation Facility Supervisor III            | S                       | Lowell                    |
| Recreation Facility Supervisor I              | S                       | Lowell                    |
| Lifeguard II                                  | S                       | Lowell                    |
| Lifeguard I (10)                              | S                       | Lowell                    |
| Summer Worker (2)                             | S                       | Lowell                    |

a. Includes staff from the Division of State Parks and Recreation who worked exclusively within the Walden Complex in 2013.

b. The number of multiple employees with the same job title are indicated in parentheses.

c. Type: Y = Year-round; S = Seasonal.

Park staff are responsible for a number of management activities in order to keep the properties clean and accessible for use year round. Duties include cleaning bathrooms, picking up litter and emptying trash barrels. Due to current limited staffing levels, these activities are not always able to be performed on a daily basis. Mowing and trimming is performed on an as needed basis, typically weekly, during the warmer months of the year.

### Bureau of Forestry and Fire Control

The Bureau manages a variety of programs, including management forestry, forest fire control, forest health and urban/community forestry, that provide technical assistance and services on forestry related issues to DCR forests, parks and reservations. Bureau staff and assets are organized

into districts that generally follow county boundaries.

Middlesex County is divided into two fire districts; the Lowell/Great Brook Planning Unit falls within Fire District 6, which is based out of Great Brook Farm State Park. Beyond fighting fires and managing prescribed burns, the fire staff does a lot of fire road maintenance.

### Bureau of Ranger Services

The Bureau of Ranger Services includes field ranger staff who provide outreach related to Massachusetts regulations and public safety services. While other DCR districts have an assigned District Ranger, the Metro West District does not.

### Division of Engineering

The Division of Engineering is responsible for the engineering and construction of parkways, dams, buildings and recreation facilities. It also provides a Regional Engineer to oversee day-to-day repair and construction projects, and to maintain a working relationship with the Regional Director in identifying capital improvement priorities. The Division also provides catch basin cleaning at Lowell Heritage State Park in support of park operations.

### Bureau of Planning, Design and Resource Protection

This Bureau prepares RMPs and Trail System Plans; develops and updates GIS data; provides technical assistance with the management of archaeological and historic resources; identifies and acquires properties to be added to the DCR system; maintains an archive of park documents; provides technical support on ecological resources and the monitoring of CRs; and designs and manages projects to enhance DCR properties.

### Office of External Affairs and Partnerships

The Office of External Affairs and Partnerships works to enhance DCR's constituency of supporters and users by: working in partnership with park users and supporters to develop and sustain community-based stakeholder groups; facilitating external financial assistance for the planning, design and construction of capital projects; managing the DCR partnerships Matching Funds Program, which leverages private contributions to improve DCR-

owned and managed facilities; and serving as a dedicated point of contact for individuals and nonprofit, institutional and community-based organizations.

## **Supplemental Staffing**

### Volunteers

Volunteers can provide a variety of human and intellectual resources to support the management and maintenance of the properties in the Lowell/Great Brook Planning Unit. Volunteer services include clean-ups, trail maintenance, monitoring, botanical surveys, grant writing, interpretive programming and others. Volunteers may be individuals or members of groups, businesses or organizations, and may be organized by DCR staff or partner organizations.

All volunteer activities must be conducted with prior approval and supervision of the DCR, and in accordance with DCR standards and volunteer policies, including documentation through a Volunteer/Stewardship Agreement Form, Volunteer Release Form and Volunteer Service Log (DCR 2013).

### **Law Enforcement and Public Safety**

The Massachusetts State Police has primary law enforcement authority on state-owned lands. Local police provide additional law enforcement in the planning unit, within their respective jurisdictions. The Executive Office of Energy and Environmental Affairs' Office of Law Enforcement (i.e., the Massachusetts Environmental Police) provides primary enforcement of hunting, fishing, boating, OHV and snowmobile regulations.

DCR Rangers are not law enforcement officers, but have the authority to enforce DCR regulations and issue citations (i.e., parking tickets and dogs off leash) on DCR property. They also coordinate search and rescue activities in forests, parks and reservations.

Municipalities provide emergency fire and medical response to incidents on state lands. DCR Forest Fire Control District 6 provides assistance to Municipalities in the detection, suppression and prevention of wildfires. DCR Rangers may provide first aid.

## **General Budgetary Info**

### Operating Budget

The annual operating budget supports daily operations and maintenance, including utilities, supplies, equipment leases, administration, and the maintenance and minor repair of facilities, vehicles and equipment. In Fiscal Year 2013, the Lowell/Great Brook Planning Unit operating budget, excluding personnel costs, was \$16,725. Funds are also available from the region for specific projects or activities within the planning unit.

### Capital Budget

The capital budget supports projects (e.g., construction and repair) and items (i.e., equipment) with a per-unit cost of at least \$5,000 and an expected lifespan of at least seven years.

Capital projects are identified and funded through a five-year capital plan. These plans identify proposed capital projects, their costs and the year in which they are to be funded. In fiscal years 2012 through 2014, improvements to the Mack building and Rynne bathhouse were completed at Lowell Heritage State Park. These projects cost \$134,471. At Great Brook Farm State Park, the Fiscal Year 2012 projects were related to the design of the dairy barn and construction of a modular storage building, which cost \$110,096. An additional project in Fiscal Year 2013 involved masonry work at the Hart Barn and cost \$9,320.

Capital plans are extensively reviewed within the DCR, approved by the Commissioner and included in the DCR's annual budget. This budget is then reviewed by the Executive Office of Energy and Environmental Affairs, the Executive Office of Administration and Finance, and the Governor. Additional capital initiatives may be identified and added to the budget by the Commissioner, Secretary or the Governor during this review process.

### Deferred Maintenance

These funds are used for infrastructure repair that exceed typical maintenance, but do not rise to the level of a capital project. They may also be used to address emergency capital projects for which funds have not been allocated. Each region is allotted deferred maintenance funds on an annual basis; the Regional Director determines how these funds are to

be used. Recent deferred maintenance projects within the planning unit include \$4,500 to bring the fire security system in buildings along the Vandenberg esplanade up to compliance; \$1,000 to fix the communication and video system at the Mack building; and approximately \$3,000 to repair trails and build boardwalks at Great Brook Farm State Park.

## **Supplemental Funding**

### **Grants**

Federal and private funds, in the form of grants, are periodically awarded on a competitive basis to the DCR for park maintenance and operation activities (e.g., recreational trails grants). There have been no recent grants awarded to the planning unit.

### **Earmarks**

Earmarks are funds directed to specific projects by the Massachusetts General Court via the annual state budget. There have been no recent earmarks for the planning unit.

### **Conservation Trust Fund**

This trust fund uses donations to support special initiatives that go above and beyond basic property maintenance. It is funded through charitable contributions to the DCR, including those donations placed into the “iron rangers” (i.e., a secure metal donation box) located at Lowell Heritage State Park (1) and Great Brook Farm State Park (2). In 2013, Lowell Heritage State Park received over \$1,000 in charitable contributions, while Great Brook Farm State Park received over \$225. As of February 11, 2014, there is approximately \$2,915 in the Conservation Trust Fund for Lowell Heritage State Park and \$5,550 in the fund for Great Brook Farm State Park.

### **Heritage Parks Fund**

In Fiscal Year 2014, 20 benches within the Mack plaza at Lowell Heritage State Park were replaced using approximately \$45,000 from this fund.

### **Dedicated Funds**

Dedicated property funds may come from a variety of sources (e.g., telecommunication tower fees), and are limited to use at the property on which they are

derived. There are no sources of dedicated funds for any property within the planning unit.

### **Retained Revenues**

The state operating budget specifies the maximum amount of park revenue from fees, licenses and rents charged by DCR that may be retained by the agency in a given FY (the amount changes yearly). Revenue is deposited in the state’s general fund. DCR may then use (or retain) up to 80% of this revenue statewide for its operating expenses and improvements to DCR facilities statewide.

Great Brook Farm State Park is the only property in this planning unit that currently generates any retained revenue. Revenue is collected from a number of different sources, including parking, annual pass sales, rental fees and event permits. In calendar year 2013, Great Brook Farm State Park collected \$33,580 in parking fees, \$12,240 in annual pass sales, \$1,126 in event fees, and \$16,680 in rental income (from lease holders), for a total of \$63,626. This total does not include revenue or in-kind investments from the farm lease or the ski concession.

### **In-kind Contributions**

In-kind contributions are the donation of goods or services, rather than funds. The Student Conservation Association (SCA) has provided work crews to assist with trail maintenance activities at Great Brook Farm State Park, contributing their time and labor. The New England Mountain Bike Association (NEMBA) also holds annual trail days at both Great Brook Farm State Park and Lowell-Dracut-Tyngsborough State Forest. NEMBA members assist with the maintenance of trails used for mountain biking purposes, providing labor and materials.



Spruce Swamp (DCR)

## SECTION 3. LOWELL-DRACUT-TYNGSBOROUGH STATE FOREST

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### 3.1. INTRODUCTION

Lowell-Dracut-Tyngsborough State Forest (1,109 acres) is a natural treasure of the Merrimack Valley. Its location between the urban centers of Lowell, MA and Nashua, NH make it unique and valuable, in terms of the recreational and educational opportunities available. The forest's network of trails provides access to largely undisturbed woodlands and wetlands, as well as several noteworthy cultural sites, for hikers, horseback riders and mountain bikers alike. It is an ideal location to discover the rich history of the region, from the influence of retreating glaciers to the course of human settlement over the last nine thousand years.

### 3.2. HISTORY OF PROPERTY

The history of Lowell-Dracut-Tyngsborough State Forest dates back thousands of years to Native American settlements along the Merrimack River. The principal tribe of the Merrimack Valley was the Pennacook, who were led by Passaconaway, and later by his son Wonalancet, two of the most renowned chiefs in New England. Both men were known for their mild dispositions, “preferring the

ease and comforts of peace to the hardships and deprivations of war,” and were respected by all of the smaller tribes in the region (Piotrowski 2002, 17).

At the start of King Philip's War in 1675, the Pennacook fled the Merrimack Valley to avoid having to take a side in the conflict. When Wonalancet returned to the area 10 years later, he sold all of his tribe's homelands to Jonathan Tyng and his partners, reserving only the right to fish and hunt. Soon after this “million-acre” sale, Wonalancet joined a tribe in Quebec, Canada and did not return to the area until 1692 (Crowley 1904; Piotrowski 2002, 18). It was at the request of a few hardy colonists, who were comforted by his presence, that Wonalancet moved back to Tyngsborough, where he lived with Jonathan Tyng in the Tyng Mansion until his death in 1696.

The area surrounding the state forest was slow to develop through the early decades of the 18<sup>th</sup> century, primarily due to unstable frontier conditions. After 1730, increased settlement took place throughout the area, especially along the riverine lowlands of the Merrimack. By 1800, Chelmsford (part of which would become Lowell), Dracut and Tyngsborough were flourishing. Farms,

quarries, mills and other small-scale manufacturing industries supported the regional economy. A series of transportation improvements throughout the 19<sup>th</sup> century, including roads and bridges, river ferries, canals and railroad corridors, maintained the vitality of the Merrimack Valley.

During the 19<sup>th</sup> century, the character of Dracut and Tyngsborough began to shift as Lowell established itself as the industrial powerhouse in the region. Both towns became popular vacation communities with established waterfront parks and resorts attracting seasonal visitors from Boston and New York. Lakeview Park (Dracut), Willowdale and Mount Rock (Tyngsborough) were just a few of the more popular destinations in the area, all of which were situated around Lake Mascuppic.

Land for Lowell-Dracut-Tyngsborough State Forest was first acquired by the Commonwealth between 1933 and 1936. During that time, federal Works Progress Administration projects were carried out in the forest, including the reconstruction of Trotting Park Road (Lowell and Tyngsborough); creation of scenic vistas from Whortleberry Hill; improvement of timber stands on Gage Hill; and construction of a tool shed and blacksmith shop. An old spring water bottling building, remnants of a company once located on the land, was repurposed as a forest headquarters (Stone & Webster Environmental Technology & Services 1998). In 1937, a 16- by 30-foot single-story woodshed and public comfort station was built at the headquarters site, which was located on the east side of Trotting Park Road (Lowell), south of the current main entrance to the state forest (Stone & Webster Environmental Technology & Services 1998).

By the early 1950s, there was considerable interest in developing the state forest into a major facility (see Appendix H). However, early efforts to act on this interest, such as the small recreation area and ski trail established near Whortleberry Hill, never became popular with visitors (Lambert 1972). For the next 20 years, the forest remained largely undeveloped; hiking and “some” snowmobiling were the principal recreation uses (DNR 1970, 2).

In 1970, the Department of Natural Resources (DNR) wrote a plan for the state forest to “help meet the increasing need for a variety of recreation and natural experiences in the rapidly suburbanizing Lowell region” (DNR 1970, 2). According to the

plan, much of the forest was “to be left in its natural state, protected and enhanced as resource management areas” (DNR 1970, 2). However, specific recommendations were made for an organized interpretive trail system, an environmental education or visitor’s center, a day use area for swimming and picnicking, and a group camping area. The plan also recommended acquiring an additional 300 acres of land to provide a larger buffer between the proposed development and more natural areas of the forest.

Several years after the DNR plan was written, but before any of its recommendations were implemented, Lowell-Dracut-Tyngsborough State Forest fell into a state of disrepair. The buildings at the headquarters site were boarded-up and the forest was “ravaged by vandalism” (Sylvester 1977). “Stripping and torching” cars was one of the more notorious activities that took place within the forest; in 1976, 85 burnt cars were found in the Dracut portion alone (Sylvester 1977). The lack of supervision over the forest’s Cut-A-Cord Program led to further abuse, with permit holders reportedly taking three or four times their share of wood from the forest and reselling it at a much higher price (Sylvester 1977).

One bright spot in the forest’s history during this time period was the partnership and agreement between the Department of Environmental Management and Greater Lowell Indian Cultural Association (GLICA). In 1978, an initial three-year Memorandum of Understanding was signed, which granted the GLICA access to 150 acres of the state forest where the group erected temporary wigwams and teepees, laid out a ceremonial circle and held cultural festivals (Anonymous 1981). The GLICA’s presence enhanced the state forest’s natural and cultural resources and helped curb some of the vandalism taking place there (Anonymous 1981).

In 1996, all of the buildings associated with the headquarters site were removed and forest operation and maintenance responsibilities shifted to eight year-round and seasonal staff based out of Lowell Heritage State Park (Stone & Webster Environmental Technology & Services 1998). Today, the state forest remains largely undeveloped and staff are based out of both Great Brook Farm State Park and Lowell Heritage State Park.

### 3.3. EXISTING CONDITIONS

#### Natural Resources

##### Physical Features

**Topography.** The state forest is shaped roughly like a bowl, with a large wetland near its center and several drumlins, or elongated hills, situated around its perimeter. The highest points within the forest are atop Whortleberry Hill (364 feet) and Gage or Huckleberry Hill (324 feet), both of which are located in the northernmost portion of the forest (see Figure 2).

**Geology.** The bedrock in the area of Lowell-Dracut-Tyngsborough State Forest is largely comprised of calcareous sandstones, siltstones and shale, with Ayer granite and Dracut diorite intruding near the Town of Dracut (Skehan 2001). The best examples of these formations fall outside of the forest, underlying the Merrimack River, near the University Avenue Bridge in Lowell (calcareous sandstones, siltstones and shale) and at Nickel Mine Hill, north of Methuen Street in Dracut (Dracut diorite; Skehan 2001).

Within the state forest itself, several large glacial erratics, or boulders, are recognized as significant natural and cultural resources (e.g., Horsehead Rock, Sheep Rock and Indian Head Rock). There is also evidence of multiple stone quarries within the forest, where granite and gneiss were collected as building material for Lowell’s canal system and textile mills (Ali and Hudon n.d.).

**Soils.** Soils within the forest vary based on the topography. Poorly and very poorly drained sandy loams and Freetown or Swansea mucks are associated with the low-lying wetlands. These soils are considered severely limited for picnic areas, paths and trails (Peragallo 2009). Well to excessively drained sandy loams and exposed stones or boulders dominate the rolling to moderately steep hills. These soils range from being severely to slightly limited for picnic areas, paths and trails (Peragallo 2009). The severe limitations are strictly related to picnic areas and the soils being too sandy, too rocky or too steep.

**Table 3.1. Soils of Lowell-Dracut-Tyngsborough State Forest**

| Soil Series                          | % of Forest | Drainage Class                       |
|--------------------------------------|-------------|--------------------------------------|
| Canton fine sandy loam               | 18.4        | Well drained                         |
| Montauk fine sandy loam              | 14.0        | Well drained                         |
| Freetown muck                        | 13.8        | Very poorly drained                  |
| Charlton-Hollis-Rock outcrop complex | 7.0         | Well to somewhat excessively drained |
| Hollis-Rock outcrop-Charlton complex | 6.6         | Well to somewhat excessively drained |
| Deerfield loamy sand                 | 6.0         | Moderately well drained              |
| Narragansett silt loam               | 5.3         | Well drained                         |
| Birdsall mucky silt loam             | 4.4         | Very poorly drained                  |
| Scituate fine sandy loam             | 4.4         | Moderately well drained              |
| Scarboro mucky fine sandy loam       | 2.9         | Very poorly drained                  |
| Merrimac fine sandy loam             | 2.8         | Somewhat excessively drained         |
| Swansea muck                         | 2.8         | Very poorly drained                  |
| Water                                | 2.6         | N/A                                  |
| Ridgebury fine sandy loam            | 2.4         | Poorly drained                       |
| Whitman fine sandy loam              | 1.6         | Very poorly drained                  |
| Wareham loamy fine sand              | 1.4         | Poorly drained                       |
| Windsor loamy sand                   | 1.1         | Excessively drained                  |
| Paxton fine sandy loam               | 1.0         | Well drained                         |
| Tisbury silt loam                    | 0.8         | Moderately well drained              |
| Sudbury fine sandy loam              | 0.5         | Moderately well drained              |
| Hinckley loamy sand                  | 0.2         | Excessively drained                  |
| Woodbridge fine sandy loam           | 0.2         | Moderately well drained              |
| Merrimac-Urban land complex          | 0.0         | Somewhat excessively drained         |

##### Water Resources

**Ponds.** There is only one named pond in Lowell-Dracut-Tyngsborough State Forest; it serves as a portion of the property’s northeastern boundary (see Figure 2). Althea Lake is a relatively small, 43-acre pond with a maximum depth of 15 feet (MassWildlife 1993a and MassGIS 2009). The DCR owns approximately 1,735 feet of the shoreline; the remaining portion is lightly developed. Emergent



Placeholder for Figure 2.

aquatic vegetation has historically been very heavy at Althea Lake, making it difficult to fish (MassWildlife 1993a).

There are approximately 33 acres of other smaller, unnamed pools and ponds within the forest.

A second named pond abuts the DCR’s Conservation Restriction in Tyngsborough (see Figure 2). Long Pond is a 158-acre interstate pond with a maximum depth of 25 feet (MassWildlife 1993b and MassGIS 2009). The DCR has an interest in approximately 1,200 feet of the shoreline; the remaining portion is heavily developed. Long Pond is an infertile body of water; it contains very little aquatic vegetation or sizeable fish (MassWildlife 1993b).

**Wetlands.** Wetlands account for nearly one-quarter of the forest’s acreage (approximately 244 acres or 22%). Spruce Swamp is the largest wetland within the forest (approximately 107 acres; see Figure 2). It contains areas of deep marsh, shrub swamp and wooded swamp, as well as acidic shrub fen, a rare Priority Natural Community. Before the construction of Carney Road (Dracut and Lowell), which dammed a small stream, Spruce Swamp was known as Indian Head Lake.

**Vernal Pools.** There are 31 certified and 15 potential vernal pools within the state forest, several of which are Civilian Conservation Corps (CCC) water holes (see Cultural Resources, below, for more information).

**Streams.** There are three named streams within the forest, all of which flow into the Merrimack River (see Figure 2). Scarlet Brook flows out of a wetland southeast of Althea Lake, towards Sherburne Avenue in Lowell, and enters the Merrimack River near Greater Lowell Technical High School. Claypit Brook originates from a wetland south of Spruce Swamp. The stream flows south towards Varnum Avenue in Lowell, where it turns east and enters the Merrimack River near Pawtucket Falls. Flag Meadow Brook is located in the easternmost portion of the forest and flows south towards Lowell General Hospital before entering the Merrimack River downstream of Claypit Brook.

**Groundwater.** There are no aquifers beneath the state forest.

**Flood Zones.** The 100-year flood zone overlaps with the wetland immediately east of Althea Lake (18 acres), the western edge of Spruce Swamp (22 acres) and portions of Scarlet Brook (29 acres). The 500-year flood zone overlaps with the northern edge of Spruce Swamp, near Forest Park Road in Dracut (six acres).

Rare Species

Lowell-Dracut-Tyngsborough State Forest is home to three state-listed species. One of these species is susceptible to collection and is not identified in this plan.

**Table 3.2. State-listed Species of Lowell-Dracut-Tyngsborough State Forest, as identified by the Natural Heritage & Endangered Species Program (NHESP)**

| Species                              | Type      | MESA <sup>a</sup> |
|--------------------------------------|-----------|-------------------|
| Blanding’s turtle                    | Reptile   | T                 |
| Blue-spotted salamander <sup>b</sup> | Amphibian | SC                |
| Data sensitive species <sup>c</sup>  | Insect    | T                 |

Source: Harper 2013

- a. Status of species listed under the Massachusetts Endangered Species Act (MESA): SC = Special Concern and T = Threatened.
- b. Blue-spotted salamander has not been re-observed at the state forest since 1989 and will be considered to be historic at this location at the end of 2014.
- c. This species is not identified in accordance with the NHESP’s policy of withholding, in site-specific documents, the name or location of rare species susceptible to collection.

Blanding’s turtles use a variety of habitats, including vernal pools, marshes, scrub-shrub wetlands and open uplands, during their life cycle (NHESP 2007a). Blue-spotted salamanders, on the other hand, rely solely on moist, moderately shaded habitats and vernal pools, in particular, for breeding (NHESP 2007b). The data sensitive species can be found in the forest’s wetlands and nearby wooded areas.

Nearly 90% of the forest (995 acres) has been designated as Priority Habitat under the Massachusetts Endangered Species Act (321 CMR 10.00; see Appendix F). Approximately 79% of the lands on which the DCR holds a Conservation Restriction are also designated as Priority Habitat (56 acres). These same areas have been identified as Core Habitat in the MassWildlife and The Nature Conservancy publication “BioMap 2: Conserving the Biodiversity of Massachusetts in a Changing World” (MassWildlife and TNC 2010).

BioMap2 highlights two types of areas important for conservation: Core Habitat and Critical Natural Landscape. The first is crucial for the long-term persistence of rare species and other species of conservation concern. The second provides habitat for wide-ranging native wildlife, supports intact ecological processes, maintains connectivity among habitats, enhances ecological resilience and buffers aquatic Core Habitats to help ensure their long-term integrity. Protection of both areas, which may overlap, is “important to conserve the full suite of biodiversity” in Massachusetts (MassWildlife and TNC 2010).

Within Lowell-Dracut-Tyngsborough State Forest, there are also 260 acres (23%) of Critical Natural Landscape, which encompass Spruce Swamp and adjacent wetlands to the north and west.

### Vegetation

**Forest Types.** In 2003, the James W. Sewall Company developed a forest inventory/land cover classification dataset for the state forests and parks. The dataset is primarily based on the interpretation of infrared aerial photography, a process that identified nine forest sub-types within Lowell-Dracut-Tyngsborough State Forest.

**Table 3.3. Forest Sub-types of Lowell-Dracut-Tyngsborough State Forest**

| Forest Sub-type              | Acres                    | % of Forest |
|------------------------------|--------------------------|-------------|
| Mixed oak                    | 299.2                    | 27.0        |
| Eastern white pine-oak       | 274.9                    | 24.8        |
| Eastern white pine           | 72.1                     | 6.5         |
| Oak-hardwoods                | 64.3                     | 5.8         |
| Eastern white pine-hardwoods | 36                       | 3.2         |
| Red maple-swamp hardwoods    | 33.9                     | 3.1         |
| Red pine plantation          | 30.8                     | 2.8         |
| Grey birch-red maple         | 10.8                     | 1.0         |
| Eastern hemlock-hardwoods    | 6.8                      | 0.6         |
| <i>Total</i>                 | <i>828.8<sup>a</sup></i> | <i>74.8</i> |

a. The difference in total acreage is due to the exclusion of wetlands and areas of open water, as well as changes in the forest’s boundaries since 2003.

More recently (2010-2011), specific areas within the forest were visited by DCR Management Foresters as part of the Massachusetts Continuous Forestry Inventory (CFI). The CFI is a network of permanent, one-fifth-acre plots on state forest lands that are routinely monitored for silvicultural purposes. The measurements and observations made within each

CFI plot are recorded in a database that dates back to 1960, when the CFI was created. Approximately 10% of the state’s CFI plots are inventoried each year, on an on-going basis. As of 2010, there were 1,768 CFI plots statewide (Goodwin 2014).

There are seven CFI plots within Lowell-Dracut-Tyngsborough State Forest. They range in age from approximately 70 to 100 years and are comprised of mostly white or red pine, pitch pine, oak or swamp hardwoods. As part of the CFI process, DCR Management Foresters also look for signs of disturbances that affect the development of vegetation in the vicinity of each CFI plot. Since 2010, four disturbance agents have been observed in the forest’s CFI plots. These agents, in decreasing order of occurrence, are: fire, clearing for pasture, insects and beavers.

**Priority Natural Communities.** One Priority Natural Community, acidic shrub fen, has been identified within Lowell-Dracut-Tyngsborough State Forest. Acidic shrub fens are typically found along wet pond margins in the eastern half of Massachusetts and consist primarily of low-growing, interwoven shrubs, with patches of Sphagnum moss growing at the shrub bases (Swain and Kearsley 2001). Acidic shrub fens have a state ranking of S3, which means that they are neither rare (S1) nor common (S5), however their conservation is encouraged. The biggest threats to this natural community are hydrological alterations that affect either water quality or quantity (Swain and Kearsley 2001).

**Invasive Species.** Since 2010, five invasive species have been observed by DCR Management Foresters in the forest’s CFI plots. These invasive species are: common buckthorn (*Rhamnus cathartica*), glossy buckthorn (*Frangula alnus*), garlic mustard (*Alliaria petiolata*), oriental bittersweet (*Celastrus orbiculatus*) and black locust (*Robinia pseudoacacia*). Japanese knotweed (*Fallopia japonica*) was also observed in the former headquarters site while conducting fieldwork for this plan.

**Pests and Disease.** Since 2010, DCR Management Foresters have observed, as part of the CFI process, several biological agents responsible for tree loss. These agents are: heart rot, black knot of cherry (*Apiosporina morbosa*), white pine weevil (*Pissodes strobe*), borers, gypsy moth (*Lymantria dispar*) and other unknown insects and biological agents.

It is also worth noting that Emerald Ash Borer, an invasive wood boring insect that was first identified in Massachusetts in 2012 and adversely affects all genera of ash trees, has recently been discovered in the neighboring town of Methuen (Church 2014).

### Wildlife

**Birds.** Approximately 150 species of birds have been recorded on, or over, the state forest in recent years (see Appendix G). Of these species, 23 are classified as Species in Greatest Need of Conservation (MassWildlife 2006).

**Mammals.** There is little current information on the forest's mammals. Sixteen species confirmed to occur within the forest and an additional 26 species that may possibly occur within the forest are identified in Appendix G.

**Reptiles.** There is little current information on the forest's reptiles. Seven species confirmed to occur within the forest, three of which are classified as Species in Greatest Need of Conservation, and an additional nine species that may possibly occur within the forest are identified in Appendix G (MassWildlife 2006).

**Amphibians.** There is little current information on the forest's amphibians. Eight species confirmed to occur within the forest, one of which is classified as a Species in Greatest Need of Conservation, and an additional 10 species that may possibly occur within the forest are identified in Appendix G (MassWildlife 2006).

**Fish.** There is no current information on the forest's fish. Surveys conducted by MassWildlife in 1978 at Althea Lake identified the following seven species: largemouth bass (*Micropterus salmoides*), chain pickerel (*Esox niger*), yellow perch (*Perca flavescens*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), yellow bullhead (*Ameiurus natalis*) and brown bullhead (*Ameiurus nebulosus*; MassWildlife 1993a). A separate MassWildlife survey at Long Pond in 1981 found these same seven species, plus white sucker (*Catostomus commersonii*) and golden shiner (*Notemigonus crysoleucas*; MassWildlife 1993b).

## **Cultural Resources**

### Pre-Contact Archaeological Sites

Two pre-Contact sites are documented within the state forest. During an archaeological survey, a camp site was uncovered on an upland terrace in Dracut dating to the Early Archaic Period (10,000-7,500 B.P.; Before Present). Many stone tools were recorded, as well as a unique feature unlike any other documented in the northeast. A small pit containing 1,200 fragments of calcined (burned) deer bone was located on a steep slope making this site potentially eligible for listing on the National Register of Historic Places. In another area of the forest (Lowell), a Late Archaic Period (5,000-3,000 B.P.) camp site was recorded. No archaeological sites have been recorded in the Tyngsborough section of the forest, however it has not been systematically surveyed. The physical characteristics, regional setting and known pre-Contact occupation in the area all confer a high archaeological potential for the state forest.

### Historic Archaeological Resources

Timothy Coburn reportedly operated one of the earliest mills in Lowell (Richardson 1978). The remnants of this mill site may fall within the southern portion of the forest, along Claypit Brook. The remnants of a dam (see Structures, below) suggest that there was also some small scale industrial activity located along the brook. However, more research is needed to determine the nature and extent of the site, to identify any additional features, and to confirm its association with one of the six men named Timothy Coburn who resided in the area in the 18<sup>th</sup> and 19<sup>th</sup> centuries (Richardson 1978).

A spring water bottling company was established at the former headquarters site in the late 19<sup>th</sup> century, operating until c1920. When the state forest was established in the 1930s, at least one building from the former bottling plant, a pump house, was renovated for forest use. The site was utilized as the forest headquarters until the 1970s, and then left vacant until the buildings were removed in 1996. A concrete pad, the foundation from the former headquarters building and a depression with stones that is likely the cellar hole of the former pump house, are still present on site. The pump house cellar hole is currently filled with branch debris. A trash pile that contains glass bottle debris, as well as

a terra cotta pipe sticking out of the ground (possibly a part of the former bottling works), was also located nearby.

Earlier research on the history of the state forest indicates that there are at least two additional cellar holes that are expected to exist on the property (Richardson 1978). These resources were sought during the fieldwork for this plan, but could not be confidently located; additional research is needed.

### Historic Resources

**Buildings.** There are no historic buildings within the state forest.

**Structures.** There are five Civilian Conservation Corps (CCC) water holes within the state forest. These water holes, typically small, stone lined ponds, were developed by the CCC in larger state forests and used as a source of water for forest fire control purposes. Two of the water holes within Lowell-Dracut-Tyngsborough State Forest are adjacent to Trotting Park Road (Lowell): one is near the former headquarters site and the other is on the edge of Spruce Swamp. A third water hole is just north of Trotting Park Road (Tyngsborough), adjacent to an unnamed administrative road and Spruce Swamp. The fourth is adjacent to Totman Road (Dracut) and is notable for being encircled by a pathway, providing more access to the resource than is typical. The fifth water hole is located north of Totman Road (Dracut) and is notable for being rectangular in shape, where the others within the forest are round. In general, the water holes are all in fair to poor condition, with some of the side walls settling and vegetation creeping in from the edges. All have drainage issues.



CCC Water Hole (DCR)

There are three stone slab bridges of unknown age located in the forest. This simple bridge type utilizes a single large, relatively flat stone, supported on either side by earth or stone abutments, to cross a small stream or brook. Two of the bridges are located in the southern portion of the forest, not far from the former headquarters site, and serve as part of the current trail system. One bridge is small, while the other is larger and covered by earth that has been held in place by wooden side rails, making the slab construction only visible from the side view. Both are in good condition. The third stone slab bridge is located off-rail, near intersection D3 on Carney Road (Dracut). This bridge is in fair condition and has some vegetative growth on it.



Stone Slab Bridge (DCR)

Four stone culverts were located during the fieldwork for this plan. One is located beneath Trotting Park Road (Lowell), adjacent to Spruce Swamp; another is located beneath the unnamed administrative road in Tyngsborough; a third culvert is located on Carney Road (Dracut), near intersection D3; and the fourth culvert is located on the former headquarter site's entrance loop road, adjacent to the CCC water hole. These culverts, which facilitate the flow of water beneath a roadway, were constructed utilizing small stones. The culvert beneath the former entrance loop road is also lined with a metal pipe, while the others are all stone. They may have been constructed as part of the Works Progress Administration improvements to the forest. All of the culverts are in poor condition, with some blockage and/or minor collapse impeding full flow.

The remnants of a dam, constructed of stone, can be found in the southern portion of the property, along

Claypit Brook. This dam may be associated with the Timothy Coburn mill site. See Historic Archaeological Resources, above, for more information on this resource.

**Objects.** There are four stone markers located within the state forest, identifying property and/or town boundaries.

- Located near an entrance to the forest on Trotting Park Road in Tyngsborough, this stone is leaning significantly and has some paint remnants on the top. The stone is inscribed with:

T  
ARD  
1822

- A small property boundary marker inscribed with a “C,” located in the southern portion of the forest.
- A town boundary marker with a “T” inscribed on one side and an “L” inscribed on the other. This stone is located at intersection of all three towns; it is leaning and covered in lichen.
- A town boundary marker with an “L” inscribed on one side and a “D” inscribed on the other. This stone is located just off of Trotting Park Road, near the boundary of all three towns. Despite some remnants of paint, it is in the best condition of any boundary marker in the forest.



Stone Boundary Marker (DCR)

Sheep Rock is located in the southern portion of the forest, not far from the former headquarters site. It is a large glacial erratic, approximately 10 feet long, 6 feet wide and 12 feet tall. A large split cuts through the rock and lichen is growing on some of the surface. The north face of Sheep Rock has been vandalized by graffiti and the south face contains the following inscription, in block letters:

SHEEP ROCK  
IN MEMORY OF GEORGE J. CARNEY  
BORN JUNE 13, 1835  
DIED APRIL 24, 1906

Local legend states that Sheep Rock saved a flock of sheep owned by William Parham, a local farmer. During a blizzard, the flock found shelter under an overhang of the boulder. There, they were able to survive for several days until being rescued. The land where Sheep Rock lies was formerly owned by George Carney.



Sheep Rock (DCR)

Stone walls can be found throughout the state forest; they are remnants of the historic land use and ownership in the area, and also reflect the geology of the region. The walls are all dry laid, rubble walls that are generally in fair to poor condition. The walls were not mapped as part of this plan.

Several of the roads in the forest pre-date the establishment of the state forest itself, including Trotting Park Road (Lowell and Tyngsborough) and Totman Road (Dracut). Totman Road, in particular, has been identified as being an older road that may have been laid out along an established Native American pathway. Today it is a typical wide, unpaved forest road that is enjoyed by hikers and mountain bikers.

**Landscapes.** Remnants of quarrying activity dot the forested landscape, where early settlers took advantage of both the underlying geology of the area and the large collection of glacial erratics. It is a fascinating collection that ties the natural and cultural history of the forest together, and provides a connection to the industrial heritage of Lowell, as stone from the forest was reportedly utilized as building material for Lowell's canal system and textile mills (Ali and Hudon n.d.).

Most of the quarrying activity that was located during the fieldwork for this plan appears to be very small scale; five areas were identified where one or two stones retain visual evidence, in the form of drill scars, of past use for quarrying. Three of these sites are located in the northern portion of the forest, near Trotting Park Road (Tyngsborough) and an unnamed administrative road (Dracut), while the other two are located in the southern portion of the forest, not far from the former headquarters site.

Two other areas were identified where larger scale quarrying took place. One of these quarries is located on the eastern edge of the forest, not far from Gumpus Road in Dracut, and is the only area where a quarry pit, now filled with water, was observed. The other area has evidence of quarrying from exposed ledge. This area, near Sheep Rock, includes a collection of ledge rock and boulders that display drill scars and drill holes.



A boulder that has been worked for quarrying stone. (DCR)

There is undoubtedly evidence of other quarrying activity elsewhere in the forest that was not captured during the fieldwork for this plan. Richardson (1978) noted that he located 73 individual quarry works, the extent of which is unclear, between the former headquarters site and Carney Road (Dracut and Lowell), an area that is popular for mountain

biking. However, only one quarry site is recorded on an MHC Inventory form (MHC #LOW.30).

The former entrance loop road that leads to the old headquarters site is a U-shaped drive located in the southern portion of the forest. It is defined by the placement of medium-sized rocks set on either side of the roadbed, approximately five feet apart. It is not known if these rocks were placed during the development of a spring water company in the late 19<sup>th</sup> century or during the transformation of the area into the state forest headquarters by the Works Progress Administration in 1936-1937.

### Recreation Resources

Lowell-Dracut-Tyngsborough State Forest is primarily accessed via motor vehicle. Individuals who live nearby may also choose to walk or ride their bicycle to any one of the trailheads. The Lowell Regional Transit Authority offers an additional, likely underutilized, means of accessing the forest. There are two bus routes, 7 and 10, that run along Varnum Avenue (Lowell) and Tyngsboro Road (Dracut), respectively, and serve downtown Lowell, local high schools and universities, and suburban shopping centers. However, there are no bus stops adjacent to the forest on either bus route.

Recreation at the state forest includes trail-based activities such as hiking and running, horseback riding, mountain biking, snowmobiling and cross-country skiing. Geocaching also occurs throughout the forest, with participants both on and off trails. As of May 2013, there were 13 known geocaches at Lowell-Dracut-Tyngsborough State Forest and two geocaches on the DCR's Tyngsborough Conservation Restriction. Evidence of off-highway vehicle (OHV) use, paintball games, alcohol consumption and campfires, which are in violation of DCR regulations, have also been found along the forest's trails.

Hunting is permitted at the state forest; however there are two designated "No Hunting Areas" (see Figure 2). The first area (approximately 173 acres) is located in the western half of the forest, south of Althea Lake, and overlaps with the portion of the forest that was formerly under agreement with the Greater Lowell Indian Cultural Association (see Section 3.4. Management Resources and Practices). The second area (approximately 36 acres) is located east of Totman Road (Dracut) and south of the

Dracut town line. Neither area is clearly marked in the field.

The Greater Lowell Indian Cultural Association (GLICA) holds several annual recreation events at the state forest each year. The events range from seasonal cleanups to traditional ceremonies that are educational in nature. Each event is open to the public and held within a designated area of the forest, south of Althea Lake in Tyngsborough. Portable sanitary facilities are routinely rented by the GLICA for these events and, in the past, were permitted through a Memorandum of Understanding (MOU) with the DCR; that MOU has expired. Open fires, cooking and camping occasionally take place at GLICA-sponsored events; these activities were also permitted per the expired MOU with the DCR. For more information on the expired MOU, see Section 3.4. Management Resources and Practices.

The Merrimack Valley Chapter of the New England Mountain Bike Association (MV-NEMBA) devotes most of its resources to trail construction and maintenance in the Greater Lowell area. The primary focus of the MV-NEMBA is Lowell-Dracut-Tyngsborough State Forest, but the group is also active at other properties within the Lowell/Great Brook Planning Unit. In addition to their trail work, the MV-NEMBA organizes several group riding and cleanup events within the state forest each year. The majority of the group's activities are approved and permitted, via a Recreational Use Permit, by the Forest and Parks Supervisor.

## **Infrastructure**

### **Property Boundary**

***Fee Interest Land.*** The 1,109-acre state forest is situated northeast of the Merrimack River, between Route 113 in Lowell and Mammoth Road in Dracut, where the City of Lowell and towns of Dracut and Tyngsborough meet. The forest can be reached by car in less than 15 minutes from Lowell, MA and less than 30 minutes from Nashua, NH.

***Conservation Restrictions.*** There are three Conservation Restrictions (CRs) associated with the forest; one each in the towns of Tyngsborough and Dracut, and one in the City of Lowell (see Figure 2).

A 47-acre CR is located off of Autumn and Alden streets in the Town of Tyngsborough. The fee interest is held by the town and its Conservation

Commission is responsible for the care and control of the property. The purpose of the CR is "...to retain the premises predominantly in its natural, scenic and open condition; to protect and promote the conservation of forests, wetlands, soils, natural watercourses, ponds, water supplies and wildlife thereon; to allow public access to Long Pond (a Great Pond) for fresh-water recreation and to the premises for the enjoyment of wildlife, natural resources, and passive recreation." Activities that are detrimental to the property's water and soil resources, including the use of motorized vehicles, are prohibited. The construction of two public parking areas, one on Alden Street for not more than 10 cars and one on Autumn Street for not more than five cars, is permitted.

A nine-acre CR is located off of Lakeview Terrace in the Town of Dracut. The fee interest is held by the Boisvert family. The purpose of the CR is "to retain the premises predominantly in its natural, scenic and open condition; to protect and promote the conservation of forests, wetlands, soils, natural watercourses, ponds, water supplies and wildlife thereon; to protect the horticultural resources of the premises; to protect and enhance the value of the abutting conservation areas; and to allow public access for enjoyment of wildlife and open space resources of the premises as specifically provided for herein." Activities that are detrimental to the property's water and soil resources, including the use of motorized vehicles, are prohibited.

A 17-acre CR is located off of Totman Road in the City of Lowell. The fee interest is held by Northeast Radio, Inc. There are existing structures, including four towers for radio transmission, on the property. The purpose of the CR is to allow the DCR to inspect the property on foot; to selectively cut and/or prune trees and erect signs interpreting or regulating access to the land; and to enter and pass through on foot to access the state forest. The property is not open to the public. In addition, activities that are detrimental to the property's water and soil resources are prohibited.

### **Buildings and Structures**

On November 29, 1935, the Town of Dracut granted the Dracut Water Supply District (DWSD), an independent entity, the right to construct and maintain water supply infrastructure on its land. According to the deed, the exact location of the



infrastructure was to be determined by the Commissioners of the DWSD at the time of construction (Middlesex County Registry of Deeds, Northern District, Book 872, Page 85). However, the next day, November 30, 1935, the town conveyed approximately 335 acres to the Commonwealth, reserving the "...rights of the Dracut Water Supply District to construct and maintain a reservoir or standpipe on parcel four (4)...together with all rights necessary and incidental thereto" (Middlesex County Registry of Deeds, Northern District, Book 876, Page 228).

Parcel four includes most of Whortleberry Hill; the reservoir and related infrastructure described below are located on the eastern side of Gage Hill (or parcel five, as described in the deed; see Figure 2). To date, neither the DWSD nor the DCR have found any correspondence regarding the construction of a reservoir, or related infrastructure, on parcel five instead of parcel four. There is also no Memorandum of Agreement, or similar document, between the DWSD and DCR that guides access to and maintenance of the infrastructure on parcel five.

**Reservoir.** The one million gallon water supply reservoir, constructed in 1939, is located on the eastern side of Gage Hill, near the summit (Riopelle 2013a). It is covered by a 93-foot square concrete slab and surrounded by a six-foot tall chain-link fence topped with barbed wire. The fence features two gates that are secured with padlocks and one sign that reads: "Public Water Supply No Trespassing." The DCR is currently reviewing a proposal by the DWSD to replace the reservoir, due to the fact that it is undersized and nearly 75 years old.

**Pump House.** Down slope of the reservoir is a 15-by 24-foot windowless, single-story, masonry block building with a wood framed roof and asphalt shingles. The building, which was constructed within the last 10 years, serves as a pump house; it has electricity and is serviced by propane gas and fuel oil providers (Riopelle 2013b). A single, double-wide, locking metal door secures the building. Next to the entrance, and affixed to the exterior of the building, is a secure propane tank storage area.

At the rear of the building are one of two fire hydrants on site and a raised, circular concrete slab, approximately six feet in diameter. On top of the

concrete slab is a secure access panel. Before the pump house was built, this structure was used to access and maintain critical water supply infrastructure. In the future, this structure will be removed and the area resurfaced to match the material and grade of the surrounding access road (Riopelle 2013b).

On the north side of the pump house are the second fire hydrant and a four- by five-foot secure, metal electrical transformer box, which is owned by National Grid. The transformer box sits on a five- by six-foot concrete slab and is surrounded by three, four-foot tall concrete bollards for safety and security purposes.

**Dam.** An illegal dam is located on the northeast side of Trotting Park Road (Tyngsborough), approximately 200 feet southeast of a DCR gate that separates the public and private portions of the road. The dam limits the flow of water from a wetland into Scarlet Brook through a culvert under Trotting Park Road (Tyngsborough). The dam primarily consists of logs greater than 12 inches in diameter and over 10 feet in length. It is not known when the dam was constructed or by whom.

Over time, water and sediment have collected behind the dam, creating a pond-like environment and promoting the growth of leafy vegetation on the dam itself. Water frequently overflows the dam, which floods and erodes portions of Trotting Park Road (Tyngsborough). At times, the erosion is significant enough to prevent DCR staff and emergency vehicles from entering the forest through the nearby DCR gate.

**Trash Dumpsters.** In the southern portion of the forest, within the former headquarters site, there are four large trash dumpsters that are in fair to poor condition. The dumpsters are primarily used by DCR staff to dispose of trash and larger debris collected at the state forest and nearby Lowell Heritage State Park.

### Roads

Althea Avenue (Tyngsborough) is the only public road that runs through Lowell-Dracut-Tyngsborough State Forest; approximately 0.3 miles of the dead end, residential street are located within the northern section of the forest.

Trotting Park Road is the forest's primary administrative road (0.8 miles; see Figure 2). It is oriented in a north-south direction and connects the public portions of Trotting Park Road in Lowell and Tyngsborough. The paved portion of this road (0.6 miles) runs from the main entrance (Trotting Park Road, Lowell) to the northwest corner of Spruce Swamp. From Spruce Swamp to Trotting Park Road in Tyngsborough, the road surface is bank run gravel (0.2 miles).

The paved portion of Trotting Park Road continues north from Spruce Swamp to Dexter Avenue (Dracut) as an unnamed administrative road (0.5 miles; see Figure 2). An additional unnamed administrative road, located off of Tyngsboro Road (Dracut), provides access to the Dracut Water Supply District reservoir and related infrastructure (paved 0.2 miles; processed gravel 0.1 miles).

### Parking

The forest has two small parking areas (see Figure 2). The first is located at the main entrance on Trotting Park Road in Lowell. It is a paved lot with a shared entrance and exit, and can accommodate approximately six vehicles. Individual spaces are not marked and there are no designated accessible spaces.

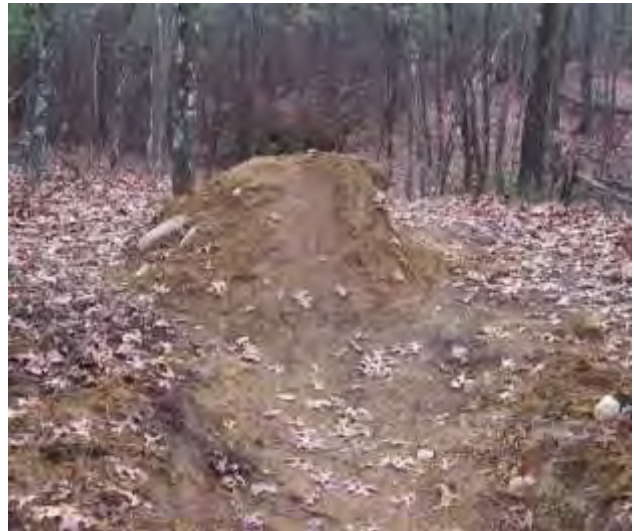
This parking area is the most popular with visitors. Vehicles are routinely parked on either end of the paved portion of the lot when there are no other spaces available. Further south on Trotting Park Road (Lowell), approximately 40 feet from the designated parking area, an "overflow" lot has been created. This unofficial parking area can accommodate three or four vehicles.

The second parking area, as indicated on the current state forest trail map, is located at the end of Trotting Park Road in Tyngsborough. It is unclear where to park when visiting this area of the forest. The most obvious location is in front of a forest gate on the west side of the road; however, this prevents DCR staff and first responders from being able to enter the forest in the event of an emergency.

### Trails

There are approximately 27 miles of trails within the state forest, nearly all of which are official. An assessment of trail condition, conducted in 2009, indicated that 95% of the official trails were in good

or fair condition and only 1.3 miles (5%) were in poor condition. Several official trails include technical features (e.g., banked or bermed corners, jumps and ramps), which are constructed to increase the technical challenge for mountain bike riders. It is unclear whether these features were subject to all applicable regulatory reviews and approved by the reviewing authorities and the DCR.



A mountain bike jump constructed in the forest. (DCR)

There is one, 1.5-mile long Healthy Heart Trail within the forest; it is located between the main entrance in Lowell and Spruce Swamp. Healthy Heart Trails are pathways used for hiking or walking that are easy to moderate in activity level and promoted by the DCR as a way to improve health through routine use.

The current version of the state forest trail map indicates four other named trails within the state forest (Thompson Lane, Totman Road, Carney Road and Gumpus Road), as well as "Public Safety Markers," or trail intersection numbers, that correspond to the town in which they are located (e.g., "L1" in Lowell, "D1" in Dracut, "T1" in Tyngsborough, etc.). Signs for these features are largely missing from the trail network. There are also more trails in the network than indicated on the current version of the state forest trail map.

### Signs and Kiosks

There is one Main Identification Sign for the state forest. It is set back from, and parallel to, the north side of Varnum Avenue (Lowell), near the intersection of Trotting Park Road (Lowell). The orientation, material and design of this sign do not

meet DCR signage standards (DCR n.d.). There are no Road Marker Signs that lead visitors to the state forest from the surrounding communities.

There are six kiosks located within the state forest; each is constructed of wood framing and has an asphalt shingle roof. Two kiosks are near the forest's parking areas and do not meet DCR signage standards for Welcome Wayside Signs (DCR n.d.). Only one kiosk, at the main entrance on Trotting Park Road in Lowell, features the current state forest trail map. Four of the six kiosks feature information on hunting (e.g., seasons, rules and regulations). The two kiosks closest to the parking area on Trotting Park Road in Tyngsborough are completely blank.

All six kiosks are in fair to good condition. Moss is growing on the roof of the kiosk at the main entrance on Trotting Park Road in Lowell. The two kiosks on Totman Road in Dracut have been vandalized with permanent marker and paint.

#### Memorials and Markers

Sheep Rock is the only known memorial within the state forest. (See Section 3.3. Existing Conditions, Cultural Resources, for additional information.)

### **3.4. MANAGEMENT RESOURCES AND PRACTICES**

See Section 2, Management Resources and Practices, for a description of the management resources and practices that apply to the entire Lowell/Great Brook Planning Unit.

#### **Natural Resources**

##### Vegetation

The Dracut Water Supply District (DWSD) maintains the vegetation along the access road leading to the summit of Gage Hill, as well as around the water supply infrastructure there. (See Section 3.3. Existing Conditions, Buildings and Structures, for additional information.) The DWSD also maintains an approximately 20-foot-wide vegetated corridor that runs from the pump house north to Tyngsboro Road (Dracut). The purpose of this corridor is to prevent woody or deep-rooted vegetation from disturbing the underground pipelines in the area (Riopelle 2013c). There is no Memorandum of Agreement, or similar document, between the DWSD and DCR that guides this maintenance activity.

#### Wildlife

For the most part, the DCR does not actively manage wildlife at the state forest. However, when beaver activity becomes a problem (e.g., it threatens public health or safety), a wildlife specialist is called upon to install one or more beaver deceivers, or to trap the animal(s). In addition, the hunting of game species is permitted outside of the forest's "No Hunting Areas" (see Section 3.3. Existing Conditions, Recreation Resources).

#### **Cultural Resources**

There are no cultural resource management activities that are unique to the state forest.

#### **Recreation Resources**

##### Greater Lowell Indian Cultural Association (GLICA) Memorandum of Understanding (MOU)

The purpose of the expired MOU between the DCR and the GLICA was to "authorize the GLICA to use approximately two hundred and fifty-two (252) acres of the Lowell-Dracut-Tyngsboro [sic] State Forest...for temporary American Indian cultural activities and special events...to promote understanding of American Indian people and customs." The document largely outlined the GLICA's responsibilities related to the use and maintenance of the agreed upon area. Permissible activities, public access to events and circumstances requiring advanced or immediate notification to the DCR were addressed, among other topics.

On April 13, 2012, the GLICA notified the DCR, in writing, of their interest in renewing the MOU that was scheduled to expire on July 1, 2012. The DCR sent a new five-year MOU (valid through July 1, 2017) to the GLICA for their signature on July 6, 2012, but that document was never signed and returned to the DCR.

##### Camping

There are no permanent campsites or cabins at Lowell-Dracut-Tyngsborough State Forest; however, temporary campsites have been designated in the past, by the Forest and Parks Supervisor, for events sponsored by the Greater Lowell Indian Cultural Association.

## Hunting and Fishing

Hunting is not permitted in two separate areas of Lowell-Dracut-Tyngsborough State Forest (see Section 3.3. Existing Conditions, Recreation Resources). The Greater Lowell Indian Cultural Association was responsible for posting and maintaining DCR approved “No Hunting” signs within the portion of the forest that was under agreement.

## Trail Use

Snowmobiles may be used on any unplowed forest road or way at Lowell-Dracut-Tyngsborough State Forest, provided that: the vehicle is registered; sub-surface soil is “solidly frozen and completely covered with a minimum of four inches of hard packed snow or ice;” and the vehicle is carrying a spare spark plug, flashlight, drive belt and “sufficient tools to effect minor repairs.” Snow vehicles may operate on frozen waters when there are five or more inches of frozen ice and in “fields, gravel banks or similar open areas where such use is permitted by appropriate signage.” (See 304 CMR 12.29; Appendix F.)

## **Infrastructure**

### Buildings and Structures

The Dracut Water Supply District (DWSD) manages the majority of the infrastructure near the summit of Gage Hill; National Grid is responsible for the maintenance of the electrical transformer box (see Section 3.3. Existing Conditions, Buildings and Structures). There is no Memorandum of Agreement, or similar document, between the DWSD and DCR that guides this management activity.

DCR staff maintain the culvert and leafy vegetation associated with the illegal dam on Trotting Park Road in Tyngsborough (see Infrastructure, above, for more information). Staff have also added a layer of course gravel to the surface of the road, however flooding remains an issue.

The four large trash dumpsters located within the former headquarters site are routinely serviced by a disposal company that is under contract with the DCR.

## Roads

The DCR’s Forest Fire Control District 6 provides forest road maintenance (e.g., roadside mowing, tree removal and road repairs) on an annual basis.

The Dracut Water Supply District (DWSD) plows the access road leading to the summit of Gage Hill. (See Section 3.3. Existing Conditions, Roads, for additional information.) There is no Memorandum of Agreement, or similar document, between the DWSD and DCR that guides this maintenance activity.

## Trails

The Merrimack Valley Chapter of the New England Mountain Bike Association performs volunteer trail work, including trail maintenance, repair and construction, and bridge building for trails, within the state forest. In the past, this work has primarily been done in consultation with the Forest and Parks Supervisor; a more formal agreement for this work is needed to ensure compliance with any required regulatory reviews. All trail work, whether performed by DCR employees or others, must be performed in accordance with general regulations and policies identified in Section 2.

## **Interpretive Services**

Interpretive service programming is not offered at the state forest, nor is any other interpretive information provided.

## **Operational Resources**

### DCR Staffing

The state forest is operated as a satellite of Lowell Heritage State Park and does not have any dedicated on site staff.

### Supplemental Staffing

Members of the Greater Lowell Indian Cultural Association and Merrimack Valley Chapter of the New England Mountain Bike Association routinely volunteer their time at the state forest for various general cleanup and trail maintenance activities. The potential exists for members of the Friends of the Forest, a group that has been inactive for several years, and students at the Greater Lowell Regional Technical High School to become more involved in organized activities at the state forest.

## Public Safety

Local emergency response and law enforcement support within the state forest is complicated by the fact that the forest occurs in three municipalities. Recent efforts to improve communication between the DCR, local responders and visitors include: adopting a town-specific trail intersection numbering system (see Section 3.3. Existing Conditions, Trails) and distributing a “safety map” of the forest to pertinent DCR staff and local officials. The safety map includes information on the forest’s trails, fire roads, major trail intersections and access gates, as well as neighboring access roads and municipal boundaries.

DCR Rangers issue citations for violations of various forest and park rules. A summary of incident reports recorded in the state forest during 2013 is provided below.

**Table 3.4. Lowell-Dracut-Tyngsborough State Forest Incident Reports, January 1 through December 31, 2013**

| <b>Incident</b>                           | <b>Number</b> |
|-------------------------------------------|---------------|
| Illegal dumping                           | 1             |
| Property damage                           | 1             |
| Violation of DCR regulations <sup>a</sup> | 2             |
| <i>Total</i>                              | <i>4</i>      |

a. These violations were related to off-highway vehicle (OHV) use and a campsite/fire within the state forest.



Vandenberg Esplanade ([Peter E. Lee](#); [CC BY-NC 2.0](#); cropped from original)

## SECTION 4. LOWELL HERITAGE STATE PARK

### 4.1. INTRODUCTION

Forty years ago, the Department of Natural Resources proposed the Commonwealth's first heritage state park in Lowell. The purpose of the park was twofold: to preserve the cultural heritage of the city and surrounding region, and to increase public appreciation and enjoyment of the area's natural and cultural resources. Through an ambitious plan of acquisition, conservation and development, the agency and its partners were able to bring their vision of urban recreation and a revitalized industrial city to life.

Lowell Heritage State Park (87 acres) is comprised of linear greenways along the Merrimack River and Lowell Canal System, and a collection of historic buildings and structures related to the industrial development of the city. The park provides much needed open space in the city's downtown; showcases the city's history, with a focus on the canal system and associated mills; and serves as an important venue for a variety of civic and social functions.

### 4.2. HISTORY OF PROPERTY

The story of Lowell Heritage State Park is closely tied to that of the Merrimack River. The river originates in Franklin, New Hampshire and runs southward for 116 miles, reaching the Atlantic Ocean in Newburyport, Massachusetts. Although the Merrimack descends "a modest average of 2.6 feet per mile," there are several waterfalls where the river drops more rapidly in elevation (Steinberg 1991, 50). Prior to the construction of dams, a total of 14 waterfalls existed along the course of the Merrimack. Both Native Americans and European colonists established settlements near many of these falls.

Native Americans were drawn to Lowell because of its natural resources and strategic location. Pawtucket Falls slowed the progress of migrating Atlantic salmon, American shad, lamprey and alewife, allowing them to be caught in large numbers (Stolte 1981). This abundant and predictable seasonal food supply, along with easy access to coastal and forest resources, attracted the Pennacook Tribe, who established a populous settlement downstream of the falls. In 1653, the Massachusetts General Court authorized John Elliot

to establish Wamesit, a praying village for the Pennacook, at the confluence of the Merrimack and Concord rivers (Hudon 2004). Twenty-three years later, however, the Pennacook abandoned Wamesit due to King Phillip's War.

As European settlements expanded, colonists sought ways to move timber and crops to coastal cities, and imported goods inland. However, Pawtucket Falls impeded the flow of river traffic, requiring goods to be shipped over land around the falls. In 1792, a group of wealthy Newburyport businessmen, known as the Proprietors of Locks and Canals on the Merrimack River (the Proprietors), constructed the Pawtucket Canal to solve this problem. The canal, which ran from upstream of the falls to the confluence of the Merrimack and Concord rivers, bypassed both the falls and a near 90-degree bend in the Merrimack. In 1801, five years after the Pawtucket Canal opened, work began on a competing canal. Beginning in 1803, the Middlesex Canal, which connected Chelmsford to Charlestown, moved raw materials and goods to the port of Boston. Although the Middlesex Canal outcompeted the Pawtucket Canal, its success was short-lived due to the arrival of the railroad in the 1830s.

The industrial development of Lowell began in 1821 when a second group of businessmen visited Pawtucket Falls to assess its potential for industrial water power (Hudon 2004). Within a month they had purchased over 350 acres of land between the bend in the river and the Pawtucket Canal, in what was then East Chelmsford. In 1822, they purchased water power rights from the Proprietors, the company that constructed the Pawtucket Canal 30 years earlier. This established the Proprietors as the developer and power broker of the city, selling land and leasing mill power to textile manufacturers for years to come (Hudon 2004).

In 1825, the Merrimack Canal, the city's first power canal, was completed. Four additional power canals were constructed between 1826 and 1835; by 1840 these canals were distributing power to 32 mills (Hudon 2004). One additional canal and an underground connector between canals were built in the late 1840s. A permanent dam across the Merrimack, constructed in 1830 and increased in height in 1833, created an 18-mile stretch of river as a water holding area to ensure an adequate supply of water for the mills. In 1845, the Proprietors bought

outlets to several bays and lakes in New Hampshire to further ensure sufficient water to power the mills.

As the mills grew, so too did the city. In 1826, the site of the mills in East Chelmsford became the town of Lowell. Ten years later, Lowell was given a city charter and in three short years, it was the third largest city in Massachusetts. This rapid population growth was driven by the arrival of mill workers. Initially, most mill workers were single, young females from the Merrimack Valley who lived in boarding houses owned by the mills. However, immigration soon changed the demographics of mill workers.

A massive influx of immigrants, from Ireland and other parts of Europe, took place in the 1840s. By 1850, the population of Lowell was 33,000. According to the 1915 state census, one-third of Merrimack Valley residents were foreign born (Hudon 2004). These immigrants remained the major source of labor until the 1920s (Farrant and Strobel 2011). Fewer immigrants made their way to Lowell between the mid-1920s and mid-1960s due to changes in immigration laws and the closing of mills. It was at the end of this period of decline, amid a 13% unemployment rate and a surplus of abandoned, deteriorating infrastructure, that an interest in revitalizing the city first took hold.

In 1974, the Department of Natural Resources (DNR) developed a nine million dollar proposal for Lowell Heritage State Park, the first of its kind in the state system. The following year, the Department of Environmental Management (DEM), a successor to the DNR, announced the completion of a Memorandum of Understanding with the City of Lowell and an accelerated development schedule for two "nodes" within the park: Francis Gate and Pawtucket Boulevard. A few years later, in 1978, President Carter signed legislation dedicating \$40 million to the creation of Lowell National Historical Park, which spurred a unique preservation partnership between local, state and federal governments, and later, the private sector.

By the mid-1980s, the DEM had exceeded its original acquisition, conservation and development goals for the park. It also created an ambitious and successful year-round interpretive program, including a living history component, which was fully integrated with the efforts of the National Park Service. At its peak in 1987, Lowell Heritage State

Park employed 16 full-time and 17 seasonal staff, and had an annual operating budget of \$480,000.

Over the next five years, the DEM's budget was greatly reduced and the agency was forced to cut personnel and park budgets. Lowell Heritage State Park presented a particular challenge, since it served as the model for the heritage park concept, and was the largest and most complex heritage park in the state system. At the request of then Commissioner Peter Webber, an intradivisional task force was convened to review the status of the park and develop recommendations for its future. The task force's report concluded that the DEM should "concentrate on maximizing the riverfront component and minimizing, but not eliminating, [its] position in the downtown" (DEM 1993, ES).

Today, the Department of Conservation and Recreation (DCR), successor to the DEM, retains an ownership interest in most of the land that once comprised Lowell Heritage State Park. However, under even greater budget constraints, the DCR continues to focus its resources on the riverfront portion of the park and uses legal agreements with its original partners, the City of Lowell and National Park Service, to operate and maintain facilities park-wide.

### 4.3. EXISTING CONDITIONS

In this section and the following, 4.4. Management Resources and Practices, the park's resources are presented in order, from west to east. In other words, under each heading (e.g., Natural Resources), resources related to the Vandenberg esplanade are presented first, followed by resources related to the downtown portion of the park. The descriptions of the downtown resources are further organized by the flow of water. In general, resources related to the Pawtucket and Northern canals are present first, followed by resources related to the remaining canals, in the same order as the water flows through the system today.

## Natural Resources

### Physical Features

**Topography.** The Merrimack and Concord rivers are the defining features of Lowell Heritage State Park (see Figure 3). The Merrimack River flows easterly through the northern portion of Lowell, dropping approximately 60 feet in its eight-mile course

through the city. The Concord River flows northerly through the eastern half of the city and enters the Merrimack near Bridge Street. In general, the Concord River is fairly level and its floodplain is mostly broad. However, within the city, the Concord River drops rapidly, due to three sets of falls, and has a relatively narrow floodplain.

**Geology.** The City of Lowell is located within the northern portion of the Nashoba terrane, a rock formation that consists of interlayered gneisses and schists. The Clinton-Newbury fault zone forms the northern boundary of the Nashoba terrane and is believed to have played a role in changing the course of the Merrimack River at the western limits of the city. The river originally flowed southeast through Woburn and into Boston Harbor. The buried bedrock valley from this original course provides valuable resources for the region. For example, wells that supply Lowell, Winchester and Woburn with abundant groundwater are situated along the former course of the river. In addition, glacial outwash deposits within the buried valley are mined for concrete aggregate and other building purposes.

**Soils.** Soils within Lowell Heritage State Park vary based on the topography and level of development near the Merrimack River. Very poorly to excessively drained silt and sandy loams are associated with the wide floodplain and limited development between the river and Varnum Avenue. These soils are considered severely limited for playgrounds and moderately limited for picnic areas, paths and trails (Peragallo 2009). Well to excessively drained glacial deposits, most of which have been disturbed by heavy development, dominate the remaining portion of the park. These soils range from being moderately to slightly limited for picnic areas, playgrounds, paths and trails (Peragallo 2009).



**Table 4.1. Soils of Lowell Heritage State Park<sup>a</sup>**

| Soil Series                        | % of Park | Drainage Class               |
|------------------------------------|-----------|------------------------------|
| Udorthents                         | 17.1      | N/A                          |
| Urban land                         | 16.1      | N/A                          |
| Suncook loamy sand                 | 12.8      | Excessively drained          |
| Merrimac-Urban land complex        | 10.8      | Somewhat excessively drained |
| Occum very fine sandy loam         | 9.9       | Well drained                 |
| Limerick silt loam                 | 8.5       | Poorly drained               |
| Water                              | 7.0       | N/A                          |
| Winooski very fine sandy loam      | 7.8       | Moderately well drained      |
| Scio very fine sandy loam          | 3.6       | Moderately well drained      |
| Birdsall mucky silt loam           | 3.5       | Very poorly drained          |
| Windsor loamy sand                 | 1.7       | Excessively drained          |
| Scio-Urban land complex            | 0.8       | Moderately well drained      |
| Canton-Charlton-Urban land complex | 0.3       | Well drained                 |

a. Excluding the Lord swimming pool and Janas skating rink.

### Water Resources

**Ponds.** There are no ponds within the park.

**Wetlands.** There are approximately 11 acres of wetlands along the Vandenberg esplanade, immediately upstream of the Rourke Bridge and north of regatta field. In addition, there is a small (0.5 acres) wetland in between the Janas skating rink and Douglas Road. (See Figure 3.)

**Vernal Pools.** There are no certified or potential vernal pools within the park.

**Streams.** There are three named streams or rivers within Lowell Heritage State Park (see Figure 3). Claypit Brook, the smallest of the water bodies, originates in Lowell-Dracut-Tyngsborough State Forest. The stream flows south from the forest towards Varnum Avenue in Lowell, where it turns east and runs near regatta field before entering the Merrimack River.

The next water body is the heart of the park and the city. Once considered one of the most polluted rivers in the country, the Merrimack River's water quality has improved greatly in the last 40 years. However, it is still considered "impaired" by the United States Environmental Protection Agency (EPA), due to a

variety of chemical and biological contaminants that are routinely detected in present day water quality assessments.

**Table 4.2. Causes of Impairment for Select Segments of the Merrimack River, Reporting Year 2012**

| Segment Location                             | Cause of Impairment                                        |
|----------------------------------------------|------------------------------------------------------------|
| NH/MA State Line to Pawtucket Dam, Lowell    | Fecal coliform, mercury in fish tissue                     |
| Pawtucket Dam, Lowell to Duck Island, Lowell | E. Coli, mercury in fish tissue, total phosphorus          |
| Duck Island, Lowell to Essex Dam, Lawrence   | E. Coli, mercury and PCBs in fish tissue, total phosphorus |

Source: EPA 2014

The remaining water body, located on the easternmost side of the park, is the Concord River. It originates at the confluence of the Sudbury and Assabet rivers and flows north, approximately 16 miles, through Concord, Carlisle, Bedford and Billerica before entering the Merrimack River in Lowell. The EPA also considers a portion of the Concord River in Lowell, from the Rogers Street Bridge to the Merrimack River, to be "impaired." The causes of impairment are: excess algal growth, fecal coliform, mercury in fish tissue and total phosphorus (EPA 2014).

**Groundwater.** A portion of two medium-yield aquifers and one high-yield aquifer occur beneath two sections of the park (see Figure 3). Near the Rourke brothers boat ramp, approximately 16 acres of the park overlap with both a high- and medium-yield aquifer that follows Stony Brook and Black Brook south, past Route 3 in Chelmsford. Further east, at the bend in the Merrimack River, between Pawtucket Falls and Aiken Street, a medium-yield aquifer extends south from Pleasant Street, along Beaver Brook, to the northern shoreline of the river. Approximately two acres of the park overlap with this aquifer.

**Flood Zones.** The 100-year flood zone covers 64 acres (73%) of the park; its boundary approximately parallels the Merrimack River and each of the canals, where the DCR has an ownership interest. All of the developed areas along the Vandenberg esplanade are included in the 100-year flood zone. In addition, many of the historic buildings within downtown Lowell are included in the 100-year flood zone. However, it should be noted that water levels

Placeholder for Figure 3 (front).

Placeholder for Figure 3 (back).

within the canal system are regulated to reduce the likelihood of flooding in this portion of the park.

The 500-year flood zone covers an additional nine acres (10%) of the park, including the majority of the Rynne bathhouse and its parking area. In downtown Lowell, the Gatekeeper’s Barn is the only historic building included in the 500-year flood zone. Further east, the 500-year flood zone also extends across the Janas skating rink parcel, impacting approximately 22% of the property (one acre), but not the skating rink itself.

### Rare Species

Lowell Heritage State Park is home to three state-listed species.

**Table 4.3. State-listed Species of Lowell Heritage State Park, as identified by the Natural Heritage & Endangered Species Program (NHESP)**

| Species            | Type   | MESA <sup>a</sup> |
|--------------------|--------|-------------------|
| Bald eagle         | Bird   | T                 |
| Cobra clubtail     | Insect | SC                |
| Umber shadowdragon | Insect | SC                |

Source: Harper 2013

a. Status of species listed under the Massachusetts Endangered Species Act (MESA): SC = Special Concern and T = Threatened.

While occasionally spotted over the park, bald eagles are more common near the mouth of the Merrimack River, where there is more suitable nesting and wintering habitat (NHESP 2012). The cobra clubtail and umber shadowdragon can also be found in the park, on occasion, primarily along the Merrimack River. Both species of dragonflies prefer large, unvegetated rivers and lakes for breeding, and the surrounding upland borders for feeding, resting and maturing (NHESP 2008a and NHESP 2008b).

Nearly half of Lowell Heritage State Park (42 riverfront acres) has been designated as Priority Habitat under the Massachusetts Endangered Species Act (321 CMR 10.00; see Appendix F). Most of this same area (39 riverfront acres) has also been identified as Core Habitat in the MassWildlife and The Nature Conservancy publication “BioMap 2: Conserving the Biodiversity of Massachusetts in a Changing World” (MassWildlife and TNC 2010).

BioMap2 highlights two types of areas important for conservation: Core Habitat and Critical Natural Landscape. The first is crucial for the long-term persistence of rare species and other species of conservation concern. The second provides habitat

for wide-ranging native wildlife, supports intact ecological processes, maintains connectivity among habitats, enhances ecological resilience and buffers aquatic Core Habitats to help ensure their long-term integrity. Protection of both areas, which may overlap, is “important to conserve the full suite of biodiversity” in Massachusetts (MassWildlife and TNC 2010).

Within the park, there are also 35 acres (40%) of Critical Natural Landscape adjacent to the Merrimack River.

### Vegetation

**Forest Types.** In 2003, the James W. Sewall Company developed a forest inventory/land cover classification dataset for the state forests and parks. The dataset is primarily based on the interpretation of infrared aerial photography, a process that identified three forest sub-types along the Vandenberg esplanade.

**Table 4.4. Forest Sub-types of Lowell Heritage State Park<sup>a</sup>**

| Forest Sub-type       | Acres                  | % of Park   |
|-----------------------|------------------------|-------------|
| Oak-hardwoods         | 3.3                    | 3.8         |
| Mixed oak             | 3.2                    | 3.7         |
| Scots pine plantation | 2.7                    | 3.1         |
| <i>Total</i>          | <i>9.2<sup>b</sup></i> | <i>10.6</i> |

a. Excluding the Lord swimming pool and Janas skating rink.

b. Only the park’s riverfront acres were included in the analysis. Of those acres, wetlands, areas of open water and day use and administrative areas were removed from the total.

There is also one Continuous Forest Inventory (CFI) plot within the park. The CFI is a network of permanent, one-fifth-acre plots on state forest lands that are routinely monitored for silvicultural purposes. The measurements and observations made within each CFI plot are recorded in a database that dates back to 1960, when the CFI was created. Approximately 10% of the state’s CFI plots are inventoried each year, on an on-going basis. As of 2010, there were 1,768 CFI plots statewide (Goodwin 2014).

Unfortunately, the plot within Lowell Heritage State Park is located within a grassy area of the Vandenberg esplanade, so it does not provide any additional information about the health of the park’s limited forest.

**Priority Natural Communities.** There are no Priority Natural Communities within the park.

**Invasive Species.** Japanese knotweed (*Fallopia japonica*) was observed along the western half of the Vandenberg esplanade, between the river and the retaining wall, while conducting fieldwork for this plan.

**Pests and Disease.** None has been identified at the park.

### Wildlife

**Birds.** There is little current information on the park's birds. Five species confirmed to occur within the park are identified in Appendix G. Of these species, one is classified as a Species in Greatest Need of Conservation (MassWildlife 2006).

**Mammals.** There is little current information on the park's mammals. Fourteen species that may possibly occur within the park are identified in Appendix G.

**Reptiles.** There is little current information on the park's reptiles. One species confirmed to occur within the park and an additional four species that may possibly occur within the park are identified in Appendix G.

**Amphibians.** There is little current information on the park's amphibians. Five species confirmed to occur within the park and an additional three species that may possibly occur within the park are identified in Appendix G.

**Fish.** The Massachusetts Office of Fishing & Boating Access lists largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), northern pike (*Esox lucius*), white perch (*Morone americana*), chain pickerel (*Esox niger*), black crappie (*Pomoxis nigromaculatus*) and walleye (*Sander vitreus*) as fish species that are typically caught in the Merrimack River (OFBA 2014).

In addition, the Department of Public Health lists American eel (*Anguilla rostrata*) and white sucker (*Catostomus commersonii*) as part of the public health fish consumption advisories for the Merrimack River and canal system (DPH 2014). (See Recreation Resources, below, for more information about the advisories.)

Finally, the United States Fish & Wildlife Service, through its Central New England Fishery Resources Office, monitors migratory fish populations in the Merrimack River. Fish passage data for the

Pawtucket Dam indicate American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*) and sea lamprey (*Petromyzon marinus*) also occur in the park (USFWS 2014).

## **Cultural Resources**

### Pre-Contact Archaeological Site

Although only three pre-Contact sites are recorded in the park, many more exist along the Merrimack River both downstream and up. Many Archaic Period village sites, camp sites and fishing grounds are documented nearby along the banks of the river. Archaeological testing along the river clearly revealed it has been reconfigured and straightened. Above Pawtucket Dam, which was constructed at the naturally occurring Pawtucket Falls, the shoreline had to be raised and straightened and Pawtucket Boulevard was constructed on the fill afterwards. Despite land modification and filling, there is a moderate potential for the complex.

### Historic Archaeological Resources

The Tremont Mills powerhouse, formerly located in Tremont Yard, on the Western Canal where it meets Father Morissette Boulevard, was partially demolished when it became a part of Lowell Heritage State Park. The single-story ruin was in a state of serious deterioration when it was completely demolished in 2008, as part of a lease for redevelopment (see Infrastructure, below, for more information). The stipulations for redevelopment included preserving the historically significant below grade features, such as the original turbine pits dating from 1847-1854. It was within this powerhouse that James B. Francis, chief engineer for the Proprietors of Locks and Canals on the Merrimack River, conducted experiments that allowed for the development of a more powerful and efficient turbine technology. The original turbine pits are viewable within the office building that is now located on the site and interpretive information is provided.

### Historic Resources

This section provides information on Lowell Heritage State Park's historic buildings, structures, objects and landscapes (see Figure 3). See Infrastructure, below, for information on the park's non-historic buildings and structures.

## Designations

With the exception of the Rynne bathhouse, all of the resources within Lowell Heritage State Park fall within the Downtown Lowell Local Historic District. This district, initially established on December 13, 1983, and later expanded in 1986 and 2004, "...seeks to ensure that development activities within the district are consistent with the preservation of its 19<sup>th</sup> century setting" (City of Lowell 2014). More protective than a National Register of Historic Places designation, the local historic district requires review of alterations to any exterior feature by the Lowell Historic Board for compliance with the design review standards and policies that have been established for this district. The DCR has a seat on the Lowell Historic Board.

There are also three National Register Districts, with some overlaps, and a National Historic Landmark designation that apply to the DCR properties within Lowell Heritage State Park:

- The City Hall District, of which only the Mack building is a part, was listed on the National Register on April 21, 1975.
- The Locks and Canals Historic District was listed on the National Register on August 13, 1976 and became a National Historic Landmark on December 22, 1977. With the exception of the Rynne bathhouse, all of Lowell Heritage State Park falls within this district.
- The Lowell National Historical Park and Preservation District was listed on the National Register on June 5, 1978. This much larger district includes all of Lowell Heritage State Park.

The Lowell Canal System has also been recognized for its significance within the field of engineering. The American Society of Civil Engineers designated the "Lowell Waterpower System" as a Historic Civil Engineering Landmark in 1984, and the American Society of Mechanical Engineers (ASME) designated the "Lowell Power Canal System and Pawtucket Gatehouse" as a Historic Mechanical Engineering Landmark in 1985 (Reese 2014; ASME 2014).

## Buildings

The *Michael Rynne Bathhouse* is the lone historic building on the Vandenberg esplanade. Located at

160 Pawtucket Boulevard, the building was constructed sometime between 1906 and 1924. It is named for Mike Rynne, a former Lowell police officer and highly regarded athlete that excelled in swimming. The bathhouse is a brick building with a flat roofed, square central core, flanked by two gable roofed wings, each three bays in length. Architectural details include brick piers on the wings, round headed door and window openings in the central core and a small, low parapet on the center of the street façade of the building. The wings of the building have wood trim, an asphalt shingle roof and the upper portion of the gable ends are sheathed in unpainted clapboard. Some of the former openings have been filled in with brick and some of the wood trim is exhibiting signs of deterioration or missing. Water damage to the roof framing is also evident on the interior of the building.

The bathhouse is open year-round. The central core contains public restrooms and each wing is used for office and storage space. DCR staff use one wing and the City of Lowell uses the other for their seasonal lifeguards and waterfront equipment (see Recreation Resources, below, for more information). The building has electricity, a phone line, domestic water and waste water disposal; it is in fair condition.



Rynne Bathhouse (DCR)

The majority of the park's historic buildings are located in downtown Lowell and associated with the city's canal system (see Figure 3). The National Park Service maintains these resources as part of an expired Memorandum of Understanding with the Department of Environmental Management, Boott Hydropower, Inc. and the Proprietors of Locks and Canals on the Merrimack River (see Section 4.4. Management Resources and Practices for more information). The Gatekeeper's House and barn are excluded from this arrangement, as the buildings are

part of the DCR's Historic Curatorship Program. The Mack building is also excluded because it is not directly associated with the canal system.

The **Pawtucket Gatehouse**, located at the eastern edge of the Pawtucket Dam and the head of the Northern Canal, was constructed in 1847. The gatehouse contains the machinery designed by James B. Francis to operate 10 sluice gates via a turbine and hoisting screws. Constructed of brick, on top of the granite dam, and extending 11 bays long, the Italianate style gatehouse has a gabled slate roof. Architectural details include denticulated cornices, pediment returns, round headed door openings and recessed, round headed, six-over-six double-hung sash windows. Twin end interior chimneys complete the picture. One corner of the building is rounded, a detail that is seemingly part of the original design, but the purpose is unclear. A navigational lock, not used since 1871, is located next to the gates. One end wall of the gatehouse has experienced some cracking, but it is otherwise in good condition. The building has electricity.



Pawtucket Gatehouse (DCR)

Next to the Pawtucket Gatehouse, at 23 School Street, is the **Gatekeeper's House**, historically home to the operator of the Pawtucket Gate. The Gatekeeper's House is a two-story, side gabled, wood frame house built in 1847, in the Italianate style. It is three bays wide by two bays deep, with a hipped roof section at the rear and a one-story kitchen ell. The projecting center entrance with enclosed pediment is an addition made sometime before 1890, and the front façade windows have round arched trim. The house is clad in wooden clapboards, has a stone foundation, asphalt shingled roof, two interior brick chimneys and wood cornerboards with a boxed cornice. The building has electricity, a phone line, domestic water and waste water disposal; it is in good condition.



Gatekeeper's House (DCR)

Behind, and perpendicular to, the Gatekeeper's House is the **Gatekeeper's Barn**. Constructed in three separate phases (dates unknown), the barn has two gable roofed sections with a smaller, shed roofed component. Clad in a combination of clapboards and vertical board sheathing, the barn has an asphalt shingle roof and is in good condition. The building also has electricity. The oldest section of the barn, located in the center, is set up as a one car garage. Due to the slope of the surrounding land, the rear façade of the building is a full story higher than the front, which provides storage space below the garage.



Gatekeeper's Barn (DCR)

The gatekeeper's property was acquired by the DCR in 1977 and housed a staff interpreter until 1986. After being vacant for 15 years, it was included in the DCR's Historic Curatorship Program and leased by curators from 2001 through 2011. The house and barn are once again vacant and available for curatorship; proposals are currently being solicited.

Located beyond the Gatekeeper's Barn is the **Blacksmith Shop**. Primarily utilized by the Proprietors of Locks and Canals on the Merrimack River as a boathouse and blacksmith shop, to fix and

maintain flashboard hardware, this building was brought or built on site in 1884. Clad in vertical board sheathing and clapboards, the Blacksmith Shop has a hipped roof covered with asphalt shingles and a brick chimney that pierces the roof line. A large exterior sliding door provides access. The building has electricity and is in excellent condition.



Blacksmith Shop (DCR)

Francis Gate Park is located on the Pawtucket Canal near Broadway Street and includes a series of resources associated with the Guard Locks. The first navigational lock was built in 1796-1798, with the development of the canal. This lock was subsequently rebuilt and several other features were added to the site over the course of the 19<sup>th</sup> century, including a dam, power canal, second navigational lock and flood gate. A manmade island separates the dam and sluice gates from the navigational locks and flood gate.

The oldest extant resource within Francis Gate Park is the **Great Gate**, also known as the Francis Gate or Francis' Folly. Constructed in 1848-1850, this Portcullis gate was designed by James B. Francis for flood control purposes. The gate itself is made of wood, constructed of 17-inch-wide southern pine timbers that are held together with vertical iron rods; it is in excellent condition. The gate protected the city from serious flood damage in 1852, and again in 1936. The Great Gate is sheltered by the **Guard Locks Great Gate Gatehouse**; a tall, narrow, wood frame building sheathed in clapboard with a cedar shingle roof. Buttresses support the building, tying it to the granite abutments. The gatehouse has electrical service, and is also in excellent condition.



Great Gate and Gatehouse (DCR)

The **Guard Locks Gatehouse** contains the hydraulic machinery for operating the sluice gates located at the dam, in the easternmost section of Francis Gate Park. Constructed in 1870, predominantly of brick with a single wood frame wall, this one-story building has a full height basement level on the upstream side of the dam. The gatehouse is sheathed in brick and clapboard, and has a slate roof. Italianate details include denticulated cornices; pediment returns; round headed, recessed, four-over-four, double-hung sash windows; and round headed door openings. Twin end interior chimneys complete the picture. The gatehouse has electricity, and it is in excellent condition.



Guard Locks Gatehouse (DCR)

The **Guard Locks Lock House** is located just north of the Guard Locks Great Gate Gatehouse, where it shelters the equipment that mechanically assists with opening the gates of the lock. Constructed in 1881, this single-story, seven-bay-long building is sheathed in clapboard and has a two stage hipped roof sheathed with slate; it is in excellent condition. Italianate architectural details include round headed,



four-over-four, double-hung sash windows; round headed door openings; projecting wooden lintels; and paneled trim along the lower portion of the building, where some of the projecting lock mechanisms are accommodated. The lock house also has electricity.



Guard Locks Gatehouse, left, and Guard Locks Lock House, right (DCR)

The **Hadley House**, located at 719 Broadway Street, was originally located in Middlesex Village. In 1990, the Federal style home was moved from 1708 Middlesex Street by the Jaycees of Lowell in an effort to save it from demolition and restore it, possibly for housing. The building has been vacant since the move and is presumably owned by the Jaycees, who may now be incorporated as the Lowell Jaycees Housing Corporation, Jaycee-Lowell Limited Partnership, or Jaycee-Lowell, LLC. There is no Memorandum of Agreement, or similar document, between the Jaycees and the DCR that describe the terms under which the Hadley House was moved to, and remains at, Francis Gate Park.



Hadley House (DCR)

The **Northern Canal Wasteway Gatehouse** was constructed in 1872, when the waste gates that are part of the Northern Canal Great Wall dam were modified to be mechanically operated by a turbine. It is the only gatehouse without electricity. Accessed by a walkway, the building sits on top of the Great River Wall and was built to shelter the mechanical equipment. The gatehouse is a rectangular, two-story timber frame building with a very low pitched shed roof. Four window bays are located on the river side of the building. The gatehouse is sheathed in clapboard and has a membrane roof; it is in excellent condition.



Northern Canal Wasteway Gatehouse (DCR)

The **Tremont Gatehouse** is located at the intersection of the Northern and Western canals; it controls the flow of water from the Northern Canal into the lower Western Canal by a pair of offset sluice gates. These gates are operated electrically, but the manual operation equipment is still located in the building. Constructed c1855, this gatehouse is in excellent condition, reflecting maintenance work that was done to remove the extensive ivy growth that covered the building in the 1970s.

This single story, gable roofed gatehouse has a granite foundation, walls constructed of brick and a slate roof. Italianate details include denticulated cornices; pediment returns; round headed, recessed, six-over-four, double-hung sash windows; and round headed doors. Twin end interior chimneys complete the picture. One corner of the building has an unusual taper, where the corner itself has been removed in what appears to be a modification of the original design.



Tremont Gatehouse (DCR)

The *Swamp Locks Gatehouse* was first constructed on the crest of the Swamp Locks dam and south sluice gate in 1859, to provide some shelter and protection for the dam. The gatehouse, a wood framed, single-story, interlocking gable roofed structure, has walls sheathed in a combination of clapboard and vertical boards, and an asphalt shingle roof. The wood windows are six-over-six, double-hung sash. The gatehouse has electricity.

Four different sections currently connect across the length of the dam. The longest section, located above the flashboard crest of the dam, is present in a historic photo from 1922, but was removed years later, as it is not present in DCR file photos from 1979. This section was reconstructed sometime after 1994, as it was not present when the National Park Service documented the site in the List of Classified Structures at that time. The gatehouse is in excellent condition.



Swamp Locks Gatehouse (DCR)

The *Hamilton Wasteway Gatehouse*, located at the head of the Hamilton Wasteway, was constructed in 1872 when the wasteway itself was rebuilt, replacing an earlier gatehouse and wasteway dating from 1850. The purpose of the wasteway was to remove ice from the Hamilton Canal and divert it into the Pawtucket Canal. The gatehouse was manually

operated until an electric motor drive was installed in the early 20<sup>th</sup> century. The small, single-story hipped roof building has rolled asphalt roofing and is clad with metal panels that have been pressed to resemble brick. The three windows that overlook the visible portion of the wasteway have four-over-four, double-hung sash windows; the remaining openings are boarded up. Vegetation is encroaching on the building, some of the cladding has been peeled away and a few pieces of the simple wood trim are missing. Unlike the other gatehouses in the park, this building is in very poor condition and lacks interpretive information.



Hamilton Wasteway Gatehouse (DCR)

Two buildings have been in place at the Lower Locks Dam since the mid-19<sup>th</sup> century; they provide shelter for the dam and house some of its mechanical components. The *Lower Locks Gatehouse*, a one-by-one-bay building clad in clapboards with a cedar shingle roof, is located at the edge of the dam, at the upstream entry to the lock. An enclosed pediment on the gable end and a diamond pane, double-hung, sash window adorn the building.

A larger, single-story, wood framed, gabled roof building is located on top of the dam. A cross gabled component of this building, known as the *Watch House*, shields the deep gate control housing. A gabled cupola sits atop the Watch House. The walls of this building are clad with vertical board siding, the windows are fixed 12-light windows and the roof is sheathed with cedar shingles.

Both of these buildings have electricity and are in excellent condition.



Lower Locks Gatehouse and Watch House (DCR)

The *Massachusetts Wasteway Gatehouse* is located at the turn in the Eastern Canal and sits slightly below Bridge Street. Built in 1862, in conjunction with the wasteway, the gatehouse protects the flashboard controls that direct water through the wasteway. The wasteway connects the Eastern Canal to the Merrimack River and assisted with ice removal in the canal.

The gatehouse is a single-story, five-by-one-bay building with a gabled roof and an inaccessible center entrance that faces the canal. Clad in clapboards, the roof is sheathed with cedar shingles and the windows are four-over-four, double-hung sash with hood moldings. The roof of the building has changed over time. Photographs from 1979 show a flat roof with a slight pitch, possibly a modification of an original gabled roof that was then rebuilt sometime between 1979 and 1994 to reflect its presumably historic appearance. The gatehouse has electricity and is in excellent condition.



Massachusetts Wasteway Gatehouse (DCR)

The *Boott Dam Gatehouse*, built above the Boott Dam in 1892 as part of a rebuilding effort, provides shelter for the dam and houses hydraulic equipment to lift the sluice gate, which controls the level of water in the Eastern Canal. The gatehouse, which has electricity, is composed of two single-story,

gable roofed sections that are situated at a slight angle to each other, probably to accommodate the infrastructure below. One section, attached to the sidewall of the Boott Mills, is slightly wider and taller than the other section. The building is clad in corrugated metal sheathing and it has a rolled asphalt roof. The only architectural detailing includes a plain vergeboard made of corrugated metal. A set of seven, six-over-six, vinyl windows stretch across the side of the building facing the canal. A brick chimney extends from the center of the building. Boston ivy has started to drape itself over part of the roof of the smaller section. The building is otherwise in good condition.



Boott Dam Gatehouse (DCR)

The *W.A. Mack & Company Building*, located at 25 Shattuck Street, is the current home of the National Streetcar Museum (first and second floors) and DCR's North Region Headquarters (third and fourth floors). The museum utilizes space within the building through an expired Memorandum of Understanding with the DCR (see Section 4.4. Management Resources and Practices for more information).

The Mack building was constructed in 1886 by Sewall Mack for the W. A. Mack & Company on land they originally leased, and later purchased, from the Proprietors of Locks and Canals on the Merrimack River. The Queen Anne style brick building, with a cast iron storefront, served as the retail arm for their ironworks. Originally a three-story building, with decorative panel brick details on the second and third floors, a fourth story was added sometime between 1890 and 1905. Four-over-two, double-hung sash windows are located in the upper stories of the façade; all 38 of the building's double-hung windows are scheduled to be replaced in the fall of 2014 (see Section 2 for more information).

A full height brick and glass, stair and elevator tower was added to the north side of the building in 1979, when it was being renovated to serve as the visitor center for Lowell Heritage State Park. The building has electricity, telephone and internet service, domestic water and waste water disposal; it is in good condition.



The Mack building, prior to the window replacement project. (DCR)

### Structures

The *Lowell Canal System* evolved steadily from 1821, when the old Pawtucket transportation canal was purchased and, a few years later, used to channel water into a series of new power canals. These virtually unaltered waterways, together with the remaining mills and their machinery, form what is “the most historically significant extant aggregation of early 19<sup>th</sup> century industrial structures and artifacts in the United States” (NPS 2014b).

**Table 4.5. Power Canals within Lowell Heritage State Park<sup>a</sup>**

| Name                        | Date(s) of Construction |
|-----------------------------|-------------------------|
| Merrimack Canal             | 1821-1823               |
| Hamilton Canal              | 1825-1826               |
| Lowell Canal <sup>b</sup>   | 1828                    |
| Western Canal               | 1831-1832               |
| Lawrence Canal <sup>c</sup> | 1831-1832               |
| Eastern Canal               | 1835                    |
| Northern Canal              | 1846-1847               |

a. See Infrastructure, below, for more information on the DCR’s ownership interest in the power canals.

b. The Lowell Canal was covered in 1880 (NPS 2014b).

c. Most of the Lawrence Canal is covered; sections of the canal have also been filled in (Herlihy 2014).

Each canal is unique, from the Pawtucket Canal, which follows the features of the surrounding landscape, to the Northern Canal, which is the deepest and widest canal, and perfectly straight. The canals are generally eight to 20 feet deep and 30 to 100 feet wide (NPS 2014b). The canal walls are constructed of natural materials, ranging from earth to granite, and the canal bottoms are mostly wood (Lowell Canalwaters Cleaners 2014). The canals are generally in good condition, however some vegetative growth and localized deterioration was observed in the canal walls while conducting fieldwork for this plan.

**Table 4.6. Dams within Lowell Heritage State Park, by the DCR’s Ownership Interest<sup>a</sup>**

| Dam                       | Class <sup>b</sup> | Last Inspection <sup>c</sup> | Condition    | DCR Interest |
|---------------------------|--------------------|------------------------------|--------------|--------------|
| Northern Canal Great Wall | S                  | 6/18/2012                    | Satisfactory | Fee and Ease |
| Guard Locks               | S                  | 6/18/2012                    | Satisfactory | Ease         |
| Swamp Locks               | S                  | 6/18/2012                    | Fair         | Ease         |
| Lower Locks               | L                  | 6/1/2006                     | Satisfactory | Ease         |
| Boott <sup>d</sup>        | N/A                | N/A                          | N/A          | Ease         |
| Rolling <sup>d</sup>      | N/A                | N/A                          | N/A          | Ease         |

a. See Infrastructure, below, for more information on the DCR’s ownership interest in the dams. In this table, ownership is summarized as: Fee = fee interest; Ease = easement interest.

b. Hazard Class: Low (L) = the dam is located where failure may cause minimal property damage to others and the loss of life is not expected; Significant (S) = the dam is located where a failure may cause the loss of life and damage to homes, industrial or commercial facilities, secondary highways or railroads, or cause interruption of use or service of relatively important facilities (MassGIS 2012).

c. Low hazard potential dams are inspected every 10 years; significant hazard potential dams are inspected every 5 years.

d. The DCR’s Office of Dam Safety defines the Boott and Rolling dams as canal gates, which are not classified or inspected.

**Northern Canal Great Wall Dam.** The Northern Canal Great Wall Dam (MA-00833), also known as the Great River Wall, is an approximately 2,000-foot-long earthen island and stone wall that runs along the south side of the Merrimack River, near Pawtucket Falls. The DCR holds a fee interest in approximately 1,000 feet of the upstream portion of the dam, which consists of a naturally deposited earthen and bedrock island, as well as some man placed earth. Downstream of the island, the dam transitions into a cut granite stone wall for a length of about 1,000 feet; the DCR holds an easement interest in this portion of the structure.

The dam was constructed in 1846-1847 to provide additional water power to downstream mills and the canal system in Lowell. Today, it continues to supply water to the canals, as well as a hydroelectric power plant owned by Boott Hydropower, Inc. Sudden gate closures at the power plant can cause the water in the Northern Canal to rise rapidly and overtop the Great River Wall. Due to this threat, the walkway along the wall and island is generally closed to the public; however the National Park Service does offer periodic guided tours along the walkway.

The most recent inspection of the dam determined that the structure was in good condition, identifying excessive vegetation on the great wall and island, and voids in between the cut granite stones along the crest of the great wall. An estimated \$204,000 in additional analysis, maintenance and repairs is needed to correct these issues (Haley & Aldrich, Inc. 2012a).

**Guard Locks Dam.** The Guard Locks Dam (MA-00834) includes a lock, earthen embankment, gatehouse and spillway with hydroelectric power mechanisms. The dam and lock system was constructed in 1848 to regulate water levels in the Pawtucket Canal for mills in the center of Lowell. Today, the locks are used by the National Park Service for tourism and the dam is used to regulate water levels in the canal for hydroelectric power and flood control purposes.

While the dam is in good condition, the following issues were identified during a recent inspection of the structure: vegetation in the walls and downstream earthen embankment, debris in the spillway area, and voids in between the granite stones. The total estimated repair cost for the Guard

Locks dam is \$120,000 (Haley & Aldrich, Inc. 2012b).

**Swamp Locks Dam.** The Swamp Locks Dam (MA-00836) was originally constructed as part of the development of the Pawtucket Canal in the 1790s. The 1822-1823 reconstruction of the Pawtucket Canal reworked the lock system from a navigational system to a power system, creating a two-tiered power canal network and placing the Swamp Locks Dam centrally within this system. This configuration was retained through several subsequent rebuilding efforts. Many of the existing components of the dam (e.g. the lock, gates, spillway and weirs) date back to those reconstruction periods in 1839-1841, 1859, 1892, 1928, 1942 and 1946. The original purpose of the dam was to regulate the flow of water as a power source for downstream mills. Today the structure is used to impound water for boat tours of the canal system and flood control purposes.

The most recent inspection of the dam identified areas of broken and missing concrete, vegetation in the stone block walls, leakage and wear on the broad crested weir and gatehouse structure. An estimated \$665,000 in additional analysis, maintenance and repairs is needed to correct these issues (Haley & Aldrich, Inc. 2012c).

**Lower Locks Dam.** The Lower Locks Dam (MA-00835) was constructed in the late 18<sup>th</sup> century as part of the Pawtucket transportation canal, which allowed boat access around Pawtucket Falls. It was rebuilt in 1822-1823 and consists of two gatehouses, a primary spillway, low level outlet (deep gate), two-bay lock chamber, canal drain pipe and valve, and a culvert system that drains excess flow from the adjacent Eastern Canal into the discharge channel downstream of the dam. Today, the dam is primarily used for flood control purposes.

During a 2006 inspection of the dam, vegetation and debris were identified as minor deficiencies. The canal drain valve control platform upstream of the dam was also noted as being potentially unstable. An estimated \$27,000 to \$42,000 in additional analysis, maintenance and repairs was needed to correct these deficiencies (Weston & Sampson 2006).

Since the inspection, the vegetation on the spillway has been removed and the canal drain valve control platform has been stabilized with guy wires; it is

unclear whether this is a temporary or permanent solution.

### *Objects*

***Boston & Maine (B&M) Railroad No. 410***, a steam locomotive built in 1911 by the American Locomotive Company's Manchester, NH works, is on permanent display at the corner of Merrimack and Dutton streets in downtown Lowell. Engines like No. 410 were used by the B&M Railroad to move freight cars around train yards throughout New England; in Lowell, the engine shuttled cars between textile mills for nearly 40 years.

In 1950, No. 410 was sold to H.E. Fletcher Company, where it was used in a quarry for approximately 30 years before being retired. In 1993, the engine was moved to its current location and is part of the interpretive components of the park. No. 410 is in excellent condition due to over 20 years of restorative work and routine annual maintenance by volunteers (see Section 4.4. Management Resources and Practices for more information). A restored 1907 Pullman Coach, owned by the National Park Service, is on display with No. 410.

### *Landscapes*

The Lowell Canal System and its associated buildings and structures, while discussed individually in this section for inventory and management documentation purposes, collectively form a historic landscape that needs to be considered as a whole. These resources shaped the historic development and growth of the city, and continue to do so today. The canal system defines the character of downtown Lowell, and together with the remaining mills, provides a physical connection to the city's illustrious industrial past.

The parcel known as Tremont Yard, located on the Western Canal between Hall Street and Father Morissette Boulevard, is the site of the former Tremont Mills. Now predominantly paved over for parking, with remnants of the tailraces below it, the only above ground feature remaining is a one-story segment of brick wall with a concrete cap that runs along the north and east edges of the property. This wall, containing arched window openings that have been bricked in, serves as an important landscape feature and a reminder of what was once located on the site. By the late 1990s, the northern section of

the wall, adjacent to Hall Street, had become a serious safety hazard, so it was dismantled by hand and partially rebuilt with the salvaged brick. The eastern section of the wall has a significant amount of vegetation growth.



The eastern section of the wall in Tremont Yard. (DCR)

### **Recreation Resources**

Visitors to Lowell Heritage State Park can drive, bike or walk to the various facilities and points of interest within the park. In addition, the Lowell Regional Transit Authority operates buses that circulate through downtown. However, there are only three bus routes (1, 7 and 8) that cross the Merrimack River and provide indirect access to the Vandenberg esplanade. The closest bus stop to the concentration of recreation resources on the western half of the esplanade is located in front of Lowell General Hospital on Varnum Avenue.

There are a variety of active and passive recreational opportunities within Lowell Heritage State Park, including:

- Bicycling
- Boating, motorized and non-motorized
- Events (e.g., concerts, movies)
- Field sports (e.g., soccer, flag football)
- Fishing
- Geocaching
- Interpretive displays and programs
- Nature study
- Pet walking
- Photography
- Picnicking
- Swimming
- Walking/jogging/running

Boating takes place in the Merrimack and Concord rivers and, to a limited extent, in the canal system (see Figure 3). Motorized and non-motorized boats are launched into the Merrimack River from the Rourke brothers boat ramp; there are no fees charged at this facility. Non-motorized boats are also launched into the Merrimack at the Bellegarde boathouse. The Merrimack River Rowing Association (MRRA) and University of Massachusetts Lowell offer a variety of kayaking and rowing programs to the public at the boathouse; some of these programs are free of charge, while others require a fee. On a much larger scale, the MRRA also hosts two regattas, the Festival Regatta and the Textile River Regatta, at the boathouse each year.

Motorized and non-motorized boats can also be found on the Concord River. Every spring, the Lowell Parks & Conservation Trust, in partnership with Zoar Outdoor, offers a unique whitewater rafting opportunity on the Concord River, for a fee. Each trip concludes with passing through the Lower Locks Lock Chambers. Finally, the National Park Service offers motorized boat tours of the entire canal system for a nominal fee. The canal system is not open to the public for boating, aside from these two opportunities.

Fishing takes place in the rivers and canal system too. The Department of Public Health alerts the general public to the possible dangers of eating fish caught in Massachusetts waters through a public health fish consumption advisory. There are several advisories for the Merrimack River and canal system; there are no advisories for the Concord River in Lowell.

**Table 4.7. Fish Consumption Advisories for the Merrimack River and Lowell Canals**

| Water Body          | Hazard                   | Advisory <sup>a</sup> | Fish Species                  |
|---------------------|--------------------------|-----------------------|-------------------------------|
| Merrimack River     | Mercury                  | P1, P3                | Largemouth bass, white sucker |
| Canals <sup>b</sup> | Mercury, lead, PCBs, DDT | P1                    | All fish                      |
| Canals <sup>b</sup> | Mercury, lead, PCBs, DDT | P2, P4                | American eel                  |

Source: DPH 2014

a. P1 = Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not consume the affected fish species; P2 = The general public should not consume the affected fish species; P3 = The general public should limit consumption of the affected fish species to two meals per month; P4 = The general public should limit consumption of non-affected fish species to two meals per month (DPH 2014).

b. For the canals, the general public is advised to consume only the fillet of non-affected fish species (DPH 2014).

Special events, such as carnivals, and athletic events take place at the Anne Dean Welcome Regatta Field (see Figure 3). The City of Lowell sells permits for the use of the field through an expired Memorandum of Understanding with the DCR (see Section 4.4. Management Resources and Practices for more information). In 2013, the city issued 46 permits; the months of May and September were the most popular for events (Faticanti 2014).

Walks for charity, large cultural events, like the Southeast Asian Water Festival, and DCR-sponsored programming also take place along the Vandenberg esplanade. In a typical year, there is a special event on the esplanade every weekend from April through October. Many of these events are coordinated from the Sampas pavilion; there are fees to use the lawn in front of the stage and the stage itself. Permits for the esplanade are issued by the Forest and Parks Supervisor or the DCR's Office of Special Events, for a fee.

Guarded, freshwater swimming is available at the Rynne beach in July and August, every year, free of charge. The City of Lowell manages the beach through an expired Special Use Permit that was issued by the Department of Environmental Management (see Section 4.4. Management Resources and Practices for more information). During the swimming season, water quality is tested weekly; if poor water quality becomes a problem,

tests are conducted daily until the results indicate improved water quality (Faticanti 2014).

**Table 4.8. Water Quality Results for the Rynne Beach, May 2013-August 2013**

| Sample Date | <i>E. coli</i> per 100ml <sup>a</sup> | Days Since Last Rainfall | Amount of Last Rainfall (inches) |
|-------------|---------------------------------------|--------------------------|----------------------------------|
| 5/31/13     | 30                                    | 1                        | 0.6                              |
| 6/6/13      | 0                                     | 2                        | 0.4                              |
| 6/12/13     | 60                                    | 1                        | 1.0                              |
| 6/20/13     | 50                                    | 3                        | 0.3                              |
| 6/25/13     | 10                                    | 8                        | 0.3                              |
| 7/2/13      | 210                                   | 1                        | 0.9                              |
| 7/4/13      | 150                                   | 3                        | 0.9                              |
| 7/9/13      | 80                                    | 1                        | 0.3                              |
| 7/15/13     | 30                                    | 6                        | 0.1                              |
| 7/22/13     | 110                                   | 11                       | 0.1                              |
| 7/29/13     | 30                                    | 8                        | 0.5                              |
| 8/6/13      | 50                                    | 5                        | 0.5                              |
| 8/12/13     | 100                                   | 2                        | 1.0                              |
| 8/19/13     | 60                                    | 6                        | 0.1                              |

a. Limit = 235 *E. coli* per 100 ml.

The Merrimack River Watershed Council (MRWC) also monitors the river’s water quality through its Safe Beaches Project. The closest sampling location to the Rynne beach is upstream, at the Bellegarde boathouse. The MRWC did not sample in 2013, due to a lack of volunteers (O’Mara 2013).

The Lord pool is another location within the park for visitors to enjoy guarded swimming (see Figure 3). The pool is open from June through August, every year; there are no fees charged at the facility. DCR staff are responsible for managing the pool and testing its water quality during the swimming season. In addition, the Department of Public Health (DPH) inspects the pool once each year as part of a Memorandum of Agreement with the DCR (see Section 4.4. Management Resources and Practices for more information). The DPH provides a brief report on the water quality, health and safety, and general sanitation conditions of the pool to DCR staff after the inspection.

**Table 4.9. DPH Water Quality Results for the Lord Pool, August 8, 2013**

| Test              | Allowable Result <sup>a</sup> | Test Result <sup>a</sup> |
|-------------------|-------------------------------|--------------------------|
| pH                | 7.2-7.8                       | 7.6                      |
| Alkalinity        | 50-150                        | 70                       |
| Calcium Hardness  | 150-1,000                     | 210                      |
| Free Chlorine     | 1.0-3.0                       | 4.2 <sup>b</sup>         |
| Combined Chlorine | 0.0-0.2                       | 0.0                      |
| Secchi Disk       | Clearly visible               | Clearly visible          |

a. Results are reported in parts per million (ppm), except for the pH and Secchi disk tests.

b. Additional testing was conducted 45 minutes later, after corrective actions were taken. The second test result, 3.8ppm, exceeded the allowable range, and the pool was closed until the free chlorine reading was brought into compliance.

The following health and safety, and general sanitation violations were also noted as part of the 2013 DPH inspection:

- The water depth is not marked at or above the water surface on the pool wall.
- A gap in the outside fence of greater than three inches.
- A broken step on the ladder in the deep end.
- An insufficient emergency communication system in the first aid room.
- The log book indicated the pool was not closed with free chlorine reading of 13.8ppm.
- The paint on the pool floor is peeling.
- A portion of the cement deck is raised, creating a tripping hazard.

Many of these violations, such as the broken step ladder, were addressed during the 2013 season and the remaining items, such the raised cement deck, will be addressed as part of the fall 2014 modernization project (see Infrastructure, below for more information).

Visitors to the Lord pool enjoy biking to the property; however there are no bike racks available for storing and securing their bikes. Social gatherings are also popular on the lawn and at the picnic tables that surround the pool. Two mature trees, near the corner of Cross and Fletcher streets, are the only source of shade in this open space.

The National Park Service (NPS) provides most of the interpretive programming within the downtown portion of the park. Visitors can participate in a free ranger-guided walking or trolley tour of the historic sites. A variety of indoor exhibits are open to the



public too, including the NPS's visitor center at Market Mills, the Boott Cotton Mills Museum (fees apply), the Patrick J. Morgan Cultural Center and the Wannalancit Mill. The NPS also co-sponsors one of the largest, free folk festivals in the world; the Lowell Folk Festival is held each summer and over 100,000 people come to Lowell and the park to celebrate traditional music, ethnic foods and crafts (NPS 2014c).

Geocaching also occurs in the park. As of March 2014, there were three known geocaches along the Vandenberg esplanade and two known geocaches in the downtown portion of the park.

## **Infrastructure**

### **Property Boundary**

**Fee Interest.** Lowell Heritage State Park (87 acres) is situated in the northern half of Lowell, adjacent to the Merrimack River and the city's historic power canals. The majority of the parcels that comprise the park are linear in nature, and most were acquired between 1976 and 1986.

By 1980, the Department of Environmental Management (DEM) purchased a fee interest in a portion of the Vandenberg esplanade, from the Rourke Bridge to the intersection of Pawtucket Boulevard and Varnum Avenue; a portion of Francis Gate Park, north of Broadway Street; the gatekeeper's property; Tremont Yard; and the Mack building. Over the next five years, the agency added a few more parcels to the Vandenberg esplanade, near the intersection of Pawtucket Boulevard and Varnum Avenue, and Francis Gate Park, south of Broadway Street.

In 1986, the DEM obtained a fee interest in the park's remaining parcels through a complicated and lengthy Order of Taking, recorded in the Middlesex County Registry of Deeds, Northern District, Book 3830, Page 70. This legal action completed the Vandenberg esplanade, from the intersection of Pawtucket Boulevard and Varnum Avenue to Pawtucket Falls, and further east, along VFW Highway. It also created a network of protected land, in combination with property owned by the National Park Service and City of Lowell, along each of the city's canals. Finally, it established the DEM's ownership interest in 13 buildings associated with the canal system (see below). Only one of these

buildings, the Rolling Dam Gatehouse, has been demolished.

1. Pawtucket Gatehouse
2. Blacksmith Shop
3. Guard Locks Great Gate Gatehouse
4. Guard Locks Gatehouse
5. Guard Locks Lock House
6. Northern Canal Wasteway Gatehouse
7. Tremont Gatehouse
8. Swamp Locks Gatehouse
9. Hamilton Wasteway Gatehouse
10. Lower Locks Gatehouse
11. Massachusetts Wasteway Gatehouse
12. Boott Dam Gatehouse
13. Rolling Dam Gatehouse (demolished)

The Janas rink and Lord pool parcels were acquired before the 10-year effort to establish Lowell Heritage State Park. In 1972, the Department of Natural Resources (DNR) purchased the two-acre Lord pool parcel from the City of Lowell; the deed is recorded in the Middlesex County Registry of Deeds, Northern District, Book 2211, Page 558. The following year, the city sold the Janas rink parcel (4.5 acres) to the DNR; the deed is recorded in the Middlesex County Registry of Deeds, Northern District, Book 2091, Page 58.

**Other Legal Interests.** The DEM also obtained a number of other legal interests through its 1986 Order of Taking (see Middlesex County Registry of Deeds, Northern District, Book 3830, Page 70). These easements and other rights are the most complicated, and confusing, parts of the taking.

With respect to the 13 canal system buildings, the DCR holds a permanent easement in the canal walls and beds or bottoms that support each building, and the associated structures and fixtures. The Proprietors of Locks and Canals on the Merrimack River (the Proprietors), and their successors and assigns, retain the right to access the buildings in order to maintain and operate the gates and canals for hydroelectric power production. In addition, the Proprietors, their successors and assigns reserve an easement for access and the right to use the Blacksmith Shop for maintaining and operating the Pawtucket Dam for hydroelectric power production.

The DCR also holds a permanent easement in the following structures, which are specifically named in the taking:

- Pawtucket Gatehouse Wall and Lock Chamber;
- Guard Locks Lock Chambers;
- Northern Canal Walkway;
- Swamp Locks Dam;
- Swamp Locks Chamber;
- Lower Locks Dam;
- Lower Locks Lock Chambers;
- Boott Dam;
- Rolling Dam; and
- YMCA Gates.

The permanent easement is for the following purposes, provided that the Proprietors, their successors and assigns are able to use, maintain and operate the structures and surrounding property for hydroelectric power production without interference.

- Support of all fixtures or structures of the Commonwealth;
- Preservation and conservation;
- Supplemental maintenance in addition to that performed by the Proprietors, their successors and assigns;
- Landscaping and erection of exhibits and structures;
- Placement of barriers and fences;
- Placement and attachment of docks, wharves, walls and boat ramps of a temporary or permanent nature;
- Placement of lighting and other utilities;
- Operation and maintenance of boat locking chambers, if any, for any and all purposes; and
- Any and all other uses consistent with the operation of the canal system as a park.

In addition to the permanent easements described above, the DCR has an interest in the following:

1. An overarching “...permanent and exclusive easement in all canal walls and beds or bottoms and in all dams and boat lock chambers located in said canals and not otherwise referred to in [the taking]...” (Book 3830, Page 102). This permanent easement is for the same purposes as described immediately above.

2. “All air rights over the canals, including the canal walls and any dams thereon, to the extent not already lawfully obstructed or occupied, for so long as such lawful obstruction or occupation continues uninterrupted in its present form” (Book 3830, Page 103).
3. “The exclusive right to use the water in the entire canal system and the Merrimack River for recreational, educational and navigational purposes, which use shall be nonconsumptive with respect to hydroelectric power generation, except for reasonable amounts to operate locking gates” (Book 3830, Page 103).

In 2001, the Highway Department (MassHighway) granted the DEM possession, care, custody and control of Anne Dean Welcome Regatta Field through a license agreement (see Section 4.4. Management Resources and Practices for more information). The DCR’s use of the property is restricted to passive recreation. MassHighway reserved the right to utilize the property, in whole or in part, for highway purposes.

#### Pocket Parks

The two smaller “pocket parks” within the downtown portion of Lowell Heritage State Park, the Mack plaza and Victorian garden, were designed by Carr, Lynch Associates, Inc. in 1982. The firm received multiple awards for their work, including a:

- Citation for Excellence in Urban Design from the American Institute of Architects (1990);
- Mayoral Proclamation for the Preservation of Lowell’s Historic Architecture (1990);
- Citation from the American Society of Landscape Architects (1987); and
- Massachusetts Governor’s Design Award (1986).

**Mack Plaza.** The Mack plaza is located next to the Mack building, on the corner of Shattuck and Market streets. Nineteen linden trees and 20 new benches enhance the brick plaza as a relaxing oasis in an otherwise busy section of the city. (See Section 2 for more information on the bench replacement project.) The fountain component of “The Worker” sculpture, when functioning, adds to the ambiance of the space (see Buildings and Structures, below, for more information).

An approximately three-foot-tall steel rail and granite post fence encloses the plaza along Market Street. For several decades, the condition of the granite posts has been deteriorating. Today, 11 of the 13 posts are badly cracked; several posts are being held in place by a temporary wooden support structure. In 2007, a close inspection of the fence identified the pin mounting system and temperature changes in the steel as the likely causes of cracking (DCR 2007c).



A cracked granite post and temporary wooden support structure in the Mack plaza. (DCR)

**Mary J. Bacigalupo Victorian Garden.** The Victorian garden is also located next to the Mack building, at the intersection of Shattuck and Middle streets. Raised beds dominate the space and support a variety of mature evergreen and deciduous trees, as well as smaller, shade-tolerant perennial and annual plantings. Seven benches situated along the garden's brick pathways offer a welcoming respite from city life. An approximately seven-foot-tall fence, identical to the one in the Mack plaza, surrounds the entire garden. There are 25 granite posts in this fence and 22 are badly cracked. One post that supported the garden's western gates was recently removed for public safety reasons (DCR 2007c).

In 2005, the garden was dedicated to Mary Bacigalupo, a Lowell citizen who was instrumental in the beautification of the City of Lowell (see Appendix H). A large granite marker bearing Mary's name is located within the garden (see Memorials and Markers, below, for more information).



Victorian Garden (DCR)

### Buildings and Structures

This section provides information on Lowell Heritage State Park's non-historic buildings and structures. See Cultural Resources, above, for information on the park's historic infrastructure.

**Rourke Brothers Memorial Boat Ramp.** The Rourke brothers boat ramp is located at the western end of the Vandenberg esplanade, upstream of the Rourke Bridge (see Figure 3). The concrete ramp, which is approximately 45 feet wide, leads from an access road and parking area off of Pawtucket Boulevard into the Merrimack River. The ramp was constructed by the Office of Fishing and Boating Access (OFBA) in 2002 and is in good condition (Sheppard 2013). Extensive regulations govern the use of OFBA sites; see Section 4.4. Management Resources and Practices for more information.

**Edmund A. Bellegarde Boathouse.** The Bellegarde boathouse, situated on a parcel of land between Pawtucket Boulevard and the Merrimack River, was once the headquarters for Lowell Heritage State Park between 1993 and 2002, but is now under the care and control of the University of Massachusetts Lowell (see Section 4.4. Management Resources and Practices for more information).

**Charles G. Sampas Pavilion.** The Sampas pavilion is located on the Vandenberg esplanade, near the intersection of Pawtucket Boulevard and Delaware Avenue (see Figure 3). The 30- by 50-foot open-air, poured concrete and steel frame structure has functioned as the park's performing arts stage for 37 years. The stage is equipped with electricity and limited performance lighting; it is in good condition.

**Merrimack River Retaining Wall.** A riprap and poured concrete retaining wall is located along the Vandenberg esplanade, from the Rourke Bridge to the Sampas pavilion. It is not known when the wall was constructed. Woody vegetation, some of which is an invasive species, is growing in the riprap portion of the wall. Many sections of the poured concrete wall are also misaligned. Overall, the retaining wall is in fair condition.

**Raymond J. Lord Memorial Swimming Pool.** The Lord swimming pool, located at 81 Cross Street, is a complex of one pool, one spray deck (formerly a wading pool), one bathhouse and one outbuilding, constructed in 1972 (see Figure 3). The pool has a maximum depth of 12 feet; a set of stairs provides access to the shallow end of the pool. In 2010, the wading pool was converted into a spray deck with one centrally located spray feature. Both the pool and the spray deck are in good condition. Pending approval and funding, plans are in place to modernize the structures in the fall of 2014 by reducing the maximum depth of the pool to five feet; replacing the stairs in the shallow end of the pool with a “zero entry” ramp; adding more spray features to the spray deck; and constructing a shade shelter.

The bathhouse, approximately 3,300 square feet, is a single-story, masonry block building with a wood framed gabled roof clad with asphalt shingles. The 983-square-foot outbuilding, which houses pool equipment (e.g., pumps, filters and chemicals), a first aid station and staff restroom, is constructed of similar materials; however it has a flat, tar and gravel roof. Both the bathhouse and outbuilding received new roofs in 2009, and new epoxy floors and fresh interior and exterior paint in 2012. The pool’s filtration system was also replaced 2012. Both buildings have electricity, domestic water and waste water disposal. In addition, the outbuilding has a phone line. Both buildings are in good condition.

**Tremont Yard.** For many years, the predominant feature on the Tremont Yard parcel, located at 257 Father Morissette Boulevard, was the one-story ruin of a brick powerhouse with below grade water power features (see Cultural Resources, above, for more information). In 2003, the Legislature authorized the DCR to lease the property (see Appendix H) and two years later, a Request for

Proposals (RFP) was issued. In 2008, a 25-year lease was signed by Tremont Yard, LLC (see Section 4.4. Management Resources and Practices for more information). That same year, construction began on a modern, five-story office building; the ruin was demolished as part of that process, but the historic power system features were preserved. Today, the site is the headquarters for the Jeanne D’Arc Credit Union, which includes a first-floor interpretive display (see Figure 3). Although this preservation effort is open to the public, there is little promotion of the space.

**Trolley Tracks.** The National Park Service (NPS) operates a free trolley service for visitors to Lowell National Historical Park. The trolleys run on approximately one-mile of track that is laid out in a “T” shape within downtown Lowell. The western terminus of the track is located on the DCR’s Tremont Yard parcel. The Department of Environmental Management granted the United States of America, through the Lowell Historic Preservation Commission, an easement for the construction of the tracks and associated fixtures. The easement is recorded in the Middlesex County Registry of Deeds, Northern District, Book 6249, Page 209.

**Lowell Public Art Collection.** From 1984 to 1995, former U.S. Senator and Lowell resident Paul Tsongas, along with staff from the Lowell Historic Preservation Commission, led the development of the Lowell Public Art Collection (Marion 2014). During that time, a series of permanent sculptures were placed throughout the downtown area, but generally within sight of the National Park Service’s canalway walking path. Each work of art addresses a theme of the federal and state park systems: the industrial city, labor, machines, power and capital.

While a few of the sculptures are located on DCR property, e.g., “The Worker” in the Mack plaza, the collection is owned by the City of Lowell, through its Cultural Affairs and Special Events Department, and the National Park Service, both of whom are responsible for its ongoing maintenance. However, oversight of the collection is limited, due to a lack of resources at the municipal and federal levels (Marion 2014).

**John J. Janas Memorial Skating Rink.** The Janas skating rink, located at 382 Douglas Road, is managed and operated by the North Shore Rink

Management Associates, Inc. through a 25-year lease (see Section 4.4. Management Resources and Practices for more information).

### Roads

Public roads, which are owned and maintained either by the City of Lowell or Department of Transportation, surround the park. Pawtucket Boulevard, or Route 113, and VFW Highway border, and provide primary access to, the riverfront portion of the park. In downtown Lowell, Broadway Street and Fletcher Street provide access to the DCR's westernmost historic resources and Lord pool, respectively. Dutton Street and Father Morissette Boulevard are the highest-capacity roads that lead to the concentration of the DCR's historic resources.

### Parking

Along the Vandenberg esplanade, there are five DCR-owned parking areas (see Figure 3). The first is a paved lot, with a shared entrance and exit, located next to the Rourke brothers boat ramp. It can accommodate 64 vehicles; 44 spaces are reserved for vehicles with trailers, while the remaining 20 spaces are reserved for vehicles with car-top boats. All of the spaces are well marked, including the lot's four accessible spaces. The parking area is signed as being DCR property and gated.

The second parking area is located next to the Bellegarde boathouse; it is not under the care and control of the University of Massachusetts Lowell (see Section 4.4. Management Resources and Practices for more information). Forty-one vehicles can park in this paved lot, which has a separate entrance and exit. All of the spaces are well marked, including the four accessible spaces. The parking area is not signed as being DCR property or gated.

A third, unpaved parking area is located next to the regatta field. This unlined lot, with a shared entrance and exit, is heavily used during events and is showing serious signs of wear and tear. Vehicles, up to 40 at one time, are sometimes forced to park haphazardly due to deep ruts that fill with rain water and small patches of shrub-like vegetation. While the regatta field itself is signed as being DCR property, the parking area is not signed. The lot is also not gated.

The remaining two parking areas are located near the Sampas pavilion. Both lots are paved and marked, and utilize shared entrances and exits. The lot upstream of the pavilion has 22 spaces, including two accessible spaces. The lot downstream of the pavilion has 14 spaces, two of which are designated as accessible. Neither lot is signed or gated.

Visitors to the downtown portion of Lowell Heritage State Park most likely utilize the National Park Service's (NPS) visitor center parking lot, located near the intersection of Broadway and Dutton streets, or municipal parking options throughout the city (see Figure 3). The NPS's visitor center parking lot was formerly owned by the Department of Environmental Management (DEM). Upon selling a portion of the property to the NPS, the DEM established a Memorandum of Understanding (MOU) with the NPS regarding the use of the parking lot (see Section 4.4. Management Resources and Practices for more information). The remaining portion of the property was sold to the City of Lowell; there is no record of an MOU, or similar document, between the city and the DEM.

The DCR leases one parking area within Tremont Yard to the University of Massachusetts Lowell (see Section 4.4. Management Resources and Practices for more information). The other three DCR-owned parking areas within downtown Lowell are located outside of the concentration of historic resources (see Figure 3).

The first of these parking areas is located on Cross Street, next to the Lord pool. It is a paved lot, with a shared entrance and exit, and can accommodate approximately 40 vehicles. The majority of the individual spaces are not marked, however there are two accessible spaces that are well marked. The parking area is not signed as being DCR property or gated and, as a result, it is heavily used by residents and visitors in the immediate area.

The second downtown parking area is located on Broadway Street, near the Pawtucket Canal. Approximately 15 vehicles can park in this gravel lot, which has a separate entrance and exit. Individual spaces are not marked and there are no designated accessible spaces. Like the parking area at the Lord pool, this lot is not signed or gated and is routinely used by students, residents and visitors in the immediate area.

The final parking area is associated with the Janas skating rink, which is under the care and control of the North Shore Rink Management Associates, Inc. as part of a 25-year lease (see Section 4.4. Management Resources and Practices for more information). This lot is paved and can accommodate 80 to 90 vehicles. Individual spaces are well marked, including two designated accessible spaces. The lot's shared entrance and exit features a large DCR sign, as well as a gate.

### Trails

There is one trail within Lowell Heritage State Park; it is a 10-foot-wide paved path located along the northern shoreline of the Merrimack River. The first section of the path, designated as the Scott Finneral Memorial Riverwalk, is approximately one mile long (see Appendix H). It runs from the Rourke Bridge to the Sampas pavilion on the Vandenberg esplanade. Portions of this path have been damaged by tree roots lifting and cracking the pavement. Sinkholes also appear along the path on occasion, due to water undermining the Merrimack River retaining wall (see Buildings and Structures, above, for more information).

The second, unnamed section of the path is approximately two miles long. It runs from Beaver Brook to near the Duck Island Wastewater Treatment Facility. Only the upstream portion, ending near the Hunts Falls Bridge, is on DCR property (approximately one mile of path). Small sections of this path can become overgrown, due to the dense vegetation that grows on both sides. Currently, the only connection between this section of the path and the Scott Finneral Memorial Riverwalk is the public sidewalk along VFW Highway.

### Signs and Kiosks

There are very few DCR signs within Lowell Heritage State Park and there are no kiosks. Five separate Site/Facility Identification Signs exist for the Rourke brothers boat ramp, regatta field, Vandenberg esplanade, Francis Gate Park and Lord pool.

- The sign for the boat ramp, located at the ramp's main entrance, does not meet DCR signage standards (DCR n.d.).

- The regatta field sign, located on the north side of Pawtucket Boulevard near the sidewalk, within the larger of the two playing fields, meets all DCR signage standards (DCR n.d.).
- The sign for the Vandenberg esplanade, which is located on the south side of Pawtucket Boulevard near the intersection of Varnum Avenue, should be double-sided in order to meet DCR signage standards (DCR n.d.).
- The Francis Gate Park sign, located near the Guard Locks Lock House, does not meet DCR signage standards (DCR n.d.).
- The sign for the Lord pool meets all DCR signage standards (DCR n.d.).

A standard Rink Identification Sign is located at the main entrance of the Janas rink (DCR n.d.).

There is one Road Marker Sign that leads visitors to Lowell Heritage State Park from the Lowell Connector. The sign reads: "Lowell National and State Parks Exit 5B;" it does not meet DCR signage standards.

A small identification sign is attached to each of the DCR-owned buildings that the National Park Service maintains (see Section 4.4. Management Resources and Practices for more information). Although these signs do not meet DCR signage standards, they are consistent in appearance and placement, and thus easily recognizable as a component of Lowell National Historical Park.



National Park Service Identification Sign (DCR)

Within the last 10 years, Lowell General Hospital constructed a three-sided directional sign on DCR property located on the corner of Pawtucket

Boulevard and Varnum Avenue. There is no record of a legal document (e.g., permit, Memorandum of Understanding, etc.) being issued or a bill being passed that authorized the construction of this sign.

### Memorials and Markers

There are five known memorials within Lowell Heritage State Park. The first, a large granite marker, is located at the entrance to the Rourke brothers boat ramp. It is inscribed with the names of three Rourke brothers, Steve, Cliff and Bud, all of whom served in World War II.

The second memorial is dedicated to Charles G. Sampas, a former columnist for the Lowell Sun. An approximately four-foot-tall, one-foot-square granite post, topped with a bronze plaque, is located near the Sampas pavilion. The plaque includes the names of the state and national parks.

Another bronze plaque, the third memorial, is mounted directly to the front of the Rynne bathhouse. It pays tribute to Michael Rynne, a former Lowell policeman and athlete, and also includes the names of the state and national parks.

The fourth memorial, located at the eastern end of the Vandenberg esplanade, is dedicated to George Scott Finneral, who was killed in action during the Persian Gulf War. It, too, is a bronze plaque mounted atop an approximately four-foot-tall, one-foot-square granite post. However, the plaque does not match the design of the other memorials.

The fifth and final memorial is small granite marker located within the Victorian garden. It is inscribed with Mary J. Bacigalupo's name and reads, in part: IN RECOGNITION FOR HER LEADERSHIP AND DEDICATION TO THE PEOPLE AND CITY OF LOWELL.

There are at least nine other bronze plaque markers, either mounted on a granite post or directly to a building, placed throughout the park. These markers provide information about the nearby buildings and objects. Each marker includes the name of the state and national parks. The plaque for the brick vault, located near the Victorian garden, was stolen and has not been replaced.



Bronze Plaque and Granite Post Marker (DCR)

Surprisingly, there is no marker for Hoyt S. Vandenberg (1899-1954), the presumed namesake of the esplanade and Lowell's highest ranking general.

## **4.4. MANAGEMENT RESOURCES AND PRACTICES**

See Section 2, Management Resources and Practices, for a description of the management resources and practices that apply to the entire Lowell/Great Brook Planning Unit.

### **Natural Resources**

Vegetation management within the park consists primarily of mowing and trimming. DCR staff maintain the lawn and landscaping at the Rourke brothers boat ramp and along the Vandenberg esplanade. The city maintains regatta field (see Recreation Resources, below for more information).

Within downtown Lowell, the National Park Service maintains the grounds around the canal system resources (see Cultural Resources, below). The maintenance of the lawn and landscaping within the Gatekeeper's property falls to the curator or DCR staff, when a curator is not present. DCR staff also maintain the grounds at the Lord pool and the plantings at the Victorian garden. The lawn and landscaping at Tremont Yard and the Janas rink are maintained by Tremont Yard, LLC and North Shore

Rink Management Associates, Inc., respectively (see Infrastructure, below).

## Cultural Resources

### Buildings and Structures

**Michael Rynne Bathhouse.** In 1996, the Department of Environmental Management (DEM) issued the City of Lowell a three-year Special Use Permit “to use and occupy the [beach] adjacent to the Rynne [bathhouse] on the Merrimack River for the purpose of providing a safe, clean and accessible swimming area for the general public.”

As part of this permit, the city was given one room in the bathhouse, “as designated by the Park Supervisor, for the purpose of a First Aid and storage area.” In addition, the DEM agreed, “subject to appropriation and available personnel, to make major repairs to the [bathhouse] such as, roof replacement, exterior painting, heating system replacement, etc.” The shared use of the bathhouse has continued, under agreeable terms, for the last 15 years without a Memorandum of Agreement or similar document in place.

**Buildings and Structures Associated with the Canal System.** In 1991, the four major stakeholders in downtown Lowell’s historic properties – the Department of Environmental Management (DEM), Boott Hydropower, Inc. (Boott), the Proprietors of Locks and Canals on the Merrimack River (Proprietors) and the National Park Service (NPS) – signed a five-year Memorandum of Understanding (MOU) for the purpose of “maintaining and operating the Lowell Canal System for the benefit and enjoyment of the general public and for the private production of hydroelectricity and for other private uses of its waters.” The agreement divided the critical tasks related to maintaining and operating the canal system, including the associated buildings and structures, among the four major stakeholders with the understanding that each held a slightly different ownership, and general, interest in the various components of the system.

In general, maintenance of the canal walls and bottoms, dams and control apparatuses fell to Boott and the Proprietors. Boott was also responsible for maintaining, and providing access to, the Eldred L. Field Power Station for interpretive tours, as well as managing the water levels and flow rates in the canal

system. The cost of utilities for the associated buildings was split between the DEM and Boott, while the DEM and NPS worked together to maintain and secure the buildings and grounds. The DEM and NPS also agreed to meet each year in order to develop building maintenance, destructive vegetation clearing, canal water surface cleanup, and long term capital improvement programs.

Despite evidence that one or more of the stakeholders attempted to renew this MOU after it expired in 1996, the maintenance and operation of the canal system continues today, under somewhat agreeable, if not confusing, terms, in the absence of any legally binding document.

**W.A. Mack & Company Building.** In 2007, the DCR and New England Electric Railway Historical Society / Seashore Trolley Museum signed a five-year Memorandum of Understanding (MOU), which authorized the group to utilize space on the first and second floors, including the window displays, of the Mack building for the purpose of operating the National Streetcar Museum. As part of this MOU, the group is responsible for:

- Any and all utility services and costs;
- Notifying the DCR’s Regional Director of any fees under consideration or charged for using and/or accessing the museum;
- Scheduling and attending an annual in-person meeting with the Regional Director;
- Receiving the approval of the Regional Director prior to making any changes or improvements to the building; and
- Notifying the Regional Director of any injuries, closures, property damage or related incidents associated with the use of the building.

Even though this MOU expired on June 30, 2012, the museum has continued to utilize the Mack building, under agreeable terms, for the last two years.

### Objects

**Boston & Maine (B&M) Railroad No. 410.** The historic steam locomotive is maintained and cleaned, at least twice a year, by the Boston & Maine Railroad Historical Society (B&MRRHS), a non-profit historical and educational organization comprised of volunteers who share a common interest in the history and operations of the B&M



Railroad. There is no Memorandum of Agreement, or similar document, between the B&MRRHS and DCR that guides this management activity.

### Recreation Resources

**Anne Dean Welcome Regatta Field.** In 2007, the DCR and City of Lowell signed a five-year Memorandum of Understanding (MOU), which authorized the city to "...manage, maintain, and schedule events and programs consistent with the recreational missions of both parties at the [field]..." As part of this agreement, the city:

- Retains the funds it generates through permitting fees;
- Schedules an annual meeting with the DCR's Regional Director to discuss the previous year's programs and compliance with the MOU;
- Receives approval from the Regional Director before making any changes or improvements to the property;
- Does not cut, remove or interfere in any manner with any natural vegetation or store equipment or property without approval from the Regional Director; and
- Notifies the Regional Director of any injuries, closures, property damage or related incidents associated with the use of the property.

Despite the fact that this MOU has expired, the management and maintenance of the field, as well as communications between the city and park staff, have seamlessly continued for the last two years.

**Rynne Beach.** In 1996, the Department of Environmental Management (DEM) issued the City of Lowell a three-year Special Use Permit "to use and occupy the [beach] adjacent to the Rynne [bathhouse] on the Merrimack River for the purpose of providing a safe, clean and accessible swimming area for the general public." As part of this permit, the city agreed, at its own expense, to:

- Assume complete management responsibility of the waterfront area, including daily maintenance of the public restrooms;
- Provide qualified personnel to staff and manage the beach from June 1<sup>st</sup> through Labor Day of each year;
- Notify the DEM of incidents, such as vandalism, accidents, serious injuries, etc.; and

- Provide the park supervisor with a weekly report that includes a summary of incidents and attendance figures.

The management and maintenance of the beach, as well as communications between the city and park staff, have seamlessly continued for the last 15 years without a Memorandum of Agreement or similar document in place. Today, the beach is generally open from July 1<sup>st</sup> through mid- to late-August; a schedule that is dependent on the availability of students to fill the lifeguard positions and the timing of the Southeast Asian Water Festival, a popular event that is held on the Vandenberg esplanade each summer (Faticanti 2014).

The lack of a small, motorized boat presents the biggest management challenge for the city (Faticanti 2014). Every year, staff must borrow a boat to place and remove moorings, or swimming area markers, in and from the river. In addition, the city borrows a boat, or more, if available, to guard the non-motorized, dragon boat races that are an integral part of the Southeast Asian Water Festival. Finally, staff are routinely called upon to assist individuals who are swimming outside of the designated area, sometimes up to a mile away.

**Raymond J. Lord Memorial Swimming Pool.** In 2011, the DCR and Department of Public Health (DPH) signed a Memorandum of Agreement in order facilitate compliance with the State Sanitary Code (105 CMR 435.00, see Appendix F). As part of this agreement, the two agencies meet a minimum of twice per year to discuss pool inspections and compliance issues; share seasonal information regarding the operation of each pool; and jointly inspect each pool at least once per season. The agreement is in effect until terminated by either agency, upon 60 days written notice.

### Infrastructure

#### Property Boundary

**Anne Dean Welcome Regatta Field.** Under the terms of the license agreement, signed by the Department of Environmental Management (DEM) and Highway Department (MassHighway) in 2001, the DEM must obtain written approval from MassHighway before altering the property and before transferring or assigning the license, in part or in whole. In addition, the DEM is responsible for

maintaining the property, as well as any existing or additional utilities needed to utilize the property. This license is in effect until terminated by MassHighway or the DEM, now DCR.

### Buildings and Structures

***Rourke Brothers Memorial Boat Ramp.*** Extensive regulations govern the use of the Office of Fishing and Boating Access (OFBA) sites, such as the Rourke brothers boat ramp (320 CMR 2.00; Appendix F). Use of these sites is restricted to the launching of watercraft and the parking of associated vehicles. No other parking or recreational uses are allowed. Special Use Permits are required for events (e.g., fishing tournaments) at OFBA sites. Permits are issued by the OFBA, following DCR review.

***Edmund A. Bellegarde Boathouse.*** Chapter 238 of the Acts of 2006 authorized the transfer of the boathouse from the DCR to the University of Massachusetts Lowell (UMass). Sections seven through nine of the Act describe the terms and conditions of the transfer, including the requirements for public access and consequences regarding a change in use. The following additional items were also agreed upon, in order to execute and deliver a “care, custody, management and control” agreement between the DCR and UMass:

- Any document transferring the property shall include a reversionary clause, stating that care, custody, management and control reverts back to the DCR if the property ceases to be used as a public boathouse and park land.
- The Division of Capital Asset Management (DCAM), in consultation with the DCR, shall survey and provide a legal description of the property to be transferred.
- UMass shall prepare and submit, at its own expense, an Environmental Notification Form (ENF) regarding a land transfer of Article 97 protected lands.
- The transfer shall not be completed until the Secretary issues a certificate stating that no Environmental Impact Report (EIR) is needed, or that the EIR is adequate until the expiration of the legal challenge period.
- UMass shall comply with all requirements of the National Park Service and shall seek and obtain any required approvals.

The boathouse was officially transferred by the DCAM in 2006 (a signed Transfer Request 1, or TR1, form was located during this planning process); however the care, custody, management and control agreement has yet to be finalized. Several items from the list above, including the property survey and ENF, could not be located during this planning process.

The area including the parking lot to the west of the boathouse and the boathouse itself was estimated to be 1.15 acres, which exceeds the agreed upon land transfer estimate of one-third of an acre. Based on the estimate of 1.15 acres, it is presumed that the parking lot was not included in the land transfer.

***Tremont Yard.*** The 25-year lease signed by Tremont Yard, LLC is a lengthy and detailed document that guides the management and operation of the DCR’s property located at 257 Father Morissette Boulevard, excluding the parking area (see Parking, below). Permitted uses, rent, insurance, maintenance and subletting, among other topics, are addressed in the agreement. The DCR’s Long-term Permit and Lease Program staff, within the Office of the General Counsel, ensure that the terms of the lease are being met. This lease is scheduled to expire on May 21, 2033, however it may also be extended for seven additional 10-year periods.

On October 31, 2008, Tremont Yard, LLC entered into a 15-year sublease with Jeanne D’Arc Credit Union. The sublease only covers the building that was constructed at 257 Father Morissette Boulevard. The credit union has options to extend the term of the lease, expand the leased premises and to purchase the property from Tremont Yard, LLC. For this sublease, Tremont Yard, LLC is the landlord and responsible for ensuring that the terms of the sublease are being met.

***John J. Janas Memorial Skating Rink.*** The 25-year lease signed by the North Shore Rink Management Associates, Inc. is a lengthy and detailed document that guides the management and operation of the DCR’s property located at 382 Douglas Road. Permitted uses, rent, insurance, maintenance and subletting, among other topics, are addressed in the agreement. The DCR’s Long-term Permit and Lease Program staff, within the Office of the General Counsel, ensure that the terms of the lease are being met. This lease is scheduled to expire on June 20, 2027.

## Parking

**National Park Service’s Visitor Center Parking Lot.** In 1982, the Department of Environmental Management (DEM) and National Park Service (NPS) signed a Memorandum of Understanding (MOU) regarding the use of the parking lot located near the intersection of Broadway and Dutton streets in downtown Lowell. As part of this MOU, the two entities agreed:

- The NPS would be solely responsible for the operation and maintenance of the property, including staffing, daily operation, trash and snow removal, and repairs;
- The DEM would maintain a continuing role in the development of management policy relative to property;
- The obligations assumed by the NPS would not be transferred, assigned or modified without written approval by the DEM;
- The NPS would maintain a sign at the entrance of property, indicating that it may be used by visitors of both state and federal parks; and
- That a reasonable number of official spaces would be reserved for use by state or federal vehicles.

The MOU acknowledged that the DEM was authorized and intended to convey a portion of the property to the NPS and to that end, stated, “This agreement shall remain in full force and effect and shall not be defeated by the execution and delivery of a deed from [the] DEM to [the] NPS in connection therewith.”

**Tremont Yard.** On January 10, 1985 the Trustees of Wannalancit Office and Technology Center Trust (Trustees) signed a 99-year lease with the Department of Environmental Management for the parking area located in the rear of 257 Father Morissette Boulevard. On September 27, 1996, the Trustees assigned the lease to the University of Massachusetts Lowell (UMass), who remains the tenant today. UMass is responsible for maintaining and, when it deems necessary, improving the parking area. Any construction on the property must be approved by the DCR. This lease is set to expire in 2084.

## **Interpretive Services**

The National Park Service provides all of the interpretive programming related to the historic resources in downtown Lowell, due to the lack of DCR interpretive staff assigned to Lowell Heritage State Park and the overlap between the state and federal parks.

Lowell Heritage State Park is a participant in the Park Passport Program; the passport box is located next to the Rynne bathhouse.

## **Operational Resources**

### Supplemental Staffing

The supplemental staff at Lowell Heritage State Park are truly invaluable. Without the help of the City of Lowell and National Park Service, many of the DCR’s most significant resources would certainly be in a state of disrepair, inaccessible to the public, or safety hazards requiring demolition. Other important partners include the Office of Fishing and Boating Access, University of Massachusetts Lowell, Merrimack River Rowing Association and Merrimack River Watershed Council, all of whom play a role in providing quality, safe access to the Merrimack River. Finally, the many volunteers in downtown Lowell – from the Lowell Canalwaters Cleaners, to the Boston & Maine Railroad Historical Society, to Park Serve Day attendees – help preserve and enhance the park’s individual resources, as well as the visitor experience overall.

### Public Safety

DCR Rangers issue citations for violations of various forest and park rules. A summary of incident reports recorded in the park during 2013 is provided below.

**Table 4.10. Lowell Heritage State Park Incident Reports, January 1 through December 31, 2013**

| <b>Incident</b>                           | <b>Number</b> |
|-------------------------------------------|---------------|
| Vandalism                                 | 1             |
| Violation of DCR regulations <sup>a</sup> | 1             |
| <i>Total</i>                              | <i>2</i>      |

a. This violation was related to alcohol consumption on state property and, in turn, a suspected drunk driver. The incident was relayed to the Lowell Police Department, as the individual drove their vehicle onto a city-owned road after leaving the park.



Dairy cows at Great Brook Farm State Park. (DCR)

## SECTION 5. GREAT BROOK FARM STATE PARK

### 5.1. INTRODUCTION

Great Brook Farm State Park is a large property – 929 acres – located in the northern section of the rural community of Carlisle, with a few acres falling over the town border to the north, in Chelmsford. Main access points to the property are located off of Curve Street, North Road and Lowell Street. This is a diverse property with a variety of resources, uses and issues, including an active dairy farm; multiple historic buildings; acres of wetlands, forests and agricultural fields; miles of trails popular with walkers, equestrians and mountain bikers; and home to a cross-country ski concession.

Great Brook Farm is the largest active farm remaining in Carlisle, and is touted as the only active dairy farm within a state park in the country. The farm complex boasts a robotic milking system, the first one to be installed in Massachusetts.

### 5.2. HISTORY OF PROPERTY

The Concord River Valley area has a long history of human occupation, with a Native American presence that stems back thousands of years. Known archaeological sites within Great Brook Farm State Park confirm pre-contact use of this property.

European settlement of the Carlisle area took place in the mid 17<sup>th</sup> century, with the establishment of three separate small settlements, one of which, Chelmsford South End, began sometime after 1655 and was located in the area of the present day park (MHC 1980*d*). River Meadow Brook provided serviceable waterpower, and mills and dwellings began appearing along its banks in the 17<sup>th</sup> century, including the area known as “The City,” a small milling community with multiple homes and even a possible garrison (Markey 2002). A fulling mill was established in 1691 by John Barrett. Saw, grist and hoop mills were also located along River Meadow Brook, operated by the Adams and Robbins families through the early 18<sup>th</sup> century. A blacksmith shop was located in the area, and small scale quarrying also took place on land that is now within the park. A hoop mill continued to operate into the late 19<sup>th</sup> century.

By the early 18<sup>th</sup> century, the Spaulding and Adams families settled in the area and established small farms. The first North District schoolhouse was authorized in 1788, and the brick school building, the second one on this site, was constructed by Benjamin Barret in 1828. Small scale agriculture continued into the early to mid 20<sup>th</sup> century.

In 1939, Farnham Smith purchased eight acres off of North Road and built himself a cabin on a small pond as a summer retreat. Attracted to the area, he began purchasing additional property – the Adams farm in 1943, the home at 886 Lowell St in 1953, and the purchase of the Hart property, including the barn and the schoolhouse shortly thereafter (Miller 1998). He ultimately purchased 29 individual parcels, owning more than 900 acres, eight houses, the former schoolhouse, and five barns (Markey 2002). Smith began dairy farming and some breeding, and in 1948 he hired a farm manager, embarking fully into the breeding of Holsteins. Great Brook Farm became one of the largest dairy farm operations in New England and a highly respected breeder of Holsteins.

In September 1974, Smith sold Great Brook Farm to the Commonwealth of Massachusetts for \$4.3 million, for the establishment of a state park. Smith retained the rights to: operate the farm for an additional three years, use and lease the North Farm house for an additional five years, use the log cabin and the East Farm house for an additional eight years, and life tenancy use of the schoolhouse. Smith decided to cease farm operations just one year later, selling off equipment and animals in 1975.

Legislation was passed in 1982 for the establishment of an interpretive farm. The cross-country ski concession has been operating since the 1983-1984 ski season (weather permitting). Applicants were sought to operate the farm in 1986, and Mark and Tamma Duffy have been operating the dairy farm component of the park under lease agreements since 1987. The ice cream stand opened in 1988.

### 5.3. EXISTING CONDITIONS

#### Natural Resources

##### Physical Features

**Topography.** The topography within Great Brook Farm State Park is composed of lowlands in the south and gently rolling hills in the north. Elevation ranges from 170 to 300 feet above sea level.

**Geology.** Located within the Nashoba terrane, Great Brook Farm State Park lies primarily within the Nashoba formation. This formation is composed of metamorphosed volcanic rocks and includes schist, gneiss and biotite gneiss as well as an abundance of

mica and sillimanite (Skehan 2001). Glacial eskers and erratics can be seen throughout the park.

**Soils.** The soils at Great Brook Farm State Park include large areas that are well suited to agricultural and pasture use, although there are some issues with droughtiness that limits crop production and pasture usage (Peragallo 2009). The wetlands present on the property are reflected in the high percentage of acres characterized as muck type soils. There are slight to moderate limitations on path and trail development in dry areas, depending on slope, and some limitations on picnic and playground development, based on slope and the stoniness of the soils (Peragallo 2009).

**Table 5.1. Soils of Great Brook Farm State Park**

| Soil Series                          | % of Park | Drainage Class                               |
|--------------------------------------|-----------|----------------------------------------------|
| Canton fine sandy loam               | 20.7      | Well drained                                 |
| Freetown muck                        | 14.4      | Very poorly drained                          |
| Hinckley loamy sand                  | 10.5      | Excessively drained                          |
| Charlton-Hollis-Rock outcrop complex | 7.6       | Well drained to somewhat excessively drained |
| Merrimac fine sandy loam             | 5.7       | Somewhat excessively drained                 |
| Swansea muck                         | 5.2       | Very poorly drained                          |
| Woodbridge fine sandy loam           | 4.6       | Moderately well drained                      |
| Scarboro mucky fine sandy loam       | 4.4       | Very poorly drained                          |
| Saco mucky silt loam                 | 2.7       | Very poorly drained                          |
| Freetown muck, ponded                | 2.3       | Very poorly drained                          |
| Carver loamy coarse sand             | 2.3       | Excessively drained                          |
| Windsor loamy sand                   | 2.2       | Excessively drained                          |
| Scituate fine sandy loam             | 2.2       | Moderately well drained                      |
| Haven silt loam                      | 2.1       | Well drained                                 |
| Hollis-Rock outcrop-Charlton complex | 2.1       | Somewhat excessively drained to well drained |
| Deerfield loamy sand                 | 2.0       | Moderately well drained                      |
| Raypol silt loam                     | 1.7       | Poorly drained                               |
| Narragansett silt loam               | 1.7       | Well drained                                 |
| Water                                | 1.2       | N/A                                          |
| Wareham loamy fine sand              | 1.1       | Poorly drained                               |
| Raynham silt loam                    | 0.8       | Poorly drained                               |
| Rock outcrop-Hollis complex          | 0.6       | Somewhat excessively drained                 |
| Udorthents                           | 0.5       | Variable                                     |
| Whitman fine sandy loam              | 0.3       | Very poorly drained                          |
| Tisbury silt loam                    | 0.2       | Moderately well drained                      |

## Water Resources

Great Brook Farm State Park is rich in water resources – almost a quarter of the park’s total acreage is made up of either ponds or wetlands.

**Ponds.** Meadow Pond, centrally located in the park, is the largest body of water in Great Brook Farm State Park (see Figure 4). Meadow Pond has an abundant amount of water chestnut (*Trapa natans*) that is impacting the chemistry and habitat of this body of water. Beaver activity, weather, and water releases from nearby cranberry bogs impact the water level, and have led to flooding on nearby trails.

There are two smaller ponds on the property. One is the farm pond located adjacent to the farm complex and the second is located north of North Road, in the eastern portion of the park, near the site of Farnham Smith’s cabin retreat (see Figure 4). There are almost 12 acres of water that are encompassed by these three ponds.

**Wetlands.** The southern portion of the park is dominated by Tophet Swamp, a 76 acre wooded wetland area consisting primarily of mixed trees (see Figure 4), along with two blocks of coniferous wooded swamp. A smaller (28 acre) coniferous wooded swamp can be found in the northern section of the park. Shrub swamps (approximately 33 acres) and deciduous wooded swamps (57 acres) can be found spread throughout the property. All combined, swamp areas cover almost 21% of the park.

Some shallow marsh meadow lands encompassing 10 acres are found north of Meadow Pond, in the area known as “The Meadows”. Small pockets of deep marsh can be found scattered nearby, totaling almost nine acres. The largest of these deep marshes is located directly northeast of Meadow Pond.

A small bog area, just over one acre in size, is located within the southern section of Tophet Swamp.

**Vernal Pools.** There are seven certified vernal pools and 12 potential vernal pools located in the park.

**Streams.** River Meadow Brook, also locally known as Great Brook, is situated roughly west-east through the park, starting in a cranberry bog west of the park and running just south of Curve Street and North Road until it enters Meadow Pond (see Figure 4). Exiting the north end of Meadow Pond, River

Meadow Brook heads northward out of the park into a series of mill ponds in Chelmsford and into the Concord River in Lowell.

Two small, unnamed streams flow into River Meadow Brook from the north, on either side of Lowell Road, while a third stream swings through a small portion of the southern border of the park, ultimately connecting to Pages Brook south of the park.

**Groundwater.** A small portion of a medium-yield aquifer lies beneath nine acres in the northern part of the park, extending from Meadow Pond north to the park boundary.

There are two drinking water wells located at Great Brook Farm State Park. One well (#3051017-01G) is located just east of the Main Farm house, and serves the farm and the ice cream stand. The second well (#3051017-02G) is located north of the Nature Center Pavilion, in the field just southeast of the North Farm House Barn, along the Litchfield Loop trail, and serves the Nature Center Pavilion. Both are categorized as Transient Non-Community Groundwater Sources by the Department of Environmental Protection.

**Flood Zones.** The 100-year flood zone covers 84 acres that fall within Great Brook Farm State Park. This zone roughly corresponds to lands adjacent to River Meadow Brook and Meadow Pond, and extends north from Meadow Pond into The Meadows. The 500-year flood zone incorporates 162 acres of land, concentrated in the Tophet Swamp area in the southern half of the park.

### Rare Species

A very small component of Great Brook Farm State Park, just 33 acres, has been designated as Priority Habitat under the Massachusetts Endangered Species Act (321 CMR 10.00). Located in the westernmost parcel of the park, the Priority Habitat is located on a non-contiguous piece of land located south of Curve Street and west of Old Morse Road, and extends into nearby municipal conservation land and private lands.

Placeholder for Figure 4.

Two rare species, both reptiles, can be found in this Priority Habitat: Blanding’s turtle and eastern box turtle (NHESP 2007a; NHESP 2007c). These two species are similar in appearance and have similar nesting habitats, and thus are often confused with each other.

**Table 5.2. State-listed Species of Great Brook Farm State Park, as identified by the Natural Heritage & Endangered Species Program (NHESP)**

| Species            | Type    | MESA <sup>a</sup> |
|--------------------|---------|-------------------|
| Blanding’s turtle  | Reptile | T                 |
| Eastern box turtle | Reptile | SC                |

Source: Harper 2013

a. Status of species listed under the Massachusetts Endangered Species Act (MESA): SC = Special Concern and T = Threatened.

Blanding’s turtles use a variety of habitats, including vernal pools, marshes, scrub-shrub wetlands and open uplands, during their life cycle, and travel long distances during their active season (NHESP 2007a). Eastern box turtles are more of a terrestrial turtle and inhabit a variety of habitat types (NHESP 2007c).

In 2010, MassWildlife and The Nature Conservancy (TNC) issued “BioMap 2: Conserving the Biodiversity of Massachusetts in a Changing World” (MassWildlife and TNC 2010). This guide identified two types of areas important for conservation: Core Habitat and Critical Natural Landscape. The first is crucial for the long-term persistence of rare species and other species of conservation concern. The second provides habitat for wide-ranging native wildlife, supports intact ecological processes, maintains connectivity among habitats, enhances ecological resilience, and buffers aquatic Core Habitats to help ensure their long-term integrity. Protection of both areas, which may overlap, is “important to conserve the full suite of biodiversity” in Massachusetts (MassWildlife and TNC 2010). At Great Brook Farm State Park, 490 acres (54% of the park) has been designated Core Habitat, a much larger area than the MESA designated Priority Habitat, but no Critical Natural Landscape areas have been designated.

### Vegetation

**Forest Types.** In 2003, the James W. Sewall Company developed a forest inventory/land cover classification dataset for the state forests and parks. The dataset is primarily based on the interpretation of infrared aerial photography, a process that

identified seven forest sub-types within Great Brook Farm State Park (Table 5.3).

**Table 5.3. Forest Sub-types of Great Brook Farm State Park**

| Forest Sub-type                      | Acres                    | % of Park   |
|--------------------------------------|--------------------------|-------------|
| Eastern white pine - oak             | 209.3                    | 22.5        |
| Eastern white pine                   | 123.8                    | 13.3        |
| Eastern white pine - hardwoods       | 83.2                     | 9.0         |
| Mixed oak                            | 76.6                     | 8.2         |
| Oak – hardwoods                      | 33.9                     | 3.6         |
| Eastern white pine - eastern hemlock | 8.8                      | 0.9         |
| Red maple - swamp hardwood           | 3.6                      | 0.4         |
| <i>Total</i>                         | <i>539.2<sup>a</sup></i> | <i>57.9</i> |

a. The difference in total acreage is due to the exclusion of wetlands and areas of open water, as well as changes in the park’s boundaries since 2003.

More recently (2010-2011), specific areas within the forest were visited by DCR Management Foresters as part of the Massachusetts Continuous Forestry Inventory (CFI). The CFI is a network of permanent, one-fifth-acre plots on state park and forest lands that are routinely monitored for silvicultural purposes, and help to gauge forest health. The measurements and observations made within each CFI plot are recorded in a database that dates back to 1960, when the CFI was created. Approximately 10% of the state’s CFI plots are inventoried each year, on an on-going basis. As of 2010, there were 1,768 CFI plots statewide (Goodwin 2014).

There are seven CFI plots at Great Brook Farm State Park. These even aged stands range in age from 70 to 100 years and are comprised mostly of white or red pine, red maple, and white, black or scarlet oak.

Some disturbance agents have been noted in these stands, including pasturing (1900 to the present); insects (1981) and wind (1985). Harvesting also occurred in these stands in 1960.

**Priority Natural Communities.** There are no Priority Natural Communities within the park.

**Invasive Species.** A number of invasive species have been observed and identified by foresters and visitors to Great Brook Farm State Park. These species include:

- Common buckthorn (*Rhamnus cathartica*), a deciduous small tree or coarse shrub that threatens wetlands, where it can suppress other species, and field edges.



- Garlic mustard (*Alliaria petiolata*), a biennial herb that can spread rapidly, displacing native vegetation and in turn altering habitat. Garlic mustard is very difficult to eradicate.
- Bittersweet, a deciduous woody vine that has the capacity to grow over 60 feet long, girdles trees and smothers other plants. Bittersweet has been observed by the ice cream stand, along the Acorn Trail, and at the small parking area at the intersection of Lowell Street and North Road.
- Purple loosestrife (*Lythrum salicaria*), an herbaceous perennial, can suppress native populations, alter wetland structure and function, and impede water flow. Dense stands can form that are unsuitable for use by wetland habitat animals. Purple loosestrife has been found in wetland areas and along the brook.
- Water chestnut (*Trapa natans*), a fast growing aquatic plant, can crowd out native species and choke waterways. Water chestnut damages habitat and can impede recreational access. This is particularly present at Meadow Pond, and has been one of the contributing factors to the decrease in recreational boating in this pond.
- Multiflora rose (*Rosa multiflora*), is a densely spreading shrub that forms thickets that crowd out native species.
- Japanese knotweed (*Polygonum cuspidatum*), a shrub-like herbaceous plant that forms dense thickets that crowd out native species and reduce wildlife habitat, posing significant threats in riparian areas in particular.
- Catalpa (*Catalpa bignonioides* or *Catalpa speciosa*), a fast growing tree that can reach a height of 50 feet and crowd out native trees in the process.
- Winged burning bush (*Euonymus alatus*), also known as winged euonymus or burning bush, is a deciduous shrub that forms dense thickets that crowd out native species.
- Japanese barberry (*Berberis thunbergii*), a spiny shrub that forms dense stands that can displace native plants and reduce wildlife habitat and forage. Barberry also harbors deer ticks that have the potential to carry the Lyme disease bacteria, functioning as a nursery of sorts for juvenile ticks (Benson 2011).

- Privet, a rapidly maturing semi-evergreen shrub that forms dense thickets that crowd out native species.

**Pests and Disease.** White pine weevil (*Pissodes strobe*) has been identified in Great Brook Farm State Park. While tree mortality from this pest is low, damage does impact tree health and reduce wood quality. Leaf feeders have also been identified here as well, although to a much lesser degree than the weevils. Leaf feeders encompass a broad category of insects that are all defoliators, impacting trees and other plants.

### Wildlife

**Birds.** Great Brook Farm State Park is popular with birders, and over 150 wild species have been recorded in or over the park in recent years (see Appendix G). Of these species, 22 are classified as Species in Greatest Need of Conservation (MassWildlife 2006). As part of the farming operation, the farmers also maintain a flock of domesticated chickens.

**Mammals.** There is little current information on the park's mammals. Nine species confirmed to occur within the park and an additional 34 species that may possibly occur within the park are identified in Appendix G. Of the confirmed species, one of them, the Eastern red bat, is classified as a Species in Greatest Need of Conservation (MassWildlife 2006).

As part of the farming operation, the farmers also maintain a herd of dairy cows for milk production, as well as some goats, sheep, pigs, rabbits and a horse. Some are family pets, while others are kept for visitor enjoyment and farm income.

**Reptiles.** There is little current information on the park's reptiles. Seven species confirmed to occur within the park and an additional nine species that may possibly occur within the park are identified in Appendix G. Of the confirmed species, two are classified as Species in Greatest Need of Conservation (MassWildlife 2006). These are the Blanding's turtle and the Eastern box turtle.

**Amphibians.** There is little current information on the park's amphibians. Ten species confirmed to occur within the park and an additional eight species that may possibly occur within the park are identified in Appendix G.

**Fish.** There is no current information on the park's fish. A survey of River Meadow Brook in 1979 yielded an American eel (*Anguilla rostrata*), a brown bullhead (*Ameiurus nebulosus*), 12 bluegill (*Lepomis macrochirus*), four pumpkinseed (*Lepomis gibbosus*), and four largemouth bass (*Micropterus salmoides*) (Wineman 1980).

### **Cultural Resources**

There is a wide range of cultural resources within Great Brook Farm State Park. Some are associated with Farnham Smith's use of the property, while others predate his acquisition of these lands. Many of the cultural resources have been documented on Massachusetts Historical Commission (MHC) inventory forms. The park was evaluated by the MHC in the late 1990s and determined at that time to be eligible for listing in the National Register of Historic Places.

#### Pre-Contact Archaeological Sites

Four pre-Contact sites have been recorded in the park. One site is a stone tool making workshop that dates to the Middle Archaic Period (7,500-5,000 B.P.). The remaining sites are identified as "find spots" with little more than locational information provided. Despite the low number of sites, the physical characteristics, regional setting, and the known patterns of pre-Contact occupation in the area, all confer a high archaeological potential for this park.

#### Historic Archaeological Resources

Remnants of the 18<sup>th</sup> – 19<sup>th</sup> century mill site operated by the Adams family are located on River Meadow Brook, adjacent to Farnham Smith's cabin. (See MHC inventory form # CAR.902.) The Adams mill site includes a dam, two sluiceways, an impoundment, and the foundation of a mill. The dam and the sluiceways were originally constructed of dry laid stone, which helped to control water and create the impoundment area. The dam, also known as Cabin Pond Dam in agency records (MA02506), has an earthen core and sluiceways with concrete reinforcing. This dam is considered non-jurisdictional, meaning it is not under the regulation or jurisdiction of the DCR Office of Dam Safety and has not been assigned a hazard code. This dam was last inspected in 2007. A gate mechanism was added in the 20<sup>th</sup> century, probably to manage the water

levels in the impoundment area. The mill foundation is located just north of the dam. According to research, this building once functioned as a grist, hoop, and saw mill (Dwyer 1995).

Not far from the Adams mill site, off of the Garrison Loop Trail, is the area locally known as "The City," also known as Chelmsford South End. This area, a collection of cellar holes likely dating from the 18<sup>th</sup> century, was potentially affiliated with the nearby mill, possibly as an area of mill worker housing. An archaeological survey of the area in 1995 identified five visible cellar holes in this area (Dwyer 1995); only two definite cellar holes and a possible third cellar hole were located during the RMP fieldwork. Archaeological work revealed a low density of artifacts, suggesting the area was not inhabited for a sustained period of time.

One of the cellar holes that is still visible is locally known as the Garrison House site. Although archival research points to a garrison located in the Great Brook area in the 17<sup>th</sup> century, the archaeological investigation yielded domestic artifacts, and cannot confirm its use as a garrison (Dwyer 1995).

Another cellar hole is located next to three pieces of quarried stone. A third, possible cellar hole is located north of these other two, near the northern intersection of Garrison Loop with the Woodchuck Trail. Lots of leaf and brush debris were noted in the cellar holes during the RMP fieldwork.

Other cellar holes that may or may not be affiliated with the settlement of "The City" can be found within the park. One of these, located across the street from the Litchfield House, consists of a dry laid stone foundation in an I-shape, with a large chimney base. This was also researched and tested during the 1995 archaeological survey of the park, at which time it was determined to have been the site of a mid to late 18<sup>th</sup> century residential structure (Dwyer 1995). This particular cellar hole is currently filled with brush.

Another cellar hole is located northeast of "The City," alongside the Woodchuck Trail. This one is small and square, with a smaller cellar hole next to it, suggesting an outbuilding. Of note are some stone walls that make some unusual turns in the immediate vicinity of this cellar hole.

The stonework remnants of John Barrett's Mill, located on River Meadow Brook near the

intersection of Lowell Street and North Road, on the west side of Lowell Street, are still somewhat visible. Local historians suggest that this was established in 1691 as one of the first fulling mill sites in the U.S., and later used as a hoop mill until the late 19<sup>th</sup> century (Lapham 1970). A stone dam that may have been affiliated with this mill site is located near this same intersection, on the east side of Lowell Street, and is known as the Lowell Road dam (MA02508). This dam is considered non-jurisdictional, meaning it is not under the regulation or jurisdiction of the DCR Office of Dam Safety and has not been assigned a hazard code. This dam was last inspected in 2006.

Two historic wells were located in the park during the RMP fieldwork. One of them, located south of North Road, once serviced the Main Farm House. A small well house covered this well until relatively recently, when it was removed for safety reasons and replaced by wooden decking. The other well, which is located southeast of the Litchfield House, is an open well located just off the trail.

### Historic Resources

**Buildings.** In the process of acquiring the acreage for his large farm, Farnham Smith acquired several nearby farms – and their buildings – over the course of about 20 years. Since the establishment of the park, some were able to be put to use for park purposes or through long-term lease agreements. However, several of them no longer function for park purposes, or are residences that in the recent past have housed DCR staff, but with the disbandment of the staff housing program are no longer utilized. The buildings are presented here in three groupings: those that are currently in active use by park staff, long-term leaseholders, or curators; those that are used solely for storage purposes by the park and/or the region; and those that are currently vacant and no longer in active use (see Figure 4).

#### *Buildings in Active Use*

**North Schoolhouse**, located at 984 Lowell Street, is also known as the Park Headquarters building. See MHC Inventory form #CAR.7. Constructed in 1828, this single-story, side gabled, three-by-four bay brick building has a granite block foundation and a slate roof. A single-story rear ell, perpendicular to the main block, has another ell added onto the first one, oriented parallel to the main block. Both are clad in

clapboard. The building has two interior brick chimneys; one is located in the main block and the other in the rear ell.

Utilized as a grade school until 1906, the former schoolhouse was adapted in the early 20<sup>th</sup> century for vegetable storage. Farnham Smith purchased the property in 1955, and renovated the schoolhouse into his farm offices in 1959, which may have been when the side entrance was modified to the present-day central recessed entrance under the elliptical arch. The rear ells, clad in clapboard, were added in 1959 and 1969 respectively.

English ivy is growing on the end walls of the main block, and the brick chimney in the rear ell is experiencing major spalling. The building is in satisfactory condition.

The North Schoolhouse has been in use as the Park Headquarters since establishment of the park.



North Schoolhouse/Park HQ (DCR)

**Hart Barn**, located at 1018 Lowell Street. This one-and-one-half story, gambrel roofed barn was once a dairy barn, constructed in the first quarter of the 20<sup>th</sup> century. With a poured concrete foundation, a concrete block first floor, a clapboard second story, and an asphalt shingle roof, this barn also has an attached milk room and metal stave silo. Aluminum framed fixed sash windows and a metal vent in the roof completes the picture.

Recent mortar repairs efforts between the concrete blocks is evident, and it appears that multiple materials were used in the process. This was done in anticipation of a repainting project scheduled for later in 2014. Asbestos abatement of the window glazing was completed in 2014. The development of a plan for the remaining lead and asbestos inside the building is also anticipated. While the southern side of the roof was replaced in the recent past, the northern side has not been in some time, and lichen

growth is evident. While work has slowly been occurring here to address major issues, the building is still in unsatisfactory condition.

The Hart Barn has been in use as the Great Brook Ski Touring Center since the 1983-1984 ski season.



Hart Barn (DCR)

The **Main Farm House**, historically known as the Adams House, is located at 247 North Road. See MHC inventory form #CAR.8. The Main Farm House is a two-story, side-gabled, three-by-two bay, central chimney, Georgian style home with a single-story rear ell. A shed roof provides a covered patio area on the rear façade, between the main block and the ell. The main house has a granite block foundation, and the ell has a concrete block foundation. The entire house is clad in clapboards and has an asphalt shingle roof. Windows are primarily six-over-nine double hung sash, with exterior storms. Architectural details include cornice returns on the gable ends, wide and flat window trim with a small projecting cornice, and top lights above the main entrance. Documentation on the MHC inventory form prepared in 1993 notes interior details including original paneling, wide pine flooring, and exposed gunstock posts in one second floor bedroom, however park staff could not confirm if these features still exist.

The house was constructed in the second half of the 18<sup>th</sup> century. Local historians differ about the date of construction - Timothy Adams, who purchased the property in 1793, may have constructed a new home on the site or may have remodeled an earlier c1760 home. The main farm complex was acquired by Smith in 1943 and a rear ell was added c1949.

While there is a gutter on the ell, there is no gutter on the main block of the house. This has led to the presence of lichen on the front and rear façades of

the house due to splash back, and the doorsill at the main entrance appears to have some moisture damage. Some minor woodpecker damage can be seen on a front corner board. This building is in satisfactory condition.

The Main Farm House is now in use as the residence of the farmers that operate Great Brook Farm under a long-term lease.



Main Farm House (DCR)

**Garage/Apartment.** Located within the core of the farm complex is a two-story, side gabled structure. This building was built for equipment storage and farm staff housing, and is still utilized for these same purposes. Constructed during Smith's ownership of the property, this concrete block and clapboard building has five vehicle bays on the first floor and a two bedroom apartment on the second floor. Park staff has use of two of these vehicle bays for storage purposes. This building is in satisfactory condition.



Garage/Apartment (DCR)

**Tie Stall Barn.** Constructed in phases, this long building consists of a single-story gable roofed tie stall barn constructed c1910-1920 on the eastern end; connected to a two-and-one-half-story gambrel roofed barn built in the 1950s; connected to a single-story gable roofed open ended building on the western end. Gabled dormers punctuate the gambrel roofed section, and small single-story additions

punctuate the eastern section, one of which links the barn to a wood stave silo that is no longer in use. The foundation is fieldstone on the eastern end and concrete block on the western end. The building is clad in drop board siding and roofed with asphalt shingles. Vinyl replacement windows dot the structure. Exposed rafter tails provide the only adornment on this building.

Some small sections of siding are in need of repair, due to cracking or pieces missing. There are serious sill and foundation issues in need of attention. The north facing roof has some lichen growth and staining, and may need replacement. The building is in satisfactory condition.

The Tie Stall Barn used to house the dairy herd. A seasonal ice cream stand that is operated by the farmers April through October is now located at the eastern end of the structure. An interior dining and event space was developed by the farmers just behind the pre-existing ice cream stand section, however it was done without prior consultation with the DCR (as stipulated in the farm lease agreement) and without the benefit of a building permit. Authorization of future use of this space for this purpose is still pending, and will not occur until all applicable permits are obtained. The remainder of the barn is currently utilized primarily for storage of hay and sawdust.



Tie Stall Barn (DCR)

**Bull Barn.** This one-and-one-half-story front gabled building, located just to the east of the Tie Stall Barn, is composed of concrete block on the first floor and clad in drop board above, and has an asphalt shingle roof. Windows are aluminum framed sliding sash, some of which may no longer function. The main entrance is located on the side of the front façade and three more doors are located on the south elevation. A door sized opening is located in the gable end of the upper floor, presumably to access

the area for storage. Like the Tie Stall Barn, the only adornment here is exposed rafter tails.

Constructed during Smith's ownership of the property, severe cracking has since occurred in the foundation through the front wall. Due to this issue, the building is in unsatisfactory condition.

This building is currently used for storage. The sign on the building, "Non-Hazardous Industrial Wastewater," reflects the nearby presence of underground piping associated with the tight tank for the Smart Barn (see the Infrastructure section for more information).



Bull Barn (DCR)

The **Litchfield House**, historically known as the East Farm, is located at 437 North Road. See MHC inventory form #CAR.6. This c1860 one-and-one-half-story front gabled Greek Revival house is composed of a three-by-three bay main block with a one-story rear ell. The ell connects to a side gabled barn and two car garage through a small shed roofed addition, forming an L-shaped plan. The home has a granite block foundation, clapboard sheathing, and an asphalt roof. Architectural details include a deep eave overhang, sidelights flanking the main entrance, and six-over-six double hung sash windows that have been fitted with exterior storms. The New England style banked barn has large at grade openings on both the front and lower rear facades. Lichen is present on the north side of the roof and some can be seen creeping up the walls. The house has two interior brick chimneys, both of which could use some minor repair work. Extensive gardens surround the house. This property was purchased by Farnham Smith in the 1940s and served as the home for his head farmer, Lowell Litchfield.

This home is currently in use as a residence under a long-term lease as a part of the DCR's Historic Curatorship Program. This building is in satisfactory condition. The curators are currently working on the rear wall of the barn, which is in poor condition.



Litchfield House (DCR)

The **Hounds House**, historically known as the Woods House, is located at 659 North Road. The Hounds House is a two-story, flat roofed modern home, constructed in c1950 of concrete block, with vertical board wood sheathing on the second floor. With metal casement windows and a deep raking eave with exposed rafters, this home reflects the modernism movement that had a large presence in nearby communities. This building is in satisfactory condition. A small one-story, front gabled wood frame horse barn is located to the rear of the home.

This home is currently used as a residential and commercial facility. It has been operating under a long-term lease to Old North Bridge Hounds, a business that kennels hound dogs and organizes local equestrian hunts.



Hounds House (DCR)

#### *Buildings Used for Storage Purposes*

**Hadley House and Garage.** Located at 1003 Lowell Street, this small mid-19<sup>th</sup> century residential

building is a one-and-one-half-story, side gabled, two-by-one bay main block with a full width one-story shed roofed component on the rear. The foundation is largely fieldstone, with some concrete block on the southwest corner. The sheathing is clapboard and the roof is asphalt shingle.

The windows are primarily two-over-two double hung sash, and the main entrance is located on the side of the building, on the south facing façade. A centrally located brick chimney pierces the roofline. A wide fascia board and gable returns are the only adornments on this building.

A lilac bush, along with some bittersweet, can be found in the back yard.

The building has no gutters, the paint is failing, and a hose coming from the basement suggests a water problem.

Most recently, the Hadley House had been in use as staff housing. Vacated about seven years ago, the house is now used for storage by the region, is in non-functioning condition and is on the agency demolition list. As the timing of demolition is unknown, park staff plans on repainting the building in 2014 to make it less of a potentially attractive nuisance.



Hadley House (DCR)

A well maintained, detached two car garage in satisfactory condition is located just south of the Hadley House. Built c 1960, the side gabled garage has a concrete slab foundation, clapboard walls and an asphalt shingle roof. A gutter is located on the front wall, but not the rear wall of the garage.

Park staff currently use this garage for snowmobile storage, and do not plan to demolish the building.

**Anderson Barn.** Located at 360 Curve Street, this one-and-one-half-story, side gabled 19<sup>th</sup> century barn has a fieldstone foundation, clapboard walls and an asphalt shingle roof. The primary façade has a pair of adjoining entrances, located slightly off center. One is composed of a set of double doors that swing inward; directly next to it is a small entrance that has an intact sliding door that is affixed to the exterior. Built into a bank, an on grade entrance to the basement level is visible on the west side façade, but not accessible due to vegetative overgrowth. Six-over-six, double-hung sash windows are present on the side and rear walls of the building. This barn has several architectural details not always present in such a utilitarian structure, including: corner boards, a full cornice that wraps the building, an overhanging eave, decorative gable end treatments, and wide and flat trim around the windows that includes a small projecting cornice.

The building is in unsatisfactory condition. Paint is failing on the wall, and some small holes have been addressed by stapling mesh wire over them to prevent access by rodents. Interior evidence suggests some recent insect damage. Lichen is starting to grow on the roof and vegetation is encroaching on the side and rear façades of the building.

This building has electrical service, and is currently utilized for storage by the regional office (including IT equipment and former exhibit materials), as well as the regional Foresters and district Fire Control. It abuts private property and is across the street from another private property that maintains horses on site.



Anderson Barn (DCR)

#### *Vacant Buildings*

**Duck Coop.** Located just to the east of the Main Farm House, the Duck Coop is a small shed roofed

outbuilding built into a bank, with the lower level providing access to a low, poorly drained area that used to function as a seasonal pond. The building has a concrete foundation, clapboard walls and an asphalt shingle roof.

Moss and lichen are present on the roof, and the foundation has been compromised by the roots of the directly abutting trees. Due to the foundation damage, this building is in unsatisfactory condition.



Duck Coop (DCR)

**Farnham Smith's Cabin.** This cross-gabled, L-shaped, single-story cabin was built by Farnham Smith in 1939 as a summer retreat, prior to his establishment of Great Brook Farm. Located adjacent to the Adams Mill site, the cabin provided him with a private spot on a small pond.

Built partially on stone and concrete piers and partially on a fieldstone foundation, the building has a shed roofed front porch and a centrally located rubblestone chimney. Although at first glance it appears to be a log cabin, the building is actually a wood frame building with half round logs that have been applied as exterior sheathing. Since they are not structural, the log ends are mitered at the corners. Exposed rafter tails complete the rustic look. The building was wired for electrical and phone service, and was also outfitted with a security system by Smith (none of these services are currently live).

The cedar shake roofing has deteriorated to the point where there are a several holes in the roof, coupled with minor vegetation growth. At least one interim repair effort involving tar paper occurred, possibly covering an earlier hole. The porch steps are deteriorating as well. The building is in unsatisfactory condition.

In the sale of the property, Farnham Smith negotiated use of the log cabin for an additional eight years. After use reverted to the DCR, the cabin

was periodically rented out for day use, primarily for corporate retreats. It was then briefly utilized as staff housing in the early 1990s. The windows are now boarded over, the door is locked, and the building is posted with “No Trespassing” signs.



Farnham Smith's Cabin (DCR)

**Farnham Smith's Cabin Shed.** A small, one-by-one bay front gabled shed is located adjacent to Farnham Smith's Cabin. Sheathed in cedar shingles, the shed is built on piers, has a tar paper roof, and is in satisfactory condition. A small open lean-to, probably used for protecting firewood, is located directly in front of this shed. Park staff does not have a key and do not use the space. Materials stored within the shed appear to date to use of the property by the former resident.



Cabin Shed and Lean-to (DCR)

**Boat House.** A small, one-story, three-by-one bay front gabled building located on the southwest end of Meadow Pond, the Boat House has a full-width front porch and rear addition. Built on a concrete block foundation, the building has drop board siding and an asphalt shingle roof.

The Boat House, unused since the early 1970s, is currently in extremely poor condition and considered to be in a state of critical failure. It has been posted

with “No Trespassing” signs and is marked off with snow fencing to discourage people from exploring the site. Chunks of siding are missing, portions of the roof are caving in, and a section of sill appears to no longer exist.

The building is slated for demolition. As per a Memorandum of Agreement with Massachusetts Historical Commission, documentation on an MHC inventory form is underway.



Boat House (DCR)

The **District 6 Fire Control Office**, historically known as the South House, is located at 841 Lowell Street. This c1950 traditional Cape Cod style former residence is a one-and-one-half story, side gabled, three-by-two bay building. The house has a concrete block foundation, a clapboard exterior, and an asphalt shingle roof. The front slope of the roof was replaced in the recent past with architectural style shingles; the rear slope has standard three-tab style shingles.

Two front gabled dormers punctuate the roof line and a single story breezeway connects the main block to a two car garage. Windows are six-over-six and eight-over-twelve double hung wooden sash. A brick chimney pierces the front slope of the roof, slightly off-center.

The exterior siding has some holes, and other minor deterioration, and the paint job is failing. There may be some foundation sill issues and several window sills are deteriorating. The building no longer has gutters and as one result, the front fascia board is deteriorating. The basement has water issues, as evidenced by the pipe leading out from a basement window.

This building was utilized as the District 6 Fire Control Office and also housed some regional staff until 2010, when those operations relocated to the new, large garage and office built on site to the rear of this building. (See the Infrastructure section for



more information.) At that time, the septic system for this building was retrofitted and re-permitted for use by the new building. This house is in unsatisfactory condition, and is on the agency demolition list.



District 6 Fire Control Office (DCR)

The *Manseau House*, historically known as the West Farm, is located at 1112 Lowell Street. This three-by-two bay, two-story, central entrance home with a hipped roof, reflects a plan that was popular in the first quarter of the 20thc. A hipped roof entry porch with some scrollwork adorns the façade, and a small single story shed roofed addition has been added to the rear entrance. The home has a fieldstone foundation, late stage aluminum siding, and an asphalt shingle roof. There are no gutters.

Two brick chimneys are present: an exterior one on the south façade and an internal one that pierces the north slope of the roof. Windows are primarily two-over-two double hung sash. Historic photos show a central hipped roof dormer, removed sometime after 1973.

The house is in poor shape. English ivy, growing up the south side and rear walls, appears to have infiltrated the interior of the home. The internal chimney is leaning and the rear entry porch is collapsing.

Most recently, the Manseau House had been in use by regional fire control as storage until about 2008, and prior to that as staff housing. Vacated by the last residents approximately 10 years ago, the house is in non-functioning condition and is on the agency demolition list.



Manseau House (DCR)

A well maintained, detached, two car garage in excellent condition is located behind the Manseau House. Built c1960, the hipped roof garage has a concrete slab foundation, clapboard walls that have recently been repainted, and an asphalt shingle roof.

The District Fire Control staff currently uses this garage for vehicle and other storage, and there are no plans to demolish this building.

**North Farm House and Barn.** Located at 107 Old North Road, this well maintained, one-and-one-half-story, cross gabled, five-by-three bay home has a fieldstone foundation, clapboard sheathing and an asphalt shingle roof. The house has two brick chimneys – an exterior one on the south façade and an interior one in the north end of the building. Windows are six-over-six double hung sash. The building is situated on a small rise with nice views of the fields to the south and the barn to the east. Extensively renovated and added onto in 1961, it appears this was originally a Cape Cod style home that had the front gable added to the north half of the front façade.

This home was utilized for staff housing until March, 2014, vacated as part of the discontinuance of the staff housing program. There are no current plans for its future use, but park staff would like the house to be reused in some capacity, especially since it is located on the edge of the park property. Neighbors have already expressed concerns to park staff, and are worried about vandalism.



North Farm House (DCR)

The North Farm House Barn, just east of the house, is a one-and-one-half-story barn with a gambrel roof. Built into a small bank, the foundation is poured concrete, the sheathing is dropboard and the roof is covered with asphalt shingles. The windows appear to be fixed wooden sash and exposed rafter tails provide the only adornment. The barn has also been well maintained.

The lower level of the barn has been used for park storage for many years, while the tenant utilized the upper level of the barn. Park staff has expressed an interest in using the upper level for additional storage, ideally for equipment that cannot stay in the Hart Barn during the winter, but no decisions have been made.

**Structures.** There are a number of different historic structures located within the park.

#### *Bridges and Culverts*

Along the Woodchuck Trail is a small **bridge** that is graced on one corner by a short cobblestone pillar with a concrete cap. The pillar appears to have had electrical service to it at some point, possibly to light the bridge. This bridge, constructed of non-historic wooden decking that rests on historic stone and concrete abutments, spans a small stream bed. The abutments appear to have been originally stone, but partially rebuilt through the addition of concrete. A concrete gate is located about 20 feet upstream from the bridge, probably utilized to create a small impoundment and control water flow.



Small bridge on Woodchuck Trail (DCR)

A **stone arch bridge** is located on the Pine Point Loop Trail, just north of the Boat House. This at grade crossing consists of a triple arch stone bridge, composed of dressed granite blocks, with low stone curbing for sidewalls, and an earthen pathway. Round holes are visible in the granite curbing, although their original purpose is unclear. While this spans the outlet of Meadow Pond, water seems to be creating problems at either end of the bridge. Debris is visible on the upstream side of the bridge and little headspace is visible through the arched culverts, suggesting that either the water level of the pond has risen over time, or that the openings may be partially blocked and impeding water flow beneath the bridge at the rate needed.



Stone bridge on Pine Point Loop Trail (DCR)

A small stone and earthen **causeway**, outfitted with a stone culvert, is located just west of the stone bridge. The culvert is composed of rough dry laid fieldstone.

#### *Farm Structures*

**Pole Barn.** This partially enclosed, side gabled barn is actually a post and beam structure with a corrugated metal roof. Where exterior walls exist, they have board and batten siding. Vegetation is

encroaching upon the rear (northern) façade of the building.



Pole Barn (DCR)

**Bunk Feeder.** The Bunk Feeder, an open air pavilion, provides shade for the farmers’ cows and is a space used for feeding. This wood frame building has a corrugated metal roof that appears to have some minor damage, including small spots of corrosion.



Bunk Feeder (DCR)

Both the Pole Barn and the Bunk Feeder were constructed during Smith’s ownership of the property, and are currently used for Heifers of breeding age. Both structures are in satisfactory condition.

**Metal Stave Silo.** This silo, one of two on the property, is located between the Pole Barn and the Bunk Feeder. It appears to be in satisfactory condition, but it is no longer used for silage.



Metal Stave Silo (DCR)

A few additional small farm structures of indeterminate age are located in the core farm area, most notably a chicken coop and a pig shed.

#### *Other Structures*

Segments of **stone walls** can be seen in many areas throughout the park, both within the woods as well as alongside some of the roadways. These walls, predominantly dry laid loose rubble, vary in condition from failing to being in good condition. These walls show how this land was used and divided over the past three centuries.

A section of **concrete retaining wall**, poured in stages, is located on the south side of North Road, across the street from the Main Farm House. The function of this retaining wall is not entirely clear. It is almost entirely covered in moss.

A free standing **stone and brick hearth**, designed for outdoor grilling, is located just south of the Adams Mill remnants, not far from Farnham Smith’s Cabin. Designed with two levels for cooking, it has a full chimney to direct smoke away from the cook. The hearth likely dates to Smith’s development of this piece of property as his cabin retreat.



Outdoor Stone and Brick Hearth (DCR)

Located outside of Great Brook Farm, proper, is a fire tower, *Massachusetts State Tower #21*, also known as the Hollis Wilkins Memorial Tower. Situated on a small (.06 acre) parcel at the peak of Robbin Hill, the property at 30 Summit Avenue in Chelmsford was purchased by the Commonwealth for 50 cents in 1918. First used as a site for fire monitoring purposes in 1911, the 60-foot-tall steel tower is the fourth one on the site, dating from 1939. The current cab dates from 1970.

The tower has also served as a host to a number of pieces of telecommunication equipment since 1978, from ham radio antennae to microwave dish antenna and repeaters for state police to commercial users. The following entities currently have equipment on this tower: Nextel, Massachusetts Department of Transportation, Greater Boston Police Council (GBPC), Massachusetts Port Authority, and the Massachusetts State Police.

A structural analysis of the tower undertaken in July, 2009 indicated the tower is in conformance with the requirements of the TIA/EIA-222-F standard (Structural Steel Standard for Steel Antenna Towers and Supporting Structures) for the current and antenna loading. An analysis completed in April, 2013 using the TIA-222-G-2 standard (Structural Standard for Antenna Supporting Structures and Antennas), a more critical standard, found the tower to be overloaded with the existing and proposed antenna load by the GBPC. However, the GBPC chose not to add the proposed antenna systems due to a lack of funding. When and if they obtain the necessary grant funding to proceed with the project, the GBPC will have to reinforce the tower to meet the TIA-222-G-2 standard and their proposed antenna load.

**Objects.** There are no historic objects within the park.

**Landscapes.** There are a range of historic landscapes within Great Brook Farm State Park that showcase the history of Carlisle.

The core of *Great Brook Farm* and its adjacent fields to the east and northeast collectively form an historic landscape that conveys the agricultural history of the property, and is documented on MHC inventory form #CAR.A. It is through this collection of historic buildings and structures, the farmyard, the adjacent manmade farm pond, and the immediate

surrounding fields that visitors can get a sense of what this place is, and see how dairy farming has evolved through the 20<sup>th</sup> century and into the 21<sup>st</sup>. The layout of these buildings and structures, as well as the fenced enclosures, provides pathways for visitors and safe spaces for animals and also help visitors understand how the farmyard functions. While the buildings and structures are described separately, the complex as a whole needs to be considered collectively.

Two other historic landscapes, the *Adams mill site* and *“The City,”* are discussed above, in the Historic Archaeological Resources section. The individual resources within these areas collectively make up larger historic landscapes, and each individual resource within these two sites needs to be considered within the full context of their larger landscape.

Finally, what appears to be a small unmarked family *cemetery* can be found off of the Woodchuck Trail, in the part of the park known as “The City.” A series of 11 or 12 small stones are lined up, possibly head and foot stones. While there are no inscriptions, and the stones are not formally shaped, their rectilinear layout suggests they were lined up for this purpose, and may have served the mill village community. Additional research is needed.

During the last few decades, stone features and other landscape elements in the park have been the subject of differing research perspectives. Some of the stone features in the park are interpreted as symbolic and having astronomical alignments, or anthropomorphic details, and some have been designated “prayer seats”. The public, independent researchers, historians, and archaeologists have all contributed to literature on the interpretation of the stone features within the park. The interpreted origins range from Precolumbian European exploration, Native Americans, and farmers. Because of the differing backgrounds, beliefs and agendas, a consensus on the debate has not been reached.



Cemetery (DCR)

## Recreation Resources

Great Brook Farm State Park is primarily accessed via motor vehicle, although some local residents and regional cyclists do visit by bicycle. There are no public transit options to reach this park.

The primary recreational activities at Great Brook Farm State Park revolve around its extensive network of trails. This network, encompassing over 26 miles of trails, provides a variety of trail experiences that help make this park a popular destination. From wooded areas, to the edges of open fields, to rocky areas with some hills, to low lying areas along wetlands, visitors are not apt to get bored with the scenery.

The trails are routinely used by walkers and hikers, often accompanied by a dog, and according to park staff, the occasional goat. Despite signs at trailheads informing users of on-leash restrictions, many dogs are off-leash.

This park is a popular destination for mountain biking, in part because the trail system provides a range of experiences that can accommodate riders of all skill levels; mountain bikers range from beginners to experienced riders, and biking occurs throughout the park. When surveying park users about their use of the park for this RMP, the majority of survey respondents (65%) indicated that they have biked here in the past year. Technically challenging sections are concentrated in the Stone Row and Indian Hill areas. Riders explore the park individually, as well as through organized club rides and events, including an annual event organized by the New England Mountain Bike Association (NEMBA) as a part of the Kona Bicycles MTB Adventure Series. Park staff reports that some

mountain bikers ride some of these trails after dark, despite the park officially closing at dusk.

The park's trails are also utilized by individuals and clubs for orienteering activities. The New England Orienteering Club has held events at Great Brook Farm State Park for several years, developing courses that are on- and off-trails. Other trail user groups include the Carlisle Trails Committee, the Cambridge Sports Union, and the local school system, which holds high school cross-country races as well as a local history search for third graders within the park.

The cross-country ski concession is very popular during the winter months, and serves as a major draw of visitors to the park. Over 8 miles of machine groomed loop trails are open, when there is enough snow to ski. The ski trails are restricted for use by skiers during the winter. An active effort made in 2010 to keep hikers off of the ski trails seems to be effective in maintaining the trails in good condition for skiers. The Lantern Loop, lit for nighttime skiing on Tuesday and Thursday evenings, provides visitors with a unique and interesting way to experience the park.

The ice cream stand at the main farm is also a big draw for visitors. Located at the eastern end of the Tie Stall Barn, ice cream is available on a seasonal basis. Approximately 10 picnic tables are located here for sitting and dining and checking out the farm animals. The farmers maintain a number of small farm animals in addition to the dairy cows, including goats, pigs, chickens and rabbits, for viewing in enclosures located adjacent to the Tie Stall Barn.

Equestrian use of the trails is also popular at the park. Complimenting the trail use, a series of cross-country horse jumps are located just off-trail in the section of the park south of North Road, most notably in the open fields to the west of Meadow Pond. These jumps, wooden fencing often flanked by overgrown cedars, are in fair condition. Some visitors complain to park staff (and also evident in the user survey for this RMP) about the frequent presence of horse droppings on the trails.

A canoe launch used to be located at the northern end of Meadow Pond, providing access to this body of water for canoeing and kayaking. This launch was removed in 2009 when a new large bridge was constructed nearby; some park users were unhappy

about this outcome. While there has been some discussion of designing and installing a new canoe launch area nearby, this has not yet happened. The abundance of water chestnut growth in the pond also poses an impediment to canoeing and kayaking. As a result, the use of the pond by boaters has decreased significantly in recent years.

## **Infrastructure**

### **Property Boundary**

Great Brook Farm State Park is located in the northern part of the Town of Carlisle, roughly in the middle of the triangle formed by state routes 4, 225 and 27. Easily accessible by car from interstates 495 and 95/128 and state routes 3 and 2, Great Brook Farm State Park is a popular destination park within the greater metro Boston region.

### **Buildings and Structures**

In addition to the historic buildings and structures discussed in the Cultural Resources section, there are a few more recent ones that have been constructed since establishment of the park, the two most prominent being the Nature Center Pavilion and the Smart Barn (see Figure 4).

The Nature Center Pavilion, constructed in 2002, provides a sheltered area under which interpretive programs can be held and visitors can relax at the six picnic tables. This pavilion also includes an enclosed portion that contains restrooms and an office for the seasonal interpreter.



Nature Center Pavilion (DCR)

Designed to reflect the agricultural history of the park, the cross gabled building features a standing seam metal roof, a bank of clerestory windows in the pavilion to help bring natural light into the sheltered

portion, and a gable end detail intended to appear as a haymow.

The Smart Barn, constructed in 2010-2011 and located within the farm complex, is equipped with a DeLaval robotic milking system to support the dairy farm operations. This robotic system is touted as the first one to be installed in Massachusetts. The barn, a cross gabled building with a standing seam metal roof, vertical board siding and a clerestory, evokes the history of the farm and blends nicely with the nearby historic barns.



Smart Barn (DCR)

Also in line with evolving agricultural practices, the silage for the cows is no longer kept in the tall vertical silos, still found on the property. Rather it is stored in a large trench silo, an open trench with large concrete block retaining walls on three sides and a central divider, to facilitate loading and unloading by heavy equipment.

The District 6 Fire Control Office and Garage is located at 841 Lowell Street. It does not have a very visible presence, as it is set back from the road, behind the vacant Cape Cod house, and is not open to the general public. A non-descript, tall, front gabled building with corrugated metal siding and a standing seam metal roof was constructed in 2010 to house vehicles and equipment utilized for regional fire control purposes.

There are several non-historic bridges in the park, facilitating trail connections over wet areas and streams. (For a review of historic bridges, see the Cultural Resources section.) The northernmost bridge, noted on the park's trail map, is located near the intersection of Woodchuck Trail and East Farm Trail and crosses River Meadow Brook. This is a wide bridge, to accommodate park vehicles if needed, constructed of preformed concrete abutments and wooden decking.

Two wooden pedestrian bridges are located over the sluiceways at the Adams mill site, located near Farnham Smith's Cabin.

The largest bridge is located next to the parking area at the Pine Point Trail Loop. It is a wide bridge with a metal truss and wooden decking, sturdy enough to accommodate vehicular traffic. Installed in 2009, this bridge provides a connection to the other end of the loop so that trail users can avoid walking on North Road. As a part of the network of groomed ski trails, this safe connection is also important to skiers.

Non-historic culverts can also be found within the park, in an effort to control water flow. Near the northern intersection of the Woodchuck Trail and Garrison Loop is a concrete culvert, bridged by wooden decking on the trail. This culvert, equipped with a small gate controlled by wood boards to control water flow, has been outfitted with a beaver deceiver. A lot of brush debris has collected around the deceiver and the wetland itself has a lot of vegetation.



A culvert at the intersection of Woodchuck Trail and Garrison Loop. (DCR)

Two other smaller pipe culverts can be found along the Woodchuck Trail.

The last category of non-historic structures is a collection of three rock shelters located in the northern portion of the park, off of the Stone Row trail. These three shelters, one with a functioning chimney, are composed of dry laid fieldstone constructed around an existing glacial outcrop, with makeshift roofing composed of branches.



Rock Shelter (DCR)

Due to local lore suggesting that these may have past and present Native American associations, one of these rock shelters was investigated during the 1995 archaeological survey of the park (Dwyer 1995). After a walk over of the site with local Native American representatives, as well as subsurface testing within one of the shelters, it was determined at that time that these are not affiliated with past or present Native American use of this land.

Park staff indicates that these shelters have been created since the development of the property as the state park. The structures reportedly began as the work of a local park user, a mason that was interested in modern druid culture, and have since been altered, rebuilt, or new ones created by others. According to long time park staff, these have only been in place for approximately the last 25 years.

### Roads

Curve Street, Lowell Street and North Road are all town-owned, locally designated scenic roads (see Figure 4). These roads provide access to Great Brook Farm State Park. While these roads are not owned by the park, impacts to any stone walls or trees on DCR land that fall in the right of way of these roads must be first seek the written consent of the Carlisle Planning Board.

### Parking

The main parking area for the park, located off of North Road, provides easy access to the Nature Center Pavilion, the farm and the ice cream stand (see Figure 4). This paved lot accommodates over 80 vehicles, and has two spots allocated for handicapped parking. A parking fee of \$2.00 is

charged seasonally (April 1<sup>st</sup> – December 1<sup>st</sup>) via a pay and display machine located on site. This parking lot contains over 20 signs, 12 of which concern parking and the use of the pay and display machine. Some of these signs are official looking, while others are laminated paper.

Adjacent to this parking lot is a low impact rain garden that the DCR installed in 2010. The garden is planted with native flowers and shrubs, and it catches and filters the water run off from the parking lot and the Nature Center Pavillion.

A paved parking lot is also located at the North School House that now serves as the park headquarters (see Figure 4). This parking area, which primarily serves park staff, is also available for public use. The lot can accommodate approximately seven vehicles and it has one spot that is demarcated for handicapped parking.

A small parking area is located off of North Road at the trail head for Pine Point Loop, adjacent to the former canoe launch location (see Figure 4). This unpaved lot holds four to six vehicles. This location also has a lot of signage and includes four separate signs that address parking and are clustered in one area. None of these signs utilize the actual name of the park.



Signage at the Pine Point Loop parking area. (DCR)

Another small, unpaved lot is located at the intersection of Lowell Street and North Road, and can accommodate parking for approximately four vehicles (see Figure 4). This area is needed for large vehicle turnaround purposes rather than parking, but it is not signed as such.

Parking is also available in the former field directly adjacent to the Hart Barn, and serves the cross-country ski concession (see Figure 4). This unpaved lot can accommodate approximately 120 vehicles. A parking fee of \$2.00 is charged seasonally (April 1<sup>st</sup>

– December 1<sup>st</sup>) via a pay and display machine located on site.

### Trails

Great Brook Farm State Park has an extensive and well utilized trail network spread over its 929 acres. This network includes a little over 24 miles of official trails (see Figure 4) and almost two miles worth of additional, unofficial trails.

Of the network of official trails, 0.5 miles are administrative roads, including the entrance to the District 6 Fire Control Office and Garage, as well as the roads within the farm complex. Unpaved forest roads make up 11.5 miles of the network and the remaining 12 miles are trails.

A survey of the trail network within Great Brook Farm State Park was undertaken in 2010. At that time, 19.4 miles were deemed to be in good condition, 4.6 miles were in fair condition, and only 0.3 miles were in poor condition, a fairly low percentage (1.5%) than is typical in other DCR properties, possibly reflecting the presence of the cross-country concession and their use of the trails and the strong volunteer participation in trail construction and maintenance by the mountain biking community. This survey does not reflect the condition of those trails that were subjected to extensive flooding while conducting fieldwork for this RMP. Some of the trails around Meadow Pond in particular were impassable due to flooding, interrupting the trail network in this area.

A series of short boardwalks are placed throughout the trail system, where necessary, for erosion control or wetland and stream crossings. Some of these structures are in good condition, while others are aging.

Great Brook Farm State Park is unique within the DCR system, as it separates trail users during the winter season. During the winter, 8.3 miles of trails in the eastern section of the park are set aside for the exclusive use of cross-country skiers. These trails are groomed to facilitate use by skiers and all other users are encouraged to use the remaining trails that are open to multi-purpose use, most of which are located on the western side of the park. Some trails in the eastern section of the park are closed to all uses during the winter season, if they connect to the groomed trails, but are not groomed for use by skiers. This practice has helped to reduce user



conflicts and maintain a high quality network of groomed trails for use by skiers.

Two trail maps have been developed for Great Brook Farm State Park; one is for summer use, while the other shows the separation of trail uses during the winter. These trail maps are available on the park's webpage, on the DCR's website, as well as at the Hart Barn (during the winter) and in the park headquarters at the North Schoolhouse.

#### Signs and Kiosks

There is one Road Marker Sign that leads visitors to the state park, located in the center of Carlisle. There is one Main Identification Sign for the state park, located at the intersection of North and Lowell roads. The orientation, material and design of this sign does meet DCR signage standards (DCR n.d.). The sign is surrounded by ornamental plantings that are starting to get tall enough to obscure the bottom of the sign.

There are two informational kiosks located at the park; one is located at the eastern end of Hart Barn parking area, and the other is located within the farm complex.

Informational signage is also located within the Nature Center Pavilion, where a glass enclosed bulletin board is located on one wall, next to a wildlife sighting white board for use by visitors.

Additional interpretive signage is also located within the Smart Barn, informing visitors about the robotic milking system.

A routed wooden sign, now partially broken, marks the site of the Garrison House.

In the user survey undertaken for this RMP, several individuals suggested that better trail signage is needed.

#### Memorials and Markers

There is one memorial within the park, dedicated to Prospera, a prized cow of Farnham Smith's. Prospera was a champion Holstein heifer, who routinely won prizes from the Holstein-Friesian Association for her level of milk production. She is buried at the entrance to the farm, just off of North Road, and the spot is marked by a stone with a brass plaque that has raised lettering:

PROSPERA  
1949 – 1969

## **5.4. MANAGEMENT RESOURCES AND PRACTICES**

See Section 2, Management Resources and Practices, for a description of the management resources and practices that apply to the entire Lowell/Great Brook Planning Unit.

### **Natural Resources**

#### Water Resources

**Drinking Water.** The Transient Non-community Ground Water Sources (TNCs) within the park are tested under contract by WhiteWater Environmental Inc., a Massachusetts certified operator. These systems are operated in accordance with applicable regulations (310 CMR 22; Appendix F).

Massachusetts' regulations require a circular protective area around public water supply wells, including TNCs. The radius of this protective area, known as a Zone I, is based on the well's pumping rate. The DEP requires that activities within Zone I be limited to those directly related to the provision of water. Best Management Practices (BMPs) for protecting Zone I areas include the following (DEP 2001):

- Keep out non-water supply activities.
- Do not establish parking areas.
- Do not store or use lawn chemicals, road salt/deicers, motor oil, gasoline or paints.
- Remove or relocate underground storage tanks, hazardous materials, and septic systems, if possible.
- Use propane or natural gas powered pumps.
- Seal floor drains.
- Properly label, store, and dispose of hazardous substances.
- Restrict access to the well and post water supply protection signs.

These are recommendations, and not requirements.

#### Vegetation

As part of the long-term lease agreement with the farmers, there are 16 separate fields, totaling 74 acres that are actively managed for agricultural purposes.

## Wildlife

A population of beavers has been present in Great Brook Farm State Park for several years, and their dam building and culvert blocking activities effect water levels, impacting the surrounding trail system. The current approach to beaver management includes the installation of beaver deceivers at some of the culverts where there has been a lot of beaver activity, along with beaver trapping by a wildlife contractor through the DCR's Lake and Ponds Program. The wildlife contractor is used at least annually, and makes the final assessment on which approach will be most effective to address the problems on hand.

Great Brook Farm State Park has been included in a statewide *Cerceris* wasp monitoring project that started in 2010. The *Cerecreis* wasp is a non-stinging wasp that makes nests in sandy soils and prey on Buprestid beetles, a family of beetles that includes the Emerald Ash Borer (EAB). Monitors examine what kinds of beetles the wasps are bringing back to their nests as one method of potential early detection of EAB. The data is currently very limited, but EAB has not been detected in the nests of the population here.

## **Cultural Resources**

The Litchfield House is under lease with the DCR and is being rehabilitated, occupied and maintained as a single family residence by Darrold and Janet Fritz-Endres through the DCR's Historic Curatorship Program. Through the program, outside partners are selected through an open and competitive proposal process to help the DCR preserve some of its vacant and dilapidated historic properties in exchange for a long-term lease. The current tenants signed a twenty-five year lease in 1996, have rehabilitated the house and grounds, and are in the final stages of restoring the historic barn. The curator's responsibilities for the property include the complete rehabilitation of the house and its systems, management of its reuse (including all utility and insurance costs), and all maintenance responsibilities for the house and surrounding 1.08 acres.

The Hounds House has been under lease to Old North Bridge Hounds since 1994. This lease was established by legislation (Chapter 424, S-1234, 1993), and there have been two subsequent lease clarifications between the Department and the

lessees, in 2002 and 2007. As part of the 2007 clarification, the lessee agreed to pay the DCR \$550.00 per month and to perform capital repairs on the buildings and grounds at 649 North Road. This lease expired on December 31, 2013; the business owners would like a new lease. While this issue is pending resolution, the lessees are continuing to pay their monthly rental fees to the agency.

Great Brook Farm itself has been leased to Mark and Tammy Duffy since 1987. The original lease, ten years in length, was extended first in 1997, and again in 2007, and next expires on April 30, 2017. The lease was amended in July, 2011 to include language covering the Smart Barn, and establish ownership and maintenance responsibilities, as well as to bring some other language up to date, including insurance provisions. Their lease area consists of 90 acres, including the farm complex, farm buildings several fields and the cranberry bog. As part of the lease agreement, the farmers pay two percent of their gross retail on a quarterly basis to the DCR. Stipulations include the provision of some public access in selected areas of the farm during park hours, and maintaining building interiors and equipment.

## **Recreation Resources**

The Hart Barn has been in use as the Great Brook Ski Touring Center, operating under a series of permit agreements with the same operators since the 1983-1984 ski season. The operators groom the designated ski trails and provide lighting on some of the trails during the ski season for nighttime skiing. The current permit for this operation runs through the 2017-2018 ski season.

For the equestrian features within the park, the DCR mows the fields where the equestrian jumps are located; the local equestrian group maintains the jumps.

## **Infrastructure**

Multiple buildings and structures are managed by outside lease holders (see Cultural Resources, above, for more information). Management responsibilities for these resources are stipulated in their lease agreements. Since these resources are predominantly historic, they must also coordinate their efforts in consultation with the DCR's Office of Cultural Resources.

## Interpretive Services

A Comprehensive Interpretive Plan was drafted in 2011 for Great Brook Farm State Park by the DCR's Interpretive Services staff. Due to staff workload issues, this plan has not yet been finalized.

The Nature Center Pavilion serves as the home base area for interpretive services. Tours revolve primarily around the farm complex, and currently emphasize the workings of the dairy farm and the technological aspects of the Smart Barn. Tours run on weekends from Memorial Day through Columbus Day.

A Seasonal Interpreter is on site from mid-April through mid-October, providing guided tours of the farm complex, conducting junior ranger and nature programs, guiding school groups, and assisting with the planning and implementation of two major events, Picnic on the Farm, held the first Sunday in June, and Down on the Farm, held the last Sunday of September.

Great Brook Farm State Park is a participant in the Park Passport Program; the passport box is located within the Nature Center Pavilion.

## Operational Resources

### Supplemental Staffing

Mark and Tamma Duffy operate and staff the agricultural business at the park as part of the terms of their long-term lease agreement. The farm is a key attraction of the park, and the farmers maintain their lease areas so that the public can access much of it.

The park occasionally gets the assistance of a crew of volunteers from the Student Conservation Association (SCA) for specific trail-related projects. In the summer of 2013, the group did work on the Acorn Trail that will be continued in the summer of 2014.

Members of the Merrimack Valley Chapter of the New England Mountain Bike Association (MV-NEMBA) also volunteer at the park, and have been involved with trail construction within the park, as well as the purchase, construction and installation of boardwalks.

Given the wide range of opportunities this park presents to visitors, the many active user groups and the network of local and regional conservation

organizations, the potential exists for the reformation of a Friends of Great Brook Farm State Park and their involvement in activities at the park.

### Public Safety

DCR Rangers issue citations for violations of various forest and park rules. A summary of incident reports recorded in the state park during 2013 is provided below.

**Table 5.4. Great Brook Farm State Park Incident Reports, January 1 through December 31, 2013**

| <b>Incident</b>                           | <b>Number</b> |
|-------------------------------------------|---------------|
| Violation of DCR regulations <sup>a</sup> | 3             |
| Suspicious activity                       | 1             |
| <i>Total</i>                              | <i>4</i>      |

a. These violations were related to after hours use of the park and dogs not under control.



A large eastern white pine tree at Carlisle State Forest. (DCR)

## SECTION 6. CARLISLE STATE FOREST

### 6.1. INTRODUCTION

Carlisle State Forest is the second smallest facility in the Lowell/Great Brook Planning Unit. Covering 25 acres, this property is tucked behind some relatively recent residential development (a subdivision known as Tall Pines), west of Hutchins Road. Access to the property is provided by Forest Park Drive on the south and Barnes Place on the north. Town owned conservation land and property owned by the Carlisle Conservation Foundation, a local land trust, abuts the property to the west.

### 6.2. HISTORY OF PROPERTY

In November of 1901, prominent landscape architect Warren Manning learned that a collection of about 100 very large eastern white pine were about to be harvested for lumber. Concerned about preserving this collection, he obtained a stay of proceedings and secured an option on the property, and convinced his fellow members of the executive committee of the Massachusetts Forestry Association to raise the funds to purchase the property.

Working in partnership with the Appalachian Mountain Club (AMC), \$1,600 was raised through subscriptions by early 1902 to purchase

approximately nine acres, with some excess funds collected going towards the AMC, which had agreed to serve as the property owner (Massachusetts Forestry Association, 1902a and 1902b).



Warren Manning at the Carlisle Pines. (Iowa State University Library Special Collections)

The AMC laid out trails and posted markers, and also selectively thinned some hardwoods on the property in order to showcase the large pines, improve growing conditions, and control gypsy moths (Goodall 1970; Shepard 1913). In 1912, the AMC expanded the reservation through the purchase of approximately 10 additional acres, and increasing

the collection of very large eastern white pine to approximately 150.

In 1934, the AMC sold the Commonwealth the Carlisle Pines and two other AMC reservations in Billerica and Warwick, with the stipulation that if these properties are no longer to be used as state forests, ownership would revert back to the AMC. Following transfer of the property to the Commonwealth, some small red pine plantations, as well as some additional white pine and Norway spruce were planted. The Hurricane of 1938 caused significant damage, knocking down all but 28 of the large eastern white pines, and after the Hurricane of 1954, further pines were lost. By 1980, there were only 14 of the large eastern white pines still standing (Stoddard 1980).

### 6.3. EXISTING CONDITIONS

#### Natural Resources

##### Physical Features

**Topography.** Carlisle State Forest is located between two ridges, and has relatively level to gently rolling terrain.

**Geology.** Carlisle State Forest falls within the Nashoba Terrane, formed of plutonic and metamorphic rocks including metamorphosed volcanic rock rich in biotite and hornblende. Surficial glacial deposits are found in the forest (Skehan 2001).

**Soils.** The soil of Carlisle State Forest consists primarily of Charlton-Hollis-Rock outcrop complex, which is a combination of soils and exposed bedrock encompassing about 50% Charlton soils, 25% Hollis soils, 15% rock outcrop and 10% other soils (Peragallo 2009). Found in upland areas, the Charlton soils can be found on toe slopes, while the Hollis soils are on hilltops and ridges. There are only slight limitations when it comes to potential trail and path development, with moderate limitations in areas where slope exceeds 15%. The Hollis soils are shallow and raise the risk of blown down trees, which could impact the forest. The Deerfield loamy sand, a very deep soil type, can be found on glacial stream terraces and deltas. These soils present moderate limitations to trail and path development due to its sandy composition (Peragallo 2009).

**Table 6.1. Soils of Carlisle State Forest**

| Soil Series                          | % of Forest | Drainage Class                               |
|--------------------------------------|-------------|----------------------------------------------|
| Charlton-Hollis-Rock outcrop complex | 74.0        | Well drained to somewhat excessively drained |
| Deerfield loamy sand                 | 18.9        | Moderately well drained                      |
| Swansea muck                         | 5.6         | Very poorly drained                          |
| Whitman fine sandy loam              | 1.3         | Very poorly drained                          |
| Scarboro mucky fine sandy loam       | 0.2         | Very poorly drained                          |

##### Water Resources

**Ponds.** There are no ponds within the forest.

**Wetlands.** There are two small wooded swamp areas in Carlisle State Forest (see Figure 5). On the western edge of the property is a 0.4 acre wooded swamp composed of deciduous trees. On the southern edge of the property is a 0.6 acre wooded swamp composed of mixed trees.

**Vernal Pools.** There are no vernal pools within the forest.

**Streams.** There are no streams within the forest.

**Groundwater.** There are no aquifers beneath the forest.

**Flood Zones.** A very small sliver of the western most corner of the forest, 0.05 acres of property, falls within the 500-year flood zone.

##### Rare Species

There have been no rare species recorded in the forest.

##### Vegetation

**Forest Types.** Carlisle State Forest exists today due to an effort led by Warren Manning to protect an impressive stand of 200+ year old, very large eastern white pine from being logged in 1901. At the time, there were approximately 150 large, mature growth white pine; the hurricanes of both 1938 and 1954 took a serious toll on this stand and by 1980 only 14 remained (Stoddard 1980). DCR Forestry staff recently noted that more have since come down. Known historically (and locally) as the Carlisle Pines, Carlisle State Forest includes a stand of white

Placeholder for Figure 5.

Pine, some hemlock, and a small, centrally located plantation of red pine.

In 2003, the James W. Sewall Company developed a forest inventory/land cover classification dataset for the state forests and parks. The dataset is primarily based on the interpretation of infrared aerial photography, a process that identified four forest sub-types within Carlisle State Forest (Table 6.2). Some large eastern hemlock that appear to be old was also identified here during the RMP fieldwork, some of which appear to have been impacted by Hemlock Woody Adelgid.

There are no Continuous Forest Inventory (CFI) plots within Carlisle State Forest.

**Table 6.2. Forest Sub-types of Carlisle State Forest**

| Forest Sub-type          | Acres                   | % of Forest |
|--------------------------|-------------------------|-------------|
| Eastern white pine       | 10.0                    | 40.0        |
| Mixed oak                | 7.3                     | 29.2        |
| Eastern white pine – oak | 3.0                     | 12.0        |
| Red pine plantation      | 0.6                     | 2.4         |
| <i>Total</i>             | <i>20.9<sup>a</sup></i> | <i>83.6</i> |

a. The difference in total acreage is due to the exclusion of wetlands and areas of open water, as well as changes in the forest’s boundaries since 2003.

**Priority Natural Communities.** There are no Priority Natural Communities within the forest.

**Invasive Species.** Common buckthorn (*Rhamnus cathartica*), a deciduous small tree or coarse shrub, threatens wetlands and field edges, where it can suppress other species. It has been observed in the southern portion of this forest in the past. Common buckthorn is often spread by seed dispersal through birds.

**Pests and Disease.** Hemlock woolly adelgid is present in the Eastern hemlock trees on this site. No other information has been located to date on pests and disease at Carlisle State Forest.

#### Wildlife

**Birds.** There is little current information on the forest’s birds. Over 175 species that have been identified in some of the other properties in this planning unit, and may possibly occur within the forest, are listed in Appendix G, Table G.1.

**Mammals.** There is little current information on the forest’s mammals. Over 45 species that have been identified in some of the other properties in this

planning unit, and may possibly occur within the forest, are listed in Appendix G, Table G.2.

**Reptiles.** There is little current information on the forest’s reptiles. Over 15 species that have been identified in some of the other properties in this planning unit, and may possibly occur within the forest, are listed in Appendix G, Table G.3.

**Amphibians.** There is little current information on the forest’s amphibians. Over 15 species that have been identified in some of the other properties in this planning unit, and may possibly occur within the forest, are listed in Appendix G, Table G.4.

**Fish.** There is no current information on the forest’s fish.

### **Cultural Resources**

#### Pre-Contact Archaeological Sites

There are no recorded pre-Contact sites in the Carlisle State Forest, and the forest has not been subject to an archaeological survey. The physical characteristics, regional setting, and the known patterns of pre-Contact occupation in the region all confer a high archaeological potential for the forest.

#### Historic Archaeological Resources

There are no recorded historic archaeological sites in the Carlisle State Forest, and the forest has not been subject to an archaeological survey.

#### Historic Resources

**Buildings.** There are no historic buildings within the forest.

**Structures.** A dry laid stone wall lines much of the eastern boundary of Carlisle State Forest. A segment of another dry laid stone wall is centrally located on the west side of the property, and runs east to west. Constructed of glacial till, these walls are in fair to poor condition.



A stone wall in Carlisle State Forest, with a granite boundary marker in the foreground. (DCR)

**Objects.** A small granite boundary marker was identified next to the stone wall that lines the eastern boundary, near the Forest Park Drive entrance.

**Landscapes.** The stand of very old and large eastern white pines that are located in the northwest section of the property inspired the protection of this land, and the creation of the state forest. These natural resources have not only catalyzed the protection of this land, but are the primary draw for visitors to this small parcel and have become a part of its history.

### **Recreation Resources**

Carlisle State Forest is primarily accessed via motor vehicle or on foot by local residents. Individuals who live nearby may walk or ride their bicycle to one of the two trailheads. There are no public transit options to reach this forest.

Recreation resources are limited to a network of 0.7 miles of trails through Carlisle State Forest. These trails are used primarily for hiking, as well as some dog walking, mountain biking, horseback riding, snowshoeing and cross-country skiing.

There is one known geocache located here as of October 2013.

### **Infrastructure**

#### **Property Boundary**

Carlisle State Forest is a 25 acre undeveloped property in the northwest section of Carlisle, located west of Curve Street and north of Westford Road /Route 225. Town owned conservation land and property owned by the Carlisle Conservation

Foundation, a local land trust, abuts the property to the west. Much of the eastern boundary is marked by a stone wall.

#### **Buildings and Structures**

There are no buildings or structures in the forest.

#### **Roads**

There are no roads in the forest.

#### **Parking**

There is no parking at Carlisle State Forest. At the end of Barnes Place, there is one unpaved parking space; it appears to be located on the abutting Town of Carlisle conservation land. Neighbors do express occasional frustration with the lack of parking in the area.

#### **Trails**

There are approximately 0.7 miles of well maintained trails in Carlisle State Forest. This network was mapped and assessed in 2009, and determined to be in good condition.

A trail map has not been created for Carlisle State Forest, and there is no information on the DCR website for the forest or its network of trails.

#### **Signs and Kiosks**

There are no Lead-in or Main Identification signs for Carlisle State Forest. The remnants of a wooden sign stanchion are located just off trail at the Forest Park Drive entrance. The only indications that this is state property are some boundary markers, found mostly at the southern edge of the property.



The former entrance sign stanchion. (DCR)

There are no informational kiosks at Carlisle State Forest.



### Memorials and Markers

There are no memorials or markers in the forest.

## **6.4. MANAGEMENT RESOURCES AND PRACTICES**

See Section 2, Management Resources and Practices, for a description of the management resources and practices that apply to the entire Lowell/Great Brook Planning Unit.

### **Natural Resources**

#### Vegetation

The DCR's forestry staff has periodically undertaken inventory of the remaining large eastern white pines, recording measurements. However, the most recent inventory was completed in 1980 (Stoddard 1980).

#### Wildlife

The DCR does not actively manage wildlife at Carlisle State Forest.

### **Cultural Resources**

There are no cultural resource management activities that are unique to this state forest.

### **Recreation Resources**

With the exception of keeping the small network of trails clear and usable, there are no other recreational resources in need of active management at this forest.

### **Infrastructure**

With the exception of the small network of trails, there is no other infrastructure at this park to manage.

### **Interpretive Services**

Interpretive service programs are not offered at Carlisle State Forest, nor is any other interpretive information provided.

### **Operational Resources**

#### DCR Staffing

Carlisle State Forest does not have any full or part-time DCR staff on site.

### Supplemental Staffing

The Carlisle Trails Committee has, in the recent past, completed volunteer trail clean ups on the trails at Carlisle State Forest, in conjunction with their work at the abutting town conservation lands.



A fitness trail through a white pine plantation at Warren Manning State Forest. (DCR)

## SECTION 7. WARREN H. MANNING STATE FOREST

### 7.1. INTRODUCTION

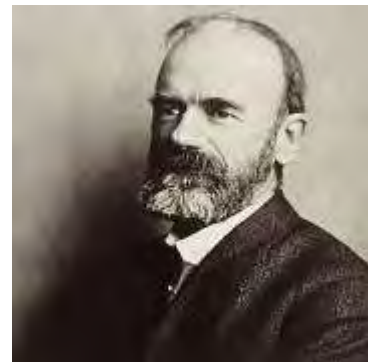
Warren H. Manning State Forest, named for influential landscape architect Warren H. Manning (1860 – 1938), is a 183-acre property located in the northwest part of Billerica. The forest is located predominantly on the east side of Route 3, and is bisected by Chelmsford Road/Route 129 into two distinctly separate sections: a developed northern section and an undeveloped southern section (see Figure 6).

The forest includes a system of trails throughout the property, utilized mostly by local residents, as well as a picnic area, fitness trail and a small spray deck in the developed, northern section of the forest. The Billerica Recreation Department staffs the spray deck and manages the parking lot and bathhouse.

### 7.2. HISTORY OF PROPERTY

The area that is now Warren H. Manning State Forest is located in a part of Billerica that was not heavily settled through the 17<sup>th</sup>, 18<sup>th</sup> and most of the 19<sup>th</sup> centuries (MHC 1980*e*). One of the few settlers in this area was Samuel Manning, who built the Manning Manse, located at 56 Chelmsford Road/Route 129, in 1696. The ancestral home of

Warren H. Manning, the Manning Manse was empty and in need of preservation when Manning moved to Billerica in 1895. A landscape architect who began working in his family's nursery business in Reading, MA, amassing an extensive horticultural background, Manning then honed his design skills in the Olmsted firm until branching out on his own in 1896. Manning was a founding member of the American Society of Landscape Architects in 1899, and pioneered a system of resource-based planning.



Warren Manning (The Cultural Landscape Foundation)

Placeholder for Figure 6.

After 1900, Manning began to acquire land in close proximity to the Manning Manse. In 1915, Manning moved his practice to Billerica, ultimately operating out of an octagonally-shaped office that was constructed in 1917 on the north side of Chelmsford Road (no longer extant). In 1923, Manning moved his practice to Cambridge when access to Boston and Lowell from Billerica became impossible via public transit.

Manning was very active in Billerica town affairs, and his efforts included promoting the creation of public woodlands in town, with a particular focus on developing a town forest system in Billerica. Manning developed the Billerica Town Forest Plan in the mid-1920s and it was accepted by the town in 1926. In 1934, Manning sold approximately 140 acres of his property surrounding the Manse to the Commonwealth, for the purpose of establishing a state forest, at a rate of \$5.00 per acre (Manning n.d.). This property included Manning's former office, which was later removed by the Commonwealth sometime after his death in 1938 (Rockwell 2002). In 1935 and 1939, additional acreage in the area was purchased, increasing the size of the facility. In 1953, even more land was acquired through takings as the Old Middlesex Turnpike was realigned, and the new Middlesex Turnpike, Route 3, cut through a portion of the property. This project left a small portion of the forest on the western side of Route 3, impacting the trail system and making this parcel inaccessible to staff and visitors.

Around 1955, a recreation area was developed in the portion of the property north of Chelmsford Road/Route 129, in what is now known locally as Manning Park. The 1950s improvements included a wading pool, equipment cabin and picnic area.

In 1961, an Act of the Legislature led to the disposition of two parcels of land west of Route 3 to the Town of Billerica for industrial purposes. (See Appendix H for more information.) A lumber yard and self storage business are located here today.

A master plan completed for the forest in the early 1970s proposed an expansion of the picnic area and the installation of a full-sized swimming pool in the northern section of the property, and development of a camping area south of Chelmsford Road; none of these proposals came to fruition.

The Town of Billerica has been managing the recreation area in the northern section of the forest since 1990. A series of Special Use Permits from 1990 through December 2004 formalized this management arrangement. A renewed permit that was to run from 2005 through 2010 was never finalized, due to disagreements between the DCR and the Town over parking revenue. As a result, the Town of Billerica has been managing this area without any formalized agreement or permit in place for almost a decade.

In 2002, the recreation area was updated and the wading pool was replaced by a spray deck. An adult fitness trail is also located on this portion of the property, installed by the Town of Billerica in 2012.

### 7.3. EXISTING CONDITIONS

#### Natural Resources

##### Physical Features

**Topography.** Warren H. Manning State Forest is fairly level in the southern section, with some low rolling uplands in the northern portions of the forest.

**Geology.** Warren H. Manning State Forest lies within the Nashoba Terrane, and the bedrock of the area includes gneiss, schists and Andover granite, a pink to buff colored granite that has a granular texture (Skehan 2001). The gneiss and schists are metamorphic rocks that may have originated as volcanic rocks. Some glacial erratics are scattered throughout the property.

**Soils.** Warren H. Manning State Forest is comprised of a wide range of soil types, from loamy sands in the uplands to muck, reflecting the presence of wetlands. The deep Hinckley loamy sands can be found on glacial outwash plains and terraces, while the Canton fine sandy loam and the Scituate fine sandy loam soils are located on the side slopes and toe slopes of uplands (Peragallo 2009). Slight to moderate limitations on path and trail development exist in the upland areas, the limitations increasing with slope and the sandiness of the soil. Severe limitations are present in the wetter areas where the muck based soils are found. Limitations on playground and picnic area development range from slight to severe, based upon slope and the stoniness of the soils present (Peragallo 2009).

**Table 7.1. Soils of Warren H. Manning State Forest**

| <b>Soil Series</b>                   | <b>% of Forest</b> | <b>Drainage Class</b>                        |
|--------------------------------------|--------------------|----------------------------------------------|
| Hinckley loamy sand                  | 27.4               | Excessively drained                          |
| Canton fine sandy loam               | 18.5               | Well drained                                 |
| Scituate fine sandy loam             | 14.2               | Moderately well drained                      |
| Saco mucky silt loam                 | 9.8                | Very poorly drained                          |
| Freetown muck                        | 9.3                | Very poorly drained                          |
| Montauk fine sandy loam              | 6.7                | Well drained                                 |
| Windsor loamy sand                   | 6.6                | Excessively drained                          |
| Deerfield loamy sand                 | 2.6                | Moderately well drained                      |
| Urban land                           | 2.4                | N/A                                          |
| Ridgebury fine sandy loam            | 1.8                | Poorly drained                               |
| Charlton-Hollis-Rock outcrop complex | 0.7                | Well drained to somewhat excessively drained |
| Udorthents                           | 0.1                | Variable                                     |

### Water Resources

**Ponds.** There are no ponds within the forest.

**Wetlands.** Wooded swamp areas containing deciduous trees can be found throughout the forest, totaling 14 acres; an additional 10 acres of wooded swamp area, centrally located within the forest, contains a mix of trees. Two smaller areas of shrub swamp, one in the center of the forest and one in the northern portion of the forest, have a combined total of just over seven acres in size. A small bog (0.9 acres), locally known as Spruce Pond, is located within the centrally located shrub swamp. See Figure 6.

**Vernal Pools.** There is one certified vernal pool located in Warren H. Manning State Forest. In addition, there are five potential vernal pools located within this facility.

**Streams.** Black Brook enters Warren H. Manning State Forest on the northern boundary and heads south, flowing under Route 129/Chelmsford Road and ends in the bog located in the western portion of the forest (see Figure 6).

**Flood Zones.** On the northern edge of the property, there are two small areas, totaling 0.09 acres of land, that abut wetlands on neighboring properties that fall

within the 100-year flood zone. These same areas expand to cover nearly four acres within the 500-year flood zone.

### Rare Species

Priority Habitat has been designated on 72 acres of Warren H. Manning State Forest, encompassing roughly two-thirds of the land between Route 3 and Route 129/Chelmsford Road.

The only rare species recorded here, the blue-spotted salamander, is an amphibian that utilizes wetland habitat for reproduction and upland forest habitat for foraging, both of which are present in this part of the forest (Natural Heritage and Endangered Species Program 2007b). This species has a MESA status of Species of Special Concern.

In 2010, MassWildlife and The Nature Conservancy (TNC) issued “BioMap 2: Conserving the Biodiversity of Massachusetts in a Changing World” (MassWildlife and TNC 2010). This guide identified two types of areas important for conservation: Core Habitat and Critical Natural Landscape. The first is crucial for the long-term persistence of rare species and other species of conservation concern. The second provides habitat for wide-ranging native wildlife, supports intact ecological processes, maintains connectivity among habitats, enhances ecological resilience and buffers aquatic Core Habitats to help ensure their long-term integrity. Protection of both areas, which may overlap, is “important to conserve the full suite of biodiversity” in Massachusetts (MassWildlife and TNC 2010).

In Warren H. Manning State Forest, there are 72 acres of Core Habitat, covering the same area that has been designated Priority Habitat. Critical Natural Landscape has not been identified at Warren H. Manning State Forest.

### Vegetation

**Forest Types.** In 2003, the James W. Sewall Company developed a forest inventory/land cover classification dataset for the state forests and parks. The dataset is primarily based on the interpretation of infrared aerial photography, a process that identified four forest sub-types within Warren H. Manning State Forest (Table 7.2).

**Table 7.2. Forest Sub-types of Warren H. Manning State Forest**

| Forest Sub-type            | Acres                    | % of Forest |
|----------------------------|--------------------------|-------------|
| Mixed oak                  | 74.1                     | 40.5        |
| Eastern white pine - oak   | 54.5                     | 29.8        |
| Eastern white pine         | 25.2                     | 13.8        |
| Red maple - swamp hardwood | 1.9                      | 1.0         |
| <i>Total</i>               | <i>155.7<sup>a</sup></i> | <i>85.1</i> |

a. The difference in total acreage is due to the exclusion of wetlands and areas of open water, as well as changes in the forest's boundaries since 2003.

Hardwood species – including oak – are uncommon in the town of Billerica. Most of the hardwood stands in town are located on DCR lands.

As part of the Massachusetts Continuous Forestry Inventory (CFI), a specific area within the forest was visited by DCR Management Foresters in 2000. The CFI is a network of permanent, one-fifth-acre plots on state forest lands that are routinely monitored for silvicultural purposes. The measurements and observations made within each CFI plot are recorded in a database that dates back to 1960, when the CFI was created. Approximately 10% of the state's CFI plots are inventoried each year, on an on-going basis. As of 2010, there were 1,768 CFI plots statewide (Goodwin 2014).

There is one CFI plot within Warren H. Manning State Forest. This even-aged, two storied stand is 55 to 60 years old and comprised of primarily of red maple, along with some white pine and swamp hardwoods, including American elm and gray birch.

As part of the CFI process, DCR Management Foresters also look for signs of disturbances that affect the development of vegetation in the vicinity of each CFI plot. One disturbance agent, snow and ice, was recorded here in 1996.

**Priority Natural Communities.** There are no Priority Natural Communities within the forest.

**Invasive Species.** A few invasive species have been observed within the forest by DCR staff however none of these species have been identified in the CFI plot. The invasive species observed here include:

- Common buckthorn (*Rhamnus cathartica*), a deciduous small tree or coarse shrub, has been observed by DCR Foresters. Common buckthorn threatens wetlands, where it can suppress other species, and field edges. It is often spread by seed dispersal through birds.

- Multiflora rose (*Rosa multiflora*) has also been observed here. It is a densely spreading shrub that forms thickets that crowd out native species.
- Japanese knotweed (*Fallopia japonica*) is a shrub-like herbaceous plant that forms dense thickets that crowd out native species and reduce wildlife habitat, posing significant threats in riparian areas in particular. This was observed along the edge of Black Brook during RMP fieldwork.

**Pests and Disease.** White pine weevil (*Pissodes strobe*) has been identified in Warren H. Manning State Forest. While tree mortality from this pest is low, damage does impact tree health and reduce wood quality. To a lesser extent, gypsy moths (*Lymantria dispar*) and Dutch elm disease have also been observed here.

### Wildlife

**Birds.** There is little current information on the forest's birds. Over 175 species that have been identified in some of the other facilities in this planning unit, and may possibly occur within the forest, are listed in Appendix G, Table G.1.

**Mammals.** There is little current information on the forest's mammals. Over 45 species that have been identified in some of the other facilities in this planning unit, and may possibly occur within the forest, are listed in Appendix G, Table G.2.

**Reptiles.** There is little current information on the forest's reptiles. Over 15 species that have been identified in some of the other facilities in this planning unit, and may possibly occur within the forest, are listed in Appendix G, Table G.3.

**Amphibians.** There is little current information on the forest's amphibians. Over 15 species that have been identified in some of the other facilities in this planning unit, and may possibly occur within the forest, are listed in Appendix G, Table G.4. Only one of these, the blue-spotted salamander, has been recorded at this forest.

**Fish.** There is no current information on the forest's fish.

## Cultural Resources

### Pre-contact Archaeological Sites

There are no recorded pre-Contact sites recorded in the forest, and no archaeological surveys have been conducted. The physical characteristics, regional setting, and the known patterns of pre-Contact occupation in the region all contribute to a high archaeological potential for the forest.

### Historic Archaeological Resources

The remnant of a concrete foundation (MHC Inventory Form #BIL-HA-46) from Manning's office complex is located just north of the Warren H. Manning Office Memorial Stone. A concrete curb covered by vegetation, it appears to have been approximately 12 feet square. Some of the ground cover in the area may be remnant plant material from when the office was in use. From c1911 – c1919, Manning built a series of buildings used by his practice, many of which were ultimately interconnected as spokes to a hub. All but two of the buildings were burned down or demolished after 1938.

The foundation of an outbuilding is located adjacent to Spruce Pond, just south of the Manning Manse property. This foundation of poured concrete has been built into a slope and is open on grade on the low sloped side, with a rustic stone retaining wall extending off the rear corner. In the corner formed by the retaining wall there is an overgrown tree that might date to Manning's involvement with the property.



Outbuilding Foundation (DCR)

## Historic Resources

**Buildings.** There are no historic buildings within the forest.

**Structures.** Stone wall remnants are located in the southern portion of the property, extending north from Old Rangeway Road. These are dry laid, loose stone walls that are in fair to poor condition.

A concrete pad foundation is located just south of Route 129, near the intersection with Rangeway Road. This foundation, roughly 20 feet by 12 feet, is becoming covered in leafy vegetation and moss. A utility pole that once served this structure is located directly adjacent to the pad and still has some severed wires dangling from it. The structure once located on this site housed a forest fire control building.

A concrete pad is located adjacent to the spray deck, and appears to be the foundation of the former bathroom that was installed in the 1950s as part of the recreational development. The building was removed in the 2002 improvements to the area.

A former bridge abutment was once located at the end of Old Rangeway Road (MHC Inventory Form #BIL-HA-44), however that seems to have been removed in a recent culvert replacement project.

**Objects.** The Warren H. Manning Office Memorial Stone (MHC Inventory Form #BIL.937) is located east of the entrance, adjacent to the picnic area. This memorial stone marks the location of where Warren Manning's office once stood, when his landscape architecture practice operated seasonally out of Billerica from 1915–1923.



Warren H. Manning Office Memorial Stone(DCR)

The memorial stone marking the location of the office, installed sometime between 1938 and 1950, is inscribed as follows:

HERE STOOD THE OFFICE OF  
WARREN H. MANNING  
LANDSCAPE DESIGNER  
A STUDENT AND LOVER OF NATURE  
AND MAN. A PIONEER AND LEADER  
IN THE FINE ART OF PLANNING THE  
WISE USE OF THE LAND FOR THE  
PLEASURE AND BENEFIT OF MANKIND.  
1860 – 1938

Some lichen growth is present on the memorial stone.

A concrete marker, approximately 8 inches tall and 3 inches square, is located north of the spray deck area. Possibly a former property boundary marker, the letter “C” is inscribed on one side.



Concrete Marker (DCR)

**Landscapes.** The forest contains a collection of two miles of woods roads that were used in the 19<sup>th</sup> century for access to woodlots, and in the 20<sup>th</sup> century as forest roads for recreational purposes and some administrative access. These unpaved roads, approximately eight feet wide in predominantly good to fair condition, vary in terms of level vegetative growth in the road pathway and make up the bulk of the network of trails in use today.

### Recreation Resources

Warren H. Manning State Forest is primarily accessed via motor vehicle. Individuals who live nearby may also choose to walk or ride their bicycle to any one of the trailheads, although the area is not particularly pedestrian friendly. The Lowell Regional Transit Authority offers an additional,

though likely underutilized, means of accessing the forest. The nearest stop is about a one mile walk to the main entrance.

Recreation at the state forest includes trail-based activities such as hiking and running, dog walking and cross-country skiing. Geocaching also occurs throughout the forest, with participants both on and off trails. As of November 2013, there were three known geocaches at the state forest.

Hunting is currently allowed in Warren H. Manning State Forest. This activity is not allowed near the spray deck area, but it is still not popular with local residents. During the development of this RMP, some concerns were expressed that hunters may be coming too close to abutting properties.

Some bikers and snowmobilers use the forest as well.

The primary recreational feature at Warren H. Manning State Forest is the spray deck area (see Figure 6). A wading pool was constructed here in the 1950s and was in use until it was replaced in 2002 with the new spray deck equipment. The spray deck, which is managed by the Billerica Recreation Department, is operational from May through the end of September. This area is very popular with young families, and on hot days often reaches capacity (Hannon-Rizza 2013).

Complementing the spray deck area is an adjacent picnic area, located between the spray deck and the parking lot. This picnic area includes 18 picnic tables, three of which are accessible, as well as nine grills for use by visitors. Four of these grills are of the metal variety on a low post, while five are concrete bases on the ground. These grills get occasional use by visitors, more so in the off-season than during the summer months. Twice a year, the Billerica Recreation Department offers an outdoor cooking program here that is very popular with families (Hannon-Rizza 2013).

The Billerica Recreation Department has created a “Story Book Trail,” a short trail that loops around a portion of the picnic area and includes a series of 10 wooden and plexiglass wayside panels. These panels have laminated pages of a children’s book within each of them, so that it is possible to walk the trail and read a story. These panels are periodically updated with a new book so that visitors can read new stories. This trail was recently marked by local



girl scouts with green trail markers affixed to trees via screws.

The Billerica Recreation Department installed an adult fitness trail in 2012. Complete with fitness equipment composed primarily of powder coated metal piping, the fitness trail has five exercise stations with 19 total pieces of equipment and 11 signs providing instruction for safe use.



Fitness Trail (DCR)

The Billerica Recreation Department offers a pre-school program at the park in the summer. The scheduling of this program is coordinated with an adult fitness program that utilizes the fitness trail equipment, providing a unique recreational opportunity for the parents of these pre-schoolers (Hannon-Rizza 2013).

## **Infrastructure**

### **Property Boundary**

Warren H. Manning State Forest is a 183 acre property that is divided into three blocks of land: a developed area located north of Chelmsford Road/Route 129; an undeveloped area south of Chelmsford Road/Route 129 and bordered on the west by Route 3; and 40 acres (22% of the forest), located west of Route 3 and cut off from the remainder of the forest by the highway. This latter piece is inaccessible to DCR staff and visitors.

Billerica State Forest is located just to the south of Warren H. Manning State Forest, and those portions of Warren H. Manning State Forest that lie south of Chelmsford Road/Route 129 are often considered by the public to be a part of Billerica State Forest. Locals refer to the northern section of the forest that contains the spray deck as Manning Park.

A utility easement cuts through the park, as a part of an underground pipeline that is owned and managed by Tennessee Gas. A trail composed of loose stone is located on the northern segment of this corridor. One access stanchion pole was located during fieldwork, located on the north side of Route 129.

### **Buildings and Structures**

There is one contact station, located at the main entrance and parking area. A small front gabled wooden structure with an asphalt roof, this station is portable, in good condition, and does not have electrical service. It is managed by the Billerica Recreation Department.



Contact Station (DCR)

There is one bathhouse at Warren H. Manning State Forest (see Figure 6). Located adjacent to the parking lot, the bathhouse is open when the park is staffed, and is also managed by the Billerica Recreation Department. It is a side gabled, concrete block structure with a metal roof that has plumbing (on town sewer system) and electrical service. It is in good condition.



Bathhouse (DCR)

The Town of Billerica has expressed interest in developing the recreation area further.

### Roads

The access road into the parking lot is the only administrative, paved road within Warren H. Manning State Forest.

There are two miles of unpaved forest roads that pre-date the establishment of the forest and continue to be used for hiking and administrative purposes.

### Parking

The only parking lot for the forest is at the main entrance, located off the north side of Chelmsford Road/Route 129 (see Figure 6). This paved lot holds 36 vehicles. There are no designated handicapped parking spaces. West of the main entrance on Chelmsford Road/Route 129, there is room for two or three cars to pull over on the north side of the road in front of a trail head.

### Trails

There are approximately 3.4 miles of trails at Warren H. Manning State Forest (see Figure 6). All of the trails are located in the eastern portion of the property. Prior to the construction of Route 3 in 1953, some trails went through the northwestern portion of the forest, however the installation of Route 3 effectively cut off this western segment of the property, and any trails that were located here have since grown in.

Of these trails, two miles are comprised of unpaved forest roads, with an additional 1.4 miles of narrow trails that are in good to fair condition.

A trail map has not been created by the DCR for Warren H. Manning State Forest and there is no information on the DCR website for the forest or its network of trails. The Town has developed a map that covers the northern section of the park only. This map is available on the Town's website.

### Signs and Kiosks

There are no Lead-in signs for this property.

The forest's Main Identification sign is located at the main entrance to the park on Chelmsford Road/Route 129. While the orientation, material and design of this sign does meet DCR signage standards (DCR n.d.), the information regarding management

is not entirely accurate as this only applies to the northern section of the forest.



Main Identification Sign (DCR)

One kiosk, maintained by the Billerica Recreation Department, is located at the northern edge of the parking lot. A small mailbox for map distribution is attached to the kiosk, as is a pet waste bag dispenser.



Informational Kiosk (DCR)

The Billerica Recreation Department has created a "Story Book Trail," a short trail that loops around a portion of the picnic area. Ten panels located alongside the trail include the pages of a popular children's book, so that one reads a story from start to finish while walking along this trail.

### Memorials and Markers

There is one memorial in Warren H. Manning State Forest, the Warren H. Manning Office Memorial Stone. For information on this memorial, please refer to the Cultural Resources section.

### Other

Residents along the southeast side of Rangeway Road have installed their mailboxes across the street on the forest property, possibly within the road right-of-way.

### **Illegal Activities**

At the southern end of the forest, just off the southernmost trail head off of Rangeway Road, tire dumping has been occurring. This appears to be relatively recent dumping, but may have occurred multiple times.



Dumping Area (DCR)

## **7.4. MANAGEMENT RESOURCES AND PRACTICES**

See Section 2, Management Resources and Practices, for a description of the management resources and practices that apply to the entire Lowell/Great Brook Planning Unit.

### **Natural Resources**

#### Vegetation

In the past, the DCR used to allow Home Fuelwood harvests to occur at this state forest. However, since this property has been designated as a Parkland through the Landscape Designation process, this activity is no longer allowed at this facility.

The vegetation in the gas pipeline corridor is managed by Tennessee Gas.

#### Wildlife

The DCR does not actively manage wildlife at Billerica State Forest; however the hunting of game species is permitted.

### **Cultural Resources**

The DCR's Office of Cultural Resources hired a team of cultural resource management professionals to undertake a survey of cultural resources at Warren Manning State Forest in 2002. The aforementioned MHC Inventory Forms are a result of that effort.

### **Recreation Resources**

The Town of Billerica, through its Recreation Department, has been operating the recreation area in the northern section of the forest since 1990. A series of Special Use Permits formalizing this arrangement were in place from 1990 through December 2004. Attempts were made to get a new permit in place for the 2005 recreation season, but appear to have stalled due to questions regarding the collection and retention of revenue by the Town through the parking fees they collected. The conversation began again in 2006, but appears to have gone nowhere since then. Despite this, the Town continues to operate the area and has since invested in the property with the installation of the fitness equipment. This installation was done in consultation with the DCR Operations staff, however the town typically does not consult with the agency on smaller projects, volunteer requests and programming.

Hunting is currently allowed in Warren Manning State Forest.

### **Infrastructure**

The parking lot, spray deck, bathhouse and "Story Book Trail" are all managed by the Billerica Recreation Department, as part of the Town's management of the northern section of the forest. The Town charges a parking fee of \$3.00, and a season pass is available for \$35.00. This revenue goes to the Town to help offset their operational costs.

### **Interpretive Services**

There are no formal interpretive service programs provided here by DCR or by the Town of Billerica.

## **Operational Resources**

### DCR Staffing

DCR does not maintain a staff presence on site. DCR staff does periodically drive through the property in the off season, when the town does not actively manage the recreation area.

### Supplemental Staffing

The Billerica Recreation Department provides seasonal staffing for the northern portion of the forest. There is staff at the facility seven days a week, from 8:30am to 6pm, from May through the end of September. There is one person on duty at a time, and they are responsible for collecting parking fees, maintaining the restrooms and the trash, and doing periodic walk-throughs of the facility (Hannon-Rizza 2013). Billerica Recreation Department staff manages the Town programming at the site.

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A forest road in Billerica State Forest. (DCR)

## SECTION 8. BILLERICA STATE FOREST

### 8.1. INTRODUCTION

Billerica State Forest is a 141-acre undeveloped property located in the northwest part of the town. Utilized primarily by local residents, due to a lack of parking, the network of trails and forest roads provide hikers with an opportunity to access nature in an otherwise dense suburban setting.

### 8.2. HISTORY OF PROPERTY

Billerica State Forest is located in an area that was not heavily settled through the 17<sup>th</sup>, 18<sup>th</sup> and 19<sup>th</sup> centuries (MHC 1980*e*). Gilson Hill is named for an early settler of Billerica, Samuel Gilson. The name first began appearing on maps in 1853. Maps from the 19<sup>th</sup> century show this area as being wooded and undeveloped; it was utilized for logging, with wood lots in active use until the turn of the 20<sup>th</sup> century.

In 1908, Warren H. Manning and John E. Rowell gifted about 25 acres of land that included Gilson Hill to the Appalachian Mountain Club (AMC), who in turn entered into a maintenance agreement with the Billerica Improvement Association (Rockwell 2002; Shepard 1913). Several other landowners soon followed their lead, encouraged by Manning and his efforts to promote and create public woodlands in

town, with a particular focus on developing a town forest system in Billerica. Manning developed the Billerica Town Forest Plan in the mid-1920s, and it was accepted by the Town in 1926. He suggested in this plan that Gilson Hill be named Start Forest, in honor of Edwin F. Start, the first Commissioner of the Massachusetts Forest Commission. Manning also suggested names for the trails through this property, many of them for friends and family members, however none of his naming suggestions were ever implemented (Rockwell 2002).

The property was sold by the AMC to the Commonwealth in 1934, along with two other AMC properties (one in Carlisle and one in Warwick), at which time it was renamed Billerica State Forest. In 1953, the Old Middlesex Turnpike was realigned, and the new Middlesex Turnpike (Route 3) cut through a portion of the property, leaving a small portion of the forest on the western side of Route 3, impacting the trail system and leaving this parcel inaccessible.

In the late 1960s and early 1970s, local interest in developing Gilson Hill into a downhill ski facility led to legislation in 1971 authorizing a transfer of this property to the Town of Billerica for this purpose. However, shortly after the town started

planning for the ski area, it was determined that the transfer was not possible due to a stipulation in the original conveyance. The deed stated that if the land were ever discontinued as a state forest it would revert to the AMC. Local pressure on the Commonwealth to develop this for ski purposes followed, but the Department of Natural Resources (DNR), a predecessor to the Department of Conservation and Recreation, staff did not feel this was possible without considerable earth moving, and did not pursue this plan (DNR 1975).

Billerica State Forest was also considered as a potential location for a regional headquarters in 1973-1974, but that plan did not move forward either (Cook 1973; Maisner 1974).

### 8.3. EXISTING CONDITIONS

#### Natural Resources

##### Physical Features

**Topography.** The primary topographic feature of Billerica State Forest is Gilson Hill (see Figure 7). At 310 feet above sea level, Gilson Hill is the second highest point in Billerica. Large glacial erratics dot the slopes of the hill, and rolling uplands surround the base of the hill.

**Geology.** Billerica State Forest lies within the Nashoba terrane, and the bedrock of the area includes gneiss, schists and Andover granite, a pink to buff colored granite that has a granular texture (Skehan 2001). The gneiss and schists are metamorphic rocks that may have originated as volcanic rocks. Gilson Hill, like the other low lying hills in Billerica, is a glacial drumlin covered in glacial till (Northern Middlesex Council of Governments 2008).

**Soils.** Over half of the state forest is covered in Paxton fine sandy loam soils, found on the convex side slopes of glaciated hills. This soil is often found alongside Montauk, Charlton and Woodbridge soils in upland areas, which are also located here. Between the stoniness of these soils and septic tank limitations due to slow percolation rates, land composed of these soils are often woodland (Peragallo 2009). Scituate fine sandy loam, found on the slopes of uplands, is also found here. All of these soils have moderate to high potential productivity for forestry. These soil types generally present slight to moderate limitations with regards to path and trail

development, as well as to picnic area and playground development (Peragallo 2009).

**Table 8.1. Soils of Billerica State Forest**

| Soil Series                          | % of Forest | Drainage Class                               |
|--------------------------------------|-------------|----------------------------------------------|
| Paxton fine sandy loam               | 46.8        | Well drained                                 |
| Woodbridge fine sandy loam           | 12.4        | Moderately well drained                      |
| Charlton fine sandy loam             | 9.0         | Well drained                                 |
| Charlton-Hollis-Rock outcrop complex | 8.8         | Well drained to somewhat excessively drained |
| Montauk fine sandy loam              | 8.2         | Well drained                                 |
| Scituate fine sandy loam             | 6.5         | Moderately well drained                      |
| Hinckley loamy sand                  | 2.8         | Excessively drained                          |
| Windsor loamy sand                   | 2.8         | Excessively drained                          |
| Swansea muck                         | 1.4         | Very poorly drained                          |
| Deerfield loamy sand                 | 0.7         | Moderately well drained                      |
| Whitman fine sandy loam              | 0.6         | Very poorly drained                          |

##### Water Resources

Billerica State Forest is largely upland, with little in the way of water resources within this facility.

**Ponds.** There are no ponds within the forest.

**Wetlands.** There are three small wetland areas within Billerica State Forest (see Figure 7). The largest one is a 0.8-acre wooded swamp, composed of deciduous trees. There is also a 0.46-acre shallow marsh meadow or fen, and a 0.08-acre shrub swamp.

**Vernal Pools.** There is one potential vernal pool at Billerica State Forest.

**Streams.** There are no streams within the forest.

**Groundwater.** There are no aquifers beneath Billerica State Forest.

**Flood Zones.** There are no flood zones within the forest.

Placeholder for Figure 7.



### Rare Species

Priority Habitat has been designated on 26 acres of Billerica State Forest, encompassing a semi-circular shaped area on the northern boundary of the forest, extending northwest from the intersection of Treble Cove Road and Winning Street.

The only rare species recorded here, the blue-spotted salamander, is an amphibian that utilizes upland forest habitat for foraging (NHESP 2007b). This species has a MESA status of Species of Special Concern.

In 2010, MassWildlife and The Nature Conservancy (TNC) issued “BioMap 2: Conserving the Biodiversity of Massachusetts in a Changing World” (MassWildlife and TNC 2010). This guide identified two types of areas important for conservation: Core Habitat and Critical Natural Landscape. The first is crucial for the long-term persistence of rare species and other species of conservation concern. The second provides habitat for wide-ranging native wildlife, supports intact ecological processes, maintains connectivity among habitats, enhances ecological resilience and buffers aquatic Core Habitats to help ensure their long-term integrity. Protection of both areas, which may overlap, is “important to conserve the full suite of biodiversity” in Massachusetts (MassWildlife and TNC 2010).

In Billerica State Forest, there are 26 acres of Core Habitat, the same area that has been designated as Priority Habitat. Critical Natural Landscape has not been identified at Billerica State Forest.

### Vegetation

**Forest Types.** In 2003, the James W. Sewall Company developed a forest inventory/land cover classification dataset for the state forests and parks. The dataset is primarily based on the interpretation of infrared aerial photography, a process that identified four forest sub-types within Billerica State Forest (Table 8.2).

**Table 8.2. Forest Sub-types of Billerica State Forest**

| Forest Sub-type              | Acres                    | % of Forest |
|------------------------------|--------------------------|-------------|
| Mixed oak                    | 124.7                    | 88.4        |
| Eastern white pine – oak     | 10.2                     | 7.2         |
| Eastern white pine           | 1.4                      | 1.0         |
| Norway spruce - white spruce | 1.3                      | 0.9         |
| <i>Total</i>                 | <i>137.6<sup>a</sup></i> | <i>97.5</i> |

a. The difference in total acreage is due to the exclusion of wetlands and areas of open water, as well as changes in the forest’s boundaries since 2003.

Hardwood species, including oak and maple, are uncommon in Billerica. Most of the hardwood stands in town can be found within Billerica and Warren H. Manning state forests. The stand of Norway spruce – white spruce is a small plantation stand that may date to Warren Manning’s involvement with the property. Images of Norway Spruce appear in his slide collection, and his autobiography notes that some planting was done on the land he owned in Billerica with his staff as part of their training (Manning n.d.). There is a stand of some very large eastern white pine trees along the northern border of the property, adjacent to Winning Street, which is still a town road and may in fact fall within the road right of way.

As part of the Massachusetts Continuous Forestry Inventory (CFI), a specific area within this forest was visited by DCR Management Foresters in 2000. The CFI is a network of permanent, one-fifth-acre plots on state forest lands that are routinely monitored for silvicultural purposes. The measurements and observations made within each CFI plot are recorded in a database that dates back to 1960, when the CFI was created. Approximately 10% of the state’s CFI plots are inventoried each year, on an on-going basis. As of 2010, there were 1,768 CFI plots statewide (Goodwin 2014).

There is one CFI plot within Billerica State Forest. The trees in this CFI plot range in age from approximately 75 to 100 years and the stand is comprised mostly of mixed oak with maple and birch associated with this sub-type. This stand has an even-aged, two-storied structure.

As part of the CFI process, DCR Management Foresters also look for signs of disturbances that affect the development of vegetation in the vicinity of each CFI plot. One disturbance agent, likely gypsy moth, was recorded here in 1981.

**Priority Natural Communities.** There are no Priority Natural Communities within Billerica State Forest.

**Invasive Species.** A number of invasive species have been observed at Billerica State Forest by DCR Management Foresters. Surprisingly however, none of these invasive species have been identified in the CFI plot. The invasive species observed here include:

- Common buckthorn (*Rhamnus cathartica*), a deciduous small tree or coarse shrub that threatens wetlands and field edges, where it can suppress other species. It is often spread by seed dispersal through birds.
- Garlic mustard (*Alliaria petiolata*), a biennial herb that can spread rapidly, displacing native vegetation and in turn altering habitat. Garlic mustard is very difficult to eradicate.
- Multiflora rose (*Rosa Multiflora*), a densely spreading shrub that forms thickets that crowd out native species.
- Japanese knotweed (*Fallopia japonica*) is a shrub-like herbaceous plant that forms dense thickets that crowd out native species and reduce wildlife habitat, posing significant threats in riparian areas in particular.
- Winged burning bush (*Euonymus alatus*), also known as winged euonymus or burning bush, is a deciduous shrub that forms dense thickets that crowd out native species.
- Japanese barberry (*Berberis thunbergii*), a spiny shrub that forms dense stands that can displace native plants and reduce wildlife habitat and forage. Barberry also harbors deer ticks that have the potential to carry the Lyme disease bacteria, functioning as a nursery of sorts for juvenile ticks (Benson 2011).
- Privet, a rapidly maturing semi-evergreen shrub that forms dense thickets that crowd out native species.

**Pests and Disease.** Billerica State Forest has experienced issues with gypsy moths, defoliators that commonly feed on oak, which is prevalent here. White pine weevil and bark beetles have also been observed here, although to a lesser extent.

### Wildlife

**Birds.** There is little current information on the forest's birds. Over 175 species that have been

identified in some of the other facilities in this planning unit, and may possibly occur within the forest, are listed in Appendix G, Table G.1.

**Mammals.** There is little current information on the forest's mammals. Over 45 species that have been identified in some of the other facilities in this planning unit, and may possibly occur within the forest, are listed in Appendix G, Table G.2.

**Reptiles.** There is little current information on the forest's reptiles. Over 15 species that have been identified in some of the other facilities in this planning unit, and may possibly occur within the forest, are listed in Appendix G, Table G.3.

**Amphibians.** There is little current information on the forest's amphibians. Over 15 species that have been identified in some of the other facilities in this planning unit, and may possibly occur within the forest, are identified in Appendix G, Table G.4. Only two of these, the blue-spotted salamander and American toad, have been recorded at this forest.



An American toad observed during fieldwork. (DCR)

**Fish.** There is no current information on the forest's fish.

## **Cultural Resources**

### Pre-contact Archaeological Sites

One pre-Contact site is recorded in the forest, but no data is available on it. There are many sites recorded adjacent to the forest including Woodland (1650 - 450 B.P.) and Late Archaic Period (5000-3000 B.P.) campsites, a village site, and burials. The physical characteristics, regional setting, and the confirmed

nearly pre-Contact occupation of the area, all confer a high archaeological potential for the forest.

### Historic Archaeological Resources

Remnants of a 19<sup>th</sup> century sawmill are reportedly located off of Rangeway Road. This site was recorded in 2002 on a Massachusetts Historical Commission (MHC) Inventory Form (in MHC Area form #BIL.S), but the site could not be located during the fieldwork for this RMP.

Evidence of quarrying activity has been located in the northwestern portion of the forest, along the northern border of Gilson Hill. Waste stone with drill scars are visible. An MHC Inventory Form completed in 2002 (#BIL.S) noted two depressions that were likely the site of the quarrying, but these were not specifically located during the RMP fieldwork.

### Historic Resources

**Buildings.** There are no historic buildings within the forest.

**Structures.** Remnants of stone walls can be found in Billerica State Forest, along the southwest and northern edges of the forest where the slope is low. These are dry laid walls, constructed using the large glacial till located on site. These remnants are in fair to poor condition, and are starting to fall apart.

**Objects.** The Rowell Memorial Stone (MHC Inventory Form #BIL.938) is located near the top of Gilson Hill. A glacial erratic that is approximately six feet wide, by 10 feet long, by three feet high, this stone contains the following inscription, in all block letters, on the north side of the boulder:

JOHN EDWIN ROWELL  
MEMORIAL

John Rowell, a Billerica resident who was active in conservation, along with Warren Manning donated the land at Gilson Hill to establish the AMC Reservation here in 1908. It is suspected that the memorial inscription was completed shortly after Rowell's death in 1927.



Inscription on Rowell Memorial Stone (DCR)

This same stone was historically called Indian Rock, due to the three large holes on the top of the boulder that are thought to have been evidence of use for grinding, a remnant of pre-contact Native American use of the area.



Grinding holes located on top of the Rowell Memorial Stone. (DCR)

Lichen growth is impacting the resource, and the inscription is becoming difficult to read, resulting in a condition assessment of unsatisfactory.

**Landscapes.** The core of Billerica State Forest, Gilson Hill, includes a system of nearly one-and-a-half miles of connected wood roads that were used in the 19<sup>th</sup> century for access to woodlots, and in the 20<sup>th</sup> century as forest roads for recreational purposes and administrative access. These unpaved roads, approximately 8 to 10 feet wide, vary in terms of level vegetative growth in the road pathway, and are a part of the network of trails in use today. These roads were a part of the appeal of the property to Warren Manning when he set out to protect this land for public enjoyment.



Slide from a lecture Warren Manning gave to the Billerica Improvement Association. Source: Iowa State Library – Warren H. Manning Digital Collection

## **Recreation Resources**

Billerica State Forest is primarily accessed via motor vehicle or on foot by local residents. Individuals who live nearby may walk or ride their bicycle to any one of the trailheads, although the area is not particularly pedestrian friendly. There are no public transit options to reach this forest.

Recreation resources are limited to a network of nearly three miles of trails on the eastern portion of the forest. These trails are used primarily for hiking, as well as some dog walking, mountain biking, snowshoeing and cross-country skiing. The construction of Route 3 in 1953, which cut off a small segment of the northwest portion of the forest, disrupted trail access to this area. This segment of the forest is now inaccessible for use.

Hunting is currently allowed in Billerica State Forest.

There is one known geocache located here as of August 2013.

There are no camping facilities at Billerica State Forest, and back country camping is not allowed here. However, a makeshift lean-to using tree branches and other camping materials (e.g., tarps and other debris) was observed just west of the peak of Gilson Hill. The landscape adjacent to this area also showed evidence of minor fire damage in the past, although it is unclear if this came about through unauthorized camping or a natural cause, such as lightning.

A stone fire ring (not recently used) was also found along one of the forest roads at the top of Gilson Hill, along with evidence of its use as a party spot.

## **Infrastructure**

### Property Boundary

Billerica State Forest is a 141-acre undeveloped property located in the northwest part of Billerica, south of Rangeway Road and Winning Street (a town road that is partially gated off from use), lying primarily in between Treble Cove Road and Route 3. A small and inaccessible portion of the forest – 12 acres (8.5%) – is located just west of Route 3 (see Figure 7).

Warren H. Manning State Forest is located just to the north of this property, and the southern portion of that property is often considered by the public to be a part of Billerica State Forest.

### Buildings and Structures

There are no buildings and structures within Billerica State Forest.

### Roads

There are no paved roads within Billerica State Forest.

There are 1.4 miles of unpaved forest roads that pre-date the establishment of the park and continue to be used for hiking and administrative purposes.

### Parking

There are no designated parking areas for Billerica State Forest. There is a place to pull off and park one vehicle in front of the northernmost gate along Treble Cove Road. This lack of access not only discourages use, but also prevents DCR staff and first responders from being able to enter the forest at that gate in the event of an emergency.

Parking also occurs informally at the gated end of Winning Street, which is not a part of the forest, but is a town road.

### Trails

There are approximately 2.8 miles of trails at Billerica State Forest, 2.6 miles of which are legal trails. All of the trails are located in the eastern portion of the property. Prior to the construction of Route 3, some trails went through the northwestern

portion of the forest. However the installation of Route 3 effectively cut off this western segment of the property, and the trails that were located here have since been lost to vegetation.

Forest roads make up just about half of the trail system, with almost 1.5 miles of unpaved forest roads that pre-date the establishment of the forest. These historic pathways were mapped and evaluated in 2008, at which time it was determined that approximately 70% were in fair condition, while the remaining 30% were in poor condition.

The remainder of the trail network consists of approximately 1.2 miles of trails, 80% of which were deemed to be in fair condition; the remaining 20% of trails were categorized as poor.

It is worth noting that the percentage of trails rated as poor is higher than normal, and none of the trails at Billerica State Forest were determined to be in good condition. This is likely due, in part, to low visitation rates. Without regular use, vegetative growth impacts both the base and the width of the trail system.

A trail map has not been created for Billerica State Forest, and there is no information on the DCR website for the forest or its network of trails.

Winning Street, which is gated a short way in from Treble Cove Road, continues heading northwest and serves as the functional northern boundary for Billerica State Forest (see Figure 7). This town road is unpaved beyond the gate and is currently not in active use. It is not counted in the total trail mileage as it is not owned by the DCR and not a part of the forest. However, it does serve as a link for several trails from the forest and is used by visitors for recreational purposes.

#### Signs and Kiosks

There are no Lead-in or Forest Entrance signs for Billerica State Forest.

There are no informational kiosks at Billerica State Forest.

#### Memorials and Markers

There is one memorial in Billerica State Forest, the Rowell Memorial Stone. For information on this memorial, please refer to the Cultural Resources section.

#### Other

There are a set of fire hydrants along Treble Cove Road. These hydrants are located within the road right of way, are owned by the town, and maintained by the Billerica Water Department (Conway 2013).

#### **Illegal Activities**

Debris has been collecting near the eastern edge of the property, adjacent to Winning Street, reflecting some illegal dumping activity. The top of Gilson Hill also appears to be used as a party spot, with debris and a makeshift fire ring found in the area during fieldwork.

### **8.4. MANAGEMENT RESOURCES AND PRACTICES**

See Section 2, Management Resources and Practices, for a description of the management resources and practices that apply to the entire Lowell/Great Brook Planning Unit.

#### **Natural Resources**

##### Vegetation

Vegetation around fire hydrants is maintained by the Billerica Water Department.

##### Wildlife

The DCR does not actively manage wildlife at Billerica State Forest; however the hunting of game species is permitted.

#### **Cultural Resources**

The DCR's Office of Cultural Resources hired a team of Cultural Resource Management professionals to undertake a survey of cultural resources at Billerica State Forest in 2002, resulting in the completion of the MHC Inventory Form for the Rowell Memorial Stone.

#### **Recreation Resources**

There are no unique recreation resource management practices at this property, beyond the trail maintenance practices described under Infrastructure.

## **Infrastructure**

### **Buildings and Structures**

The Town of Billerica owns the fire hydrants located alongside Treble Cove Road, within the road right-of-way; these hydrants are maintained by the Billerica Water Department. There is no Memorandum of Agreement (MOA), or similar document, between the DCR and the town that guides this management activity.

### **Roads**

The DCR's Forest Fire Control District 6 provides forest road maintenance on an annual basis.

### **Trails**

Trail maintenance is performed on a limited basis by DCR staff, and is typically at the request of the DCR's Forest Fire Control District 6 to meet their access needs.

### **Interpretive Services**

Interpretive service programming is not offered at Billerica State Forest, nor is any other interpretive information provided.

### **Operational Resources**

Billerica State Forest does not have any full or part-time DCR staff on site.

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The Concord River, as viewed from Governor Thomas Dudley State Park. (DCR)

## SECTION 9. GOVERNOR THOMAS DUDLEY STATE PARK

### 9.1. INTRODUCTION

Governor Thomas Dudley State Park is the smallest facility in the Lowell/Great Brook Planning Unit, just under 11 acres in size. The park is located off of Dudley Road in Billerica, a locally designated scenic road, providing access to the Concord River (see Figure 8). Access to the property is through an adjacent parcel of Town of Billerica conservation land, as there is no frontage on Dudley Road. Other abutting properties include a parcel owned by the Department of Fish and Game (DFG) and a parcel that is part of the Great Meadows National Wildlife Refuge. This park is approximately one quarter of a mile from the town line with Bedford.

The three properties now owned by the DCR, DFG and Town of Billerica was once a single 21 acre parcel that was split and acquired by these three entities for conservation purposes. A management agreement between these organizations exists, and the Town of Billerica is the primary management and enforcement authority for all three parcels.

This park is located within the Two Brothers Rocks-Dudley Road National Register Historic District, which is located in both Billerica and Bedford.

This property was identified in the Massachusetts Scenic Landscape Inventory of 1982.

This section of the Concord River is also within the Sudbury, Assabet and Concord National Wild and Scenic Rivers designation and the Sudbury/Concord River Valley State Important Bird Area, as recognized by the National Audubon Society (National Park Service 2008; National Audubon Society 2008).

### 9.2. HISTORY OF PROPERTY

Part of a 1637 Massachusetts General Court land grant of 1,000 acres to then Deputy Governor Thomas Dudley, this area was known at the time as Dudley Farm. Sold in 1652 in several parcels, the farm became an early focus of settlement in Billerica (Broomer 2010). The land along this section of Dudley Road became a part of the Stearns family farm holdings in the late 17<sup>th</sup> century, and stayed in the family until 1850 when Moses Greenwood purchased the property. The western edge of the Greenwood property along the Concord River was known as Greenwood Grove as early as 1891, and likely functioned as a picnic grove. By 1910, the Greenwood family owned 10 cottages on the property, probably providing a source of income in



Placeholder for Figure 8.

the form of summer rentals. The cottage community grew to 17 by 1930, but was back down to 10 by 1939, and by 1950 only six remained (Broomer 2010). No cottages survive.

Parcels of Greenwood Grove began to be subdivided and sold off in the late 1970s. In 1985, 24 acres of the former Greenwood property were sold for the development of a subdivision known as Heatherwood Estates, with 17 individual homesites planned. In January 1988, three adjoining parcels in Billerica were jointly acquired from the developer for open space protection by the Town of Billerica, the Department of Environmental Management (the DCR’s predecessor agency), and the Department of Fisheries, Wildlife and Environmental Law Enforcement (the DFG’s predecessor), totaling approximately 21 acres. Acquisition of this land occurred in part to contribute to the Massachusetts Bay Circuit Trail land protection efforts. A cooperative management agreement among these three entities details how the entities agreed to manage the land. Lands adjacent to these three properties are also protected as part of the Great Meadows National Wildlife Refuge property, which is owned by the US Fish and Wildlife Service (USFWS).

### 9.3. EXISTING CONDITIONS

#### Natural Resources

A portion of the Great Meadows National Wildlife Refuge abuts Governor Thomas Dudley State Park along the park’s western border. The Final Comprehensive Conservation Plan for the wildlife refuge identifies a wide range of natural resources within the property (USFWS 2005). It is worth noting that some of the resources identified within the refuge, particularly flora and fauna, may also exist within the state park.

#### Physical Features

**Topography.** The topography is rolling uplands, with a high point of approximately 150 feet above sea level roughly in the middle of the property, and decreasing elevations to the eastern side and on the western side, by the Concord River.

**Geology.** Falling within the Nashoba terrane, the bedrock of the area surrounding Governor Thomas Dudley State Park is largely Andover granite,

commonly pink granite with a granular texture. (Skehan 2001).

**Soils.** Soils for this property are primarily Merrimac fine sandy loam, with some concentrations of Hinckley loamy sand. The Merrimac fine sandy loam is a very deep, somewhat excessively drained soil. The Hinckley loamy sand deposits in the Concord River Valley are three to four feet thick, and are underlain by glacial till (Northern Middlesex Council of Governments 2005). These soil types are formed in glaciofluvial deposits. Both types have primarily slight limitations for path and trail development, with some moderate to severe limitations in areas where the slope is above 15% (Peragallo 2009).

**Table 9.1. Soil Types of Governor Thomas Dudley State Park**

| Soil Type                | % of Park | Drainage Class               |
|--------------------------|-----------|------------------------------|
| Merrimac fine sandy loam | 66.3      | Somewhat excessively drained |
| Hinckley loamy sand      | 22.3      | Excessively drained          |
| Deerfield loamy sand     | 9.3       | Moderately well drained      |
| Rippowam fine sandy loam | 1.5       | Poorly drained               |
| Saco mucky silt loam     | 0.3       | Very poorly drained          |
| Windsor loamy sand       | 0.03      | Excessively drained          |

#### Water Resources

**Ponds.** There are no ponds within the park.

**Wetlands.** There is a small shrub swamp, less than a half acre in size, located in this park.

**Vernal Pools.** There are no vernal pools within the park.

**Streams.** Governor Thomas Dudley State Park lies on the eastern shore of the Concord River, a 16 mile long river that drains an area of 27 miles. The Concord River has slow moving characteristics and little change in elevation along its length (USFWS 2005). A portion of the Concord River, including the section that abuts the park, has been designated as a Wild and Scenic River. The Town of Billerica utilizes the Concord River as its sole source of drinking water (Northern Middlesex Council of Governments 2005).

**Groundwater.** There are no aquifers beneath the park.

**Flood Zones.** A small half-acre section of the western most edge of the park, alongside the Concord River, falls within the 100-year flood zone.

### Rare Species

No part of Governor Thomas Dudley State Park falls within land that has been designated as Priority Habitat. A very large swath of land just south of the park, extending into the western edge of Bedford and encompassing much of the northern half of Concord is currently designated as Priority Habitat.

In 2010, MassWildlife and The Nature Conservancy issued “BioMap 2: Conserving the Biodiversity of Massachusetts in a Changing World” (MassWildlife and TNC 2010). This guide identified two types of areas important for conservation: Core Habitat and Critical Natural Landscape. The first is crucial for the long-term persistence of rare species and other species of conservation concern. The second provides habitat for wide-ranging native wildlife, supports intact ecological processes, maintains connectivity among habitats, enhances ecological resilience, and buffers aquatic Core Habitats to help ensure their long-term integrity. Protection of both areas, which may overlap, is “important to conserve the full suite of biodiversity” in Massachusetts (MassWildlife and TNC 2010). The entire park has been designated Core Habitat, and three-and-a-half of these acres (33%) have also been designated as Critical Natural Landscape.

Despite the lack of Priority Habitat designation within this facility, two rare species have been identified by the Natural Heritage and Endangered Species Program (NHESP) here: Blanding’s turtle and river bulrush.

Blanding’s turtles are reptiles that use both wetland and upland habitats and travel long distances during their active season (NHESP 2007a). This species has a MESA status of Threatened.

River bulrush, a plant, was formerly protected under MESA but has been delisted, and is now on the NHESP Plant Watch list, which is a non-regulatory tool. It is robust perennial sedge that can be found on river shores and in floodplains.

### Vegetation

**Forest Types.** In 2003, the James W. Sewall Company developed a forest inventory/land cover classification dataset for the state forests and parks. The dataset is primarily based on the interpretation of infrared aerial photography, a process that identified two forest sub-types within Governor Thomas Dudley State Park (Table 9.2).

**Table 9.2. Forest Sub-types of Governor Thomas Dudley State Park**

| <b>Forest Sub-type</b>         | <b>Acres</b> | <b>% of Park</b> |
|--------------------------------|--------------|------------------|
| Eastern white pine - hardwoods | 8.1          | 73.6             |
| Eastern white pine             | 1.7          | 15.5             |
| <i>Total</i>                   | <i>9.8</i>   | <i>89.1</i>      |

a. The difference in total acreage is due to the exclusion of wetlands and areas of open water, as well as changes in the park’s boundaries since 2003.

The 2008 Billerica Open Space and Recreation Plan Update identified the predominant species in town as red oak and white pine, noting that white pine thrives in this area (Northern Middlesex Council of Governments 2008).

There are no Continuous Forest Inventory (CFI) plots within Governor Thomas Dudley State Park providing additional site specific data for any part of this property.

**Priority Natural Communities.** There are no Priority Natural Communities within Governor Thomas Dudley State Park.

**Invasive Species.** No information has been located to date on invasive species within Governor Thomas Dudley State Park.

**Pests and Disease.** No information has been located to date on pests and disease within Governor Thomas Dudley State Park.

### Wildlife

**Birds.** There is little current information on the park’s birds. Over 175 species that have been identified in some of the other facilities in this planning unit, and may possibly occur within the park, are listed in Appendix G, Table G.1. The Final Comprehensive Conservation Plan for the wildlife refuge also contains information that may apply here (USFWS 2005).

**Mammals.** There is little current information on the park’s mammals. Over 45 species that have been

identified in some of the other facilities in this planning unit, and may possibly occur within the park, are listed in Appendix G, Table G.2. The Final Comprehensive Conservation Plan for the wildlife refuge also contains information that may apply here (USFWS 2005).

**Reptiles.** There is little current information on the park's reptiles. Over 15 species that have been identified in some of the other facilities in this planning unit, and may possibly occur within the park, are listed in Appendix G, Table G.3. Only one of these, Blanding's turtle, has been recorded at this park. The Final Comprehensive Conservation Plan for the wildlife refuge also contains information that may apply here (USFWS 2005).

**Amphibians.** There is little current information on the park's amphibians. Over 15 species that have been identified in some of the other facilities in this planning unit, and may possibly occur within the park, are listed in Appendix G, Table G.4. The Final Comprehensive Conservation Plan for the wildlife refuge also contains information that may apply here (USFWS 2005).

**Fish.** A small portion of the boundary of this property is at the edge of the Concord River. The Final Comprehensive Conservation Plan for the wildlife refuge identifies 19 different species of fish, including several common varieties of pike, perch and trout (USFWS 2005). The plan also notes an alewife recovery program that was underway while the plan was being written (USFWS 2005). Many of these species may be present in the waters off of Governor Thomas Dudley State Park.

## **Cultural Resources**

### Pre-contact Archaeological Sites

Governor Thomas Dudley State Park has not been systematically surveyed and contains no recorded pre-Contact sites. The physical characteristics, regional setting, and the known patterns of pre-Contact occupation in the region all confer a high archaeological potential for the park.

### Historic Archaeological Resources

Governor Thomas Dudley State Park has not been systematically surveyed and contains no recorded historic archaeological sites.

## Historic Resources

**Buildings.** There are no historic buildings within the park.

**Structures.** A small stretch of dry laid stone wall can be found on this property, and more of the historic system of walls can also be seen on adjacent properties. This wall is in fair to poor condition.

**Objects.** There are no historic objects within the park.

**Landscapes.** The primary entrance trail into the property is a former cart path that passes through the Town of Billerica conservation land, and has an aging allee of white pine trees. The majority of this allee is on the town owned land, but the western end of it does fall on DCR property. This historic allee may be a remnant from Greenwood Grove.



White Pine Allee (DCR)

## **Recreation Resources**

Governor Thomas Dudley State Park is primarily accessed via motor vehicle. There are no public transit options to reach this park.

Recreation resources within Governor Thomas Dudley State Park consist of a small network of trails for passive walking and hiking use. These trails connect the DCR parcel to the adjacent town, DFG and USFWS lands. There is no boat access to the river.

One picnic table is located alongside the entrance trail, providing a place to rest about halfway between the entrance and the western edge of the property.

There is one known geocache located here as of November 2013.

## **Infrastructure**

### Property Boundary

Governor Thomas Dudley State Park is an 11 acre undeveloped property located in the southwest corner of Billerica, very close to the town line with Bedford (see Figure 8). The park is located west of Route 4, and east of the Concord River. A small portion of the western property line abuts the river itself. Directly to the north is property owned by the DFG, and to the east is property owned by the Town of Billerica. These parcels are collectively managed by the town. Much of the western boundary abuts a portion of the Great Meadows Wildlife Refuge, which is managed by the USFWS, and to the south is private property.

No boundary markers were noted during fieldwork, and only one trail marker was located.

### Buildings and Structures

There are no buildings or structures at Governor Thomas Dudley State Park.

### Roads

There are no roads in Governor Thomas Dudley State Park. The main entrance trail on the property, a former cart path, is wide enough at the entry to be gated, but it quickly narrows.

### Parking

There is no parking on the DCR portion of Governor Thomas Dudley State Park. This parcel does not have frontage access on nearby Dudley Road.

One small unpaved parking area is located off of Dudley Road on the adjacent parcel owned by the Town of Billerica. This lot can fit approximately six vehicles.

### Trails

There are 0.4 miles of trails in good to fair condition within Governor Thomas Dudley State Park (see Figure 8). With the exception of the main entrance trail, a former cart path, the trails are narrow in nature and do not appear to be extensively utilized. Primary use of these trails is for walking and hiking. These trails connect to a similar system of trails that

fall on the DFG land, with some leading further north, into the Great Meadows Wildlife Refuge.

### Signs and Kiosks

There is currently no signage at this facility of any kind, and as a result, visitors and local residents are not entirely familiar with the ownership or management of the property. There are no kiosks providing any information. The management agreement between the Town, DCR and DFG stipulated that the three agencies would provide identification and informational signage, as well as a trail map for the property, but it does not appear as if this occurred.

### Memorials and Markers

There are no memorials and markers in Governor Thomas Dudley State Park.

## **9.4. MANAGEMENT RESOURCES AND PRACTICES**

See Section 2, Management Resources and Practices, for a description of the management resources and practices that apply to the entire Lowell/Great Brook Planning Unit.

The facility is managed by the Billerica Conservation Commission as per the management agreement between the Commonwealth and the Town. This agreement is supposed to be reviewed every five years; however DCR staff indicates that this does not currently occur.

Despite the lack of management responsibilities here, DCR Operations staff does periodically walk through the facility.

### **Natural Resources**

The DCR does not actively manage the natural resources at this park.

### **Cultural Resources**

The DCR does not actively manage the cultural resources at this park.

### **Recreation Resources**

The DCR does not actively manage the recreational resources at this park. As per the management agreement, trails are to be managed by the Town of Billerica.

Hunting is not allowed at Governor Thomas Dudley State Park.

### **Infrastructure**

With the exception of the small network of trails, there is no other infrastructure at this park to manage.

A trail map has not been created for Governor Thomas Dudley State Park, and there is no information on the DCR website for the park or its network of trails.

### **Interpretive Services**

There are no interpretive services provided at Governor Thomas Dudley State Park, either by DCR, DFG or the Town of Billerica.

### **Operational Resources**

#### **DCR Staffing**

Governor Thomas Dudley State Park does not have any full or part-time DCR staff on site.

#### **Supplemental Staffing**

The facility is managed by the Billerica Conservation Commission as per the management agreement between the Commonwealth and the Town. This management agreement is supposed to be reviewed by all parties every five years.

#### **Public Safety**

As per the management agreement between the DCR, DFG and Town of Billerica, the Town is responsible for policing the property and enforcing use restrictions.

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Pawtucket Falls and Gatehouse ([Peter E. Lee](#); [CC BY-NC 2.0](#); cropped from original)

## SECTION 10. RECOMMENDATIONS

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### 10.1. INTRODUCTION

The DCR has a broad and dynamic mission that encompasses resource protection, providing public access to recreational opportunities, and active forest management. This multi-faceted mission often results in complex management challenges. These responsibilities are central to the agency's mission and statutory charge.

To help meet this broad mission, the DCR has developed a two-tier system for guiding the management of all state forest and park properties under its care. The two systems, known as Landscape Designations and Land Stewardship Zoning, work in an integrated fashion to accommodate primary ecosystem services while recognizing and providing site-specific resource protection.

The application of Landscape Designations and Land Stewardship Zoning to properties within the Lowell/Great Brook Planning Unit is summarized below. For a more detailed description of Landscape Designations and Land Stewardship Zoning, please see Appendix I.

### 10.2. LANDSCAPE DESIGNATIONS

Applied statewide at the property level to assess and guide management activities throughout the DCR system, Landscape Designations are based on primary ecosystem services and guide management decisions based upon these services. The designations also communicate the agency's landscape-level management objectives to the public.

As a result of a robust public process called Forest Futures Visioning, the DCR established the following designations for properties under its jurisdiction:

***Reserves.*** Properties designated as reserves provide backcountry recreational experiences and protect the least fragmented forested areas and diverse ecological settings. Successional processes are allowed to progress unimpeded by human disturbance, and are monitored to assess and inform long-term forest stewardship.

***Woodlands.*** Woodlands demonstrate exemplary forest management practices for landowners and the general public, while supporting the range of ecosystem services that sustainably-managed forests



offer, including a diversity of native species and age classes, and compatible recreational opportunities.

**Parklands.** Areas designated as parklands focus on providing public recreational opportunities while protecting resources of ecological and cultural significance.

Selection criteria and management guidelines for all three landscape designations are described in *Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines* (DCR 2012b).

### **Applied Landscape Designations**

All properties within the Lowell/Great Brook Planning Unit have been designated as Parklands.

### **10.3. LAND STEWARDSHIP ZONING**

Land Stewardship Zoning, and the resource management planning process of which it is a part, addresses the agency's statutory responsibilities in M.G.L. Chapter 21: Section 2F. The legislation requires the DCR to prepare management plans that encompass all reservations, forests and parks; provide for the protection and stewardship of natural, cultural and recreation resources under the agency's management; and ensure consistency between recreation, resource protection and sustainable forest management.

#### **Land Stewardship Zoning Guidelines**

The Land Stewardship Zoning Guidelines define three types of zones to ensure resource protection based upon site-specific field data and provide guidance for current and future management based upon resource sensitivities. The inventory and assessment of resources during the preparation of an RMP is factored into land use management and decision-making, and provides guidance for stewardship of these resources. The process results in zoning of areas and specific sites within DCR properties based on their sensitivity to recreational and management activities that are appropriate for each facility as recognized during the RMP process. In this way, the Land Stewardship Zoning system helps to ensure that recreational and management activities do not degrade various resources and values.

The three land stewardship zones provide a general continuum to categorize resources (relative to

potential degradation from human activities) from undisturbed sites with highly sensitive resources, through stable/hardy resources, to sites that have been developed and are consistently used for intensive recreation or park administration purposes. The Land Stewardship Zoning system also includes Significant Feature Overlays that may be applied to highlight resource features that have been assessed and documented by professional resource specialists.

Below is a description on the various zones used for Land Stewardship Zoning.

#### **Zone 1**

**Management Objective.** Protection of sensitive resources from management, or other human activities, that may adversely impact the resources.

**General Description.** This zone encompasses areas with highly sensitive ecological and cultural resources that require additional management approaches and practices to protect and preserve the special features and values identified in the RMP. Zone 1 areas are not suitable for future intensive development.

**Examples.** Examples identified as being highly sensitive to human activities include rare species habitat or natural communities, areas with concentrations of sensitive aquatic habitats, excessively steep slopes with erodible soils, and archaeological sites or fragile cultural sites, where stewardship of these resources must be the primary consideration when assessing management and recreational activities in these areas.

#### **Zone 2**

**Management Objective.** Provide for a balance between the stewardship of natural and cultural resources and recreational opportunities that can be appropriately sustained.

**General Description.** This zone encompasses stable yet important natural and cultural resources. Zone 2 is a very important component to the DCR's management responsibilities, because the protected landscape within this zone provides a buffer for sensitive resources, recharge for surface and groundwater, and large areas where existing types of public recreational activities can be managed at sustainable levels.

**Examples.** Examples include areas of non-intensive use that contain diverse ecosystems, rare species habitat that is compatible with dispersed recreation and sustainable management practices, and cultural resources that are not highly sensitive to human activities.

### Zone 3

**Management Objective.** Provide public access to safe and accessible recreational opportunities, as well as administrative and maintenance facilities that meet the needs of DCR visitors and staff.

**General Description.** This zone includes altered landscapes in active use and areas suitable for future administrative, maintenance and recreation purposes. The resources in this zone can accommodate concentrated use and require regular maintenance by DCR staff.

**Examples.** Examples of areas of concentrated use include park headquarters and maintenance areas, parking lots, swimming pools and skating rinks, paved bikeways, swimming beaches, campgrounds, playgrounds and athletic fields, parkways, golf courses, picnic areas and pavilions, and concessions. Examples of future use areas include disturbed sites with no significant ecological or cultural values that are not suitable for restoration, identified through the RMP or in a Master Plan as being suitable for intensive recreation or park administration sites. Note that development would be preceded by detailed site assessments to ensure protection of natural and cultural resources.

### Significant Feature Overlays

**Management Objective.** Provide precise management guidance in order to maintain or preserve recognized resource features, regardless of the zone in which they occur.

**General Description.** The three land stewardship zones may be supplemented with Significant Feature Overlays that identify formally designated or recognized resources. These resource features have been recognized through research and assessment by professional resource specialists. Information on the significant features is brought into the RMP process via review of previous research projects and associated designations.

**Examples.** A natural or cultural resource, recognized through professional inventory or research, which cuts across more than one land stewardship zone, or which is located in an area characterized by intensive visitor use. In the latter case, the Significant Feature Overlay is used to highlight the potential conflict between resource stewardship and ongoing visitor use, and provide mitigation strategies. Examples include:

- National Register Historic District.
- Areas subject to public drinking water regulations.
- Priority Habitat for species that are not sensitive to human activities.
- BioMap 2 Core Habitat.
- Designated Areas of Critical Environmental Concern.
- A NHESP Priority Natural Community associated with a summit that is also a popular destination for hikers.
- A barrier beach that provides habitat for rare shorebirds and is subject to CZM barrier beach management guidelines and coastal wetlands regulations, but also supports thousands of visitors during the summer season.
- A significant cultural site such as Plymouth Rock that is subject to ongoing, intensive visitation.
- A natural or cultural resource, recognized through professional inventory or research, which is located in an area characterized by intensive visitor use.

### Applied Land Stewardship Zoning

The following Land Stewardship Zoning is recommended for properties in the Lowell/Great Brook Planning Unit. A figure (i.e., Figure 9, 10 and 11) accompanies each property with more than one type of zoning. The remaining properties, which only have one type of zoning, do not have a corresponding figure.

#### Lowell-Dracut-Tyngsborough State Forest

**Zone 1.** Spruce Swamp, home to several rare species and a rare Priority Natural Community, is designated a Zone 1 (see Figure 9).

**Zone 2.** The remainder of the forest is designated a Zone 2; it is not particularly sensitive or heavily developed.

**Zone 3.** The main parking area for the forest, located at the end of Trotting Park Road, and the former headquarters site are designated a Zone 3 (see Figure 9).

**Significant Feature Overlay.** There are no significant feature overlays.

#### Lowell Heritage State Park

**Zone 1.** No sections of the park have been designated a Zone 1.

**Zone 2.** No sections of the park have been designated a Zone 2.

**Zone 3.** The entire park has been designated a Zone 3. While it is historically significant, it is also an integral part of a heavily developed urban landscape.

**Significant Feature Overlay.** There are no significant feature overlays.

#### Great Brook Farm State Park

**Zone 1.** Due to the sensitivity of the area around "The City," it is designated a Zone 1 (see Figure 10).

**Zone 2.** The remainder of the park is designated a Zone 2; it is not particularly sensitive or heavily developed.

**Zone 3.** The portion of the park that includes the active farm complex, the Hart Barn, the North Schoolhouse (home of the park headquarters), and the two largest parking areas in the park, are all designated a Zone 3 (see Figure 10).

**Significant Feature Overlay.** There are no significant feature overlays.

#### Carlisle State Forest

**Zone 1.** No sections of the forest have been designated a Zone 1.

**Zone 2.** The entire forest has been designated a Zone 2; it is not particularly sensitive or heavily developed.

**Zone 3.** No sections of the forest have been designated a Zone 3.

**Significant Feature Overlay.** There are no significant feature overlays.

The Land Stewardship Zoning for Carlisle State Forest should be reviewed following the recommendation to update the large tree inventory, in order to determine if there should be a Zone 1 designation or a Significant Feature Overlay to encompass these resources.

#### Warren H. Manning State Forest

**Zone 1.** No sections of the forest have been designated a Zone 1.

**Zone 2.** The remainder of the forest outside of the active recreation area has been designated a Zone 2; it is not particularly sensitive or heavily developed.

**Zone 3.** The active recreation area, including the parking lot, spray deck and picnic area, has been designated a Zone 3 (see Figure 11).

**Significant Feature Overlay.** There are no significant feature overlays.

#### Billerica State Forest

**Zone 1.** No sections of the forest have been designated a Zone 1.

**Zone 2.** The entire forest has been designated a Zone 2; it is not particularly sensitive or heavily developed.

**Zone 3.** No sections of the forest have been designated a Zone 3.

**Significant Feature Overlay.** There are no significant feature overlays.

#### Governor Thomas Dudley State Park

**Zone 1.** No sections of the park have been designated a Zone 1.

**Zone 2.** The entire park has been designated a Zone 2; it is not particularly sensitive or heavily developed.

**Zone 3.** No sections of the park have been designated a Zone 3.

**Significant Feature Overlay.** There are no significant feature overlays.

Placeholder for Figure 9.

Placeholder for Figure 10.

Placeholder for Figure 11.

## 10.4. MANAGEMENT RECOMMENDATIONS

### Management Principle

The resource management planning process for the Lowell/Great Brook Planning Unit resulted in the following management principle:

*Protect the natural and cultural resources of the planning unit and provide enhanced recreational and educational opportunities for visitors through the creative use of state resources and partnerships.*

### Management Goals

The following management goals have been identified to achieve the management principle. These goals are of equal importance, and are not presented in order of priority.

**Goal 1.** Preserve natural and cultural resources through appropriate stewardship strategies.

**Goal 2.** Offer diverse recreational opportunities and facilities to ensure visitor safety and access.

**Goal 3.** Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.

**Goal 4.** Improve engagement with partners, stakeholders, visitors and volunteers.

### Recommendations

These management recommendations have been organized first by the planning unit in its entirety, for those that apply to all or most of the properties, and then by individual property. Each set of recommendations is presented by the management goals identified for the planning unit.

Recommendations are also characterized on the basis of priority (i.e., high, medium or low) and resource availability. High priority recommendations are those that address regulatory compliance or public health and safety; prevent immediate damage to, or loss of, resources; or repair or replace damaged equipment or systems critical to operations. They are typically time sensitive. Medium priority recommendations maintain existing resources and visitor experiences. Low priority recommendations enhance resources or visitor experiences; they are not time sensitive.

Resource availability considers both funding and labor. A resource availability of one (1) indicates that funding and/or labor are available to implement the recommendation. A resource availability of two (2) indicates that funding and/or labor are not currently available, but may become so in the near future (i.e., the next five years). A resource availability of three (3) indicates that funding and/or labor are not anticipated in the next five years. Resources to implement these recommendations may, or may not, become available after five years.

**Table 10.1. Recommendations for the Lowell/Great Brook Planning Unit<sup>a</sup>**

| Recommendation                                                                                                                                                     | Priority <sup>b</sup> | Resources <sup>c</sup> | Implementation <sup>d</sup> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-----------------------------|
| <b><i>Goal 1. Preserve natural and cultural resources through appropriate stewardship strategies.</i></b>                                                          |                       |                        |                             |
| Complete the certification process for the potential vernal pools within the planning unit.                                                                        | M                     | 2                      | P, M, V                     |
| Develop a Vegetation Management Plan to address the invasive species observed within the planning unit.                                                            | M                     | 2                      | P, C, F                     |
| Undertake a mapping effort to document the stone walls located on these properties and record their condition.                                                     | L                     | 3                      | P, F                        |
| Review and apply the Best Management Practices developed by the Office of Cultural Resources for stone wall protection.                                            | M                     | 1                      | P, M                        |
| <b><i>Goal 2. Offer diverse recreational opportunities and facilities to ensure visitor safety and access.</i></b>                                                 |                       |                        |                             |
| Review and update or create, where appropriate, a trail map for each of the properties in the planning unit, and make the maps available through multiple outlets. | H                     | 1                      | M, X                        |
| <b><i>Goal 3. Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.</i></b>                          |                       |                        |                             |
| <i>There are no recommendations associated with this goal.</i>                                                                                                     | -                     | -                      | -                           |
| <b><i>Goal 4. Improve engagement with partners, stakeholders, visitors and volunteers.</i></b>                                                                     |                       |                        |                             |
| Fill the Metro West District Ranger position.                                                                                                                      | H                     | 3                      | M                           |
| Establish webpages on the DCR website for the properties in the planning unit that currently do not have a webpage.                                                | H                     | 1                      | M, X                        |

a. These recommendations apply to all, or most, properties in the planning unit.

b. Priorities are High (H), Medium (M), or Low (L).

c. Availability of resources for implementing recommendations: 1 = funding and/or labor is currently available; 2 = funding and/or labor is currently unavailable, but may become so in the near future; and 3 = funding and/or labor is currently unavailable, but may become so in more than five years.

d. The following codes identify the party or parties responsible for implementing the recommendation: C = Contractor; E = Division of Engineering; F = Bureau of Forest Fire Control and Forestry; L = Office of the General Counsel; M = Division of MassParks; O = Other; P = Bureau of Planning, Design and Resource Protection; U = Universal Access Program; V = Volunteer or partner; and X = Office of External Affairs and Partnerships.



**Table 10.2. Recommendations for Lowell-Dracut-Tyngsborough State Forest**

| <b>Recommendation</b>                                                                                                                                                                                            | <b>Priority<sup>a</sup></b> | <b>Resources<sup>b</sup></b> | <b>Implementation<sup>c</sup></b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------|-----------------------------------|
| <b><i>Goal 1. Preserve natural and cultural resources through appropriate stewardship strategies.</i></b>                                                                                                        |                             |                              |                                   |
| Work with the Natural Heritage & Endangered Species Program to conduct a survey for the blue-spotted salamander.                                                                                                 | M                           | 2                            | P, M, O, V                        |
| Investigate the nature and extent of the Coburn mill site.                                                                                                                                                       | L                           | 2                            | P, M                              |
| Acquire additional land in the southern part of the forest, if necessary, in order to protect the Coburn mill site.                                                                                              | L                           | 2                            | P, L                              |
| Remove the debris at the former headquarters site that poses a threat to significant resources (i.e., the pump house cellar hole) and public safety (i.e., glass bottles).                                       | H                           | 1                            | M, V                              |
| Undertake further research on the cellar holes that were not located during the fieldwork for this plan.                                                                                                         | L                           | 3                            | P, M                              |
| Stabilize the walls and remove the vegetation from the forest's CCC water holes.                                                                                                                                 | M                           | 2                            | P, M                              |
| Address the culverts within the forest that are blocked and/or collapsing.                                                                                                                                       | H                           | 2                            | P, M, E                           |
| Reposition and clean, where applicable, the stone markers within the forest.                                                                                                                                     | L                           | 2                            | P, M                              |
| Remove the graffiti from Sheep Rock and work with the Environmental Police to curb the illegal activities that take place at the site.                                                                           | H                           | 2                            | P, M, O                           |
| <b><i>Goal 2. Offer diverse recreational opportunities and facilities to ensure visitor safety and access.</i></b>                                                                                               |                             |                              |                                   |
| Work with the Environmental Police to curb the illegal recreation activities (e.g., off-highway vehicle use and paintball games) taking place at the forest.                                                     | H                           | 1                            | M, O                              |
| Post signs that clearly indicate the boundary of the forest's "No Hunting Areas."                                                                                                                                | H                           | 1                            | M, F, V                           |
| Formalize the main parking area at the forest's main entrance on Trotting Park Road in Lowell; consider signing, paving and expanding the area, lining the spaces and designating at least one accessible space. | M                           | 3                            | P, M, C                           |
| Investigate the options for establishing a more suitable parking area on Trotting Park Road in Tyngsborough.                                                                                                     | L                           | 1                            | P, M                              |
| Improve the trail signage within the forest, adding trail names and intersection numbers where appropriate.                                                                                                      | H                           | 2                            | M, F, V                           |
| <b><i>Goal 3. Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.</i></b>                                                                        |                             |                              |                                   |
| Investigate the options for removing the illegal dam on Trotting Park Road in Tyngsborough.                                                                                                                      | M                           | 1                            | E                                 |

*Continued on next page.*

**Table 10.2. Recommendations for Lowell-Dracut-Tyngsborough State Forest (Continued)**

| Recommendation                                                                                                                                                                                                              | Priority <sup>a</sup> | Resources <sup>b</sup> | Implementation <sup>c</sup> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-----------------------------|
| <b><i>Goal 4. Improve engagement with partners, stakeholders, visitors and volunteers.</i></b>                                                                                                                              |                       |                        |                             |
| Renew the agreement with the Greater Lowell Indian Cultural Association (GLICA).                                                                                                                                            | H                     | 2                      | M, L                        |
| Work with the Dracut Water Supply District to address and resolve the issues surrounding the current location of their water supply infrastructure.                                                                         | M                     | 2                      | M, L                        |
| Establish a formal agreement with the Dracut Water Supply District regarding their access to and maintenance of the water supply infrastructure located on Gage Hill.                                                       | M                     | 2                      | M, L                        |
| Arrange a meeting between the Dracut Water Supply District and appropriate DCR staff to discuss their need to replace the reservoir at the forest.                                                                          | H                     | 1                      | M, L                        |
| Work with the Merrimack Valley Chapter of the New England Mountain Bike Association to review and approve, where appropriate, the existing technical features in the forest.                                                | H                     | 1                      | P, M, L                     |
| Develop a formal agreement with the Merrimack Valley Chapter of the New England Mountain Bike Association regarding the review and approval of their trail maintenance, repair and construction projects within the forest. | H                     | 1                      | P, M, L                     |
| Install a new Main Identification and several Road Marker signs at the forest.                                                                                                                                              | M                     | 1                      | M, O                        |

a. Priorities are High (H), Medium (M), or Low (L).

b. Availability of resources for implementing recommendations: 1 = funding and/or labor is currently available; 2 = funding and/or labor is currently unavailable, but may become so in the near future; and 3 = funding and/or labor is currently unavailable, but may become so in more than five years.

c. The following codes identify the party or parties responsible for implementing the recommendation: C = Contractor; E = Division of Engineering; F = Bureau of Forest Fire Control and Forestry; L = Office of the General Counsel; M = Division of MassParks; O = Other; P = Bureau of Planning, Design and Resource Protection; U = Universal Access Program; V = Volunteer or partner; and X = Office of External Affairs and Partnerships.

**Table 10.3. Recommendations for Lowell Heritage State Park**

| Recommendation                                                                                                                                                                                                        | Priority <sup>a</sup> | Resources <sup>b</sup> | Implementation <sup>c</sup> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-----------------------------|
| <b>Goal 1. Preserve natural and cultural resources through appropriate stewardship strategies.</b>                                                                                                                    |                       |                        |                             |
| Assess the condition of the interior and exterior of the Rynne bathhouse and make repairs, where necessary.                                                                                                           | H                     | 2                      | P, E, M                     |
| Work with the National Park Service to repair the cracked end wall of the Pawtucket Gatehouse.                                                                                                                        | M                     | 2                      | P, E, M, V                  |
| Meet with the National Park Service to develop and implement a preservation plan for the Hamilton Wasteway Gatehouse.                                                                                                 | H                     | 1                      | P, E, M, V                  |
| Work with the National Park Service to remove the Boston ivy from the Boott Dam Gatehouse.                                                                                                                            | M                     | 2                      | P, E, M, V                  |
| Work with Boott Hydropower, Inc. to assess the condition of the Lowell Canal System and make repairs, where necessary.                                                                                                | L                     | 3                      | P, E, M, V                  |
| Work with Boott Hydropower, Inc. to implement the recommendations featured in the DCR’s Office of Dam Safety dam inspection reports for the Northern Canal Great Wall, Guard Locks, Swamp Locks and Lower Locks dams. | L                     | 3                      | P, E, M, V                  |
| Repair the steel rail and granite post fences at the Mack plaza and Victorian garden.                                                                                                                                 | H                     | 3                      | P, E, M, C                  |
| <b>Goal 2. Offer diverse recreational opportunities and facilities to ensure visitor safety and access.</b>                                                                                                           |                       |                        |                             |
| Post fish consumption advisory signs in multiple, locally spoken languages at popular fishing spots along the Merrimack River and Lowell Canal System.                                                                | H                     | 1                      | M, X, V                     |
| Ensure that all of the violations noted in the most recent inspection of the Lord pool are addressed in the upcoming modernization project.                                                                           | H                     | 1                      | E, C                        |
| Install a bike rack at the Lord pool.                                                                                                                                                                                 | M                     | 2                      | P, M, C, V                  |
| Plant additional trees or construct a shade structure(s) in the lawn surrounding the Lord pool.                                                                                                                       | L                     | 3                      | P, M, C, V                  |
| Work with the Department of Transportation and City of Lowell to improve the parking area at regatta field.                                                                                                           | M                     | 2                      | M, O, C                     |
| Assess and repair, where necessary, the condition of the Scott Finneral Memorial Riverwalk.                                                                                                                           | M                     | 2                      | P, M, C                     |
| Consider adding a formal, off-road connection between the Scott Finneral Memorial Riverwalk and the eastern end of the Vandenberg esplanade.                                                                          | L                     | 3                      | P, M                        |
| Consider options, such as the DCR’s Matching Funds Program, for acquiring a small, motorized boat for public safety purposes at Rynne beach.                                                                          | M                     | 3                      | P, M, X                     |
| <b>Goal 3. Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.</b>                                                                                    |                       |                        |                             |
| Complete an assessment of the Merrimack River retaining wall and make repairs, where needed.                                                                                                                          | M                     | 2                      | M, E                        |
| <b>Goal 4. Improve engagement with partners, stakeholders, visitors and volunteers.</b>                                                                                                                               |                       |                        |                             |
| Determine the owner of the Hadley House and establish an agreement that guides the management and use of the building.                                                                                                | H                     | 1                      | P, M, L                     |
| Meet with the University of Massachusetts Lowell to develop and implement a preservation plan for the eastern section of the wall in the Tremont Yard parking area.                                                   | M                     | 2                      | P, M, L                     |
| Meet with Tremont Yard, LLC to discuss ways in which the preserved, below grade water power features within the Jeanne D’Arc Credit Union can be promoted.                                                            | L                     | 2                      | M, L                        |
| Install DCR signs at the parking areas along the Vandenberg esplanade, next to the Lord pool and on Broadway Street.                                                                                                  | H                     | 2                      | M, O                        |
| Install gates at the parking areas next to the Lord pool and on Broadway Street.                                                                                                                                      | H                     | 3                      | M, C                        |
| Install a new Main Identification Sign at Francis Gate Park.                                                                                                                                                          | M                     | 2                      | M, O                        |

Continued on next page.

**Table 10.3. Recommendations for Lowell Heritage State Park (Continued)**

| Recommendation                                                                                                                                                             | Priority <sup>a</sup> | Resources <sup>b</sup> | Implementation <sup>c</sup> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-----------------------------|
| <b><i>Goal 4. Improve engagement with partners, stakeholders, visitors and volunteers.</i></b>                                                                             |                       |                        |                             |
| Establish an agreement with Lowell General Hospital regarding the placement and maintenance of their three-sided directional sign.                                         | M                     | 2                      | M, L                        |
| Replace the bronze plaque for the brick vault.                                                                                                                             | L                     | 3                      | P, M                        |
| Confirm that the namesake of the Vandenberg esplanade is Hoyt S. Vandenberg and update DCR signage to reflect the full and proper name of the esplanade, where needed.     | L                     | 3                      | P, L, O                     |
| Renew the agreements with the City of Lowell related to their management of the regatta field and Rynne beach, as well as their use of the Rynne bathhouse.                | H                     | 1                      | M, L                        |
| Renew the agreement with the stakeholders in the Lowell Canal System.                                                                                                      | H                     | 1                      | M, L                        |
| Renew the agreement with the New England Electric Railway Historical Society / Seashore Trolley Museum.                                                                    | H                     | 1                      | M, L                        |
| Establish an agreement with the Boston & Maine Railroad Historical Society regarding their maintenance of the B&M 410.                                                     | H                     | 2                      | M, L                        |
| Finalize the transfer of the Bellegarde boathouse, obtaining a copy of the items listed in Section 4.4. and executing the care, custody, management and control agreement. | H                     | 1                      | L                           |
| Work with the National Park Service to establish signage at the visitor center lot that indicates the parking area is open to state park visitors.                         | M                     | 2                      | M, V                        |

a. Priorities are High (H), Medium (M), or Low (L).

b. Availability of resources for implementing recommendations: 1 = funding and/or labor is currently available; 2 = funding and/or labor is currently unavailable, but may become so in the near future; and 3 = funding and/or labor is currently unavailable, but may become so in more than five years.

c. The following codes identify the party or parties responsible for implementing the recommendation: C = Contractor; E = Division of Engineering; F = Bureau of Forest Fire Control and Forestry; L = Office of the General Counsel; M = Division of MassParks; O = Other; P = Bureau of Planning, Design and Resource Protection; U = Universal Access Program; V = Volunteer or partner; and X = Office of External Affairs and Partnerships.

**Table 10.4. Recommendations for Great Brook Farm State Park**

| Recommendation                                                                                                                                                                                            | Priority <sup>a</sup> | Resources <sup>b</sup> | Implementation <sup>c</sup> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-----------------------------|
| <b><i>Goal 1 Preserve natural and cultural resources through appropriate stewardship strategies.</i></b>                                                                                                  |                       |                        |                             |
| Work with the DCR Lakes and Ponds program to assess the water chestnut growth in Meadow Pond and make a plan for eradication.                                                                             | M                     | 1                      | P, O, M                     |
| Undertake a hydrological study to gain a complete understanding of water flow through the park, assessment of existing culvert capacity and impacts to trails, and make recommendations for improvements. | H                     | 3                      | P, C                        |
| Revisit the draft Comprehensive Interpretive Plan; revise and update as necessary and finalize.                                                                                                           | H                     | 1                      | M                           |
| Develop interpretive programs, opportunities, and products as identified in the Comprehensive Interpretive Plan, working to expand interpretive offerings beyond the smart barn tours.                    | H                     | 2                      | M                           |
| Clear the debris currently built up around the beaver deceivers to maintain water flow and keep them operational.                                                                                         | H                     | 1                      | M, C                        |
| Make sure park and regional staff are aware of local scenic road designations and local review requirements.                                                                                              | L                     | 1                      | P, M                        |
| Remove leaf and brush debris from all cellar holes and routinely monitor these sites for other disturbances.                                                                                              | M                     | 2                      | M                           |
| Routinely monitor the Adam’s Mill dam site for stability and potential disturbances.                                                                                                                      | M                     | 2                      | M                           |
| Routinely monitor “The City,” particularly the Garrison House site, for stability and potential disturbances.                                                                                             | H                     | 1                      | M, P                        |
| Remove the broken sign at the Garrison House site.                                                                                                                                                        | H                     | 1                      | M                           |
| North Schoolhouse: Carefully remove the English ivy from the walls, with guidance from DCR’s Office of Cultural Resources.                                                                                | H                     | 2                      | M, P                        |
| North Schoolhouse: Assess the condition of the chimney, and identify and address the moisture issue that is causing the spalling.                                                                         | M                     | 2                      | P, E                        |
| Main Farm Area: Request a reevaluation of the Main Farm Area for National Register eligibility by the Massachusetts Historical Commission, and complete a nomination if still deemed eligible.            | L                     | 3                      | P                           |
| Hart Barn: Replace the roofing shingles on the north side of the barn.                                                                                                                                    | M                     | 2                      | E, C                        |
| Hart Barn: Assess the effectiveness and stability of the recent mortar repairs.                                                                                                                           | M                     | 2                      | E                           |
| Main Farm House: Install an appropriate gutter, with guidance from DCR’s Office of Cultural Resources.                                                                                                    | H                     | 2                      | P, V, C                     |
| Main Farm House: Clean the lichen growth that has appeared on the walls of the house.                                                                                                                     | M                     | 2                      | V                           |
| Main Farm House: Complete minor repairs to the siding and the front door sill, with guidance from DCR’s Office of Cultural Resources.                                                                     | H                     | 2                      | P, V, C                     |
| Tie Stall Barn: Undertake selective siding repair, with guidance from DCR’s Office of Cultural Resources.                                                                                                 | M                     | 3                      | P, V, C                     |
| Tie Stall Barn: Replace the roofing shingles on the north side of the barn.                                                                                                                               | M                     | 2                      | E, V, C                     |
| Tie Stall Barn: Assess the stability of the foundation in areas where it has visibly been compromised, and repair as necessary, with guidance from DCR’s Office of Cultural Resources.                    | H                     | 1                      | P, E, V, C                  |
| Pole Barn: Carefully remove vegetation from the rear façade.                                                                                                                                              | L                     | 3                      | V                           |
| Duck Coop: Assess the stability of the foundation.                                                                                                                                                        | L                     | 3                      | E                           |
| Duck Coop: Work with the farmer to determine if any new uses are possible for this building.                                                                                                              | L                     | 2                      | P, E, V, M                  |
| Silos: Assess structural stability of each and explore possible interpretive opportunities with farmer, park, and interpretive staff.                                                                     | M                     | 2                      | E, M, V                     |

*Continued on next page.*

**Table 10.4. Recommendations for Great Brook Farm State Park (Continued)**

| Recommendation                                                                                                                                                                                                | Priority <sup>a</sup> | Resources <sup>b</sup> | Implementation <sup>c</sup> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-----------------------------|
| <b><i>Goal 1 Preserve natural and cultural resources through appropriate stewardship strategies.</i></b>                                                                                                      |                       |                        |                             |
| Silos: Assess structural stability of each and explore possible interpretive opportunities with farmer, park, and interpretive staff.                                                                         | M                     | 2                      | E, M, V                     |
| Litchfield House: Complete repairs to the barn.                                                                                                                                                               | H                     | 2                      | V, P                        |
| Litchfield House: Clean the lichen growth that has appeared on the walls of the house.                                                                                                                        | M                     | 2                      | V                           |
| Litchfield House: Identify the cause of the lichen growth on the roof and address.                                                                                                                            | M                     | 2                      | V, P                        |
| Litchfield House: Assess the chimneys to determine if any repairs are necessary.                                                                                                                              | M                     | 3                      | V, P                        |
| Cemetery: Apply the BMP developed by the office of Cultural Resources.                                                                                                                                        | L                     | 1                      | M, P                        |
| <b><i>Goal 2. Offer diverse recreational opportunities and facilities to ensure visitor safety and access.</i></b>                                                                                            |                       |                        |                             |
| Working with the Lakes and Ponds program, determine if a new canoe launch should be designed and installed to reopen Meadow Pond for recreational boating.                                                    | M                     | 1                      | M, O                        |
| Develop a trails plan, assessing existing density and incorporating critical information developed through the hydrological study to better address areas that have trail washout problems.                   | H                     | 2                      | P                           |
| Work with the local equestrian community to formalize the maintenance of the horse jumps, and prune the vegetation growth around them.                                                                        | M                     | 1                      | M, X, V                     |
| Securely cover the open well located southeast of the Litchfield House.                                                                                                                                       | H                     | 1                      | M                           |
| Reassess all boardwalk crossings to identify older ones in need of replacement, including those on the Acorn Trail.                                                                                           | H                     | 1                      | M                           |
| <b><i>Goal 3. Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.</i></b>                                                                     |                       |                        |                             |
| Routinely monitor the area around the rock shelters for possible illicit activities.                                                                                                                          | M                     | 1                      | M                           |
| Former Regional HQ site: remove former sign holder and pavement to let the site return to a natural state.                                                                                                    | H                     | 2                      | M, E                        |
| Tie Stall Barn: Address the outstanding permit issues for the event space and renew discussions about future use.                                                                                             | H                     | 2                      | V, E, M                     |
| Farnham Smith's Cabin: Undertake a structural assessment and reuse feasibility study to determine if reuse is possible and develop some potential options.                                                    | H                     | 2                      | P, E, M                     |
| Cabin Shed: Access and clean out the interior of the shed, so that it does not become a potential nuisance.                                                                                                   | H                     | 1                      | M                           |
| Boat House: Complete and submit MHC Inventory form.                                                                                                                                                           | H                     | 1                      | P                           |
| Boat House: Undertake demolition.                                                                                                                                                                             | H                     | 2                      | E, C                        |
| South House/District 6 Fire Control: Assess for any reuse possibilities by the park and/or the region, such as accommodating the storage needs currently being met by the Hadley House and the Anderson Barn. | H                     | 2                      | F, M, P                     |
| Hadley House: Investigate alternative uses of the property and possibly making it available to be moved. If not possible, identify a funding source for demolition before it becomes an attractive nuisance.  | H                     | 2                      | P, M, E                     |
| West Farm/Manseau House: Assess for inclusion in the Historic Curatorship Program. If not a good candidate, identify a funding source for demolition, before it becomes an attractive nuisance.               | H                     | 2                      | P, M, E                     |

*Continued on next page.*

**Table 10.4. Recommendations for Great Brook Farm State Park (Continued)**

| Recommendation                                                                                                                                                                                                                                              | Priority <sup>a</sup> | Resources <sup>b</sup> | Implementation <sup>c</sup> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-----------------------------|
| <b><i>Goal 3. Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.</i></b>                                                                                                                   |                       |                        |                             |
| North Farm House and Barn: Make sure the buildings are secure, and routinely monitor to ensure they aren't damaged or broken into.                                                                                                                          | H                     | 1                      | M                           |
| North Farm House and Barn: Work with current long term leaseholders of other facilities within the park to identify any potential complementary reuses for this property, and explore putting out a Request for Proposals.                                  | H                     | 1                      | P, X, M                     |
| Anderson Barn: Explore any potential interest in, and options for, permitting use of the barn by others, and relocate current storage closer to the Park HQ.                                                                                                | H                     | 2                      | P, M                        |
| <b><i>Goal 4. Improve engagement with partners, stakeholders, visitors and volunteers.</i></b>                                                                                                                                                              |                       |                        |                             |
| Conduct annual meetings with lease holders and annual property inspections of leased property as specified in lease agreements and permits.                                                                                                                 | H                     | 1                      | M, L                        |
| Twice a year, hold a joint meeting of park staff and all leaseholders, to maintain the lines of communication among all parties and make sure that everyone is aware of activities, events, or other projects that have the potential to impact each other. | M                     | 1                      | M, X                        |
| Encourage and support the re-establishment of a Friends of Great Brook Farm State Park.                                                                                                                                                                     | L                     | 1                      | M, X                        |
| Pine Point Loop Parking Area: Streamline the signage as to not visually overwhelm visitors, but still inform them.                                                                                                                                          | M                     | 1                      | M, X                        |
| Main Parking Area: Streamline the signage as to not visually overwhelm visitors, but still inform them.                                                                                                                                                     | M                     | 1                      | M, X                        |
| Litchfield House: Identify joint interpretive and public programming opportunities with the Curators that enhance interpretive activities while promoting DCR's Historic Curatorship Program.                                                               | L                     | 1                      | P, M, V, X                  |
| Woods House: Update and renew the expired lease agreement for the Woods House with the old North Bridge Hounds.                                                                                                                                             | H                     | 1                      | L                           |

a. Priorities are High (H), Medium (M), or Low (L).

b. Availability of resources for implementing recommendations: 1 = funding and/or labor is currently available; 2 = funding and/or labor is currently unavailable, but may become so in the near future; and 3 = funding and/or labor is currently unavailable, but may become so in more than five years.

c. The following codes identify the party or parties responsible for implementing the recommendation: C = Contractor; E = Division of Engineering; F = Bureau of Forest Fire Control and Forestry; L = Office of the General Counsel; M = Division of MassParks; O = Other; P = Bureau of Planning, Design and Resource Protection; U = Universal Access Program; V = Volunteer or partner; and X = Office of External Affairs and Partnerships.

**Table 10.5. Recommendations for Carlisle State Forest**

| Recommendation                                                                                                                            | Priority <sup>a</sup> | Resources <sup>b</sup> | Implementation <sup>c</sup> |
|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-----------------------------|
| <b><i>Goal 1. Preserve natural and cultural resources through appropriate stewardship strategies.</i></b>                                 |                       |                        |                             |
| Update the inventory of the large eastern white pine trees, last done in 1980.                                                            | H                     | 1                      | F                           |
| After completion of tree inventory update, revisit the Land Stewardship Zoning to determine if any changes are applicable.                | H                     | 1                      | P, F                        |
| Establish a Continuous Forest Inventory (CFI) plot within the forest.                                                                     | L                     | 2                      | F                           |
| Develop an interpretive program around the natural and cultural history of the Carlisle Pines.                                            | L                     | 1                      | M, P                        |
| Monitor and assess red pine stands within the forest; manage if necessary for public safety or ecological need.                           | M                     | 1                      | F                           |
| Monitor for invasive pests, especially hemlock wooly adelgid. Propose biological or chemical controls if warranted on the specimen trees. | H                     | 1                      | F                           |
| <b><i>Goal 2. Offer diverse recreational opportunities and facilities to ensure visitor safety and access.</i></b>                        |                       |                        |                             |
| Develop and install an informational kiosk that includes interpretive information, for installation within the interior of the property.  | M                     | 2                      | M                           |
| <b><i>Goal 3. Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.</i></b> |                       |                        |                             |
| <i>There are no recommendations associated with this goal.</i>                                                                            | -                     | -                      | -                           |
| <b><i>Goal 4. Improve engagement with partners, stakeholders, visitors and volunteers.</i></b>                                            |                       |                        |                             |
| Clear the vegetation from around the former DEM sign stanchion, and hang a new DCR entrance sign from the existing sign stanchion.        | H                     | 1                      | M                           |
| Continue to partner with the Carlisle Trails Committee for assistance with trail work.                                                    | M                     | 1                      | M, P, X,                    |

a. Priorities are High (H), Medium (M), or Low (L).

b. Availability of resources for implementing recommendations: 1 = funding and/or labor is currently available; 2 = funding and/or labor is currently unavailable, but may become so in the near future; and 3 = funding and/or labor is currently unavailable, but may become so in more than five years.

c. The following codes identify the party or parties responsible for implementing the recommendation: C = Contractor; E = Division of Engineering; F = Bureau of Forest Fire Control and Forestry; L = Office of the General Counsel; M = Division of MassParks; O = Other; P = Bureau of Planning, Design and Resource Protection; U = Universal Access Program; V = Volunteer or partner; and X = Office of External Affairs and Partnerships.



**Table 10.6. Recommendations for Warren H. Manning State Forest**

| Recommendation                                                                                                                                                                                                | Priority <sup>a</sup> | Resources <sup>b</sup> | Implementation <sup>c</sup> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-----------------------------|
| <b>Goal 1. Preserve natural and cultural resources through appropriate stewardship strategies.</b>                                                                                                            |                       |                        |                             |
| Undertake further research on the outbuilding foundation located near Spruce Pond to determine if it has any connection to Warren Manning.                                                                    | L                     | 2                      | P                           |
| Clean up the dumping debris located off of Rangeway Road, and continue to monitor the area for illegal dumping.                                                                                               | H                     | 2                      | M                           |
| <b>Goal 2. Offer diverse recreational opportunities and facilities to ensure visitor safety and access.</b>                                                                                                   |                       |                        |                             |
| Establish designated handicapped accessible parking spaces in the parking lot, total number to be determined in consultation with DCR's Universal Access Program.                                             | H                     | 1                      | E, U                        |
| <b>Goal 3. Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.</b>                                                                            |                       |                        |                             |
| Assess the accessibility and potential uses of the portion of the state forest west of Route 3, and evaluate options to better utilize this space and/or establishing connections to other nearby open space. | L                     | 2                      | P, M, V, X                  |
| <b>Goal 4. Improve engagement with partners, stakeholders, visitors and volunteers.</b>                                                                                                                       |                       |                        |                             |
| Work with the Town of Billerica to get a Special Use Permit in place, to formalize their operation of the recreational area.                                                                                  | H                     | 1                      | L, M                        |
| Hold bi-annual meetings with the Town of Billerica Recreation Department to discuss programs, events, and maintenance and operation of the recreational area.                                                 | H                     | 1                      | M, X                        |
| Provide DCR information on the informational kiosk.                                                                                                                                                           | H                     | 1                      | X                           |

a. Priorities are High (H), Medium (M), or Low (L).

b. Availability of resources for implementing recommendations: 1 = funding and/or labor is currently available; 2 = funding and/or labor is currently unavailable, but may become so in the near future; and 3 = funding and/or labor is currently unavailable, but may become so in more than five years.

c. The following codes identify the party or parties responsible for implementing the recommendation: C = Contractor; E = Division of Engineering; F = Bureau of Forest Fire Control and Forestry; L = Office of the General Counsel; M = Division of MassParks; O = Other; P = Bureau of Planning, Design and Resource Protection; U = Universal Access Program; V = Volunteer or partner; and X = Office of External Affairs and Partnerships.

**Table 10.7. Recommendations for Billerica State Forest**

| <b>Recommendation</b>                                                                                                                                                                                                                                                     | <b>Priority<sup>a</sup></b> | <b>Resources<sup>b</sup></b> | <b>Implementation<sup>c</sup></b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------|-----------------------------------|
| <b><i>Goal 1. Preserve natural and cultural resources through appropriate stewardship strategies.</i></b>                                                                                                                                                                 |                             |                              |                                   |
| Carefully clean the lichen from the Rowell Memorial Stone.                                                                                                                                                                                                                | L                           | 1                            | P, M                              |
| Document the network of historic forest roads on a MHC inventory form.                                                                                                                                                                                                    | L                           | 2                            | P                                 |
| Clean up illegal camping debris located near the top of Gilson Hill.                                                                                                                                                                                                      | M                           | 1                            | M                                 |
| Dismantle the fire ring located at the top of Gilson Hill, to discourage use.                                                                                                                                                                                             | H                           | 1                            | M                                 |
| Clean up the dumping debris located adjacent to Winning Street, and continue to monitor the area for illegal dumping.                                                                                                                                                     | H                           | 2                            | M                                 |
| Develop interpretive materials to tell the story of this land and the establishment of the forest – it is an interesting piece of Billerica history.                                                                                                                      | L                           | 2                            | M                                 |
| <b><i>Goal 2. Offer diverse recreational opportunities and facilities to ensure visitor safety and access.</i></b>                                                                                                                                                        |                             |                              |                                   |
| Establish a system of routine trail maintenance to address the high percentage of trails in poor condition, possibly partnering with other organizations such as the Student Conservation Association or other local organizations for assistance with specific projects. | M                           | 3                            | M, P                              |
| Evaluate potential locations and establish a small formal parking area (possibly adjacent to an existing gate) to facilitate safe access to the forest.                                                                                                                   | M                           | 3                            | M, E, C                           |
| <b><i>Goal 3. Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.</i></b>                                                                                                                                 |                             |                              |                                   |
| Assess the accessibility and potential uses of the portion of the state forest west of Route 3, and evaluate options to better utilize this space and/or establishing connections to other nearby open space.                                                             | L                           | 2                            | P, M, V, X                        |
| <b><i>Goal 4. Improve engagement with partners, stakeholders, visitors and volunteers.</i></b>                                                                                                                                                                            |                             |                              |                                   |
| Monitor the area for future illegal camping activities, engaging local residents and police for additional assistance.                                                                                                                                                    | M                           | 1                            | M                                 |
| Install a DCR entrance sign for the forest.                                                                                                                                                                                                                               | H                           | 1                            | M                                 |

a. Priorities are High (H), Medium (M), or Low (L).

b. Availability of resources for implementing recommendations: 1 = funding and/or labor is currently available; 2 = funding and/or labor is currently unavailable, but may become so in the near future; and 3 = funding and/or labor is currently unavailable, but may become so in more than five years.

c. The following codes identify the party or parties responsible for implementing the recommendation: C = Contractor; E = Division of Engineering; F = Bureau of Forest Fire Control and Forestry; L = Office of the General Counsel; M = Division of MassParks; O = Other; P = Bureau of Planning, Design and Resource Protection; U = Universal Access Program; V = Volunteer or partner; and X = Office of External Affairs and Partnerships.

**Table 10.8. Recommendations for Governor Thomas Dudley State Park**

| Recommendation                                                                                                                                                                                                                                | Priority <sup>a</sup> | Resources <sup>b</sup> | Implementation <sup>c</sup> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|-----------------------------|
| <b>Goal 1. Preserve natural and cultural resources through appropriate stewardship strategies.</b>                                                                                                                                            |                       |                        |                             |
| Conduct further research on the historic drive and allee of trees to determine if it is a remnant of Greenwood Grove.                                                                                                                         | L                     | 2                      | P                           |
| Develop interpretive materials to tell the story of this property and the connection to Governor Dudley.                                                                                                                                      | M                     | 2                      | M                           |
| <b>Goal 2. Offer diverse recreational opportunities and facilities to ensure visitor safety and access.</b>                                                                                                                                   |                       |                        |                             |
| In coordination with abutting property owners, establish a system of routine trail maintenance for the park, possibly partnering with other organizations such as the Student Conservation Association for assistance with specific projects. | M                     | 3                      | M, X, V                     |
| <b>Goal 3. Address underutilized buildings and structures to improve visitor experiences and DCR operational responsibilities.</b>                                                                                                            |                       |                        |                             |
| <i>There are no recommendations associated with this goal.</i>                                                                                                                                                                                | -                     | -                      | -                           |
| <b>Goal 4. Improve engagement with partners, stakeholders, visitors and volunteers.</b>                                                                                                                                                       |                       |                        |                             |
| Hold an annual meeting with the MA Department of Fish & Game and the Town of Billerica Conservation Commission to discuss any issues, plans or projects.                                                                                      | H                     | 1                      | M                           |
| With the MA Department of Fish & Game and the Town of Billerica Conservation Commission, conduct the stipulated 5 year review of the Management Agreement.                                                                                    | H                     | 1                      | M, L                        |
| Establish and maintain an active relationship with the Sudbury, Assabet and Concord Wild & Scenic River Stewardship Council.                                                                                                                  | M                     | 2                      | M                           |
| Establish and maintain active communication with US Fish & Wildlife about the resources in this general area and potential collaborative efforts.                                                                                             | M                     | 2                      | M, P                        |
| Working with the Town of Billerica and the MA Department of Fish & Game, identify an appropriate location for an entrance sign that recognizes the partners.                                                                                  | H                     | 2                      | M                           |

a. Priorities are High (H), Medium (M), or Low (L).

b. Availability of resources for implementing recommendations: 1 = funding and/or labor is currently available; 2 = funding and/or labor is currently unavailable, but may become so in the near future; and 3 = funding and/or labor is currently unavailable, but may become so in more than five years.

c. The following codes identify the party or parties responsible for implementing the recommendation: C = Contractor; E = Division of Engineering; F = Bureau of Forest Fire Control and Forestry; L = Office of the General Counsel; M = Division of MassParks; O = Other; P = Bureau of Planning, Design and Resource Protection; U = Universal Access Program; V = Volunteer or partner; and X = Office of External Affairs and Partnerships.

## Appendix E

### Legislation

16 USC 410cc.



#### LOWELL NATIONAL HISTORICAL PARK

##### PART A—ESTABLISHMENT OF PARK AND PRESERVATION DISTRICT

###### § 410cc. Congressional statement of findings and purpose

(a) The Congress finds that—

(1) certain sites and structures in Lowell, Massachusetts, historically and culturally the most significant planned industrial city in the United States, symbolize in physical form the Industrial Revolution;

(2) the cultural heritage of many of the ethnic groups that immigrated to the United States during the late nineteenth and early twentieth centuries is still preserved in Lowell's neighborhoods;

(3) a very large proportion of the buildings, other structures, and districts in Lowell date to the period of the Industrial Revolution and are nationally significant historical resources, including the five-and-six-venths-mile power canal system, seven original mill complexes, and significant examples of early

housing, commercial structures, transportation facilities, and buildings associated with labor and social institutions; and

(4) despite the expenditure of substantial amounts of money by the city of Lowell and the Commonwealth of Massachusetts for historical and cultural preservation and interpretation in Lowell, the early buildings and other structures in Lowell may be lost without the assistance of the Federal Government.

(b) It is the purpose of sections 410cc-37 of this title to preserve and interpret the nationally significant historical and cultural sites, structures, and districts in Lowell, Massachusetts, for the benefit and inspiration of present and future generations by implementing to the extent practicable the recommendations in the report of the Lowell Historic Canal District Commission.

(Pub. L. 95-290, § 1, June 5, 1978, 92 Stat. 290.)

**§ 410cc-1. Definitions**

For purposes of sections 410cc to 410cc-37 of this title—

(1) the term "park" means the Lowell National Historical Park, established by section 410cc-11(a)(1) of this title;

(2) the term "preservation district" means the Lowell Historic Preservation District, established by section 410cc-11(a)(1) of this title;

(3) the term "Commission" means the Lowell Historic Preservation Commission established by section 410cc-31(a) of this title;

(4) the term "Secretary" means the Secretary of the Interior; and

(5) the term "report of the Lowell Historic Canal District Commission" means the report submitted to the Congress by the Lowell Historic Canal District Commission pursuant to an Act entitled "An Act to provide for a plan for the preservation, interpretation, development and use of the historic, cultural, and architectural resources of the Lowell Historic Canal District in Lowell, Massachusetts, and for other purposes", approved January 4, 1975 (88 Stat. 2730). (Pub. L. 95-290, § 2, June 5, 1978, 92 Stat. 290.)

Reference is first made to the Act entitled "An Act to provide for a plan for the preservation, interpretation, development and use of the historic, cultural, and architectural resources of the Lowell Historic Canal District in Lowell, Massachusetts, and for other purposes", approved January 4, 1975 (88 Stat. 2730), referred to in par. (5), in Pub. L. 95-645, Jan. 4, 1975, 88 Stat. 2730, and is set out as a note under section 461 of this title.

**§ 410cc-11. Establishment of Lowell National Historical Park; establishment and administration of Lowell Historic Preservation District; establishment, publication, and revision of boundaries**

(a) (1) To carry out the purpose of sections 410cc to 410cc-37 of this title, there is established as a unit of the National Park System in the city of Lowell, Massachusetts, the Lowell National Historical Park. There is further established in an area adjacent to the park the Lowell Historic Preservation District, which will be administered by the Secretary and by the Commission in accordance with sections 410cc to 410cc-37 of this title. The boundaries of the park and preservation district shall be the boundaries depicted on the map entitled "Lowell National Historical Park, Massachusetts", dated March 1978, and numbered "Low-80-008A". Such map shall be on file and available for inspection in the office of the National Park Service, Department of the Interior, and in the office of the city clerk, city of Lowell.

(2) The Secretary shall publish in the Federal Register as soon as practicable after June 5, 1978, a detailed description and map of the boundaries established under paragraph (1) of this subsection.

(b) The Secretary may make minor revisions of the park and preservation district boundaries established under subsection (a)(1) of this section, after consulting with the Commission and the city manager of Lowell, by publication of a revised drawing or other boundary description in the Federal Register, but no waters, lands, or other property outside of the park or preservation district boundaries established under such subsection may be added to the park or preservation district without the consent of the city manager of Lowell and the city council of Lowell. A boundary

revision made under this subsection shall be effective only after timely notice in writing is given to the Congress.

(Pub. L. 95-290, Title I, § 101, June 5, 1978, 92 Stat. 291.)

**§ 410cc-12. Consultations, cooperation, and conduct of activities by Federal entities; issuance of licenses or permits by Federal entities**

(a) Any Federal entity conducting or supporting activities directly affecting the park or preservation district shall—

(1) consult with, cooperate with, and to the maximum extent practicable, coordinate its activities with the Secretary and with the Commission; and

(2) conduct or support such activities in a manner which (A) to the maximum extent practicable is consistent with the standards and criteria established pursuant to section 410cc-32(e) of this title, and (B) will not have an adverse effect on the resources of the park or preservation district.

(b) No Federal entity may issue any license or permit to any person to conduct an activity within the park or preservation district unless such entity determines that the proposed activity will be conducted in a manner consistent with the standards and criteria established pursuant to section 410cc-32(e) of this title and will not have an adverse effect on the resources of the park or preservation district.

(Pub. L. 95-290, Title I, § 102, June 5, 1978, 92 Stat. 291.)

**§ 410cc-13. Authorization of appropriations**

(a) General authority; maximum amounts

There are authorized to be appropriated such sums as may be necessary to carry out sections 410cc to 410cc-37 of this title, except that—

(1) the total of the amounts authorized to be appropriated for the purpose of acquisition and development under the park management plan established pursuant to section 410cc-21(b) of this title and emergency assistance under section 410cc-23(a)(1) of this title shall not exceed \$18,500,000; and

(2) the total of the amounts authorized to be appropriated for the purpose of carrying out section 410cc-32(b)(2) of this title, for the payment of grants and loans under section 410cc-33 of this title, for the acquisition of property under section 410cc-34 of this title, and for carrying out any transportation program and any educational and cultural program described in section 410cc-32(c) of this title shall not exceed \$21,500,000.

(b) Commencement date

No funds shall be authorized pursuant to this section prior to October 1, 1978.

(c) Availability of appropriations

Funds appropriated under subsection (a) of this section shall remain available until expended.

(d) Aggregate amount of money expended; certifying statement to Congress as limiting availability of appropriated amounts

(1) Within 60 days after June 5, 1978, and on each subsequent October 1 and March 1, the Secretary shall submit to the Congress a statement certifying the aggregate amount of money expended by the Commonwealth of Massachusetts, the city of Lowell, and by any nonprofit entity for activities in the city of Lowell consistent with the purpose of sections 410cc to 410cc-37 of this title during the period beginning on January 1, 1974, and ending on the date such statement is submitted.

(2) The aggregate amount of funds made available by the Secretary to the Commission from funds appropriated under subsection (a)(2) of this section may not exceed the amount certified by the Secretary in the most recent statement submitted to the Congress under paragraph (1) of this subsection.

(Pub. L. 95-290, Title I, § 103, June 5, 1978, 92 Stat. 292.)

**§ 410cc-14. Funding limitations**

Notwithstanding any other provision of sections 410cc to 410cc-36 of this title, no authority to enter into agreements or to make payments under sections 410cc to 410cc-37 of this title shall be effective except to the extent, or in such amounts, as may be provided in advance in appropriation Acts.  
(Pub.L. 95-290, Title 1, § 104, June 6, 1978, 92 Stat. 292.)

**PART B—POWERS AND DUTIES OF SECRETARY**

**§ 410cc-21. Park management plan; submission date and contents of preparatory statement to Congress; establishment, submission date, contents, etc., of plan**

(a) The Secretary shall submit a statement to the Congress, within two years after the date on which funds are made available to carry out sections 410cc to 410cc-37 of this title, which—

- (1) reports on the progress that the Secretary has made in acquiring the properties identified under section 410cc-22 of this title, and describes the way the Secretary intends to use these properties;
- (2) identifies the properties within the park and preservation district respecting which the Secretary has entered into or intends to enter into agreements relating to interpretive exhibits or programs under section 410cc-23(a) of this title;

(3) (A) reports on the progress of the Secretary in leasing a portion of the Lowell Manufacturing Company, located on Market Street, for the purpose of establishing a visitors' center in close proximity to parking and other transportation facilities, and (B) identifies any other property within the park which the Secretary has leased or intends to lease for purposes of the park;

(4) reports any other activities which the Secretary has taken or intends to take to carry out the purpose of sections 410cc to 410cc-37 of this title; and (5) contains a tentative budget for the park and preservation district for the subsequent five fiscal years.

(b) (1) Not later than three years after the date on which funds are made available to carry out sections 410cc to 410cc-37 of this title, the Secretary shall establish and submit to the Congress a park management plan containing the information described in subsection (a) of this section. Such plan shall, upon request, be available to the public.

(2) After consulting with the Commission, the city manager of Lowell, and the Commonwealth of Massachusetts, the Secretary may make revisions in the park management plan established pursuant to paragraph (1) of this subsection by publication of such revisions in the Federal Register. A revision made under this paragraph shall be effective 90 days after written notice of the revision is submitted to the Congress.  
(Pub.L. 95-290, Title 1, § 201, June 6, 1978, 92 Stat. 292.)

**§ 410cc-22. Acquisition of property**

(a) Specified property; manner of acquisition

The Secretary is authorized to acquire the properties designated in paragraph (2) of this subsection, or any interest therein, by donation, purchase with donated or appropriated funds, condemnation, or otherwise. Any property or interest therein owned by the Commonwealth of Massachusetts or any political subdivision thereof may be acquired only by donation. The Secretary may initiate condemnation proceedings under this paragraph only after making every reasonable effort to acquire property through negotiations and purchase, and consulting with the Commission (if established) and the city council of Lowell.

(2) The properties referred to in paragraph (1) of this subsection are the following:

- (A) The Linus Childs House, 63 Kirk Street.
- (B) The H and H Paper Company (commonly referred to as Boot Mill Boarding House), 42 French Street.

- (C) Old City Hall, 226 Merrimack Street.
- (d) Merrimack Gatehouse, 269 Merrimack Street.
- (E) The Wannamant Textile Company, 582 Suffolk Street.
- (F) The structures containing the Jade Pagoda and Solomon's Yard Goods, 210 and 200 Merrimack Street.

(b) Other property within park or preservation district; criteria for acquisition; manner of acquisition

Until the date on which the Commission conducts its first meeting, the Secretary may acquire any property within the park or preservation district not designated in subsection (a) (2) of this section, or any interest therein, if such property—

- (1) is identified in the report of the Lowell Historical Canal District Commission as a property which should be preserved, restored, managed, developed, or maintained in a manner consistent with the purpose of sections 410cc to 410cc-37 of this title;
- (2) is listed in the National Register of Historic Places, as maintained by the Secretary pursuant to section 470(a) of this title, and section 462(b) of this title; or

(3) is determined by the Secretary to be of national significance, and would be subject to demolition or major alteration in a manner inconsistent with the purposes of sections 410cc to 410cc-37 of this title unless acquired by the Secretary. Such property may be acquired only as provided in subsection (a) (1) of this section.

(c) Easements; manner of acquisition

The Secretary may acquire easements within the park for the purpose of carrying out sections 410cc to 410cc-37 of this title. Such easements may be acquired only as provided in subsection (a) (1) of this section.  
(Pub.L. 95-290, Title 1, § 202, June 6, 1978, 92 Stat. 293.)

**§ 410cc-23. Agreements and technical assistance**

(a) The Secretary may enter into agreements with any owner of property with national historic or cultural significance within the park to provide for interpretive exhibits or programs. Such agreements shall provide, whenever appropriate, that—

- (1) the public may have access to such property at specified, reasonable times for purposes of viewing such property or the exhibits or attending the programs established by the Secretary under this subsection; and
- (2) the Secretary may make such minor improvements to such property as the Secretary deems necessary to enhance the public use and enjoyment of such property, exhibits, and programs.

(b) (1) The Secretary shall provide, upon request, technical assistance to—

- (A) the city of Lowell to assist the city in establishing regulations or laws consistent with the standards and criteria established pursuant to section 410cc-32(e) of this title; and
- (B) the Commission to assist the Commission in establishing the index and the standards and criteria required by section 410cc-32 of this title.

(2) The Secretary may provide to any owner of property within the park or preservation district, the Commission, the Commonwealth of Massachusetts, the city of Lowell, and any other Federal entity or any institution such technical assistance as the Secretary considers appropriate to carry out the purpose of sections 410cc to 410cc-37 of this title.  
(Pub.L. 95-290, Title 1, § 203, June 6, 1978, 92 Stat. 294.)

**§ 410cc-24. Withholding of funds; criteria**

The Secretary may refuse to obligate or expend any money appropriated for the purposes described in section 410cc-33(a)(1) or section 410cc-33(a)(2) of this title if the Secretary determines that—

- (a) the city of Lowell has failed to establish regulations or laws consistent with the standards and criteria established pursuant to section 410cc-32(e) of this title within one year after the date such standards and criteria have been established, except that the Secretary may extend such one-year period for not

more than six months if the Secretary determines that the city has made a good faith effort to establish such regulations or laws;

(b) the city of Lowell has failed to notify the Commission of (1) applications for building permits or zoning variances respecting any property which is included in the index established pursuant to section 410cc-32(d) of this title, or (2) any proposals of the city of Lowell to change the regulations or laws described in paragraph (c)(1) of this subsection;

(c) (1) during the period before the city of Lowell has established regulations or laws consistent with the standards and criteria established pursuant to section 410cc-32(e) of this title, the city of Lowell has granted any building permit or zoning variance or has taken any other action respecting any property within the park or preservation district, which either the Secretary or the Commission consider to be inconsistent with such standards and criteria;

(2) after the city of Lowell has established the regulations or laws described in subparagraph (1) of this paragraph, the city of Lowell has granted any building permit or zoning variance or has taken any other action respecting any property within the park or preservation district, which either the Secretary or the Commission consider to be inconsistent with such regulations or laws; or (d) the Commission has not made good faith efforts to (1) provide for the preservation, restoration, management, development, or maintenance of property within the park and preservation district or (2) carry out the park preservation plan approved under section 410cc-32 of this title.

(Pub L. 95-290, Title II, § 204, June 5, 1978, 92 Stat. 294)

**§ 410cc-25. Administrative functions**

(a) Implementation of park management plan: emergency assistance for protection of property owners: availability of funds for Commission

(1) The Secretary, acting through the National Park Service, shall take appropriate actions to implement to the extent practicable the park management plan established pursuant to section 410cc-21(b) of this title. In carrying out such plan, the Secretary shall administer the park in accordance with laws, rules, and regulations applicable to the national park system. Before the date on which the Commission conducts its first meeting, the Secretary may take any other action the Secretary deems necessary to provide owners of property with national historic or cultural significance within the park or preservation district with emergency assistance for the purpose of preserving and protecting their property in a manner consistent with the purpose of sections 410cc to 410cc-37 of this title.

(2) Subject to sections 410cc-24 and 410cc-32(b) of this title, the Secretary shall make available to the Commission any funds appropriated under section 410cc-13a (2) of this title for the purpose of carrying out sections 410cc-31 to 410cc-36 of this title.

(b) Acceptance of donations of funds, property, or services for implementation of park management plan

Notwithstanding any other provisions of law, the Secretary may accept donations of funds, property, or services from individuals, foundations, corporations, and other private entities, and from public entities, for the purpose of implementing the park management plan.

(c) Sponsorship or coordination of educational or cultural programs

The Secretary may sponsor or coordinate within the park and preservation district such educational or cultural programs as the Secretary considers appropriate to encourage appreciation of the resources of the park and preservation district.

(d) Acquisition of leases respecting property within park

The Secretary may acquire such leases respecting property within the park as may be necessary to carry out the purpose of sections 410cc to 410cc-37 of this title. (Pub L. 95-290, Title II, § 205, June 5, 1978, 92 Stat. 295)

**PART C—POWERS AND DUTIES OF PRESERVATION COMMISSION**

**§ 410cc-31. Lowell Historic Preservation Commission**

(a) Establishment and administrative role: composition of membership

There is established within the Department of the Interior a commission to be known as the Lowell Historic Preservation Commission which shall administer the preservation district and provide certain services within the park in accordance with this part. The Commission shall consist of fifteen members appointed by the Secretary as follows:

(1) Three members who are members of the city council of Lowell, appointed from recommendations made by the mayor of Lowell.

(2) Three members appointed from recommendations made by the city manager of Lowell of persons who are representative of organized labor, the business community, local neighborhoods, and cultural institutions, and who are not elected officials.

(3) One member appointed from recommendations made by the president of the University of Lowell.

(4) Three members appointed from recommendations made by the Governor of the Commonwealth of Massachusetts.

(5) One member appointed from recommendations made by the Secretary of Commerce and who shall be an employee of the Department of Commerce.

(6) One member appointed from recommendations made by the Secretary of Transportation and who shall be an employee of the Department of Transportation.

(7) One member appointed from recommendations made by the Secretary of Housing and Urban Development and who shall be an employee of the Department of Housing and Urban Development.

(8) Two members who are qualified to serve on the Commission because of their familiarity with programs of the Department of the Interior involving national parks and historic preservation and who shall be an employee of the Department of the Interior.

(b) Continuation of status as appointed member for member leaving government office or becoming elected official of government: duration

If any member of the Commission who was appointed to the Commission under paragraph (1) or (4) of subsection (a) of this section as a member of the city council of Lowell or any other government leaves that office, or if any member of the Commission who was appointed from persons who are not elected officials of any government becomes an elected official of a government, such person may continue as a member of the Commission for not longer than the thirty-day period beginning on the date such person leaves that office or becomes such an elected official, as the case may be.

(c) Terms of office and reappointment of members

(1) Except as provided in paragraph (2) of this subsection, members shall be appointed for terms of two years. A member may be reappointed only three times and as such member was originally appointed to fill a vacancy pursuant to subsection (e)(1) of this section, in which case such member may be reappointed four times.

(2) Of the members first appointed pursuant to subsection (a) of this section, the following shall be appointed for terms of three years:

(A) The members appointed pursuant to paragraphs (2), (3), and (8) of such subsection.

(B) One of the members appointed pursuant to paragraph (4) of such subsection, as designated by the Secretary at the time of appointment upon recommendation of the Governor.

(d) Chairman: election by members: term of office

The chairman of the Commission shall be elected by the members of the Commission. The term of the chairman shall be two years.

(c) **Vacancies: appointment and term of office; service by member after expiration of term**  
(1) Any vacancy in the Commission shall be filled in the same manner in which the original appointment was made.

(2) Any member appointed to fill a vacancy shall serve for the remainder of the term for which his predecessor was appointed. Any member may serve after the expiration of his term for a period not longer than thirty days.

(f) **Quorum and holding of hearings**  
Eight members of the Commission shall constitute a quorum, but a lesser number may hold hearings.

(g) **Meetings**  
The Commission shall meet at least once each month, at the call of the chairman or a majority of its members.

(h) **Compensation: travel expenses and per diem**  
(1) Except as provided in paragraph (2) of this subsection, members of the Commission shall each be entitled to receive \$100 for each day (including travel time) during which they are engaged in the performance of the duties of the Commission.

(2) Members of the Commission who are full-time officers or employees of the United States, the city of Lowell, or the Commonwealth of Massachusetts shall receive no additional pay on account of their service on the Commission.

(3) While away from their homes or regular places of business in the performance of services for the Commission, members of the Commission shall be allowed travel expenses, including per diem in lieu of subsistence, in the same manner as persons employed intermittently in the Government service are allowed expenses under section 5703 of Title 5.

(i) **Termination**  
The Commission established pursuant to sections 410cc to 410cc-37 of this title, shall cease to exist ten years from June 5, 1978.  
(Pub. L. 95-290, Title III, § 301, June 5, 1978, 92 Stat. 295.)

**§ 410cc-32. Park preservation plan and index**

(a) **Submission by Commission and approval or disapproval by Secretary of draft and final plans; procedures applicable; revisions in approved plan**

(1) Within one year after the date on which the Commission conducts its first meeting, the Commission shall submit to the Secretary a draft park preservation plan meeting the requirements of subsection (c) of this section. The Secretary shall review the draft park preservation plan and, within ninety days after the date on which such plan is submitted to the Secretary, suggest appropriate changes in such plan to the Commission.

(2) Within eighteen months after the date on which the Commission conducts its first meeting, the Commission shall submit to the Secretary a park preservation plan which meets the requirements of subsection (c) of this section. The Secretary shall, within ninety days after the date on which such plan is submitted to the Secretary, approve or disapprove such plan. The Secretary may not approve such plan unless the Secretary determines that such plan would adequately carry out the purpose of sections 410cc to 410cc-37 of this title.

(3) If the Secretary disapproves a park preservation plan, the Secretary shall advise the Commission of the reasons for such disapproval together with the recommendations of the Secretary for revision of such plan. Within such period as the Secretary may designate, the Commission shall submit a revised park preservation plan to the Secretary. The Secretary shall approve or disapprove any revised park preservation plan in the same manner as required in paragraph (2) of this subsection for the approval or disapproval of the original park preservation plan.

(4) If the Secretary approves a park preservation plan, the Secretary shall publish notice of such approval in the Federal Register and shall forward copies of the approved plan to the Congress.

(b) **Any park preservation plan or draft plan submitted to the Secretary under this subsection shall, upon request, be available to the public.**

(c) **No changes other than minor revisions may be made in the approved park preservation plan without the approval of the Secretary. The Secretary shall approve or disapprove any proposed change in the approved park preservation plan, except minor revisions in the same manner as required in paragraph (2) of this subsection for the approval or disapproval of the original park preservation plan.**

(d) **Funding availability and requirements for plan implementation, activities, etc.**  
(1) Except as provided in paragraph (2) of this subsection, the Secretary shall not make any funds available to the Commission to carry out section 410cc-33 or 410cc-34 of this title until a park preservation plan has been approved under subsection (a) of this section.

(2) Before a park preservation plan is approved under subsection (a) of this section, the Secretary may make available to the Commission such funds as the Commission may request to carry out any activity specified in paragraph (3) of this section. However, no funds shall be made available under this paragraph unless a proposal describing such activity is reviewed and approved by the Secretary.

(3) **The Commission may request funds from the Secretary to—**  
(A) carry out activities to preserve, restore, manage, develop, or maintain any property identified in subsection (c) (1) of this section;

(B) take any action the Commission considers necessary to provide owners of property with national historical or cultural significance within the park or preservation district with emergency assistance for the purpose of preserving and protecting their property in a manner consistent with the purpose of sections 410cc to 410cc-37 of this title; or

(C) acquire in accordance with section 410cc-34 of this title, any property within the park which—  
(1) is identified in the report of the Lowell Historic Canal District Commission as a property which should be preserved, restored, managed, developed, or maintained in a manner consistent with the purpose of sections 410cc to 410cc-37 of this title;

(2) is listed in the National Register of Historic Places, as maintained by the Secretary pursuant to section 4704(a) of this title, and section 462(b) of this title; or

(3) is determined by the Secretary to be of national significance; and would be subject to demolition or major alteration in a manner inconsistent with the purpose of sections 410cc to 410cc-37 of this title unless acquired by the Commission.

(e) **Requirements for plan**  
Any plan submitted to the Secretary under subsection (a) of this section shall—  
(1) describe the manner in which the Commission, to the extent practicable in accordance with the recommendations in the report of the Lowell Historic Canal District Commission, proposes to provide for the preservation, restoration, management, development, or maintenance of—

- (A) the Welles Block, 169 Merrimack Street;
- (B) the Jordan Marsh Company Building, 153 Merrimack Street and 15 Kirk Street;
- (C) the York Club, 91 Dutton Street;
- (D) the Lowell Gas Light Company, 22 Shattuck Street;
- (E) St. Anne's Church and Rectory, 237 Merrimack Street;
- (F) Lowell Institution for Savings, 18 Shattuck Street;
- (G) the Ahpepa Building, 31 Kirk Street;
- (H) Broot Mill, Foot of John Street;
- (I) Lowell Manufacturing Company on Market Street; and
- (J) the structure commonly referred to as the Early Renaissance, 45, 47, and 49 Kirk Street;

(2) identify the properties included in the index established pursuant to subsection (d) of this section;



(3) Identify the properties which the Commission intends to acquire under section 410cc-34 of this title and specify how such properties shall be used;

(4) Include the standards and criteria established pursuant to subsection (e) of this section;

(5) Provide a detailed description of the manner in which the Commission intends to implement the grant and loan programs under section 410cc-33 of this title, including information relating to the estimated amount of such grants and the manner in which such grants shall be awarded by the Commission;

(6) Provide for a transportation program by which the Commission shall provide, directly or by agreement with any person or any public or private entity, transportation services and facilities for park and preservation district visitors, including barge equipment, docking facilities, and local rail facilities;

(7) Provide for educational and cultural programs to encourage appreciation of the resources of the park and preservation district; and

(8) Include a tentative budget for the subsequent five fiscal years.

(a) Establishment and contents of index: modification of index  
The Commission shall establish, within one year after the date on which the Commission conducts its first meeting, an index which includes—

(1) any property in the park or preservation district (except for any property identified in section 410cc-21(a)(2) of this title) which should be preserved, restored, managed, developed, maintained, or acquired by the Commission because of its national historic or cultural significance; and

(2) any property which should be preserved, restored, managed, developed, or maintained in a manner compatible with the purpose of sections 410cc to 410cc-37 of this title because of its proximity to (A) any property referred to in paragraph (1) of this subsection, or (B) any property designated in section 410cc-21(a)(2) of this title.

The index may be modified only by a majority vote of the members of the Commission, taken when a quorum is present.

(e) Standards and criteria for construction, preservation, etc., of properties within preservation district and park; authorization; establishment; revisions; publication in Federal Register  
(1) The Commission shall establish standards and criteria applicable to the construction, preservation, restoration, alteration, and use of all properties within the preservation district with the advice of the Commonwealth of Massachusetts and of the Secretary, and the consent of the city manager of Lowell.

(2) The Commission shall establish the standards and criteria described in paragraph (1) of this subsection for any property within the park with the advice of the Commonwealth of Massachusetts and the city manager of Lowell and subject to the review and approval of the Secretary.

(3) The Commission shall establish standards and criteria under paragraphs (1) and (2) of this subsection within one year after the date on which the Commission conducts its first meeting. Such standards and criteria may be revised in the same manner in which they were originally established.

(4) The Secretary shall publish the standards and criteria established under paragraphs (1) and (2) of this subsection, and any revisions thereof, in the Federal Register.  
(Publ. L. 95-290, Title III, § 802, June 5, 1978, 92 Stat. 297.)

§ 410cc-33. Financial and technical assistance

(a) Loans to Lowell Development and Financial Corporation for loans for preservation, etc., of property; terms of loan agreement with corporation; determination of compliance by corporation with requirements for loans; repayment by corporation  
The Commission may make loans to the Lowell Development and Financial Corporation (established under chapter 844 of the Massachusetts General Laws and hereinafter referred to as the "corporation") to enable the corporation to provide low interest loans for the preservation, restoration, or development of any property described in section 410cc-32(d) (1) of this title. The Commission may make any such

loan to the corporation only after entering into a loan agreement with the corporation which includes the following terms:

(1) The loan to the corporation shall have a maturity of thirty-five years. At the end of such period, the corporation shall repay to the Secretary of the Treasury (in a lump sum) for deposit in the general fund of the Treasury the full amount of the loan and any additional amounts accruing to the corporation pursuant to this subsection excepting those amounts expended by the corporation for reasonable administrative expenses.

(2) The money received from the Commission, and any interest earned on such money, may be obligated by the corporation only for low interest loans made under paragraphs (6) and (7) of this subsection, except that the corporation may use such money to the extent the Commission considers reasonable to satisfy the costs of the corporation in administering the loan or procuring loan guarantees or insurance.

(3) Within five years after receiving the loan from the Commission, the corporation shall make loans under paragraphs (6) and (7) of this subsection which, in the aggregate, obligate the full amount of money received from the Commission (minus any amount required to satisfy the costs described in paragraph (2) of this subsection).

(4) As loans made under paragraphs (6) and (7) of this subsection are repaid, the corporation shall make additional loans under such paragraphs with the money made available for obligation by such repayments.

(5) The corporation shall make available to the Commission and to the Secretary, upon request, all accounts, financial records, and other information related to loans made under paragraphs (6) and (7) of this subsection.

(6) Before the corporation approves any application for a low interest loan for which money has been made available to the corporation by the Commission, the corporation shall require the prospective borrower to furnish the Commission, with a statement from the Commission stating that the Commission has reviewed the application and has determined that any loan received by the prospective borrower will be spent in a manner consistent with—

(A) the standards and criteria established pursuant to section 410cc-32(e) of this title, and  
(B) the goals of the park preservation plan approved under section 410cc-32(a) of this title.

(7) The corporation may approve any application for a low interest loan which meets the terms and conditions prescribed by the corporation with the approval of the Commission and for which money has been made available to the corporation by the Commission if—  
(A) the prospective borrower furnishes the corporation with the statement described in paragraph (6) of this subsection;

(B) the corporation determines that such borrower has sufficient financial resources to repay the loan; and  
(C) such borrower satisfies any other applicable credit criteria established by the corporation.

In order to determine whether the corporation has complied with this subsection, the Commission, or such other appropriate person or entity as the Commission may designate, shall conduct an audit at least once every two years of all accounts, financial records, and other information related to loans made under paragraphs (6) and (7) of this subsection. If the Commission determines, after conducting a hearing on the record, that the corporation has substantially failed to comply with this subsection, the outstanding balance of any loan made to the corporation under this subsection shall become payable in full upon the demand of the Commission.

(b) Grants to property owners for preservation, etc., of property; grants to persons or public or private entities for educational and cultural programs or for necessary services; terms of grant agreement; recovery of amounts for incidental uses  
(1) The Commission may make grants to owners of property described in section 410cc-32(d) (1) of this title for the preservation, restoration, management, development, or maintenance of such property in a manner consistent with the standards and criteria established pursuant to section 410cc-32(e) of this title.

(2) The Commission, with the approval of the Secretary, may make grants to any person or any public or private entity to provide for (i) educational and cultural programs which encourage appreciation of the resources of the park and preservation district, or (ii) any planning, transportation, maintenance, or other services the Commission considers necessary to carry out the purposes of sections 410cc-37 to 410cc-37 of this title.

(3) Grants under this subsection shall be made under agreements which specify the amount of the grant, the installments (if any) by which the grant shall be paid to the grant recipient, the purpose for which the grant may be used, and any other condition the Commission considers appropriate. The Commission shall be entitled, under the terms of any grant agreement, to recover from the recipient any funds used in a manner inconsistent with such grant agreement.

(c) Technical assistance to property owners, etc.

The Commission with the advice of the Secretary may provide technical assistance to—

(1) owners of property within the park or preservation district to assist such owners in (A) making repairs to or improvements in any property included in the index established pursuant to section 410cc-32(d) of this title; or (B) applying for loans under subsection (a) of this section; and

(2) any other person or public or private entity to assist such person or entity in taking actions consistent with the purpose of sections 410cc to 410cc-37 of this title.

(d) Availability to loans and grants relating to leases and grants

The Commission shall make available to the Secretary, upon request, all accounts, financial records, and other information of the Commission relating to grants and loans made under this section.

(e) Annual report to Congress, contents

The Secretary shall make an annual report to the Congress describing the loans, grants, and technical assistance provided under this section and under section 410cc-23 of this title. Such report shall specify the amount, recipient, and purpose of any loan, grant or technical assistance so provided and contain such additional information as the Secretary considers appropriate.

(Pub.L. 95-290, Title III, § 303, June 5, 1978, 92 Stat. 300)

§ 410cc-34. Acquisition and disposition of property

(a) Acquisition of specified property; manner of acquisition

(1) The Commission may acquire any property designated in paragraph (3) of this subsection, any property described in section 410cc-32(d)(1) of this title, or any interest therein, by donation, by purchase with donated or appropriated funds, or by condemnation in accordance with paragraph (2) of this subsection.

(2) Only properties within the park or property designated in paragraph (3) of this subsection may be acquired by the Commission by condemnation. The Commission may initiate condemnation proceedings only after making every reasonable effort to acquire any such property through negotiations and purchase and consulting with the city council of Lowell. No lands or interests therein may be acquired by the Commission by condemnation without the approval of the Secretary.

(3) The Commission may acquire in accordance with paragraph (1) of this subsection the following properties, or any interest therein:

(A) World Furniture Building, 125 Central Street; and  
(B) The Martin Building, 102-122 Central Street.

(b) Sale or lease of specified property; conditions

The Commission, with the approval of the Secretary, may sell or lease any property which it acquires under subsection (a) of this section subject to such deed restrictions or other conditions as the Commission deems appropriate to carry out the purpose of sections 410cc to 410cc-37 of this title.

(c) Agreement for disposal of specified property to Commonwealth of Massachusetts; powers of transfer

Pursuant to a written agreement between the Commission and the Commonwealth of Massachusetts, the Commission, with the approval of the Secretary, may sell, donate, lease, or in any other manner the Commission and the Secretary deem appropriate make available to the Commonwealth any property which the Commission has acquired under subsection (a) of this section in order to provide for the administration or maintenance of such property by the Commonwealth in a manner consistent with the purpose of sections 410cc to 410cc-37 of this title.

(Pub.L. 95-290, Title III, § 304, June 5, 1978, 92 Stat. 302)

§ 410cc-35. Powers of Commission

(a) Conduct of hearings, etc.

The Commission may for the purpose of carrying out sections 410cc to 410cc-37 of this title hold such hearings, sit and act at such times and places, take such testimony, and receive such evidence, as the Commission may deem advisable. The Commission may administer oaths or affirmations to witnesses appearing before it.

(b) Authorization of action by member or agent

When so authorized by the Commission, any member or agent of the Commission may take any action which the Commission is authorized to take by this section.

(c) Receipt of necessary information from other Federal departments or agencies; information furnished upon request by Chairman

Subject to section 552a of Title 5, the Commission may secure directly from any department or agency of the United States information necessary to enable it to carry out sections 410cc to 410cc-37 of this title. Upon request of the chairman of the Commission, the head of such department or agency shall furnish such information to the Commission.

(d) Authorization to seek and accept donations of funds, property, or services

Notwithstanding any other provision of law, the Commission may seek and accept donations of funds, property, or services from individuals, foundations, corporations, and other private entities, and from public entities, for the purpose of carrying out its duties.

(e) Use of funds for obtaining additional money

The Commission may use its funds to obtain money from any source under any program or law requiring the recipient of such money to make a contribution in order to receive such money.

(f) Use of mails

The Commission may use the United States mails in the same manner and upon the same conditions as other departments and agencies of the United States.

(g) Purchase, rental, donation, etc., of property, facilities, and services; manner of acquisition; transfer to Department of Interior upon termination of Commission

The Commission may obtain by purchase, rental, donation, or otherwise, such property, facilities, and services as may be needed to carry out its duties. Any acquisition of property by the Commission shall be in accordance with section 410cc-34 of this title. *Provided, however,* That the Commission may not acquire lands or interests therein pursuant to this subsection by condemnation. Upon the termination of the Commission, all property, personal and real, and unexpended funds shall be transferred to the Department of the Interior.

(Pub.L. 95-290, Title III, § 305, June 5, 1978, 92 Stat. 302)

§ 410cc-36. Staff of Commission

(a) Appointment and compensation of Director

The Commission shall have a Director who shall be appointed by the Commission and who shall be paid at a rate not to exceed the rate of pay payable for grade GS-15 of the General Schedule.

(b) Appointment and compensation of additional personnel

The Commission may appoint and fix the pay of such additional personnel as the Commission deems desirable.

(c) Applicability of civil service provisions to appointment and compensation of Director and staff

The Director and staff of the Commission may be appointed without regard to the provisions of Title 5 governing appointments in the competitive service, and may be paid without regard to the provisions of chapter 51, and subchapter III of chapter 53 of such title relating to classification and General Schedule pay rates, except that no individual so appointed may receive pay in excess of the annual rate of basic pay payable for grade GS-15 of the General Schedule.

(d) Temporary or intermittent services: procurement and compensation

Subject to such rules as may be adopted by the Commission, the Commission may procure temporary and intermittent services to the same extent as is authorized by section 3109(b) of Title 5, but at rates determined by the Commission to be reasonable.

(e) Detail of personnel from other Federal agencies represented by members on Commission: reimbursement by Commission; administrative support services by Administrator of General Services Administration; reimbursement by Commission

(1) Upon request of the Commission, the head of any Federal agency represented by members on the Commission may detail, on a reimbursable basis, any of the personnel of such agency to the Commission to assist it in carrying out its duties under sections 410cc-37 of this title.

(2) The Administrator of the General Services Administration shall provide to the Commission on a reimbursable basis such administrative support services as the Commission may request.

(Pub.L. 95-290, Title III, § 306, June 5, 1978, 92 Stat. 303)

§ 410cc-37. Use of funds; maintenance of financial records; audits

(a) Any revenues or other assets acquired by the Commission by donation, the lease or sale of property or fees for services shall be available to the Commission, without fiscal year limitation, to be used for any function of the Commission authorized under sections 410cc-37 of this title. The Commission shall keep financial records fully disclosing the amount and source of revenues and other assets acquired by the Commission, and shall keep such other financial records as the Secretary may prescribe.

(b) The Secretary shall require audits of the financial records of the Commission to be conducted not less frequently than once each year in order to ensure that revenues and other assets of the Commission are being used in a manner authorized under sections 410cc-37 of this title.

(Pub.L. 95-290, Title III, § 307, as added Pub.L. 96-344, § 10, Sept. 8, 1980, 94 Stat. 1186)

Oct 16, 1987  
[H.R. 2335]

To amend the Act establishing Lowell National Historical Park, and for other purposes.

An Act

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. AMENDMENTS.

The Act entitled "An Act to provide for the establishment of the Lowell National Historical Park in the Commonwealth of Massachusetts, and for other purposes", approved June 5, 1978 (92 Stat. 290; 16 U.S.C. 410cc et seq.), is amended—

16 USC 410cc-12

(1) in section 103(a)—

(A) by striking "\$18,500,000" and inserting "\$19,300,000" in paragraph (1) and

16 USC 410cc-31.

(B) by striking "\$21,500,000" and inserting "\$33,600,000" in paragraph (2);

16 USC 410cc-13  
now.

SEC. 2. EFFECTIVE DATES.

(a) IN GENERAL.—Except as provided in subsection (b), the amendments made by section 1 shall take effect on the date of the enactment of this Act.

(b) EFFECTIVE DATE OF AUTHORIZATION OF APPROPRIATION.—The amendments made by section 1(1) shall take effect on October 1, 1987.

Approved October 16, 1987.

## Lowell Hydroelectric Project (FERC Project No. 2790) Relicensing Pre-Application Document Information Questionnaire

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc. (Enel), is the Licensee and operator of the Lowell Hydroelectric Project (FERC No. 2790) (Project), with principal Project facilities located along the Merrimack River in Middlesex County, Massachusetts and a reservoir extending upstream to Hillsborough County, New Hampshire (see attached map). Boott, with assistance from HDR, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Project. Accordingly, Boott is preparing a Pre-Application Document (PAD) that will provide FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project that will be used to prepare documents related to analyzing the relicensing application to be prepared by Boott. To prepare the PAD, Boott will use information in its possession and information obtained from additional sources. This PAD Information Questionnaire will be used by Boott to help identify sources of existing, relevant, and reasonably available information that are not currently in Boott's possession.

1. Information about person completing the questionnaire:

|               |                                         |
|---------------|-----------------------------------------|
| Name & Title  | PETER AUCELLA, ASSISTANT SUPERINTENDENT |
| Organization  | LOWELL NATIONAL HISTORICAL PARK         |
| Address       | 67 KIRK ST., LOWELL, MA. 01852          |
| Phone         | 978-275-1722                            |
| Email Address | PETER_AUCELLA@NPS.GOV                   |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)     No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li><input type="checkbox"/> Geology and soils</li> <li><input type="checkbox"/> Water resources</li> <li><input type="checkbox"/> Fish and aquatic resources</li> <li><input type="checkbox"/> Wildlife and botanical resources</li> <li><input type="checkbox"/> Wetlands, riparian, and littoral habitat</li> <li><input type="checkbox"/> Rare, threatened &amp; endangered species</li> </ul> | <ul style="list-style-type: none"> <li><input type="checkbox"/> Recreation and land use</li> <li><input type="checkbox"/> Aesthetic resources</li> <li><input checked="" type="checkbox"/> Cultural resources</li> <li><input type="checkbox"/> Socio-economic resources</li> <li><input type="checkbox"/> Tribal resources</li> <li><input type="checkbox"/> Other resource information</li> </ul> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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**Additional Representative Contact Information (Optional)**

|               |                                           |
|---------------|-------------------------------------------|
| Name          | CELESTE BERNARDO, SUPERINTENDENT          |
| Address       | LOWELL NHP, 67 KIRK ST, LOWELL, MA. 01852 |
| Phone         | 978-275-1700                              |
| Email Address | CELESTE_BERNARDO@NPS.GOV                  |

*Additional Information (additional space provided on the following page):*

---

*Comments and/or questions may be sent via email to:*

Jim Gibson, HDR, at [Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com) or  
Rob Quiggle, HDR, at [Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

If you have any questions about the Project, or the upcoming FERC licensing processes, please contact Mr. Kevin Webb, Enel Relicensing Manager for the Lowell Hydroelectric Project, at (978) 681-1900 ext. 809 or [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com); Jim Gibson at (315) 414-2202; or Rob Quiggle at (315) 414-2216.

**Please return this questionnaire in the enclosed, self-addressed, stamped envelope within 21 days of receipt to allow for any follow-up contact that may be necessary by a representative from Boott or HDR.** Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

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NATIONAL REGISTER OF HISTORIC PLACES  
INVENTORY -- NOMINATION FORM

SEE INSTRUCTIONS IN HOW TO COMPLETE NATIONAL REGISTER FORMS  
TYPE ALL ENTRIES -- COMPLETE APPLICABLE SECTIONS

1 NAME

HISTORIC  
Locks and Canals Historic District  
AND/OR COMMON  
same

2 LOCATION

STREET & NUMBER  
multiple  
CITY, TOWN  
Lowell  
STATE  
Massachusetts  
VICINITY OF  
CODE  
025  
CONGRESSIONAL DISTRICT  
5  
COUNTY  
Middlesex  
CODE  
017

3 CLASSIFICATION

| CATEGORY                                     | OWNERSHIP                                      | STATUS                                                | PRESENT USE                                    |
|----------------------------------------------|------------------------------------------------|-------------------------------------------------------|------------------------------------------------|
| <input checked="" type="checkbox"/> DISTRICT | <input type="checkbox"/> PUBLIC                | <input checked="" type="checkbox"/> OCCUPIED          | <input type="checkbox"/> AGRICULTURE           |
| <input type="checkbox"/> BUILDING(S)         | <input type="checkbox"/> PRIVATE               | <input type="checkbox"/> UNOCCUPIED                   | <input checked="" type="checkbox"/> COMMERCIAL |
| <input type="checkbox"/> STRUCTURE           | <input checked="" type="checkbox"/> BOTH       | <input checked="" type="checkbox"/> WORK IN PROGRESS  | <input type="checkbox"/> EDUCATIONAL           |
| <input type="checkbox"/> SITE                | <b>PUBLIC ACQUISITION</b>                      | <b>ACCESSIBLE</b>                                     | <input type="checkbox"/> ENTERTAINMENT         |
| <input type="checkbox"/> OBJECT              | <input checked="" type="checkbox"/> IN PROCESS | <input type="checkbox"/> YES: RESTRICTED              | <input type="checkbox"/> GOVERNMENT            |
|                                              | <input type="checkbox"/> BEING CONSIDERED      | <input checked="" type="checkbox"/> YES: UNRESTRICTED | <input checked="" type="checkbox"/> INDUSTRIAL |
|                                              |                                                | <input type="checkbox"/> NO                           | <input type="checkbox"/> MILITARY              |
|                                              |                                                |                                                       | <input type="checkbox"/> OTHER:                |
|                                              |                                                |                                                       | <input type="checkbox"/> MUSEUM                |
|                                              |                                                |                                                       | <input type="checkbox"/> PRIVATE RESIDENCE     |
|                                              |                                                |                                                       | <input type="checkbox"/> RELIGIOUS             |
|                                              |                                                |                                                       | <input type="checkbox"/> SCIENTIFIC            |
|                                              |                                                |                                                       | <input type="checkbox"/> TRANSPORTATION        |

4 OWNER OF PROPERTY

NAME  
multiple ownership  
STREET & NUMBER  
CITY, TOWN  
Lowell  
VICINITY OF  
STATE  
Massachusetts

5 LOCATION OF LEGAL DESCRIPTION

COURTHOUSE,  
REGISTRY OF DEEDS, ETC.  
Northern Middlesex District Registry of Deeds  
STREET & NUMBER  
Goreham Street  
CITY, TOWN  
Lowell  
STATE  
Massachusetts

6 REPRESENTATION IN EXISTING SURVEYS

TITLE  
Inventory of the Historic Assets of the Commonwealth/ HAER  
DATE  
1976  
DEPOSITORY FOR SURVEY RECORDS  
Massachusetts Historical Commission/ Library of Congress  
CITY, TOWN  
Boston/ Washington D.C.  
STATE  
Massachusetts  
FEDERAL  STATE  COUNTY  LOCAL

# DESCRIPTION

| CONDITION                                |                                       | CHECK ONE                                   | CHECK ONE                                         |
|------------------------------------------|---------------------------------------|---------------------------------------------|---------------------------------------------------|
| <input type="checkbox"/> EXCELLENT       | <input type="checkbox"/> DETERIORATED | <input type="checkbox"/> UNALTERED          | <input checked="" type="checkbox"/> ORIGINAL SITE |
| <input checked="" type="checkbox"/> GOOD | <input type="checkbox"/> RUINS        | <input checked="" type="checkbox"/> ALTERED | <input type="checkbox"/> MOVED      DATE _____    |
| <input type="checkbox"/> FAIR            | <input type="checkbox"/> UNEXPOSED    |                                             |                                                   |

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

The Locks and Canals Historic District encompasses all of the canals in Lowell, (built between 1793 and 1848), their associated locks, and the mills that were powered by the canals. There are about five miles of canals, and the associated mill yards increase the acreage of the nominated district to approximately 100 acres. The canals are all contiguous though they meander throughout the city. The mill buildings and yards are all associated directly with a canal, and three boarding houses, not contiguous to the canals but built by mill owners for their workers, are also included in the district.

The Pawtucket Canal, the first canal to be built in Lowell, leaves the Merrimack River a few hundred yards upstream from the Pawtucket Dam. The site of the guard locks, about 1,000 feet from the head of the canal, has been in continuous use since the canal was opened to navigation in 1796, and the present structures and facilities include the Francis Gate, a lock house and a sluice gate house. The Francis Gate (#2) also known locally as Francis' Folly, is a proticullis flood gate, built in 1848-1850. The lock house (#1), built in 1881 over the upstream gate of the locking chamber, replaced an earlier 1852 structure. It is a wooden frame building with round arched windows and a slate hipped roof. The sluice gate house (#3) built in 1870, is a brick Romanesque structure with round arched windows and a slate ridge roof, containing machinery for five gates. Masonry work around the Guard Locks includes the lower part of the dam (1832), the upper dam portion (1848), the walls of the upstream island and lock chamber (1801) and downstream lock chamber (1877) and the downstream wall of the power canal chamber, built in 1867 and 1900.

The Northern Canal (#7), the last canal to be built, was constructed in 1846-48. It was built as a feeder canal to supplement the Pawtucket Canal and to raise the water level at the lower end of the canal system. Its construction provided for almost perfect control of the water level in the canal system and greatly increased its complexity by reversing flows and transforming some canals from power to feeder uses.

The Great River Wall surmounted by the Northern Canal Walk (#8) was created by the construction of the Northern Canal. The Great Wall is a 2,200 foot section of the canal wall that separates the Northern Canal from the river. The Northern Canal Gatehouse, the blacksmith shop and the Gate Keeper's Cottage are all located at the head of the Northern Canal. The Gatehouse (#4), constructed in 1847, is a one-story brick Romanesque Revival structure with round arched windows and a slate ridge roof; the interior contains ten guard sluice gates and the Francis turbine. Opposite the building is a navigation lock. The Locks and Canals Blacksmith Shop (#5) is a simple wood shed built next to the river, and is used to repair the lock machinery after spring flooding. Next to the Gate House is the Gate Keeper's Cottage (#6), a one and one-half story Victorian wood frame cottage built c. 1850 to serve as living quarters for the gate keeper.

The Suffolk Millyard (#9) adjacent to the Northern Canal, covers approximately five acres. One of the earliest corporations, the yard was built in 1831, but the major courtyard was built in 1863. The buildings are primarily Romanesque Revival although much of the early Federal styling remains. Structures of particular interest are the Counting House and an 1831 boarding house converted for industrial use. The Suffolk Manufacturing Company Boarding Houses (#3) across French Street from the Suffolk Yard, were constructed in 1845. Five units at the northern end of this fine example of workers' row housing were removed in the 1960's to allow construction of the French Street extension, a part of the Northern Canal Urban Renewal Project, but the remaining block has been re-habed.

continued

**SIGNIFICANCE**

**PERIOD**

- PREHISTORIC
- 1400-1499
- 1500-1599
- 1600-1699
- 1700-1799
- 1800-1899
- 1900-

- ARCHEOLOGY-PREHISTORIC
- ARCHEOLOGY-HISTORIC
- AGRICULTURE
- ARCHITECTURE
- ART
- COMMERCE
- COMMUNICATIONS

**AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW**

- |                                                 |                                                 |                                                    |
|-------------------------------------------------|-------------------------------------------------|----------------------------------------------------|
| <input type="checkbox"/> COMMUNITY PLANNING     | <input type="checkbox"/> LANDSCAPE ARCHITECTURE | <input type="checkbox"/> RELIGION                  |
| <input type="checkbox"/> CONSERVATION           | <input type="checkbox"/> LAW                    | <input type="checkbox"/> SCIENCE                   |
| <input type="checkbox"/> ECONOMICS              | <input type="checkbox"/> LITERATURE             | <input type="checkbox"/> SCULPTURE                 |
| <input type="checkbox"/> EDUCATION              | <input type="checkbox"/> MILITARY               | <input type="checkbox"/> SOCIAL/HUMANITARIAN       |
| <input checked="" type="checkbox"/> ENGINEERING | <input type="checkbox"/> MUSIC                  | <input type="checkbox"/> THEATER                   |
| <input type="checkbox"/> EXPLORATION/SETTLEMENT | <input type="checkbox"/> PHILOSOPHY             | <input checked="" type="checkbox"/> TRANSPORTATION |
| <input checked="" type="checkbox"/> INDUSTRY    | <input type="checkbox"/> POLITICS/GOVERNMENT    | <input type="checkbox"/> OTHER (SPECIFY)           |
| <input type="checkbox"/> INVENTION              |                                                 |                                                    |

SPECIFIC DATES 1790-1870

BUILDER/ARCHITECT

**STATEMENT OF SIGNIFICANCE**

The Locks and Canals Historic District in Lowell is significant for its contributions to the development of Lowell as the first great industrial city in the United States. The industrial revolution in North America was first initiated on a large scale in Lowell, and our industrial economy and present levels of technology are a reflection of Lowell's manufacturing experiments.

In 1792 Governor John Hancock signed a charter incorporating the Proprietors of the Locks and Canals on the Merrimack River. The charter gave to this group of Newburyport merchants riparian rights on the Merrimack River from the Massachusetts border to the Atlantic Ocean, and more specifically, the right to build locks and a canal to circumvent the Pawtucket Falls. This canal, opened in 1796, formed an island between itself and the Merrimack River, where the City of Lowell later developed. The canal was used to transport lumber, foodstuffs and people around the Pawtucket Falls on their journey from New Hampshire to Newburyport. In 1803 the Middlesex Canal opened, funnelling off to Boston the traffic which had been going to Newburyport, and caused the Pawtucket Canal to fail financially.

In 1822 the Merrimack Manufacturing Company, founded by Patrick Tracy Jackson and Nathan Appleton, bought up the holdings of the Proprietors and all of the land between the Merrimack River and the Pawtucket Canal. Both Jackson and Appleton had been partners of Francis Cabot Lowell in his successful mill at Waltham, Massachusetts where, for the first time, cotton was processed into cloth within a single building. At the Waltham mill Francis Lowell had developed the system of boarding houses and strict social regulation, which brought New England farm girls into the mills and had such an impact on the early days of the American industrial revolution. Expansion of the mill at Waltham was not possible because the Charles River was too slow moving to provide sufficient power, so after Lowell's death in 1816, his partners, searching for a new site, chose the area that is now the city of Lowell.

In 1825 the Merrimack Manufacturing Company had widened the Pawtucket Canal and constructed the Merrimack Canal. They built the first large mill (no longer extant) to be established in Lowell between the Merrimack River and Merrimack Canal and paved the way for future mill development. The first mill used only a fraction of the available water power, so the Merrimack Company, determined to keep out of the development business, sold its water power rights and unused land back to the Proprietors of the Locks and Canals, who were reorganized to develop the area by selling land and water power, building additional canals and supplying textile machinery to the mills. The Locks and Canals Company built the Hamilton Canal in 1826, the Lowell Canal in 1828, the Western Canal in 1831-32, the Eastern Canal in 1835, and finally the Northern Canal in 1847. Each of the new canals supplied power to new mill companies, built on the best sites to obtain power. The first priority in the development of the town was to bring water power to these mills; corporate housing, private businesses, and homes were built only where they did not interfere with the

continued



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PAGE 1

#7:

The Tremont Gatehouse (#10), a one-story ridge roof Romanesque Revival building, five bays wide, was constructed in 1855 as a component of the Northern Canal Project. Its purpose was to direct the flow of water from the Northern Canal through the upper level of the Western Canal to the Lawrence Yard, should the flow from the Suffolk and Tremont tailraces prove insufficient. The Tremont Yard (#11), next to the Western Canal, incorporates a site of about five acres and was the location of the Tremont Corporation, formed in 1830. The structures were razed in the 1930's and only fragments of the buildings remain.

The Lawrence Yard (#12), bounded by the Western Canal and the Merrimack River, covers approximately nine acres and contains structures ranging in date from 1826 to 1909. The weaving and spinning mills are principally Federal in style, four to six stories in height with Romanesque Revival additions and ornamentation. The Counting House is a particularly notable two-story High Victorian Gothic structure distinguished by the polychromatic banding of its slate roof. The Lawrence Canal, about 500 feet long, was constructed in 1831 and runs westerly from the Western Canal to provide water power for the Lawrence Yards.

Completed in 1848, the Moody Street Feeder (#13) was also built as part of the Northern Canal project, to increase the supply of water flowing into the Merrimack and Eastern Canals via the Boott Penstock. The Feeder extends from the Western Canal to the Merrimack Canal and consists of three brick vaulted tunnels. The Merrimack Canal Gate House (#14), built over the Moody Street Feeder and completed in 1848, is a Romanesque Revival building, two bays wide and six bays long. The building is distinguished by its fine dentiled cornice. The Gate House contains three service gates, each manually operated with counterweighted rock and pinion equipment over the waterway. The gate operating equipment is original to the feeder construction except for the counterweight system which was added in 1853. The building is already listed in the National Register as part of the City Hall Historic District.

The Eastern Canal (#22) runs northerly from the Pawtucket Canal just above the lower locks and, bending 90°, runs parallel to the Merrimack River but flows in the opposite direction. The Canal is 1,913 feet long and provided power to the Prescott, Massachusetts and Boott Mills. The Boott Mills (#15), bounded by the Merrimack River and the Eastern Canal, were founded in 1839. The cores of the majority of the buildings date from this period, but the yard was extensively rebuilt in the 1860's. The Romanesque Revival style of this completely intact millyard is enhanced by a graceful octagonal cupola and bell tower. The site comprises about six acres and is completely enclosed by buildings which form two interior courtyards.

The Massachusetts Mills Boarding House (#18), constructed in the 1840's by the Massachusetts Mills, is a three and one-half story Greek Revival building. The first floor has been altered for commercial use. The Boott Mills Boarding House (#17), across French Street from the Massachusetts Mills Boarding House, was also constructed in the 1840's. In the 1890's a Queen Anne facade was applied to the Bridge Street elevation and a wing was attached at the southwest corner, facing French Street.

continued

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#7:

The Pawtucket Canal, both upper (#31) and lower (#23) portions, was originally constructed between 1792-96 with four sets of locks, for use as a navigation canal around the Pawtucket Falls on the Merrimack River. Falling into disuse after the opening of the Middlesex Canal in 1805, it was extensively rebuilt between 1821-25 to provide both transportation and water power to the Lowell mills. The canal is 9,188 feet long and is the backbone of the locks and canals system. The Lower Locks (#19) on the Lower Pawtucket Canal were originally built in 1822, and rebuilt in 1841. The locks consist of a dam and two navigation locks, covered by a frame structure. The Merrimack Canal (#27) was built in 1822-23 to provide water power to the Merrimack Manufacturing Co., Lowell's first mill yard, no longer extant. It runs in a northerly direction 2,586 feet from the Pawtucket Canal at the Swamp Locks and eventually discharges into the Merrimack River. It includes a dam and a connector to the Eastern Canal, the Boott Penstock. The Bigelow Yard (#20), originally founded in 1828, is located between the Merrimack and Lower Pawtucket Canals. The only extant structures include a four-story Romanesque Revival structure from the 1870's and three other buildings from the 1890's. The Lowell Canal, now covered, was built in 1828 to supply water to this yard. It is 500 feet long, has a drop of thirteen feet, and runs between the Merrimack and Lower Pawtucket Canals.

The Hamilton Canal (#25), 1,771 feet long, runs parallel to the Pawtucket Canal from the Swamp Locks and discharges into the Pawtucket Canal by raceways through the Hamilton and Appleton Yards. It was constructed in 1826 to power the aforementioned mills, and has a fall of 13 feet. The Hamilton Yard (#21) was the site of Lowell's second oldest manufacturing company, the Hamilton Mills, incorporated in 1825. The structure now standing along the Pawtucket Canal is early Greek Revival distinguished by triangular granite pediments over the windows, and granite lintels on square brackets. The fifth and sixth floors and the other structures in the yard are Romanesque Revival dating from the rebuilding of the 1860's and 70's. The Appleton Mills (#24) east of the Hamilton Yard, were founded in 1828. The structures on the island between the Hamilton and Pawtucket Canals nearly all date from the c. 1905 rebuilding; the structures on the south side of Jackson Street were built in 1873 and are Romanesque Revival. The Swamp Locks (#26) similar to the Lower Locks, were built in 1822-23 and rebuilt in 1839-41.

The Lowell Machine Shop (#28), razed in the 1930's, stood in the island formed by the Lowell, Merrimack and Pawtucket Canals. The only remaining portions of the shop are on Dutton Street; a mill, constructed c. 1890 and c. 1910, and a reinforced concrete plant built in 1911 now cover the site of the Machine Shop boarding houses. The Proprietors of the Locks and Canals Yard, containing one and one-half and two-story buildings now used as offices and shops, are frame Italianate structures built in the 1850's to serve as the administrative headquarters for the canal system.

The Western Canal (#30), a mile long, originally ran northwesterly from the Pawtucket Canal to provide water power to the Tremont, Suffolk and Lawrence Mills. The construction of the Northern Canal changed its direction so that it now flows south from the Northern Canal to the Swamp Locks, but continues to flow north from the Tremont Gate House to power

continued

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#7:  
the Tremont, Suffolk and Lawrence Mills.

The Pawtucket Dam (#32), built between 1826-1830 at the Pawtucket Falls, created a "mill pond" on the Merrimack River eighteen miles long. The dam has been continually modified throughout the nineteenth century.

#8:  
routing of water power and the production of textiles. The population of Lowell mushroomed during this period, from 200 people in 1822 to over 33,000 in 1850.

The engineering involved in the construction of the canals was extremely complex, and each new canal was built in an attempt to solve the problem of keeping all the mills supplied with a sufficient supply of power. The construction of the Northern Canal, the most complex of all because it reversed the flow of the Western Canal, finally increased the average flow of water to each mill sufficiently to solve the distribution problem. The hydro-engineering breakthroughs of the canal engineers, including James Francis and George Whistler, received international acclaim and recognition, and their techniques were used world-wide. The sociological pattern of corporate paternalism in Lowell, manifested by the mill-owned boarding houses and strictly run social functions, also received international recognition and served as a model for Utopian industrial communities in the United States and Europe.

Unfortunately, Lowell's position as a leader in the field of science and as an ideal industrial society was lost in the last quarter of the nineteenth century. The latter nineteenth century mill owners were more concerned about making a profit than in their workers' welfare and the waves of immigrants who poured into Lowell completed the destruction of the boarding house system; speculative tenement flats became the norm. In this century, when many of the major textile companies left the north to move south to cheaper power and labor sources, Lowell was left with huge empty mill buildings, a large canal system and a high level of unemployment. The entire city has been affected by this economic depression and most of the commercial, industrial and residential buildings in the district have deteriorated.

Prospects for Lowell are now looking brighter. The State of Massachusetts, through the Department of Environmental Management, is in the process of acquiring all of the locks and canals and turning them into a state heritage park. The Federal government is considering the creation of an urban cultural park in Lowell, and Federal funds, through the Department of Housing and Urban Development and funds appropriated especially for Lowell are being expended to upgrade housing and to rehab existing mill buildings. New uses are being sought for the abundant mill space in the district, both in order to save the buildings and to provide jobs.

# 9 MAJOR BIBLIOGRAPHICAL REFERENCES

Historic American Engineering Record Survey Inventory; Spec Struc:Hydra (81.2), 1975  
 Coolidge, John, Mill and Mansion, Russell & Russell, New York 1967  
 Malone, Patrick, The Power Canals of Lowell, Massachusetts; Human Services Corporation  
 Lowell, 1973

# 10 GEOGRAPHICAL DATA

ACREAGE OF NOMINATED PROPERTY approximately 100 acres

UTM REFERENCES

|   |      |         |          |   |      |         |          |
|---|------|---------|----------|---|------|---------|----------|
| A | 19   | 3091960 | 4724900  | B | 19   | 311290  | 4723840  |
|   | ZONE | EASTING | NORTHING |   | ZONE | EASTING | NORTHING |
| C | 19   | 309360  | 4722680  | D | 19   | 308540  | 4724760  |
|   | ZONE | EASTING | NORTHING |   | ZONE | EASTING | NORTHING |

VERBAL BOUNDARY DESCRIPTION

see district sketch map

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

| STATE | CODE | COUNTY | CODE |
|-------|------|--------|------|
| STATE | CODE | COUNTY | CODE |

# 11 FORM PREPARED BY

NAME / TITLE

Christine Boulding, Preservation Planner, and Joe Orfant

ORGANIZATION

Massachusetts Historical Commission

DATE

March 1976

STREET & NUMBER

294 Washington Street

TELEPHONE

617-727-8470

CITY OR TOWN

Boston

STATE

Massachusetts 02108

# 12 STATE HISTORIC PRESERVATION OFFICER CERTIFICATION

THE EVALUATED SIGNIFICANCE OF THIS PROPERTY WITHIN THE STATE IS:

NATIONAL

STATE

LOCAL

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

STATE HISTORIC PRESERVATION OFFICER SIGNATURE

*Elizabeth Reed Amadon*

TITLE Executive Director, Massachusetts Historical Commission

DATE 3/30/76

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I HEREBY CERTIFY THAT THIS PROPERTY IS INCLUDED IN THE NATIONAL REGISTER

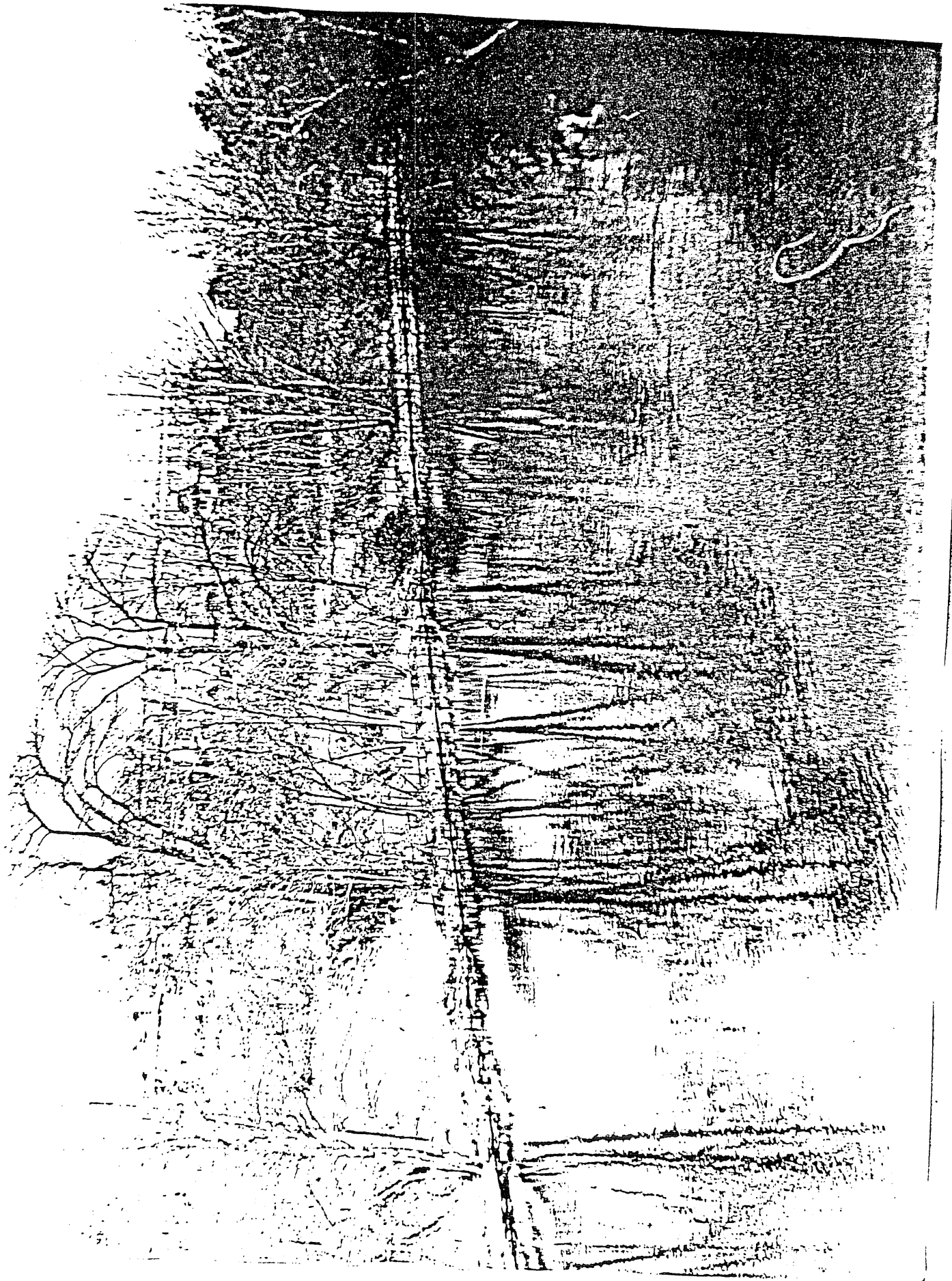
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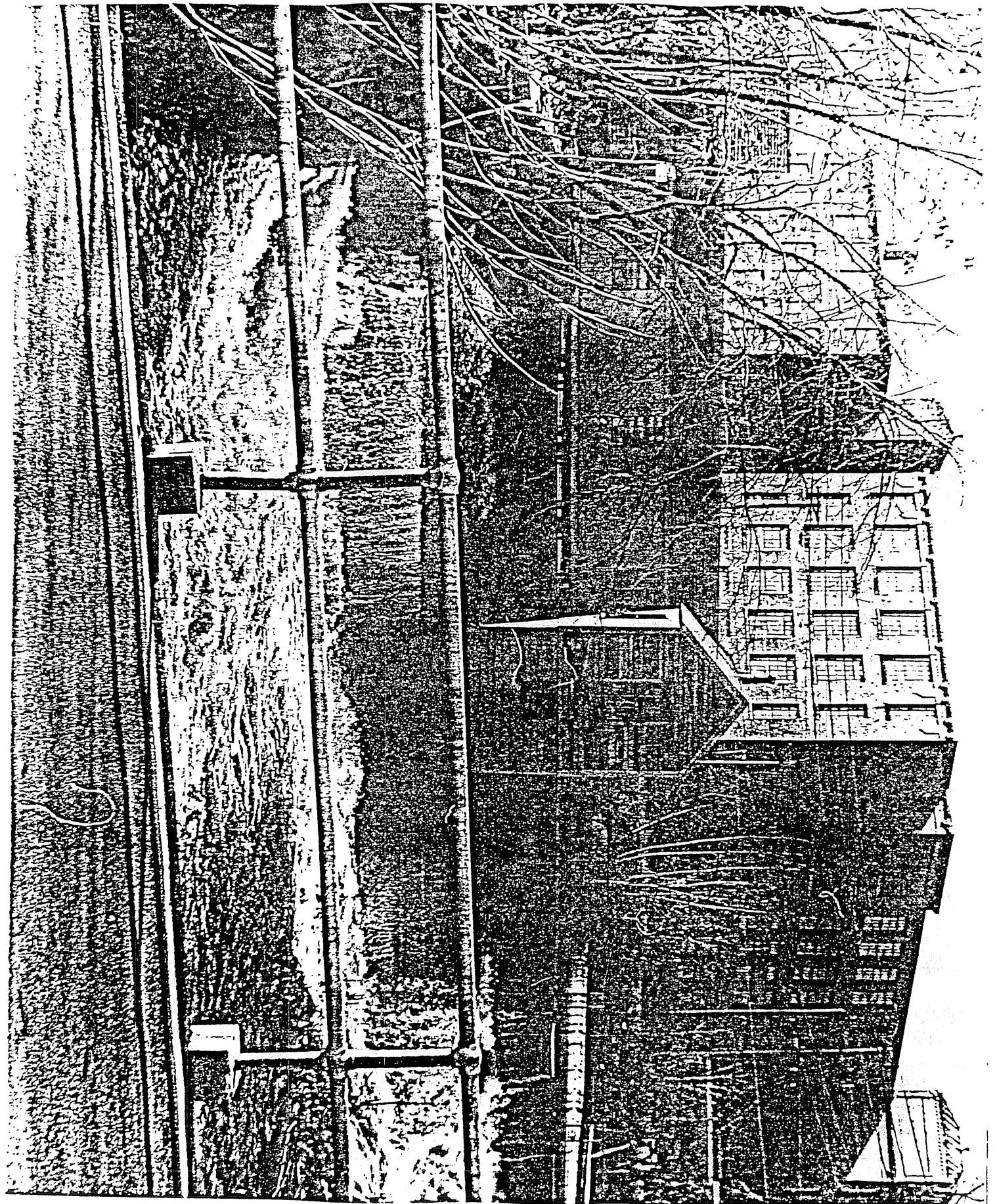
DIRECTOR, OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION

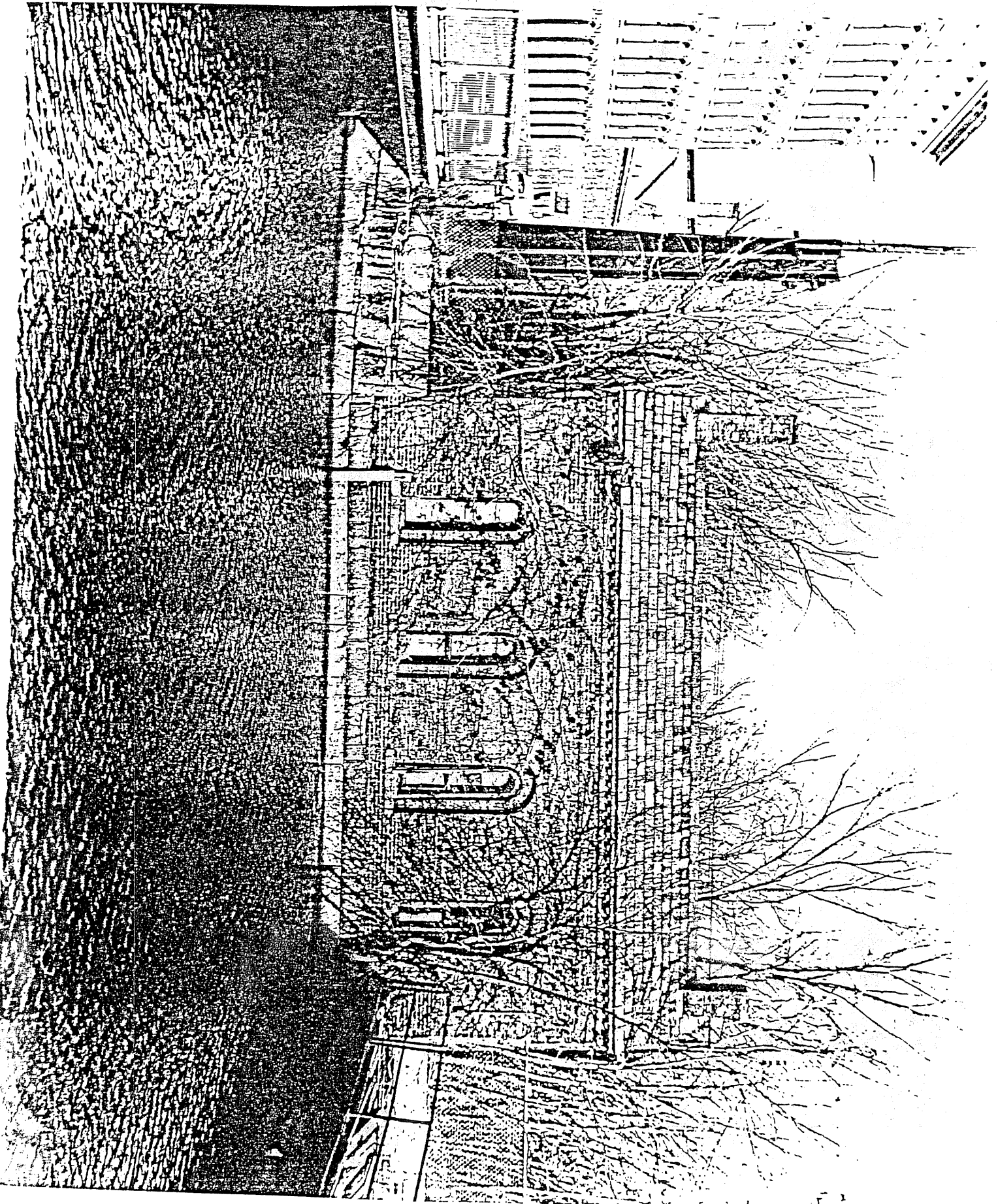
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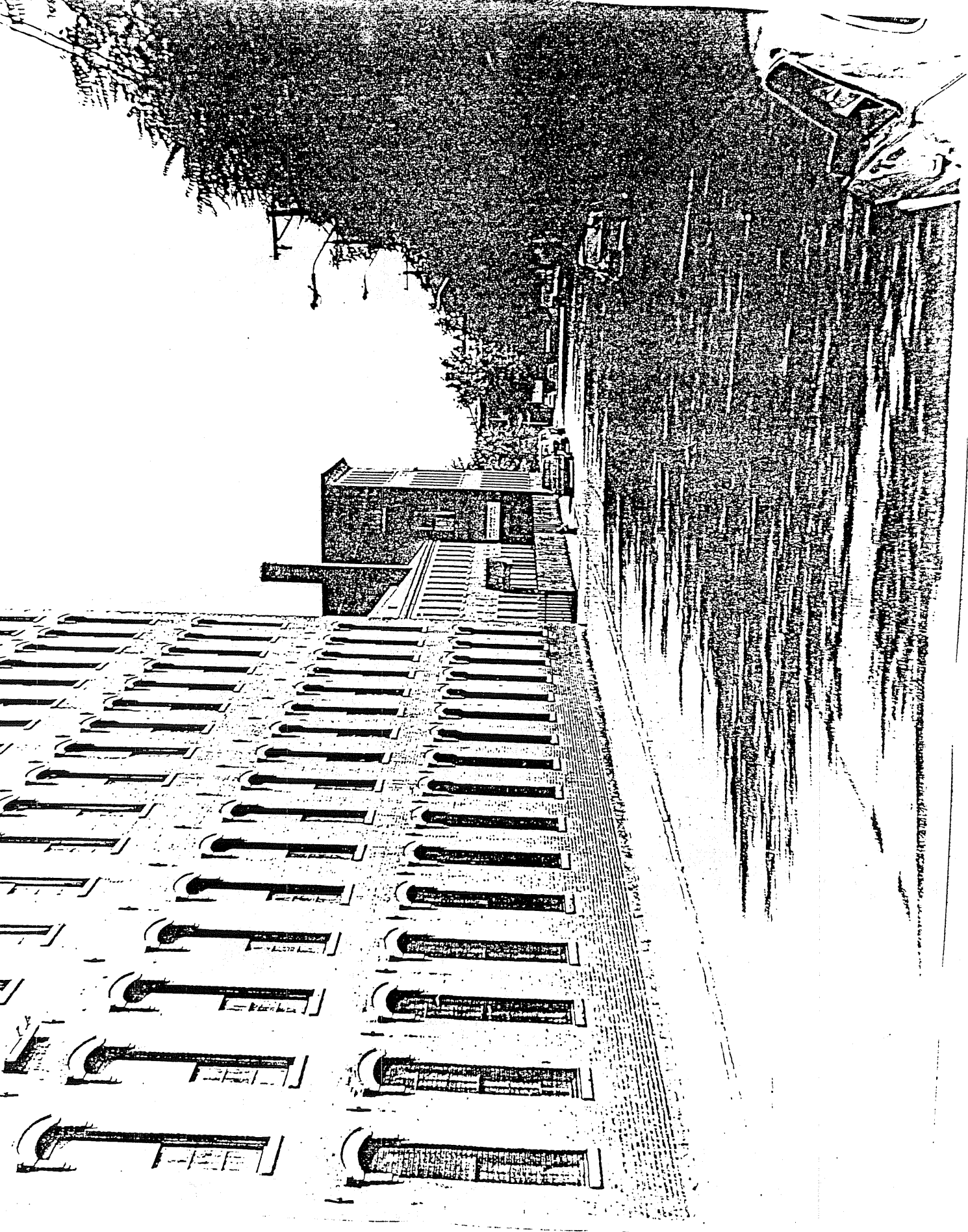
TEST:

KEEPER OF THE NATIONAL REGISTER

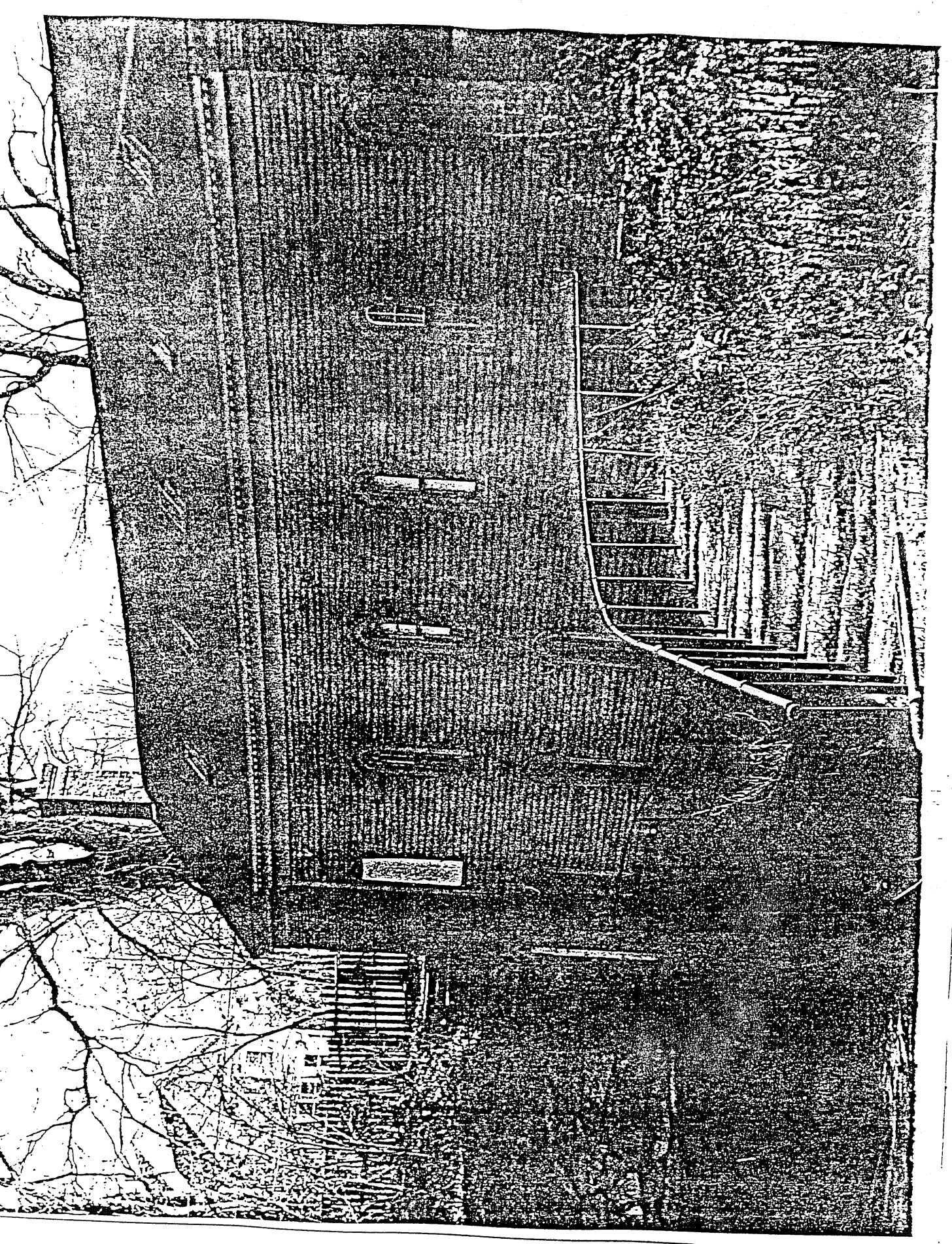


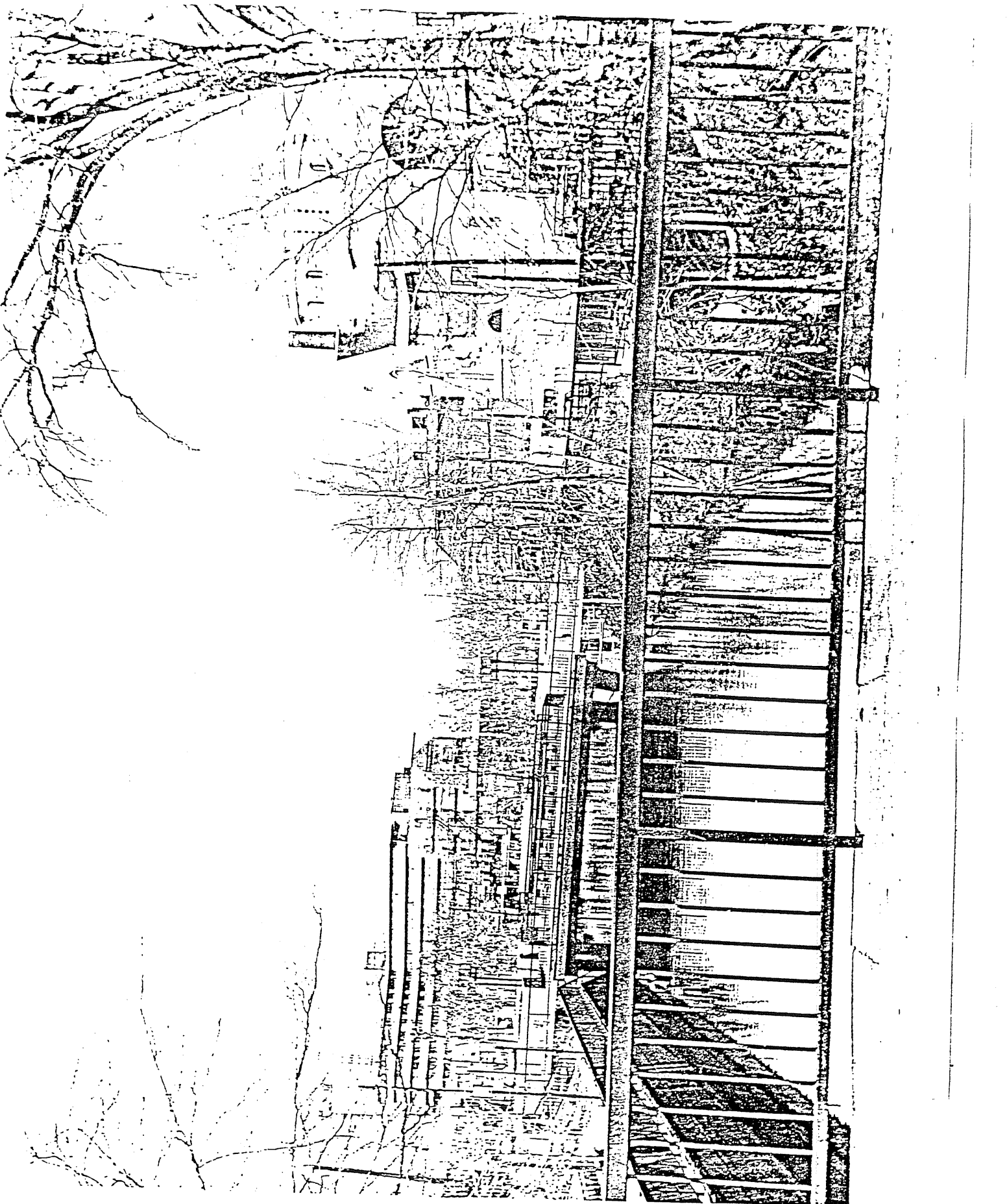












Locks and Canals Historic District, Lowell, MA  
Joe Orfant, 1975  
City Development Authority, Lowell, MA  
Looking northeasterly from the O'Donnell Bridge  
at the Northern Canal and the Canal Walk  
photo #1

Locks and Canals Historic District, Lowell, MA  
Joe Orfant, 1975  
CDA, 50 Arcand Drive, Lowell  
Looking southwest at the Swamp Locks Dam and  
Sluiceway, in the Background is the 1890  
plant of the Lowell Machine Shop  
photo #2

Locks and Canals Historic District, Lowell, MA  
Joe Orfant, 1975  
CDA, 50 Arcand Drive, Lowell  
Looking north from French Street Extension to  
Tremont Gatehouse and the Suffolk Yard  
on the left  
photo #3

Locks and Canals Historic District, Lowell, MA  
Joe Orfant, 1975  
CDA, 50 Arcand Drive, Lowell  
Looking north on Suffolk Street to the Suffolk  
County House on the left, the Lawrence County House  
in the background, and the Tremont Yard on  
the right  
photo #4

Locks and Canals Historic District, Lowell, MA  
Joe Orfant, 1975  
CDA, 50 Arcand Drive, Lowell  
Looking south at the sluiceways gatehouse  
at the Francis Gate site  
photo #5

Locks and Canals Historic District, Lowell, MA  
Joe Orfant, 1975  
CDA, 50 Arcand Drive, Lowell  
Looking northwest from Broadway at the  
Western Canal  
photo #6

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Key to sketch Map

| Number    | Property name                                             | Location |
|-----------|-----------------------------------------------------------|----------|
| 1 - 1144  | Lock House - Broadway                                     | Lowell   |
| 2 - 1145  | Francis Gate and House - Broadway                         | Lowell   |
| 3 - 1146  | Sluice gate house - Broadway                              | Lowell   |
| 4         | Northern Canal Gatehouse                                  | Lowell   |
| 5 - 1147  | Locks and Canals Blacksmith Shop - School St              | Lowell   |
| 6 - 1148  | Gate Keeper's Cottage - School St                         | Lowell   |
| 7 - 1149  | Northern Canal - Northern Canal                           | Lowell   |
| 8 - 1150  | Northern Canal Walk and Great River Wall - Northern Canal | Lowell   |
| 9         | Suffolk Millyard                                          | Lowell   |
| 10        | Tremont Gatehouse                                         | Lowell   |
| 11 - 1151 | Tremont Yard - Hall St                                    | Lowell   |
| 12        | Lawrence Yard                                             | Lowell   |
| 13 - 1152 | Moody Street Feeder - Moody St                            | Lowell   |
| 14 - 1153 | Moody Street Feeder Gatehouse - Patton St                 | Lowell   |
| 15        | Boott Mills                                               | Lowell   |
| 16        | Massachusetts Mills                                       | Lowell   |
| 17 - 1154 | Boott Mills Boarding House - Bridge St                    | Lowell   |
| 18        | Massachusetts Mills Boarding House                        | Lowell   |
| 19 - 1155 | Lower Locks, Pawtucket Canal - Lower Pawtucket Canal      | Lowell   |
| 20 - 1156 | Bigelow Yard - Market St                                  | Lowell   |
| 21        | Hamilton Yard                                             | Lowell   |
| 22 - 1157 | Eastern Canal - Eastern Canal                             | Lowell   |
| 23 - 1158 | Lower Pawtucket Canal - Lower Pawtucket Canal             | Lowell   |
| 24        | Appleton Mills                                            | Lowell   |
| 25 - 1159 | Hamilton Canal - Hamilton Canal                           | Lowell   |
| 26 - 1160 | Swamp Locks - Lower Pawtucket Canal                       | Lowell   |
| 27 - 1161 | Merrimack Canal - Merrimack Canal                         | Lowell   |
| 28 - 1162 | Lowell Machine Shop - DUTTON ST                           | Lowell   |
| 29 - 1163 | Proprietors of Locks and Canals Yard - Broadway           | Lowell   |
| 30 - 1164 | Western Canal - Western Canal                             | Lowell   |
| 31 - 1165 | Upper Pawtucket Canal - Upper Pawtucket Canal             | Lowell   |
| 32 - 1166 | Pawtucket Dam - Pawtucket Canal                           | Lowell   |
| 33        | Suffolk Manufacturing Company Boarding Houses             | Lowell   |



# Locks and Canals

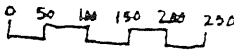
## Historic District

including  
existing

Mill Yards



Scale: 1" = 250'



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McManamon

AUG 7 1980

Clapper

32-NAR(PC)

MASS. HIST. COMM.

Memorandum

To: Assistant Manager, Cultural Resources Management Division,  
Washington (560)

From: Regional Director, North Atlantic Region

Subject: National Register Data for Lowell National Historical Park

Enclosed are continuation sheets for the five properties which will eventually come under federal ownership. All of the structures are already listed on the National Register, but because they are included as parts of large historic districts, the existing forms contain little specific information. This amplification of sections seven and eight will provide a greater understanding of those sites for all who are involved in the management and compliance processes. Please forward them on to the National Register at your earliest convenience.

(SGD.) RICHARD L. STANTON

Richard L. Stanton

cc: LOWE, Supt.  
Mass. SPO

project file

DPitcaithley:id 7/31/80

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Locks and Canals

CONTINUATION SHEET Historic District ITEM NUMBER 7

PAGE 1

Merrimack Gate House

Situated over the eastern terminus of the Moody Street Feeder, this rectangular one-and-one-half-story brick gate house was built in 1848<sup>1</sup>. The Merrimack Gate House extends approximately 60' along Dutton Street and the Merrimack Canal. Its southern facade faces Merrimack Street. The waters of the Moody Street Feeder flow through the three granite arches on which this structure rests. Its exterior walls are red brick laid in Flemish bond. The pitched roof is covered in slate shingles. Chimneys are situated at the ridge near the north and south end walls.

Stylistically, the Merrimack Gate House is a hybrid of the Italianate and Romanesque Revival styles. Its windows are inserted and round arched. The cornice features brick dentils. The date '1848' appears incised on its eastern foundation and in raised brick on the gable of its southern facade.

There are three gates for the Moody Street Feeder housed within the Merrimack Gate House. The gates are original with the exception of the woodbox counterweights which were added in 1853<sup>2</sup>.

Structurally, the Merrimack Gate House is in good condition. Exterior and interior alterations date, with a few exceptions, from the early 1970s<sup>3</sup>. A doorway has replaced a window on the Merrimack Street facade. Other alterations include the addition of interior platforms, stairs, restrooms and a heating system. At some point in the late nineteenth or early-twentieth-century the two original stoves disappeared and a vent was added to the center of the roof.

<sup>1</sup> Shepley, Bulfinch, Richardson and Abbott, Lowell National Historical Park and Preservation District Cultural Resources Inventory, 1979, n.p.

<sup>2</sup> Merrimack Valley Textile Museum, and H.A.E.R., The Lower Merrimack River Valley, An Inventory of Historic Engineering and Industrial Sites. p. 80, 1976.

<sup>3</sup> Roberts, Shelley K., Historic Structures Report-Merrimack Gate House, 1979 p.36.

Francis Gate Complex

The structures located at the head of the Pawtucket Canal, presently referred to as the Francis Gate Complex, include a Guard Dam Gate House, Guard Locks Lock House, and the Great Gate. An island, formed in 1822<sup>1</sup>, is situated between the canal and boat lock. The Guard Dam Gate House and Great Gate stand atop the dam. The Guard Locks Lock House which shelters the headgates is upstream of the dam at a lower level.

The Guard Dam Gate House, built in 1870<sup>2</sup>, contains the controls to the sluice gates. The upstream side of the Guard Dam Gate House shelters five sluice gates, some of which retain their original lifting machinery. Although most of the openings in the brick portion of the building have been bricked in, much of the original fabric is intact and is in good condition.

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CONTINUATION SHEET Historic District ITEM NUMBER 7 PAGE 2

The present guard dam may contain elements of the earlier dam (1832) which served the same purpose on this site.<sup>3</sup> This rectangular structure is built of wood frame and is two stories tall. The rest of the building is brick and a single story in height. Both portions display round headed openings and a plain frieze and dentils at the cornice. A brownstone plaque set into the east end of the Gate House near the gable is inscribed:

Guard Dam built A.D. 1832  
Raised A.D. 1848  
Sluice Gates reconstructed A.D. 1970

This Italianate/Romanesque structure culminates in chimneys situated at either end of the ridge roof. The slope of the roof features five small square skylights.

The Pawtucket Canal Guard Locks Lock House was built in 1881. This Lock House structure stands over the upstream pair of gates for the navigational lock.<sup>4</sup> The single-story Lock House is constructed of wood and is of an "I" shaped plan. It has a granite foundation and exterior walls faced with painted clapboards approximately four inches wide. The hipped roof is covered with slate shingles. A hybrid of the Italianate and Romanesque Revival in style, the exterior walls of the Lock House are pierced by narrow round-arched openings.

The chain and windlass equipment which assists in opening the navigational lock date from 1881.<sup>5</sup> The head lock gates are badly deteriorated. The Guard Locks Lock House has been severely vandalized in recent years, threatening the structural integrity of the southern end of the building. That end was built with long horizontal slots through the walls to accommodate the ends of the gate-lever beams. These beams have been broken and burned away.

The navigation lock below the Lock House extends beneath the Francis Gate, ending at a downstream pair of gates which appear to be in good condition.<sup>6</sup>

The Great or Francis Gate was built 1848-50 for the purpose of flood control. This portcullis gate is sheltered by a rectangular wood frame structure. The Great Gate consists of 26 timbers, each 27' long and 17" wide, assembled in two separate sections held together by vertical iron rods. The wooden gate is suspended over the boat lock by an iron strap.<sup>7</sup> Both the Great Gate and its shelter are in good condition.

1 Robbins, John, Historic Structure Report, Architectural Data, Pawtucket Canal Guard Gates, Locks and Great Gate and Northern Canal Guard Gates and Lock (NPS: February, 1980), pg. 54.



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Historic District

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CONTINUATION SHEET      ITEM NUMBER      7      PAGE      3

- 2 Shepley, Bulfinch, Richardson and Abbott, Lowell National Historical Park and Preservation District Cultural Resource Inventory, Lowell Canal System, (1979)
- 3 Ibid.
- 4 Ibid.
- 5 Ibid.
- 6 Ibid.
- 7 Ibid., pg. 16

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Tremont Gate House/Tremont Yard

1. The Tremont Gate House is located at the point where the northern and western canals meet. It was built in 1855 to replace a temporary installation that had performed the same function since 1847<sup>1</sup>. The gate house shelters sluice gates which control the flow of water into the lower level of the Western Canal which in turn feeds the Lawrence Canal.

This diminutive one-story building is of a rectangular plan. It rests on a granite ashlar foundation. The gate house's exterior walls are constructed of red brick laid in common bond. The pitched roof is covered with slate shingles. Chimneys are at the ridge near the east and west ends. Access to the guard house's interior is gained via the narrow round-arched doorway on the western facade.

Stylistically, the Tremont Gate House is a hybrid of the Italianate and Romanesque Revival styles. Its windows are inset and round arched. The cornice features brick dentils.

Structurally, the Tremont Gate House is in good condition. The northern facade's wide round-arched doorways are boarded over. The slate shingles of the roof's southern slope are in need of replacement.

2. Tremont Yard is the site of the Tremont Mill complex which existed from 1831 until its demolition during the 1930s<sup>2</sup>. The western boundary of this rectangular parcel is Suffolk Street. To the east is Tremont Street. The southern boundary is adjacent to the Tremont Gate House and railroad tracks.

Foundations of buildings which pre- and post-date the 1862<sup>3</sup> reconstruction of the Tremont Mill complex are still evident as are traces of three tail races which date from the late 1860s<sup>4</sup>, the remains of a cloth chute, and the locations of hydrants from the mills' fire-fighting system.

The Tremont Yard is presently framed on the east, north and west by the exterior walls of Mills No. 1, 9, 4 and 3 which have been reduced to a height of 5 to 6'.

Mill No. 2 at the south end of the yard is also in ruins. Beneath the floor of Mill No. 2 are four Morgan-Smith 46" turbines for electric power which date from 1919-1924<sup>5</sup>.

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- <sup>1</sup> Peter M. Molloy, editor. The Lower Merrimack River Valley. An Inventory of Historic Engineering and Industrial Sites sponsored by Merrimack Valley Textile Museum, North Andover, Mass. and Historic American Engineering Record. National Park Service, Washington, D. C. 1976. p. 76.
- <sup>2</sup> Shepley, Bulfinch, Richardson and Abbott, Lowell National Historical Park and Preservation District, Cultural Resource Inventory, prepared for Division of Cultural Resources, North Atlantic Regional Office, National Park Service. see volume entitled "Industrial: Merrimack Manufacturing Company Site through Whipple's Mills and Wamesit Canal. Research Report: Suffolk Manufacturing Co." pp. 2 and 28.
- <sup>3</sup> ibid. p. 14
- <sup>4</sup> ibid. p. 24
- <sup>5</sup> ibid. p. 28.

Wannalancit Textile Company (Suffolk Manufacturing Company)

Mill buildings formerly owned by the Suffolk Manufacturing Company occupy a large square parcel within Lowell's northwestern industrial district. The Suffolk site is bounded by Hall Street to the north, Suffolk Street to the east, the Northern Canal to the south and Cabot Street to the west.

With the exception of the William J. Graham Company building (Suffolk Machine Shop) the eastern half of the Suffolk complex is owned by the Wannalancit Textile Company. This company leases the first floor of Mills No. 8 and 6 to the Lowell Museum.

To the west of Wannalancit property are Suffolk buildings which are presently controlled by Stoney Brook Properties and Tewksbury Wood Products Company. These buildings include Mill No. 10 and its annex, Boiler House No. 2, and Building No. 12.

The Wannalancit buildings are grouped around a large rectangular open yard which is parallel to Suffolk Street. Entrance and egress to the Suffolk Yard is provided by a passage defined by the southern wall of the Counting House and Mill No. 8's northern wall. Mill No. 8 and Mill No. 6 frame the southeastern corner of the yard. Mill No. 8 is parallel to the Northern Canal. The central portion of Mill No. 6's northern wall is abutted by Mill No. 5. Running from Mill No. 6 to Hall Street, Mill No. 5 forms the yard's western boundary. The former Suffolk Machine Shop and the Repair Shop portion of the Counting House enclose the yard's northeastern corner.

The mills surrounding the Suffolk Yard display a uniformity of plan, materials, and height. These rectangular red brick buildings rise to a height of five stories. Mill roofs are either flat or slightly pitched. Most of the Suffolk building stock dates from 1862-1900<sup>1</sup>. The two-story Counting House, however, was built prior to 1850<sup>2</sup>.

Its flat, simply detailed facades show the influence of the Federal Style. The majority of Suffolk buildings exhibit a surface plasticity characteristic of the

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Italianate style. Projecting from factory facades are brick segmental lintels and corbelled cornices. Particularly picturesque are the octagonal stair towers situated at the southeastern and northeastern corners of Mill No. 5. The towers' facades are ornamented with the curved forms of narrow round-arched openings and oculus windows inset in recessed elliptical panels. Below the cornice of the eastern facade of Mill No. 5's central pavillion are three granite plaques. Placed at regular intervals, these plaques proclaim in raised lettering, "REBUILT 1831.... Suffolk Mills... Rebuilt 1862."

The Suffolk Complex has served as a manufacturing facility for almost one hundred and fifty years. The good condition of Suffolk Manufacturing Company buildings' exterior and interior fabric is probably attributable to the periodic maintenance which accompanies continuous occupancy.

<sup>1</sup>Shepley, Bulfinch, Richardson, and Abbott. Lowell National Historical Park and Preservation District Cultural Resource Inventory prepared for Division of Cultural Resources, North Atlantic Regional Office, National Park Service. See volume entitled Industrial: Merrimack Manufacturing Company Site through Whipples Mills and Wameset Canal." Suffolk Mfg. Co. 1979 Research Report" pp. 14-29.

<sup>2</sup>Cornelia E. Wyma and Paul C. Cloyd, Historic Structures Report Wampanoag Textile Company, Lowell National Historical Park 1979. n.p. See Existing Conditions chapter--raises questions about traditional 1831 dates for the Counting House.

Dutton Street Parking Lot

The Dutton Street Parking Lot is a roughly trapezoidal parcel situated to the southeast of the Market and Dutton Streets intersection. The northern boundary of this asphalt-paved parking facility is in line with the southern wall of two brick additions which project from Bigelow Lowell Building #1. Its eastern and southern boundaries are demarcated by a chain link fence which separates the lot from Pandel Bradford and Pellon Corporation property. The eastern boundary is parallel to the Merrimack Canal. A ten-foot-wide strip of Locks and Canals land is situated between the Dutton Street Parking Lot and the Merrimack Canal

Entrance and egress to the lot is provided via a road which leads from Dutton Street into the southwestern portion of this site. To the immediate north of this entrance is a portion of the Lowell Machine Shop offices' western wall.

This parking lot site and adjacent areas were covered by Lowell Machine Shop and Lowell Manufacturing Company buildings, Canal Components, and railroad tracks. The lot was paved with asphalt sometime after the 1930s<sup>1</sup>. Accompanying this description are maps which show the locations of these earlier structures and features.

<sup>1</sup>Shepley, Bulfinch, Richardson and Abbott, Lowell National Historical Park and Preservation District Cultural Resource Inventory. Industrial: Lowell Machine Shop Site through Massic Falls Industrial Site. Lowell Machine Shop Research Report pg. 6.

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Merrimack Gate House

The Merrimack Gatehouse is a significant element of the district because it possesses a high degree of structural integrity. The exterior of the structure as well as the interior with its three original gates has changed only slightly since the mid-nineteen century.

Despite its rather diminutive scale, the Merrimack Gate House occupies a commanding position in the downtown streetscape. The effects of its canal-side site is maximized through considerable length compared to width and its crisp detailing (including locally unusual use of Flemish bond brickwork).

Francis Gate Complex

The Francis Gate Complex is a key component of the Lowell Power Canal System. Since the mid-nineteenth century it has functioned as a power, navigation and flood control facility on the Pawtucket Canal. It is significant that a high percentage of its original structural and mechanical fabric dating from 1848-1881 is still extant.

The Francis Gate Complex has important historical associations with James B. Francis. Francis was chief engineer and agent of the Proprietors of the Locks and Canals from 1834-1885. He designed the Francis Gate Complex's most famous feature, the Francis or Great Gate. Initially dubbed Francis' Folly upon its completion in 1850, the Great Gate saved the heart of the city from the great floods of 1852 and 1936<sup>2</sup>.

Francis gained international recognition for his improvement of water turbine design and the publication of Lowell Hydraulic Experiments (1855)<sup>3</sup>. He might well be called "the Father of American Hydraulic Engineering."

The Francis Gate Complex was the last major hydraulic engineering project completed in Lowell during the Ante-bellum era.

<sup>1</sup> Merrimack Valley Textile Museum and Historic American Engineering Record. The Lower Merrimack River Valley, an Inventory of Historic Engineering and Industrial Sites. p. 1976.

<sup>2</sup> Shepley, Bulfinch, Richardson and Abbott. Lowell National Historical Park and Preservation District Cultural Resources Inventory. prepared for Division of Cultural Resources North Atlantic Regional Office, National Park Service. Industrial Lowell Canal System Volume . n.p. Pawtucket Canal North of Broadway.

<sup>3</sup> Arthur L. Eno, Jr. ed. Cotton was King, a History of Lowell, Massachusetts. p. 219 New Hampshire Publishing Company 1976.

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Tremont Gate House/Tremont Yard

1. The Tremont Gate House, built in 1855<sup>1</sup>, is significant as a Lowell Power Canal System component which retains most of its mid-nineteenth century structural and mechanical fabric. The sluice gates' original manually operated rack and pinion equipment is sheltered within the gate house<sup>1</sup>.

Despite its diminutive scale, the Tremont Gate House occupies a commanding position on the southern perimeter of Lowell's northwestern industrial district. Its ivy-covered red brick southern wall, pierced by narrow round-arched openings, picturesquely presides over the Western Canal's northern terminus.

2. Construction of the Tremont Mill buildings was begun in 1832<sup>3</sup>. During the 1860s, however, this complex was dismantled and the Tremont Mills were rebuilt<sup>4</sup>. The final phase of building on the Tremont site occurred in the 1890s<sup>5</sup>. The Tremont Millyard was demolished between 1929 and 1933<sup>6</sup>. The significance of this site is its potential for yielding significant information. It could be developed as an interpreted industrial archeological site.

The razed Tremont Yard is a perfect foil for the largely intact Suffolk Yard as its original configuration was essentially the mirror image of the adjacent Suffolk Complex. The Tremont site affords the opportunity to view features of a hydropower system (e.g. turbines and tail races) which were originally located underground. A similarly disposed and equipped hydropower system exists beneath the Suffolk millyard.

<sup>1</sup>Peter M. Molloy, editor. The Lower Merrimack River Valley, an Inventory of Historic Engineering and Industrial Sites. sponsored by the Merrimack Valley Textile Museum and Historic American Engineering Record. 1976. p. 77.

<sup>2</sup>ibid. p. 77

<sup>3</sup>Shepley, Bulfinch, Richardson and Abbott. Lowell National Historical Park and Preservation District Cultural Resources Inventory. prepared for Division of Cultural Resources North Atlantic Regional Office, National Park Service. see volume-Industrial Merrimack Manufacturing Co. Site through Whipple Mill and Wamesit Canal. Research Report: Suffolk Manufacturing Co. p. 5.

<sup>4</sup>ibid. p. 16.

<sup>5</sup>ibid. p. 27.

<sup>6</sup>ibid. p. 28.

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Wannalancit Textile Co. (Suffolk Mfg. Co.)

From 1831 until 1926<sup>1</sup> the buildings currently occupied by the Wannalancit Textile Company were known as the Suffolk Mills. The Suffolk Manufacturing Company was incorporated in 1831<sup>2</sup>. Mill building construction began in the spring of 1832<sup>3</sup>. During the 1860s<sup>4</sup> the Suffolk and Tremont Yards were the scene of an ambitious rebuild campaign. The modernized mills merged in 1872<sup>5</sup>. Sold to the Nashua Manufacturing Company in 1926, the Suffolk Complex survived the 1930s essentially intact<sup>6</sup>. Edward A. Lartner, Jr., owner and president of the Wannalancit Mills has controlled most of the Suffolk Millyard since 1950<sup>7</sup>.

The Suffolk Complex is an important survivor of the initial phase of the American Industrial Revolution. It is the only Lowell mill still engaged in the manufacturing of textiles. Virtually every stage of the Suffolk Millyard's development is presently represented by buildings dating from 1831-1915<sup>8</sup>. The Suffolk Mills have significant historical associations with prominent nineteenth-century Boston and Lowell business leaders. Its founders included "Proper Bostonians" such as Amos and Abbott Lawrence, Samuel and William Appleton, Henry Cabot and George W. Lyman.<sup>9</sup> Local patent medicine tycoon James C. Ayer directed the Suffolk and Tremont's merger in 1872<sup>10</sup>.

<sup>1</sup> Shepley, Bulfinch, Richardson and Abbott. Lowell National Historical Park and Preservation District Cultural Resource Inventory. prepared for Division of Cultural Resources, North Atlantic Regional Office, National Park Service. see volume entitled Industrial: Merrimack Manufacturing Company Site through Whipples Mills and Wamesit Canal. Suffolk Mfg. Co. Research Report pgs. 2-28.

<sup>2</sup> *ibid.* pg. 2.

<sup>3</sup> *ibid.* pg. 2.

<sup>4</sup> *ibid.* pg. 14-25.

<sup>5</sup> *ibid.* pg. 25

<sup>6</sup> *ibid.* pp. 28-31

<sup>7</sup> *ibid.* p. 29

<sup>8</sup> *ibid.* pp. 2, 28.

<sup>9</sup> *ibid.* p.2.

<sup>10</sup> *ibid.* p. 25.

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CONTINUATION SHEET Historic District ITEM NUMBER 8 PAGE 2

The Dutton Street Parking Lot

The Dutton Street Parking Lot has a high potential for yielding subsurface archeological remains. From the 1820s until the 1930s<sup>1</sup>, Lowell Machine Shop and Lowell Manufacturing Company buildings covered portions of this site. Presumably the foundations of machine shops, storehouses, and offices exist below ground. An understanding of 19th and early 20th century onsite activities would be fostered by the recovery of mechanical apparatus, tools and other artifact deposits associated with social and industrial activities.

This asphalt-paved parcel overlies, as well, components of the Lowell Power Canal System. No longer visible are the Lowell Canal, three penstocks and a rectangular "basin." The Lowell Canal, laid out in 1828<sup>2</sup>, is covered for its entire 500' length. It was filled in during the 1930s<sup>3</sup>. Three penstocks lie beneath the central and southern portion of this lot.

Immediately to the southeast of the junction of the Merrimack and Lowell Canals was a rectangular body of water labeled "basin" on an 1828 Lowell Manufacturing Company plan<sup>4</sup>. A raceway lead from the basin to a sawmill. The sawmill was situated to the east of the present lot. The basin is of particular interest because it was aligned with a semicircular basin to the west of Dutton Street which was apparently designed for purely decorative purposes<sup>5</sup>. All of these canal features are significant remnants of the important Lowell industrial power system which was one of the most elaborate and sophisticated ever developed. In addition to being the physical remains of this historically important system, their configuration and characteristics probably contain important information about the construction, modification and maintenance of the canal system.

<sup>1</sup> Shepley, Bulfinch, Richardson and Abbott. Lowell National Historical Park and Preservation District Cultural Resource Inventory. Inventory Forms and Research Reports. Industrial: Lowell Machine Shop site through Massic Falls Industrial site. Lowell Machine Shop research report pp. 1-8. Lowell Manufacturing Co. research report pp. 1-19.

<sup>2</sup> ibid, Industrial: Lowell Canal System Lowell Canal System Research Report. p. 6.

<sup>3</sup> ibid, p. 7.

<sup>4</sup> ibid. Industrial: Lowell Machine Shop site through Massic Falls Industrial site. Lowell Manufacturing Company Research Report Fig. 2.

<sup>5</sup> ibid. Lowell Machine Shop Research Report Figure 3A.



**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc. (Enel), is the Licensee and operator of the Lowell Hydroelectric Project (FERC No. 2790) (Project), with principal Project facilities located along the Merrimack River in Middlesex County, Massachusetts and a reservoir extending upstream to Hillsborough County, New Hampshire (see attached map). Boott, with assistance from HDR, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Project. Accordingly, Boott is preparing a Pre-Application Document (PAD) that will provide FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project that will be used to prepare documents related to analyzing the relicensing application to be prepared by Boott. To prepare the PAD, Boott will use information in its possession and information obtained from additional sources. This PAD Information Questionnaire will be used by Boott to help identify sources of existing, relevant, and reasonably available information that are not currently in Boott's possession.

1. Information about person completing the questionnaire:

|               |                                                                      |
|---------------|----------------------------------------------------------------------|
| Name & Title  | Robert Kubit, Environmental Engineer                                 |
| Organization  | MA Department of Environmental Protection<br>Central Regional Office |
| Address       | 8 New Bond St, Worcester MA 01606                                    |
| Phone         | 508 767 2854                                                         |
| Email Address | robert.kubit@state.ma.us                                             |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)     No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                   |                                                     |
|-------------------------------------------------------------------|-----------------------------------------------------|
| <input checked="" type="checkbox"/> Geology and soils             | <input type="checkbox"/> Recreation and land use    |
| <input checked="" type="checkbox"/> Water resources               | <input type="checkbox"/> Aesthetic resources        |
| <input type="checkbox"/> Fish and aquatic resources               | <input type="checkbox"/> Cultural resources         |
| <input type="checkbox"/> Wildlife and botanical resources         | <input type="checkbox"/> Socio-economic resources   |
| <input type="checkbox"/> Wetlands, riparian, and littoral habitat | <input type="checkbox"/> Tribal resources           |
| <input type="checkbox"/> Rare, threatened & endangered species    | <input type="checkbox"/> Other resource information |

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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b. Please briefly describe the information referenced above or list available documents *(additional information may be provided on pages 3 or 4 of this questionnaire)*.

c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative *(additional information may be provided on pages 3 or 4 of this questionnaire)*.

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes     No

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

|               |                                                                                                  |
|---------------|--------------------------------------------------------------------------------------------------|
| Name          | Robert Kubit                                                                                     |
| Address       | MA Dept. Environmental Protection<br>Central Regional Office<br>8 New Bond St Worcester MA 01606 |
| Phone         | 508 767 2854                                                                                     |
| Email Address | robert.kubit@state.ma.us                                                                         |

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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**Additional Representative Contact Information (Optional)**

|               |  |
|---------------|--|
| Name          |  |
| Address       |  |
| Phone         |  |
| Email Address |  |

*Additional Information (additional space provided on the following page):*

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*Comments and/or questions may be sent via email to:*

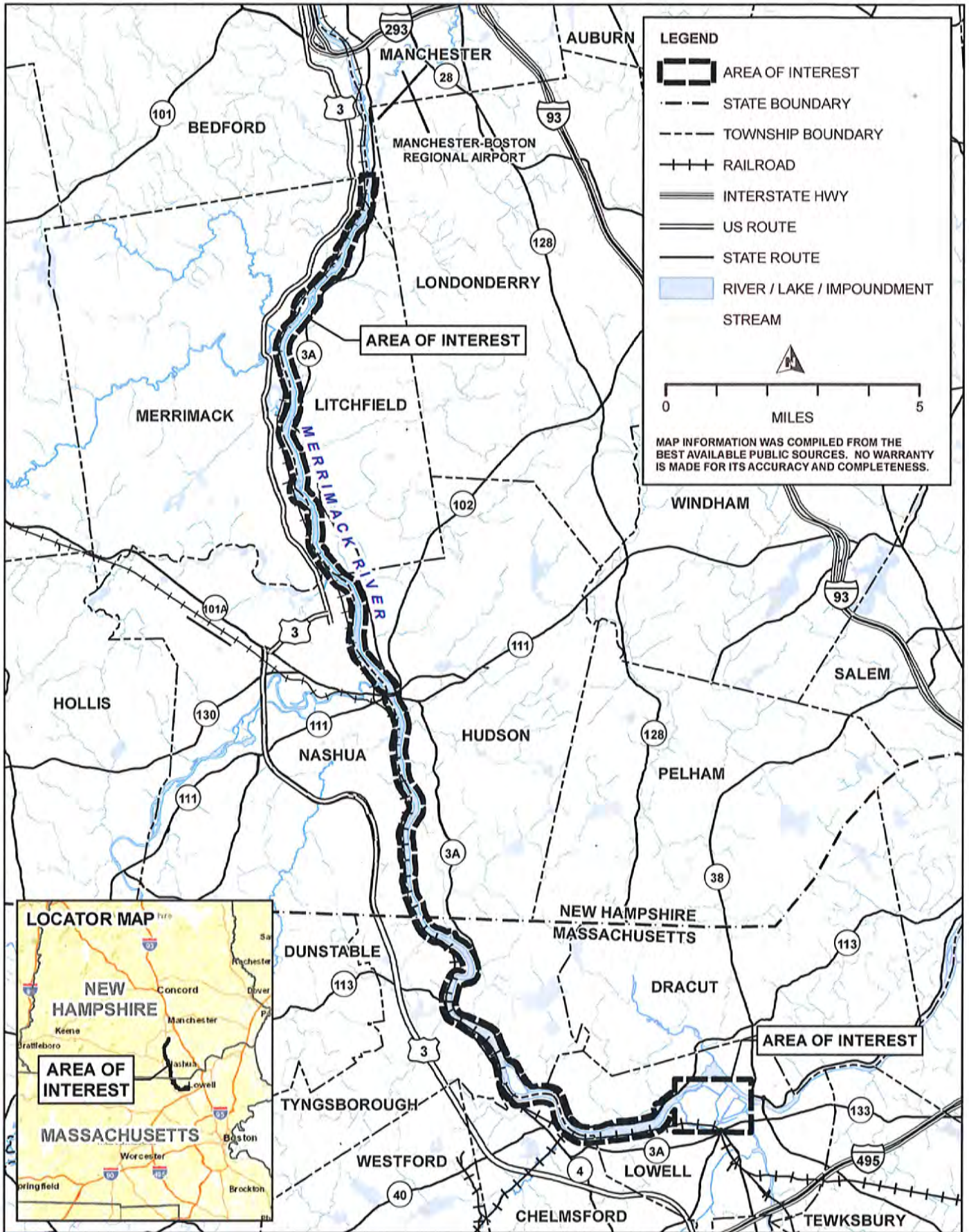
Jim Gibson, HDR, at [Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com) or  
Rob Quiggle, HDR, at [Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

If you have any questions about the Project, or the upcoming FERC licensing processes, please contact Mr. Kevin Webb, Enel Relicensing Manager for the Lowell Hydroelectric Project, at (978) 681-1900 ext. 809 or [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com); Jim Gibson at (315) 414-2202; or Rob Quiggle at (315) 414-2216.

**Please return this questionnaire in the enclosed, self-addressed, stamped envelope within 21 days of receipt to allow for any follow-up contact that may be necessary by a representative from Boott or HDR.** Not responding within 21 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project environment or known potential impacts of the Project.

**Lowell Hydroelectric Project (FERC Project No. 2790)**  
**Relicensing Pre-Application Document Information Questionnaire**

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**LOWELL HYDROELECTRIC PROJECT**  
**FERC NO. 2790**  
**BOOTT HYDRO, LLC.**





## Scida, Rebecca

---

**From:** MacVane, Kelly  
**Sent:** Friday, April 06, 2018 11:45 AM  
**To:** Scida, Rebecca  
**Cc:** Gibson, Jim; Quiggle, Robert  
**Subject:** FW: Request for Integrated Report or Assessment Report  
**Attachments:** 20180406114453026.pdf

Hi Becky-

Can you please add this response to the log? Also please PDF the email and attach to the PAD response.

Thanks,  
Kelly

Kelly MacVane  
D 207-239-3828 M 207-775-4495

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

---

**From:** Gibson, Jim  
**Sent:** Friday, April 6, 2018 11:41 AM  
**To:** MacVane, Kelly <[Kelly.MacVane@hdrinc.com](mailto:Kelly.MacVane@hdrinc.com)>  
**Cc:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Subject:** FW: Request for Integrated Report or Assessment Report

Note the links at the bottom of the email

Jim Gibson, MPA, MSES  
*Vice President*

HDR  
1304 Buckley Road, Suite 202  
Syracuse, NY 13212  
D 315.414.2202 M 315.415.2729  
[jim.gibson@hdrinc.com](mailto:jim.gibson@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

---

**From:** Kubit, Robert (DEP) [<mailto:robert.kubit@state.ma.us>]  
**Sent:** Friday, April 6, 2018 11:39 AM  
**To:** Gibson, Jim <[Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com)>; Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Subject:** FW: Request for Integrated Report or Assessment Report

Gentlemen,

The attachment and information below provides the information you need from the MA Department of Environmental Protection.

Thanks.

Bob

Robert Kubit, P.E.  
MassDEP  
Division of Watershed Management  
8 New Bond Street  
Worcester MA 01606  
Telephone: (508) 767-2854  
Email: [robert.kubit@state.ma.us](mailto:robert.kubit@state.ma.us)  
Fax: (508) 791-4131

---

**From:** Kennedy, Laurie (DEP)  
**Sent:** Thursday, April 05, 2018 2:31 PM  
**To:** Kubit, Robert (DEP)  
**Subject:** RE: Request for Integrated Report or Assessment Report

Hi Bob,  
Here is the link to the Merrimack River water quality assessment reports:  
<https://www.mass.gov/lists/water-quality-assessment-reports-merrimack-through-weymouth-weir-watersheds>

Here is the link to the Interactive Mapping of the Integrated List of Waters  
<http://www.mass.gov/eea/agencies/massdep/water/watersheds/integrated-list-of-waters.html>

Here is the link to the 2014 Integrated List of Waters  
<http://www.mass.gov/eea/docs/dep/water/resources/07v5/14list2.pdf>

Link to MassDEP 1994-2014 Water Quality Monitoring Stations and to the data  
<https://docs.digital.mass.gov/dataset/massgis-data-massdep-1994-2014-water-quality-monitoring-stations>  
<https://www.mass.gov/guides/water-quality-monitoring-program-data>

Hope this helps!  
Laurie

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**From:** Kubit, Robert (DEP)  
**Sent:** Thursday, April 05, 2018 12:30 PM  
**To:** Kennedy, Laurie (DEP)  
**Subject:** Request for Integrated Report or Assessment Report

Hi Laurie,

If you could provide public links to the Integrated/Assessment Reports for the Merrimack River Watershed, I will be able to fulfill a public record request.

Thank you.

Bob

Robert Kubit, P.E.  
MassDEP  
Division of Watershed Management  
8 New Bond Street  
Worcester MA 01606



Telephone: (508) 767-2854

Email: [robert.kubit@state.ma.us](mailto:robert.kubit@state.ma.us)

Fax: (508) 791-4131



MASSWILDLIFE

## DIVISION OF FISHERIES & WILDLIFE

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

Jack Buckley, *Director*

April 18, 2018

Kelly MacVane  
HDR Engineering, Inc  
970 Baxter Boulevard, Suite 301  
Portland ME 04103

RE: Project Location: Lowell Hydroelectric Project, Merrimack River  
Town: LOWELL  
NHESP Tracking No.: 07-21482

To Whom It May Concern:

Thank you for contacting the Natural Heritage and Endangered Species Program of the MA Division of Fisheries & Wildlife (the "Division") for information regarding state-listed rare species in the vicinity of the above referenced site. Based on the information provided, this project site, or a portion thereof, is located **within** *Priority Habitat 1987* (PH 1987) and *Estimated Habitat 1320* (EH 1320) as indicated in the *Massachusetts Natural Heritage Atlas* (14<sup>th</sup> Edition). Our database indicates that the following state-listed rare species have been found in the vicinity of the site:

| <u>Scientific name</u>          | <u>Common Name</u> | <u>Taxonomic Group</u> | <u>State Status</u> |
|---------------------------------|--------------------|------------------------|---------------------|
| <i>Haliaeetus leucocephalus</i> | Bald Eagle         | Bird                   | Threatened          |
| <i>Stylurus amnicola</i>        | Riverine Clubtail  | Dragonfly              | Endangered          |

The species listed above are protected under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) and its implementing regulations (321 CMR 10.00). State-listed wildlife are also protected under the state's Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and its implementing regulations (310 CMR 10.00). Fact sheets for most state-listed rare species can be found on our website ([www.mass.gov/nhesp](http://www.mass.gov/nhesp)).

Please note that projects and activities located within Priority and/or Estimated Habitat **must be reviewed by the Division** for compliance with the state-listed rare species protection provisions of MESA (321 CMR 10.00) and/or the WPA (310 CMR 10.00).

### **Wetlands Protection Act (WPA)**

If the project site is within Estimated Habitat and a Notice of Intent (NOI) is required, then a copy of the NOI must be submitted to the Division so that it is received at the same time as the local conservation commission. If the Division determines that the proposed project will adversely affect the actual Resource Area habitat of state-protected wildlife, then the proposed project may not be permitted (310 CMR 10.37, 10.58(4)(b) & 10.59). In such a case, the project proponent may request a consultation with the Division to discuss potential project design modifications that would avoid adverse effects to rare wildlife habitat.

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A streamlined joint MESA/WPA review process is available. When filing a Notice of Intent (NOI), the applicant may file concurrently under the MESA on the same NOI form and qualify for a 30-day streamlined joint review. For a copy of the NOI form, please visit the MA Department of Environmental Protection's website: <http://www.mass.gov/eea/agencies/massdep/service/approvals/wpa-form-3.html>.

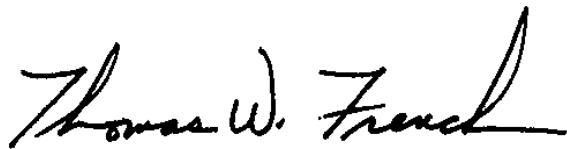
**MA Endangered Species Act (MESA)**

If the proposed project is located within Priority Habitat and is not exempt from review (see 321 CMR 10.14), then project plans, a fee, and other required materials must be sent to Natural Heritage Regulatory Review to determine whether a probable Take under the MA Endangered Species Act would occur (321 CMR 10.18). Please note that all proposed and anticipated development must be disclosed, as MESA does not allow project segmentation (321 CMR 10.16). For a MESA filing checklist and additional information please see our website: [www.mass.gov/dfw/nhosp/regulatory-review](http://www.mass.gov/dfw/nhosp/regulatory-review).

We recommend that rare species habitat concerns be addressed during the project design phase prior to submission of a formal MESA filing, as avoidance and minimization of impacts to rare species and their habitats is likely to expedite endangered species regulatory review.

This evaluation is based on the most recent information available in the Natural Heritage database, which is constantly being expanded and updated through ongoing research and inventory. If the purpose of your inquiry is to generate a species list to fulfill the federal Endangered Species Act (16 U.S.C. 1531 et seq.) information requirements for a permit, proposal, or authorization of any kind from a federal agency, we recommend that you contact the National Marine Fisheries Service at (978)281-9328 and use the U.S. Fish and Wildlife Service's Information for Planning and Conservation website (<https://ecos.fws.gov/ipac>). If you have any questions regarding this letter please contact Emily Holt, Endangered Species Review Assistant, at (508) 389-6385.

Sincerely,



Thomas W. French, Ph.D.  
Assistant Director

## Scott, Kelsey

---

**From:** Cheeseman, Melany (FWE) <melany.cheeseman@state.ma.us>  
**Sent:** Wednesday, April 18, 2018 3:22 PM  
**To:** MacVane, Kelly  
**Subject:** MESA Info Request, Lowell Hydroelectric Project. NHESP 07-21482.  
**Attachments:** Lowell\_07-21482.pdf

**Follow Up Flag:** Follow up  
**Flag Status:** Flagged

Kelly,

We received the Information Request form and fee (check #905, \$50) for the Lowell Hydroelectric project. Please see the attached letter. The rare species Priority/Estimated habitat mapping is only in a portion of the project site. This area extends from just south of the New Hampshire border on the northern end to just south of the Greater Lowell Technical High School on the southern end. The priority habitat polygon can be viewed on our interactive map viewer : <https://www.mass.gov/service-details/regulatory-maps-priority-estimated-habitats>  
Let me know if you have any questions.

Thank you,

### **Melany Cheeseman**

Endangered Species Review Assistant  
Natural Heritage & Endangered Species Program  
Massachusetts Division of Fisheries & Wildlife  
1 Rabbit Hill Road, Westborough, MA 01581  
ph: 508.389.6357 | fax: 508.389.7890  
[melany.cheeseman@state.ma.us](mailto:melany.cheeseman@state.ma.us) | [www.mass.gov/nhesp](http://www.mass.gov/nhesp)

## Scott, Kelsey

---

**From:** Lamb, Amy <Amy.Lamb@dncr.nh.gov>  
**Sent:** Monday, April 16, 2018 4:16 PM  
**To:** MacVane, Kelly  
**Cc:** Tuttle, Kim  
**Subject:** NHB review: NHB18-1178  
**Attachments:** NHB18-1178\_MacVane.pdf

Attached, please find the review we have completed. If your review memo includes potential impacts to plants or natural communities please contact me for further information. If your project had potential impacts to wildlife, please contact NH Fish and Game at the phone number listed on the review.

Best,  
Amy

Amy Lamb  
Ecological Information Specialist

NH Natural Heritage Bureau  
DNCR - Forests & Lands  
172 Pembroke Rd  
Concord, NH 03301  
603-271-2834

# Memo



NH NATURAL HERITAGE BUREAU  
NHB DATACHECK RESULTS LETTER

**To:** Kelly MacVane, HDR Engineering, Inc.  
970 Baxter Boulevard  
Portland, ME 04103

**From:** Amy Lamb, NH Natural Heritage Bureau  
**Date:** 4/16/2018 (valid for one year from this date)

**Re:** Review by NH Natural Heritage Bureau

NHB File ID: NHB18-1178

Town: Bedford, Merrimack, Litchfield,  
Nashua, Hudson

Location: Merrimack River from Lowell, MA to  
Bedford, NH

Description: On behalf of Boott Hydropower, LLC (Boott), HDR, Inc. (HDR) is gathering information in support of the Pre-Application Document (PAD) for the upcoming Federal Energy Regulatory Commission (FERC) relicensing of the Lowell Hydroelectric Project (FERC No. 2790) (Project). In support of this process, HDR is requesting information regarding the following within the Project area:

- State-listed threatened or endangered species;
- Species proposed for listing as threatened or endangered, or species of concern;
- Designated or proposed critical habitat; and
- Candidate species.

The Lowell Hydroelectric Project is located on the Merrimack River in Middlesex County, Massachusetts, and an impoundment extending upstream to Hillsborough County, New Hampshire.

cc: Kim Tuttle

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

**Comments: This site is within an area flagged for possible impacts on the state-listed *Alasmidonta varicosa* (brook floater) in the Merrimack River**

## Invertebrate Species

Brook Floater (*Alasmidonta varicosa*)

| State <sup>1</sup> | Federal | Notes                                        |
|--------------------|---------|----------------------------------------------|
| E                  | --      | Contact the NH Fish & Game Dept (see below). |

## Natural Community

Hemlock forest\*

| State <sup>1</sup> | Federal | Notes                                                                                                 |
|--------------------|---------|-------------------------------------------------------------------------------------------------------|
| --                 | --      | Threats include logging, introduction of invasive species, and direct destruction due to development. |

High-gradient rocky riverbank system

|    |    |                                                                                                                                                                                    |
|----|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| -- | -- | Threats are primarily changes to the hydrology of the river, land conversion and fragmentation, introduction of invasive species, and increased input of nutrients and pollutants. |
|----|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

# Memo



| Plant species                                                                                   | State <sup>1</sup> | Federal | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------|--------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| arrow-head rattlebox ( <i>Crotalaria sagittalis</i> )*                                          | E                  | --      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| bird-foot violet ( <i>Viola pedata</i> var. <i>pedata</i> )                                     | T                  | --      | This species occurs in sandplains, disturbed openings, dry forests, and thin woods. Threats would include direct destruction of the plants or major alterations in their habitat.                                                                                                                                                                                                                                                                                                                                                             |
| clasping milkweed ( <i>Asclepias amplexicaulis</i> )*                                           | T                  | --      | This species grows in sandplains and disturbed openings, and is sensitive to disturbances that eliminate its habitat.                                                                                                                                                                                                                                                                                                                                                                                                                         |
| dry land sedge ( <i>Carex siccata</i> )*                                                        | E                  | --      | Threats to this species are mainly loss of habitat.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| long-spined sandbur ( <i>Cenchrus longispinus</i> )*                                            | E                  | --      | This species grows in sandplains and disturbed openings, and is sensitive to disturbances that eliminate its habitat.                                                                                                                                                                                                                                                                                                                                                                                                                         |
| red-footed spikesedge ( <i>Eleocharis erythropoda</i> )*                                        | E                  | --      | This wetland species, which occurs in bogs/fens/seeps, and marshes, would be threatened by changes to local hydrology, including increased nutrient input from stormwater runoff, and sedimentation from nearby disturbance.                                                                                                                                                                                                                                                                                                                  |
| river birch ( <i>Betula nigra</i> )                                                             | T                  | --      | The population could be deleteriously affected by any project activities that alter the hydrology of its habitat, by increased sedimentation, and by increased nutrients/pollutants in stormwater runoff.                                                                                                                                                                                                                                                                                                                                     |
| unpretentious yellow-seeded false pimpernel ( <i>Lindernia dubia</i> var. <i>anagallidea</i> )* | E                  | --      | The pond shore habitat that supports this species can only withstand a limited amount of human disturbance. Trampling, removal, and burying of vegetation are all destructive and can also result in the introduction of non-native invasive species. Dams that reduce natural fluctuations in water level threaten the long-term survival of this habitat, e.g., by allowing woody shrubs and other more competitive vegetation to become established. Another threat is the contamination of water quality by road and agricultural runoff. |
| wild lupine ( <i>Lupinus perennis</i> ssp. <i>perennis</i> )                                    | T                  | --      | This wildflower grows in extremely dry, sandy openings and is easily identified in the field (see any wildflower guide) between early May and August. It is tolerant of surrounding disturbance and depends upon periodic mowing (or, historically, wildfire) to eliminate trees that would otherwise shade it out. It does not transplant well due to a tap root that can be more than three feet long.                                                                                                                                      |
| Wright's spikesedge ( <i>Eleocharis diandra</i> )                                               | E                  | --      | Primarily vulnerable to changes to the hydrology of its wetland habitat, especially alterations that change water levels. It may also be susceptible to increased pollutants and nutrients carried in stormwater runoff.                                                                                                                                                                                                                                                                                                                      |

## Vertebrate species

State<sup>1</sup> Federal Notes

## Memo



## NH NATURAL HERITAGE BUREAU NHB DATACHECK RESULTS LETTER

|                                                                 |    |    |                                              |
|-----------------------------------------------------------------|----|----|----------------------------------------------|
| American Eel ( <i>Anguilla rostrata</i> )                       | SC | -- | Contact the NH Fish & Game Dept (see below). |
| Bald Eagle ( <i>Haliaeetus leucocephalus</i> )                  | SC | -- | Contact the NH Fish & Game Dept (see below). |
| Banded Sunfish ( <i>Enneacanthus obesus</i> )                   | SC | -- | Contact the NH Fish & Game Dept (see below). |
| Blanding's Turtle ( <i>Emydoidea blandingii</i> )               | E  | -- | Contact the NH Fish & Game Dept (see below). |
| Eastern Hognose Snake ( <i>Heterodon platirhinos</i> )          | E  | -- | Contact the NH Fish & Game Dept (see below). |
| Eastern Meadowlark ( <i>Sturnella magna</i> )                   | T  | -- | Contact the NH Fish & Game Dept (see below). |
| Grasshopper Sparrow ( <i>Ammodramus savannarum</i> )            | T  | -- | Contact the NH Fish & Game Dept (see below). |
| New England Cottontail ( <i>Sylvilagus transitionalis</i> )     | E  | -- | Contact the NH Fish & Game Dept (see below). |
| Northern Black Racer ( <i>Coluber constrictor constrictor</i> ) | T  | -- | Contact the NH Fish & Game Dept (see below). |
| Northern Leopard Frog ( <i>Lithobates pipiens</i> )             | SC | -- | Contact the NH Fish & Game Dept (see below). |
| Peregrine Falcon ( <i>Falco peregrinus anatum</i> )             | T  | -- | Contact the NH Fish & Game Dept (see below). |
| Redfin Pickerel ( <i>Esox americanus americanus</i> )           | SC | -- | Contact the NH Fish & Game Dept (see below). |
| Sea Lamprey ( <i>Petromyzon marinus</i> )                       | SC | -- | Contact the NH Fish & Game Dept (see below). |
| Smooth Green Snake ( <i>Opheodrys vernalis</i> )                | SC | -- | Contact the NH Fish & Game Dept (see below). |
| Sora ( <i>Porzana carolina</i> )                                | SC | -- | Contact the NH Fish & Game Dept (see below). |
| Spotted Turtle ( <i>Clemmys guttata</i> )                       | T  | -- | Contact the NH Fish & Game Dept (see below). |
| Vesper Sparrow ( <i>Pooecetes gramineus</i> )                   | SC | -- | Contact the NH Fish & Game Dept (see below). |
| Wood Turtle ( <i>Glyptemys insculpta</i> )                      | SC | -- | Contact the NH Fish & Game Dept (see below). |

<sup>1</sup>Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (\*) indicates that the most recent report for that occurrence was more than 20 years ago.

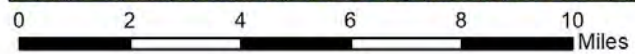
Contact for all animal reviews: Kim Tuttle, NH F&G, (603) 271-6544.

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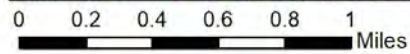
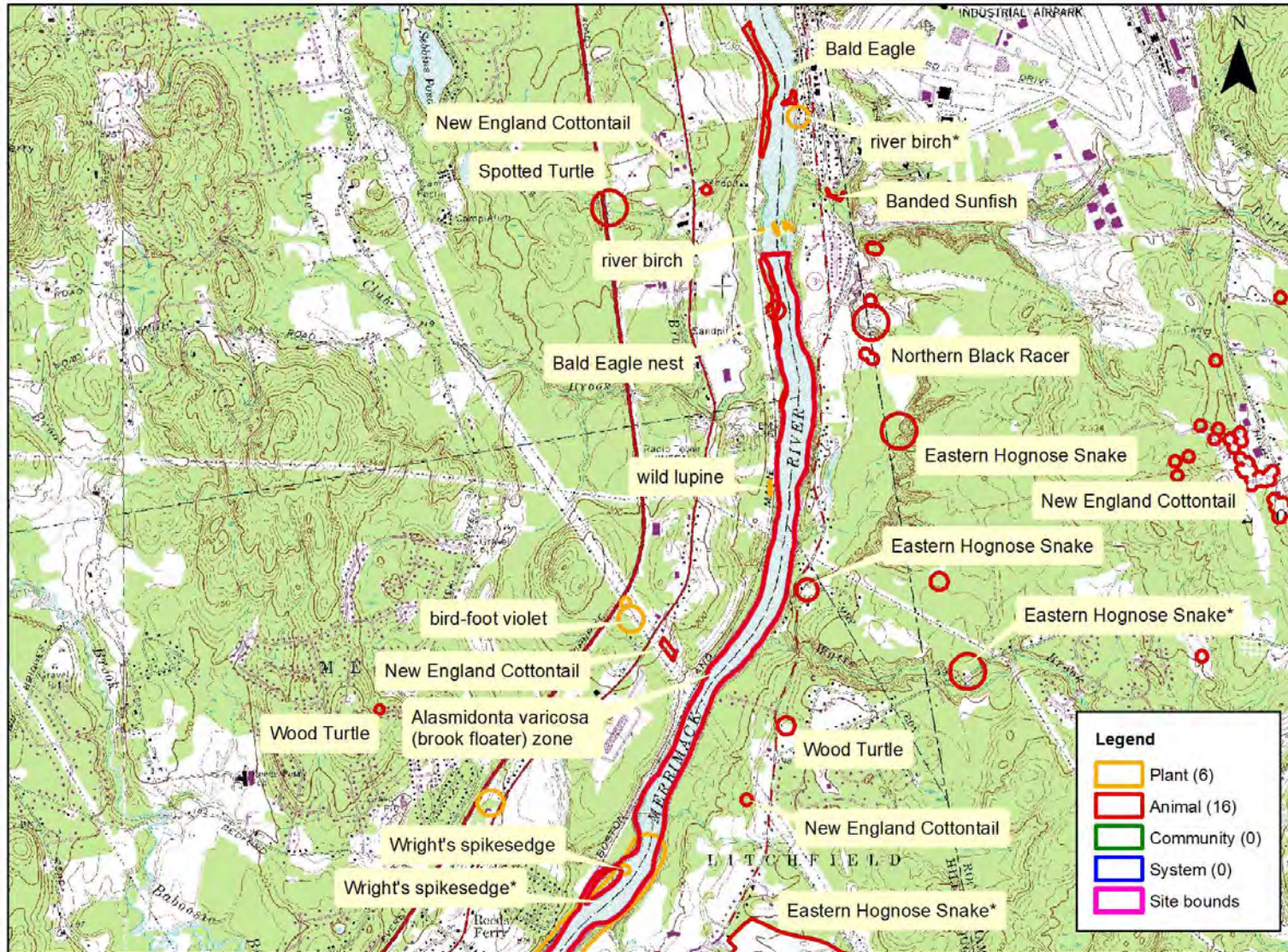
A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. An on-site survey would provide better information on what species and communities are indeed present.



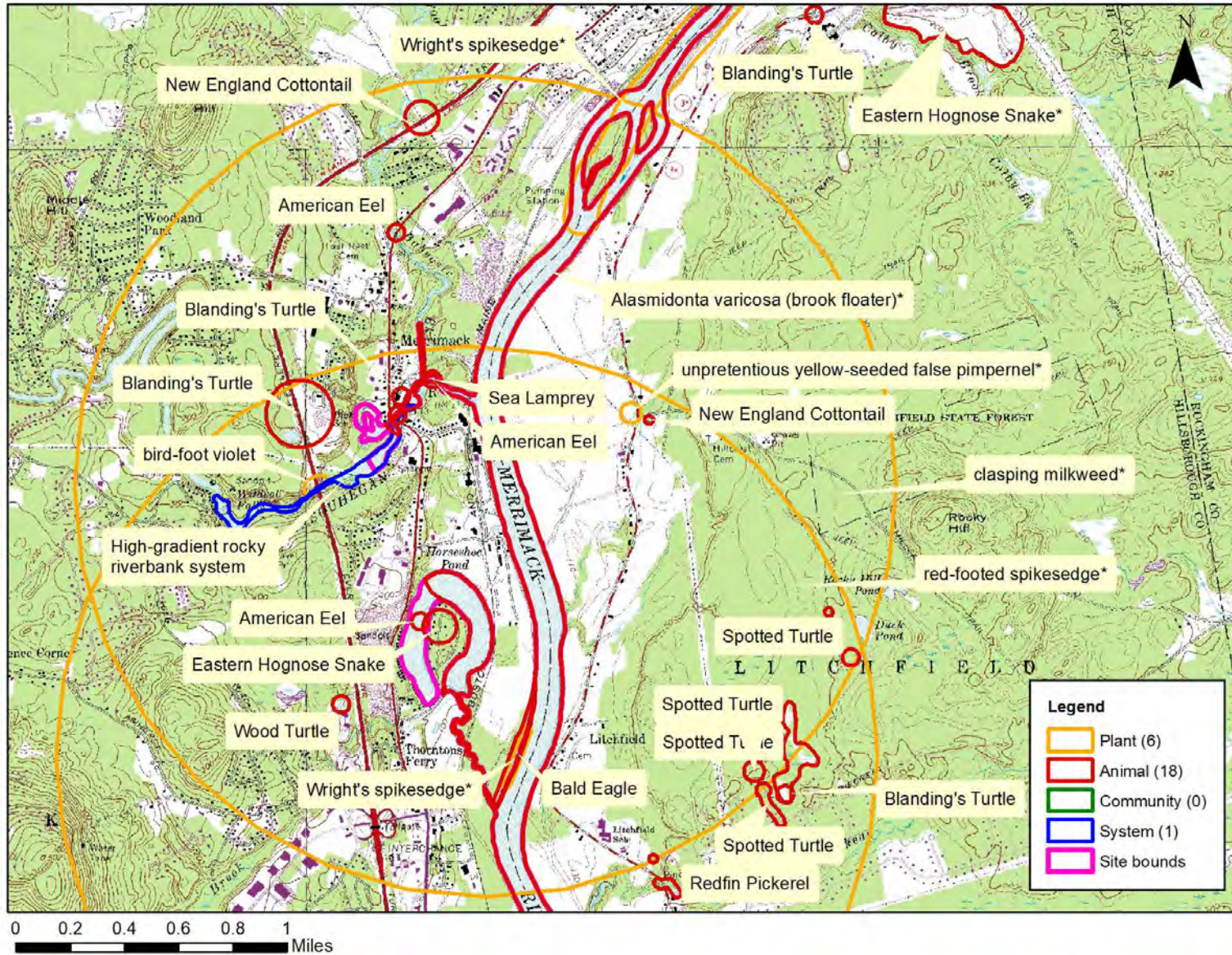
NHB18-1178



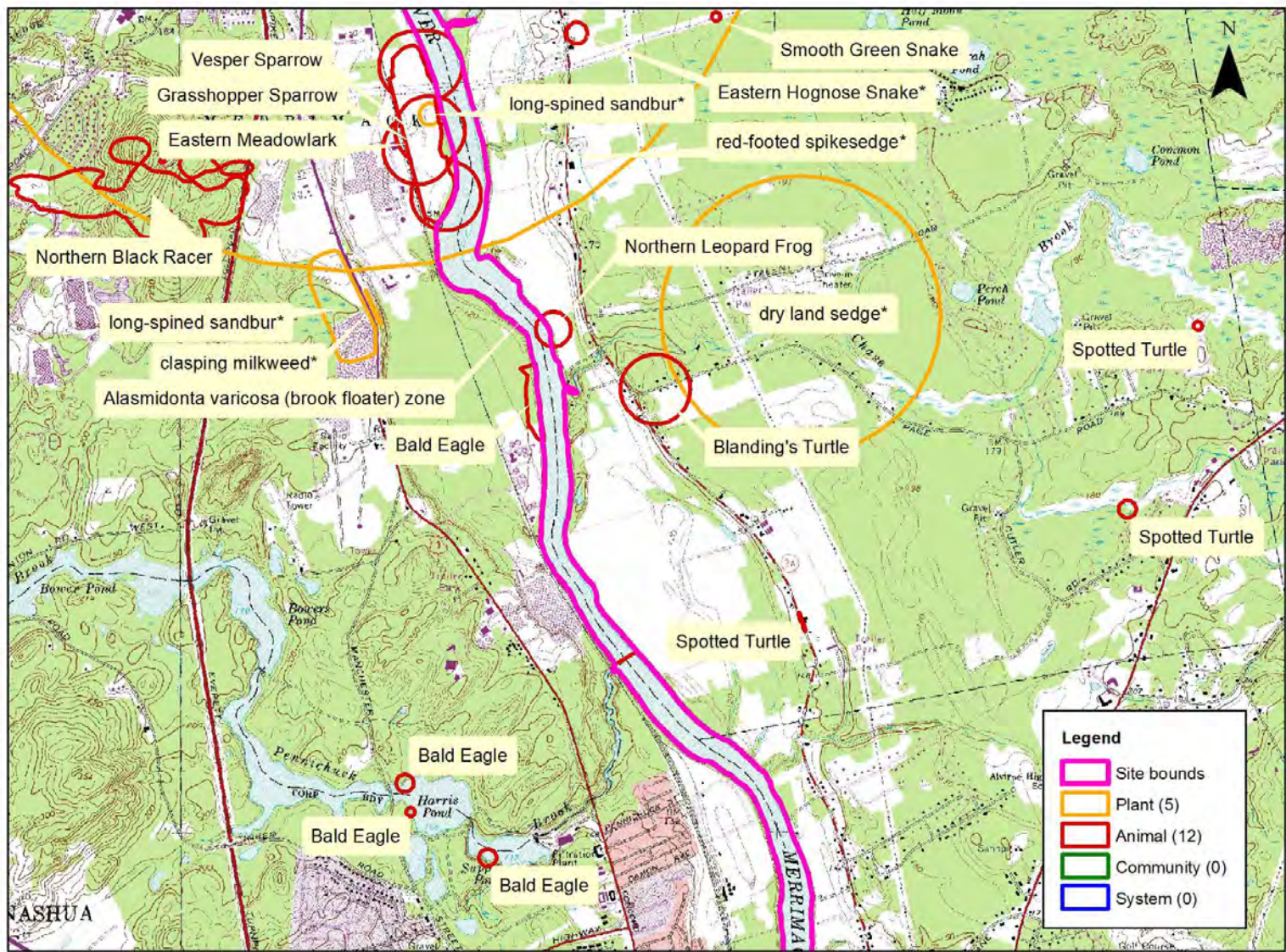
# NHB18-1178



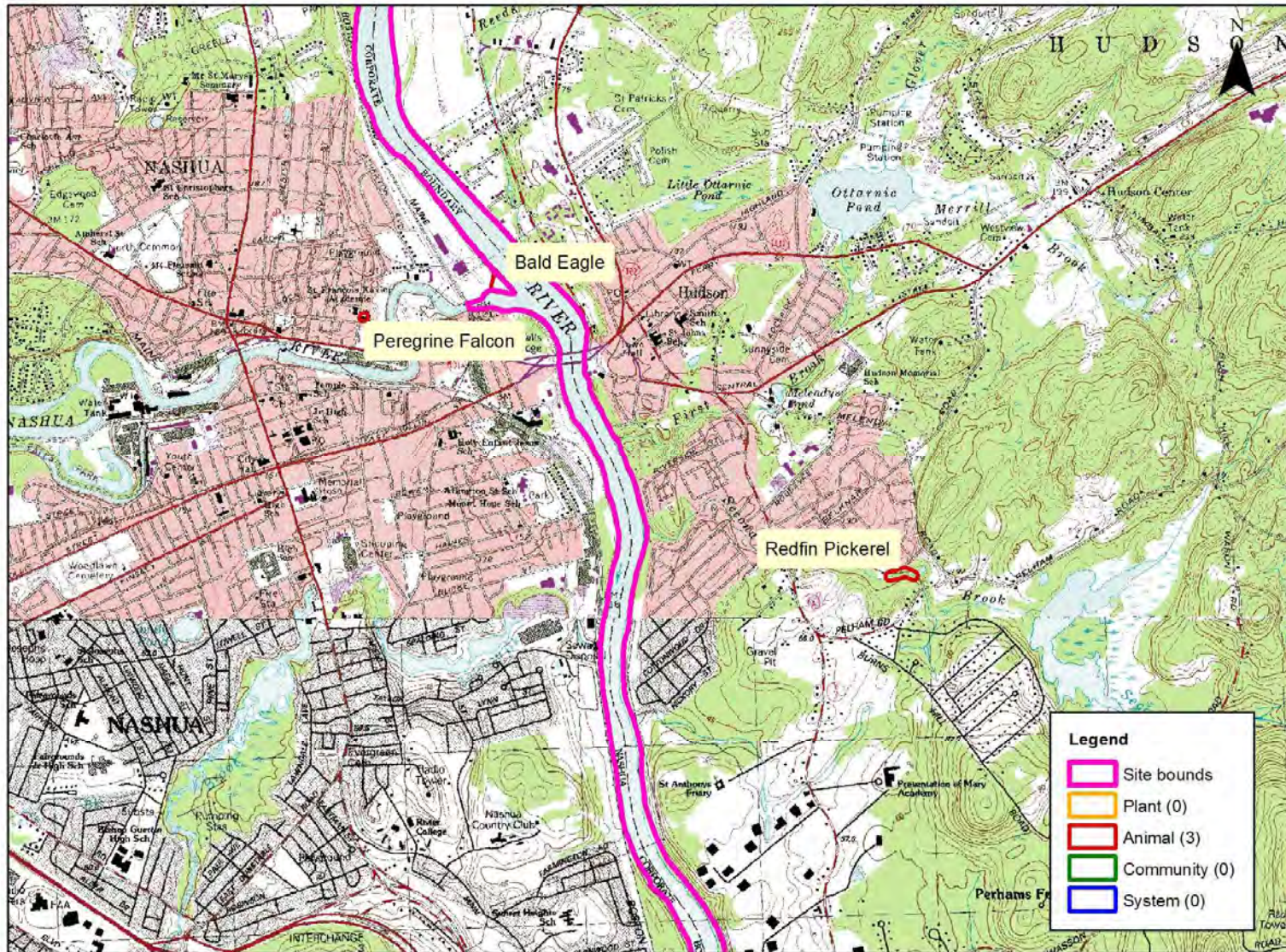
# NHB18-1178



# NHB18-1178

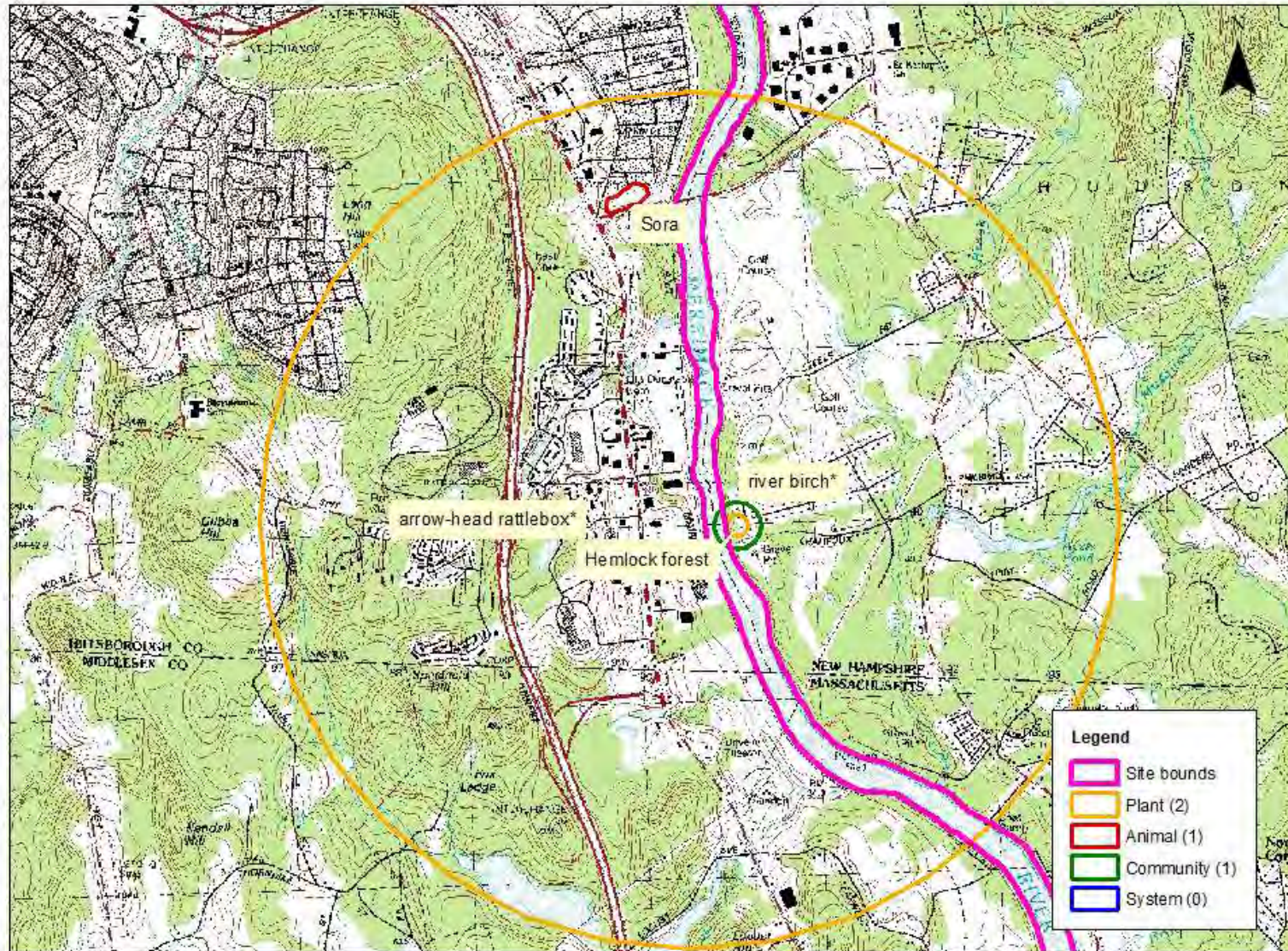


NHB18-1178



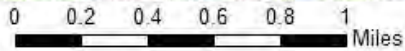
0 0.2 0.4 0.6 0.8 1 Miles

NHB18-1178

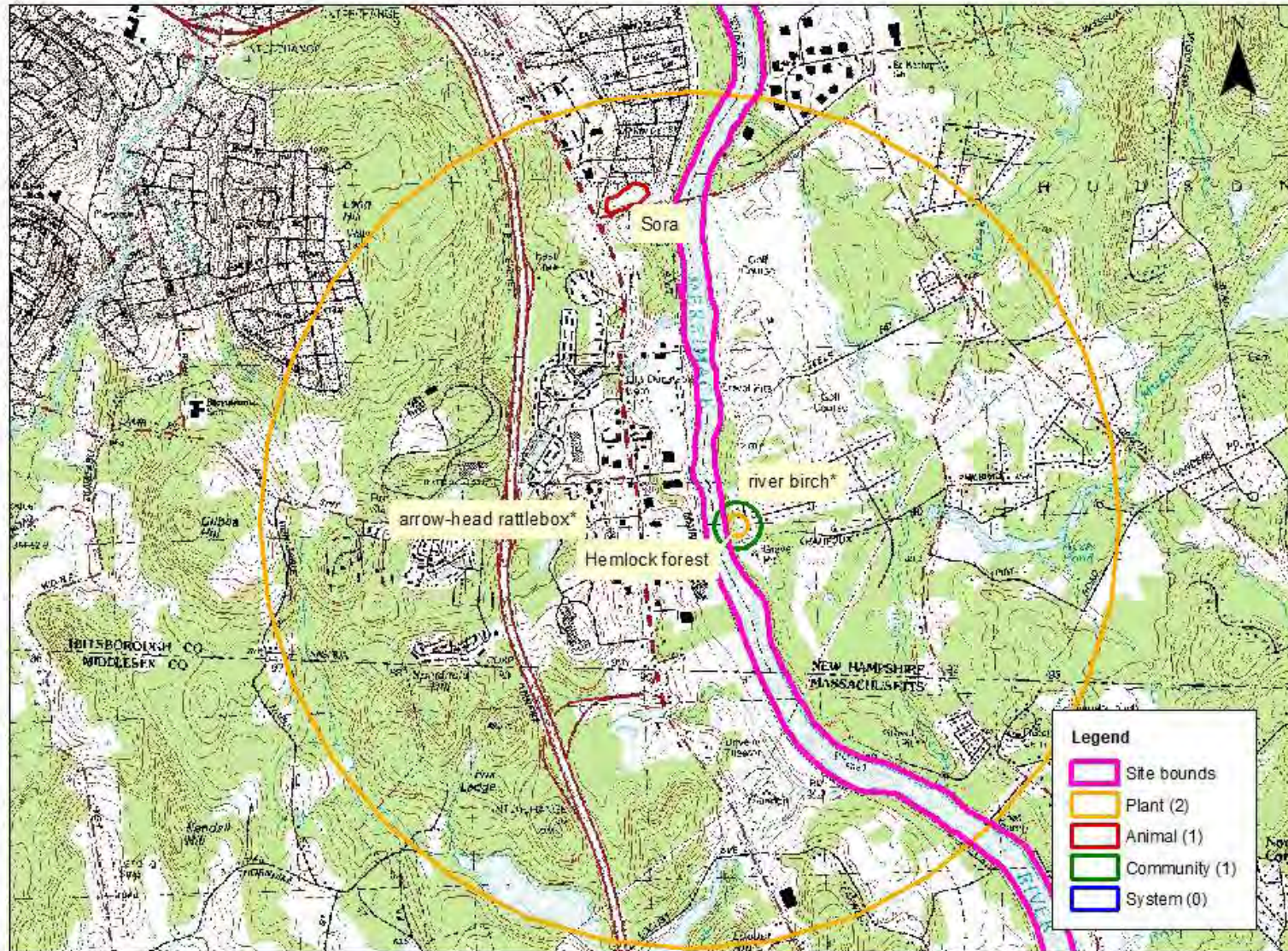


**Legend**

- Site bounds
- Plant (2)
- Animal (1)
- Community (1)
- System (0)

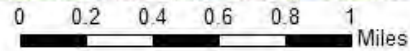


NHB18-1178



**Legend**

- Site bounds
- Plant (2)
- Animal (1)
- Community (1)
- System (0)



## New Hampshire Natural Heritage Bureau - Community Record

### Hemlock forest

#### **Legal Status**

Federal: Not listed  
State: Not listed

#### **Conservation Status**

Global: Not ranked (need more information)  
State: Apparently secure but with cause for concern

#### **Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
Comments on Rank: Small, formerly cut over

Detailed Description: 1985: Small area of steep bank with *Thuja* and *Tsuga* dominant. Similar to a disjunct occurrence of *Thuja* on Cape Cod, MA. Both sites with steep western exposure, dense *Tsuga* and access to constant light source from adjacent opening.

General Area: 1985: Steep forested riverbluff above Merrimack River with unusual occurrence of *Thuja*.

General Comments: Lack of escaped *Thuja* in acidic soils of SNE also supports native probability.

Management

Comments:

#### **Location**

Survey Site Name: Riverbluff West of Chalifoux Road

Managed By: Hi-Tension Realty Corp.

County: Hillsborough

Town(s): Hudson

Size: 13.6 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Hudson. Riverbluff west of Chalifoux Road. Small, steep bluff along the Merrimack River, due west of Chalifoux Road. Just north of 'Sanders'.

#### **Dates documented**

First reported: 1985

Last reported: 1985-07-06



## New Hampshire Natural Heritage Bureau - System Record

## High-gradient rocky riverbank system

**Legal Status**

Federal: Not listed  
State: Not listed

**Conservation Status**

Global: Not ranked (need more information)  
State: Rare or uncommon

**Description at this Location**

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).

Comments on Rank: 2010: This is a borderline EO (BC rank for an S3 system). Because this type of system is rare in this part of the state, it is considered exemplary with the BC score.

Detailed Description: 2010: This system supports *acidic riverbank outcrop*, *boulder - cobble river channel*, and *cobble - sand river channel* communities. Sections of the mapped polygon are also moderate-gradient. 1984: Canopy consists of *Quercus alba*, *Pinus strobus*, *Tsuga canadensis*, and *Acer rubrum*. Possible vegetative stems of *Allium schoenoprasum* var. *sibiricum* found on gravel bar.

General Area: 2010: Upland communities adjacent to river include *hemlock - beech - oak - pine forest* and *dry Appalachian oak forest*. This system crosses below two large roads (F.E. Everett Turnpike and the old Rte. 3 [Daniel Webster Highway]). Residential and commercial land use also occur adjacent to river in several areas. 1984: Steep, sandy, forested riverbank and rocky gorge along steep gradient of river, with sandy gravel bar terraces.

General Comments: 1984: Field check for *Allium schoenoprasum* var. *sibiricum* during June or July.

Management  
Comments:

**Location**

Survey Site Name: Wildcat Falls

Managed By: Currier Road Conservation Area

County: Hillsborough

Town(s): Merrimack

Size: 17.1 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2010: From Baboosic Lake Road, turn south onto Currier Road and follow to end (0.45 miles). Park at Currier Road Conservation Area trailhead. 1984: Wildcat Falls of the Souhegan River, west of the Daniel Webster Highway (Rte. 3).

**Dates documented**

First reported: 1984-09-24

Last reported: 2010-09-27

## New Hampshire Natural Heritage Bureau - Plant Record

### arrow-head rattlebox (*Crotalaria sagittalis*)

#### **Legal Status**

Federal: Not listed  
 State: Listed Endangered

#### **Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Not ranked (need more information)

#### **Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
 Comments on Rank:

Detailed Description: 1958: In limited numbers. Specimen collected.

General Area: Sandplain.

General Comments: First New Hampshire record.

Management

Comments:

#### **Location**

Survey Site Name: Merrimack River  
 Managed By: Hi-Tension Realty Corp.

County: Hillsborough

Town(s): Nashua

Size: 4592.3 acres

Elevation:

Precision: Within 1.5 miles of the area indicated on the map (location information is vague or uncertain).

Directions: Nashua. Merrimack River. Sandplain of western side of Merrimack River ca. 1 to 2 miles south of city.

#### **Dates documented**

First reported: 1958-09-11

Last reported: 1958-09-11

## New Hampshire Natural Heritage Bureau - Plant Record

### bird-foot violet (*Viola pedata* var. *pedata*)

#### Legal Status

Federal: Not listed  
State: Listed Threatened

#### Conservation Status

Global: Demonstrably widespread, abundant, and secure  
State: Imperiled due to rarity or vulnerability

#### Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).  
Comments on Rank: Plants transplanted; survival and management are questionable.

Detailed Description: 2016: Area 4: 2 plants, 1 mature with 9 blossoms, the other a seedling.<br />1993: Site 1 (east side) had over 70 plants (flowering and not flowering). Site 1A had over 100 plants (flowering and not flowering). Site 2 had 15 plants in northern subpopulation (more had been transplanted originally), southern sub-population could not be located. Sites 3 and 4 were not visited in 1993.<br />1991: plants were transplanted from a site that was going to be destroyed. Plants were just beginning to flower.

General Area: 2016: Area 4: The plants were found growing in the mowed grassy shoulder immediately adjacent to the northbound side of the Everett Turnpike and beneath electric transmission corridor. The immediate area where the larger of the 2 plants are growing is moss covered with scattered grasses and herbaceous growth. The seedling is growing in an area with short grasses.<br />1993: Mowed grassy area on the side of a highway.

General Comments: All plants were transplanted to these sites.

Management Comments: 2016: Area 4: Management plans for transmission tower maintenance will include maps with plant locations marked as sensitive with instructions to avoid.<br />1993: DOT is aware that mowing should be done after June (post seed set) or done with a blade at least 6 inches high so that seeds plants are not cut before seed set.

#### Location

Survey Site Name: Old Toll Booth Site  
Managed By:

County: Hillsborough

Town(s): Merrimack

Size: 11.1 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2016: Area 4: Side of Everett Turnpike at power line crossing [42.900804, -71.464557].<br />1993: Five sites along either side of the Everett Turnpike. All are transplants. Site 1 (east) and 1A (west) are on each side of turnpike just north of the Souhegan River crossing. Site 2 is 0.3 miles north of Souhegan River bridge on east side of road, about 30 yards east of road and 20 yards south of lone pine tree. Plants are in 2 groups, 1 group about 20 yards south of lone pine, another about 20 yards south of first group. Site 3 is along the northbound side 0.4 miles north of exit 12. Site 4 is along the northbound side under powerlines ca. 1.1 miles north of exit 12.

#### Dates documented

First reported: 1991

Last reported: 2016-05-03

## New Hampshire Natural Heritage Bureau - Plant Record

**clasping milkweed (*Asclepias amplexicaulis*)****Legal Status**

Federal: Not listed  
 State: Listed Threatened

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
 Comments on Rank:

Detailed Description: 1963: Hodgdon specimen at NHA (ARH & FLS 12733).

General Area: Dry bank, riverside.

General Comments:

Management

Comments:

**Location**

Survey Site Name: Merrimack River

Managed By: Currier Road Conservation Area

County: Hillsborough

Town(s): Merrimack

Size: 4592.3 acres

Elevation:

Precision: Within 1.5 miles of the area indicated on the map (location information is vague or uncertain).

Directions: Merrimack. Merrimack River, western side, on dry roadside bank.

**Dates documented**

First reported: 1963

Last reported: 1963-07-01

## New Hampshire Natural Heritage Bureau - Plant Record

**clasping milkweed (*Asclepias amplexicaulis*)****Legal Status**

Federal: Not listed  
 State: Listed Threatened

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
 Comments on Rank: 1 plant, hardly defensible.

Detailed Description: 2010: Searched for but not found. 1984: 1 plant, in fruit.

General Area: 1984: Sandy roadside.

General Comments:

Management

Comments:

**Location**

Survey Site Name: Sanders Trailer Park

Managed By:

County: Hillsborough

Town(s): Merrimack

Size: .1 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 1984: East side of Rte. 3, ca. 100 meters north of entrance to Sanders Trailer Park.

**Dates documented**

First reported: 1984-09-19

Last reported: 1984-09-19

## New Hampshire Natural Heritage Bureau - Plant Record

**dry land sedge (*Carex siccata*)****Legal Status**

Federal: Not listed  
 State: Listed Endangered

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
 Comments on Rank:

Detailed Description: 1931: Specimen collected.

General Area: 1931: Sandy bank.

General Comments:

Management

Comments:

**Location**

Survey Site Name: Darrah Pond, SW of  
 Managed By: Town of Litchfield Land

County: Hillsborough

Town(s): Litchfield

Size: 494.3 acres

Elevation:

Precision: Within 1.5 miles of the area indicated on the map (location information is vague or uncertain).

Directions: 1931: 1 mile SW of Darrah Pond.

**Dates documented**

First reported: 1931-08-09

Last reported: 1931-08-09

## New Hampshire Natural Heritage Bureau - Plant Record

**long-spined sandbur (*Cenchrus longispinus*)****Legal Status**

Federal: Not listed  
State: Listed Endangered

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
Comments on Rank: Habitat destroyed by development and road construction.

Detailed Description: 2010: Searched for but not found. Habitat destroyed. Presumed extirpated. But area searched was probably south of the original observation. 1984: Abundant ("much").

General Area: 1984: Sandy, disturbed field. [Possibly "a south-facing sandy slope with an abundance of dwarf chestnut oak (*Quercus prinoides*) and pitch pine (*Pinus rigida*)", but this description could refer to another nearby area.]

General Comments: 2010: (Area south of probable original observation): Based on this area now being a parking lot for several BAE (and aerial) systems and the altered nature of the landscape west of the lot (fill, mowing, etc.), suggest changing status to extirpated.

Management  
Comments:

**Location**

Survey Site Name: Merrimack  
Managed By: Merrimack Technology Park

County: Hillsborough

Town(s): Merrimack

Size: 35.2 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 1984: [West side of Rte. 3, sandy disturbed field north of Sanders Associates].

**Dates documented**

First reported: 1984-09-19

Last reported: 1984-09-19

## New Hampshire Natural Heritage Bureau - Plant Record

**long-spined sandbur (*Cenchrus longispinus*)****Legal Status**

Federal: Not listed  
 State: Listed Endangered

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
 Comments on Rank:

Detailed Description: 1986: Details not recorded.

General Area: 1986: Edge of field.

General Comments:

Management

Comments:

**Location**

Survey Site Name: Merrimack River, near Anheuser-Busch Brewery  
 Managed By:

County: Hillsborough

Town(s): Merrimack

Size: 2.8 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Edge of field behind Anheuser-Busch plant near salt storage barn.

**Dates documented**

First reported: 1986

Last reported: 1986-09



## New Hampshire Natural Heritage Bureau - Plant Record

**red-footed spikeseed (*Eleocharis erythropoda*)****Legal Status**

Federal: Not listed  
 State: Listed Endangered

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
 Comments on Rank:

Detailed Description: 1929: COLLECTED BY PEASE 1929.

General Area: 1929: Sandy riverbank.

General Comments:

Management

Comments:

**Location**

Survey Site Name: Thorntons Ferry  
 Managed By: Merrimack Village District Land

County: Hillsborough

Town(s): Merrimack

Size: 4592.3 acres

Elevation:

Precision: Within 1.5 miles of the area indicated on the map (location information is vague or uncertain).

Directions: Merrimack. Thorntons Ferry. Sandy riverbank.

**Dates documented**

First reported: 1929

Last reported: 1929

## New Hampshire Natural Heritage Bureau - Plant Record

### river birch (*Betula nigra*)

#### Legal Status

Federal: Not listed  
State: Listed Threatened

#### Conservation Status

Global: Demonstrably widespread, abundant, and secure  
State: Imperiled due to rarity or vulnerability

#### Description at this Location

Conservation Rank: Fair quality, condition and/or landscape context ('C' on a scale of A-D).  
Comments on Rank:

Detailed Description: 2015: Area 1: 8 plants. Area 2: 13 plants. Area 3: 8 plants. Area 4: 7 plants. In addition to the tree and shrub size individuals, seedlings were also observed. The plants are located within a ROW and show evidence of past maintenance. Many of the shrubs are vigorous stump sprouts.  
1992: River birch saplings were found growing within riverside outcrop community.

General Area: 2015: Individual shrubs and saplings were tightly associated with the ordinary high water mark of the river, at the base of steep slopes, and on an island in the river.  
1992: Riverside outcrop community.

#### General Comments:

Management 2015: Trees occur in a power line right-of-way and show evidence of past maintenance.  
Comments: Many of the shrubs are vigorous stump sprouts.

#### Location

Survey Site Name: Peninsula North of Goffs Falls  
Managed By: Merrimack Riverfront

County: Hillsborough  
Town(s): Manchester  
Size: .5 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2015: Area 1: From the rear (east side) of the industrial building at 15 Iron Horse Drive in Bedford, walk approximately 300 feet east across the railroad and into the powerline corridor to the Merrimack River. Individuals are located on the west bank of the Merrimack River. Area 2: From 285 Hazleton Ave in Manchester where the street intersects the powerline corridor, walk approximately 500 feet west down the corridor to the east bank of the Merrimack River. Individuals are located along the west bank of the roughly 800 foot long island in the river. Note that depending on current water levels, the island may be inaccessible by foot. Areas 3 and 4: From 285 Hazleton Ave in Manchester where the street intersects the powerline corridor, walk approximately 500 feet west down the corridor to the east bank of the Merrimack River. Individuals are located along the bank of the river, and along the east bank of an adjacent island roughly 800 feet long. Note that depending on current water levels, the island may be inaccessible by foot. Manchester. Island in Merrimack River.

#### Dates documented

First reported: 1992 Last reported: 2015-09-16



## New Hampshire Natural Heritage Bureau - Plant Record

### river birch (*Betula nigra*)

#### **Legal Status**

Federal: Not listed  
 State: Listed Threatened

#### **Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Imperiled due to rarity or vulnerability

#### **Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
 Comments on Rank:

Detailed Description: 1992: River birch saplings were found growing within riverside outcrop community.

General Area: 1992: Riverside outcrop community.

General Comments:

Management

Comments:

#### **Location**

Survey Site Name: Peninsula South of Goffs Falls

Managed By:

County: Hillsborough

Town(s): Manchester

Size: 2.8 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Manchester. Merrimack River corridor subsites. Peninsula south of Goffs Falls.

#### **Dates documented**

First reported: 1992

Last reported: 1992

## New Hampshire Natural Heritage Bureau - Plant Record

### unpretentious yellow-seeded false pimpernel (*Lindernia dubia* var. *anagallidea*)

#### **Legal Status**

Federal: Not listed  
State: Listed Endangered

#### **Conservation Status**

Global: Apparently secure but with cause for concern  
State: Not ranked (need more information)

#### **Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
Comments on Rank:

Detailed Description: 1992: No detailed notes taken. *Lindernia* occurs along with the similar but more common *Lindernia dubia*. Other associated spp include: *Eleocharis ovata*, *Juncus canadensis*, and *Cyperus strigosus*.

General Area: 1992: Disturbed marshy wetland scrape surrounded by golf course.

General Comments:  
Management  
Comments:

#### **Location**

Survey Site Name: Litchfield Golf Course  
Managed By:

County: Hillsborough

Town(s): Litchfield

Size: 2.8 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Litchfield. Located just north of the Hillcrest Road and Rte 3A junction in wetland scrape surrounded by golf course and fairly close to the road.

#### **Dates documented**

First reported: 1992-09-23

Last reported: 1992-09-23

## New Hampshire Natural Heritage Bureau - Plant Record

**wild lupine (*Lupinus perennis* ssp. *perennis*)****Legal Status**

Federal: Not listed  
 State: Listed Threatened

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Fair quality, condition and/or landscape context ('C' on a scale of A-D).  
 Comments on Rank: Small population along well-used trail but apparently increasing in size.

Detailed Description: 2011: 22 stems in scattered clumps. 6 plants in flower, 3 plants with seed. Evidence of herbivory on one plant. Population observed for at least two years and the number of plants has increased. 2010: No details (see 2011).

General Area: 2011: Flat trail, sandy soil. Associated plants include sweet-fern (*Comptonia peregrina*), eastern white pine (*Pinus strobus*), pitch pine (*P. rigida*), scrub oak (*Quercus ilicifolia*), northern red oak (*Q. rubra*), and common lowbush blueberry (*Vaccinium angustifolium*).

General Comments:  
 Management  
 Comments:

**Location**

Survey Site Name: Pointer Club Brook, south of  
 Managed By:

County: Hillsborough  
 Town(s): Merrimack  
 Size: .0 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2011: Travel south on Daniel Webster Highway and park at Table of Stone, 759 Daniel Webster Highway. Access the Heritage Trail from adjacent property after getting landowner permission. Alternatively (longer walk), access the Heritage Trail at new bridge over the Merrimack River. Head south on trail to a storage facility (currently named Extra Space Storage). Plants start parallel with unit 560 and continue along both sides of the trail up to the end of the storage facility. There is a fence between the trail and the storage facility.

**Dates documented**

First reported: 2010  
 Last reported: 2011-06-10

## New Hampshire Natural Heritage Bureau - Plant Record

**Wright's spikeseed (*Eleocharis diandra*)****Legal Status**

Federal: Not listed  
State: Listed Endangered

**Conservation Status**

Global: Imperiled due to rarity or vulnerability  
State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2016: 10 plants observed in two locations, in an area totaling approximately 5 x 0.5 meters.  
General Area: 2016: Plants are scattered along a very narrow sandy/silty strip that is between the river and the eroded drop-off edge of a vegetation mat, all near the upstream end of the island. The back channel is now impounded by beavers, and significant ATV use has created a worn track a short distance from the bank dropoff. Associated species include nodding beggar-ticks (*Bidens cernua*), two stamens umbrella sedge (*Cyperus diandrus*), red-root umbrella sedge (*Cyperus erythrorhizos*), incurved umbrella sedge (*Cyperus squarrosus*), straw-colored umbrella sedge (*Cyperus strigosus*), American barnyard grass (*Echinochloa muricata*), blunt spikeseed (*Eleocharis obtusa* var. *obtusa*), slender fimbry (*Fimbristylis autumnalis*), clammy hedge-hyssop (*Gratiola neglecta*), dwarf St. John's-wort (*Hypericum mutilum*), Canada rush (*Juncus canadensis*), rice cut grass (*Leersia oryzoides*), red lobelia (*Lobelia cardinalis*), common water-primrose (*Ludwigia palustris*), and purple loosestrife (*Lythrum salicaria*).

General Comments:  
Management  
Comments:

**Location**

Survey Site Name: Reeds Ferry  
Managed By:

County: Hillsborough  
Town(s): Merrimack  
Size: .4 acres  
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2016: [Plants are along water's edge at bottom of eroded bank of sand bar island on west side of river, near Reed's Ferry, Merrimack].

**Dates documented**

First reported: 2016-10-20  
Last reported: 2016-10-20

## New Hampshire Natural Heritage Bureau - Plant Record

**Wright's spikesedge (*Eleocharis diandra*)****Legal Status**

Federal: Not listed  
 State: Listed Endangered

**Conservation Status**

Global: Imperiled due to rarity or vulnerability  
 State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
 Comments on Rank:

Detailed Description: 2016: Searched for but not found.<br />1929: Specimen collected.

General Area: 1929: Sandy riverbank.

General Comments: 2016: "Chris Kane spent a couple of hours on September 22, 2016 scouring up and downstream of the general site area known as Thornton's Ferry, Merrimack. Knowing exactly where the original collection site was will probably never be known. Very few *Eleocharis* of any kind were observed, the habitat did not look particularly suitable for *Eleocharis diandra*, and none of the notable associated species such as *Cyperus squarrosus* and *Cyperus diandrus* were present."

Management

Comments:

**Location**

Survey Site Name: Thornton's Ferry

Managed By:

County: Hillsborough

Town(s): Merrimack

Size: 4.8 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Thornton's Ferry.

**Dates documented**

First reported: 1929-07-31

Last reported: 1929-07-31



## New Hampshire Natural Heritage Bureau - Plant Record

**Wright's spikeseed (*Eleocharis diandra*)****Legal Status**

Federal: Not listed  
 State: Listed Endangered

**Conservation Status**

Global: Imperiled due to rarity or vulnerability  
 State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
 Comments on Rank:

Detailed Description: 1931: Specimen collected.

General Area: 1931: Muddy bank.

General Comments:

Management

Comments:

**Location**

Survey Site Name: Reeds Ferry  
 Managed By: Moores Falls Conservation Area

County: Hillsborough

Town(s): Litchfield

Size: 121.3 acres

Elevation:

Precision: Within 1.5 miles of the area indicated on the map (location information is vague or uncertain).

Directions: Reeds Ferry.

**Dates documented**

First reported: 1931-08-27

Last reported: 1931-08-27

## New Hampshire Natural Heritage Bureau - Animal Record

**American Eel (*Anguilla rostrata*)****Legal Status**

Federal: Not listed  
State: Special Concern

**Conservation Status**

Global: Apparently secure but with cause for concern  
State: Rare or uncommon

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2000: Area 13216: Not enumerated.

General Area:

General Comments:

Management

Comments:

**Location**

Survey Site Name: Baboosic Brook  
Managed By: Twin Bridges Park

County: Hillsborough

Town(s): Merrimack

Size: 1.9 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2000: Baboosic Brook

**Dates documented**

First reported: 2000

Last reported: 2000

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### American Eel (*Anguilla rostrata*)

#### **Legal Status**

Federal: Not listed  
State: Special Concern

#### **Conservation Status**

Global: Apparently secure but with cause for concern  
State: Rare or uncommon

#### **Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2008: Area 13321M: 1 observed.2007: Area 13321M: 1 observed.

General Area:

General Comments:

Management

Comments:

#### **Location**

Survey Site Name: Beaver Brook  
Managed By:

County: Hillsborough

Town(s): Merrimack

Size: 1.9 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2008: Souhegan River, below Merrimack Village Dam to Merrimack River.

#### **Dates documented**

First reported: 2007-08-21

Last reported: 2008-07-02

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### American Eel (*Anguilla rostrata*)

**Legal Status**

Federal: Not listed  
State: Special Concern

**Conservation Status**

Global: Apparently secure but with cause for concern  
State: Rare or uncommon

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2009: Area 13333: 1 observed.  
General Area: 2009: Area 13333: Ledge/boulder habitat downstream of Rte. 3.  
General Comments:  
Management  
Comments:

**Location**

Survey Site Name: Beaver Brook  
Managed By:

County: Hillsborough  
Town(s): Merrimack  
Size: 1.9 acres                                              Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2009: Souhegan River

**Dates documented**

First reported: 2009-08-20                                              Last reported: 2009-08-20

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.



## New Hampshire Natural Heritage Bureau - Animal Record

### Bald Eagle (*Haliaeetus leucocephalus*)

#### Legal Status

Federal: Not listed  
State: Special Concern

#### Conservation Status

Global: Demonstrably widespread, abundant, and secure  
State: Imperiled due to rarity or vulnerability

#### Description at this Location

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2002-2012: Wintering eagles regularly observed at locations along the Merrimack River, day perching and night roosts:2012: Solitary eagles observed at 2 separate locations on 1/7. Solitary eagles observed at 2 separate locations on 1/31. 2 eagles observed at a single location on 2/7. 1 eagle observed on 2/9. Solitary eagles observed at 3 separate locations on 2/25.2011: 3 eagles observed at a single location and 2 at a separate location on 1/8. 1 eagle observed on 1/9. 1 eagle observed on 1/11. 1 eagle observed on 1/13. 2 eagles observed at a single location on 2/7. 1 eagle observed on 2/9. 1 eagle observed on 2/15. 1 eagle observed on 2/17. 1 eagle observed on 2/22. 1 eagle observed on 3/2. 4 eagles observed at a single location, 2 eagles at 2 separate locations, and a solitary eagle observed on 2/26. 1 eagle observed on 12/13. 1 eagle observed on 12/15. 2010: 7 eagles observed at a single location, 4 eagles at a single location, 2 eagles at a single location, and solitary eagles at 6 locations on 1/9. Solitary eagles at 2 separate locations on 2/28. 1 eagle observed on 12/17. 1 eagle observed on 12/20. 1 eagle observed on 12/22. 1 eagle observed on 12/30.2009: 4 eagles observed at a single location, 2 eagles observed at 2 separate locations, and solitary eagles at 5 separate locations on 1/10. 4 eagles observed at a single location, and 2 eagles located at 4 separate locations on 2/28.2008: 3 eagles observed at a single location, 2 eagles at a single location, and solitary eagles at 2 separate locations on 1/12. 2 eagles observed at a single location and 1 at a separate location on 2/23.2007: 6 eagles observed at a single location, 2 eagles at a single location, and solitary eagles at 2 separate locations on 2/24.2006: 3 eagles observed at 3 separate locations, 2 eagles at 3 separate locations, and solitary eagles at 7 separate locations on 1/7. 2 eagles observed at a single location and 1 at a separate location on 2/18. 6 eagles observed at a single location, 3 at a single location, 2 eagles at 2 separate locations, and a solitary eagle at 1 location on 2/25.2005: Solitary eagles observed at 6 separate locations on 1/8. 1 eagle observed on 1/10. 12 eagles observed at a single location, 5 eagles at a single location, and 3 eagles at 2 separate locations on 2/4. 5 eagles observed at a single location, 3 eagles at a single location, and solitary eagles at 4 separate locations on 2/26.2004: Solitary eagles observed at 6 separate locations on 1/10. 1 eagle observed on 12/20.2003: 4 locations with 2 eagles observed on 1 location with a single eagle on 1/9. 2 eagles at a single location on 1/11. 1 eagle observed on 1/31. 4 eagles at a single location on 2/1. 5 eagles at one location and 2 at another location on 2/2. 9 eagles at a single location on 2/28. 3 eagles at a single location, 2 eagles at 2 separate locations, and 1 eagle at 2 separate locations on 3/1.2002: 2 eagles observed at separate locations on 1/12. Observations of 2 and 3 eagles at 2 separate locations on 12/22.1993: Near Amoskeag Bridge, suspected roosting behind the Youth Center, perching on north side of bridge. Perching on Amoskeag Islands. Some sightings near mouth of Piscataquog River. Also roosting behind Caldor's, NSS Corporation. Confirmed roosting at Sebbins Brook between Rte 3 and the river. Also at Reed's Ferry islands, Pennichuck Brook, all the way south to the Nashua River. 1991: Consistent perching near Amoskeag Bridge, between Queen City bridge and 101/283. Roosting behind Youth Development Center north of Amoskeag Bridge.

General Area:  
General Comments:  
Management  
Comments:

Eagles perch, sometimes roost in large white pines along the riverbank.

#### Location

Survey Site Name: Lower Merrimack River  
Managed By: Smiths Ferry Heritage Park

County: Hillsborough  
Town(s): Manchester  
Size: 116.0 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Various locations along the banks of the Merrimack River.

**Dates documented**

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First reported: 198? Last reported: 2012-02-25

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### **Bald Eagle (*Haliaeetus leucocephalus*)**

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#### **Legal Status**

Federal: Not listed  
 State: Special Concern

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#### **Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Imperiled due to rarity or vulnerability

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#### **Description at this Location**

Conservation Rank: Not ranked  
 Comments on Rank:

Detailed Description: 2017: Nest 3: Nest active, no chicks fledged.<br />2016: Nest 2: Nest active, no chicks fledged.<br />2014: Nest 2: 2 chicks fledged.<br />2013: Nest 1: 2 chicks fledged.

General Area:  
 General Comments:  
 Management  
 Comments:

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#### **Location**

Survey Site Name: Pennichuck Brook  
 Managed By: Pennichuck Water Works

County: Hillsborough  
 Town(s): Nashua  
 Size: 4.3 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

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#### **Dates documented**

First reported: 2013 Last reported: 2017

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.



## New Hampshire Natural Heritage Bureau - Animal Record

### Banded Sunfish (*Enneacanthus obesus*)

#### Legal Status

Federal: Not listed  
State: Special Concern

#### Conservation Status

Global: Demonstrably widespread, abundant, and secure  
State: Rare or uncommon

#### Description at this Location

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2005: Area 8978: 2 observed, age and sex unknown. Area 8972: 1 observed, age and sex unknown. 2000: Area 260: 1 observed, age and sex unknown (Obs\_id 368). 1938: Cohas Brook: Specimen collected.

General Area: 2005: Area 8978: Freshwater - stream or river. Area 8972: Freshwater - stream or river. Wide channel with a lot of pickerel weed and submerged vegetation. Marsh and pond-like area. 2000: Area 260: Freshwater - stream or river (Obs\_id 368). 1938: Cohas Brook: Vegetation moderate, rushes and *Potamogeton* (pondweed). Partly wooded shore, moderate current.

General Comments: 2000: Area 260: Sampled by DES electrofishing 150 meter index site (Obs\_id 368).  
Management  
Comments:

#### Location

Survey Site Name: Cohas Brook  
Managed By: NHDOT Mitigation

County: Hillsborough  
Town(s): Manchester  
Size: 84.8 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 1938: Cohas Brook: Cohas Brook from I93 W to Little Island Pond. 2000: Area 260: Cohas Brook at DES Station 00m-50. 2005: Area 8978: Little Cohas Brook on Hall Rd. Area 8972: Cohas Brook on Auburn Rd. at sand and gravel pit.

#### Dates documented

First reported: 1938  
Last reported: 2005-10-03

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### Blanding's Turtle (*Emydoidea blandingii*)

---

**Legal Status**

Federal: Not listed  
State: Listed Endangered

---

**Conservation Status**

Global: Apparently secure but with cause for concern  
State: Critically imperiled due to rarity or vulnerability

---

**Description at this Location**

Conservation Rank: Fair quality, condition and/or landscape context ('C' on a scale of A-D).  
Comments on Rank:

Detailed Description: 2001: Area 996: 1 adult male.  
General Area: 2001: Area 996: Highway breakdown lane near wetland.  
General Comments:  
Management  
Comments:

---

**Location**

Survey Site Name: Wildcat Falls  
Managed By:

County: Hillsborough  
Town(s): Merrimack  
Size: 30.8 acres                                              Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2001: Area 996: On Rte. 293 north, in breakdown lane just north of wetland (north of Souhegan River).

---

**Dates documented**

First reported: 2001-08-06                                              Last reported: 2001-08-06

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

**Blanding's Turtle (*Emydoidea blandingii*)****Legal Status**

Federal: Not listed  
State: Listed Endangered

**Conservation Status**

Global: Apparently secure but with cause for concern  
State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2002: Area 1007: 1 turtle.

General Area:

General Comments:

Management

Comments:

**Location**

Survey Site Name: Nesenkeag Brook  
Managed By:

County: Hillsborough

Town(s): Litchfield

Size: 30.8 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2002: Area 1007: Page Road, couple hundred yards east of Rte. 3A, forested wetlands and stream system of Chase Brook.

**Dates documented**

First reported: 2002-06-15

Last reported: 2002-06-15

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.



## New Hampshire Natural Heritage Bureau - Animal Record

**Blanding's Turtle (*Emydoidea blandingii*)****Legal Status**

Federal: Not listed  
State: Listed Endangered

**Conservation Status**

Global: Apparently secure but with cause for concern  
State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2010: Area 13118: 1 adult observed.  
General Area: 2010: Area 13118: Grassy field at town park.  
General Comments:  
Management  
Comments:

**Location**

Survey Site Name: Souhegan River Mouth  
Managed By:

County: Hillsborough  
Town(s): Merrimack  
Size: 1.9 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2010: Area 13118: Watson Park, Merrimack.

**Dates documented**

First reported: 2010-06-23 Last reported: 2010-06-23

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### Blanding's Turtle (*Emydoidea blandingii*)

**Legal Status**

Federal: Not listed  
 State: Listed Endangered

**Conservation Status**

Global: Apparently secure but with cause for concern  
 State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Not ranked  
 Comments on Rank:

Detailed Description: 2012: Area 13546: 1 adult female observed.  
 General Area: 2012: Area 13546: Urban/suburban. Near sandy area adjacent to Colby Brook.  
 General Comments: 2012: Area 13546: Observation comment: Crossing Charles Bancroft Hwy and released in Colby Brook.

Management  
 Comments:

**Location**

Survey Site Name: Reeds Ferry  
 Managed By:

County: Hillsborough  
 Town(s): Litchfield  
 Size: 1.9 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2012: Area 13546: Charles Bancroft Hwy, Litchfield, NH.

**Dates documented**

First reported: 2012-06-23 Last reported: 2012-06-23

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### **Eastern Hognose Snake (*Heterodon platirhinos*)**

---

**Legal Status**

Federal: Not listed  
State: Listed Endangered

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
State: Critically imperiled due to rarity or vulnerability

---

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2012: Area 13089: 1 adult observed, 18-20" in length. 2008: Area 11548: 1 adult seen. 1984: Area 12169M: 1 observed. 1979: Area 11548a: 1 snake found in garden and killed. 1972: Area 6596: 1 seen. Adult. Area 12169M: 1 individual observed, 16-18 inches long.

General Area: 2012: Area 13089: Residential yard in wooded area. 2008: Area 11548: It was located just to the north and east of the bigger pond on the north end of the parcel. 1979: Area 11548a: Snake found in garden. 1972: Area 12169M: In a small cemetery. Area shaded and grassy.

General Comments: 2003: Area 12169M: Formerly Pettengill Cemetery. Now busy road. NHHNB was contacted on 29 June 1984 by a neighbor of individual who killed the snake.

Management  
Comments:

---

**Location**

Survey Site Name: Litchfield  
Managed By: NHDOT Mitigation

County: Rockingham  
Town(s): Londonderry  
Size: 12.5 acres                                  Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2012: Area 13089: End of Sunflower Lane in Londonderry. The woods in the back border the Manchester town line. 1979: Litchfield. About 4 houses over town line from Manchester on Rte. 3. 1972: Area 6596: Bill Boucher residence, 272 Litchfield Road, 1/2 mile east of Route 3A at the junction of Watts Brook. Area 12169M: Londonderry. Found in a small old cemetery on north side of Pettingill Road which runs west off of Harvey Road. Near Little Cohas Marsh.

---

**Dates documented**

First reported: 1972-07-01                                  Last reported: 2012-09-02

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

**Eastern Hognose Snake (*Heterodon platirhinos*)****Legal Status**

Federal: Not listed  
State: Listed Endangered

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2004: 1 seen. Adult. (Obs\_id 2004.0093).

General Area:

General Comments:

Management

Comments:

**Location**

Survey Site Name: Horseshoe Pond  
Managed By:

County: Hillsborough

Town(s): Merrimack

Size: 7.7 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2004: Near Horseshoe Pond. 79 Island Drive in yard (Obs\_id 2004.0093).

**Dates documented**

First reported: 2004-06-05

Last reported: 2004-06-05

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.



## New Hampshire Natural Heritage Bureau - Animal Record

### Eastern Hognose Snake (*Heterodon platirhinos*)

#### **Legal Status**

Federal: Not listed  
 State: Listed Endangered

#### **Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Critically imperiled due to rarity or vulnerability

#### **Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
 Comments on Rank:

Detailed Description: 1966: 1 individual 18 inches long seen.

General Area: 1966: Pine knoll in field.

General Comments:

Management

Comments:

#### **Location**

Survey Site Name: Litchfield Field  
 Managed By:

County: Hillsborough

Town(s): Litchfield

Size: 60.7 acres

Elevation:

Precision: Within 1.5 miles of the area indicated on the map (location information is vague or uncertain).

Directions: North of Colby Brook on pine knoll in field between brook and powerline right-of-way to east of Rte 3A.

#### **Dates documented**

First reported: 1966

Last reported: 1966

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### Eastern Hognose Snake (*Heterodon platirhinos*)

#### **Legal Status**

Federal: Not listed  
 State: Listed Endangered

#### **Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Critically imperiled due to rarity or vulnerability

#### **Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
 Comments on Rank:

Detailed Description: 1993: Ca. 7.5 inches; run over by lawnmower.

General Area:

General Comments:

Management

Comments:

#### **Location**

Survey Site Name: Litchfield  
 Managed By:

County: Hillsborough

Town(s): Litchfield

Size: 2.8 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Litchfield. Whittemore Drive, sandy area near open fields and powerlines.

#### **Dates documented**

First reported: 1993-09-11

Last reported: 1993-09-11

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### Eastern Hognose Snake (*Heterodon platirhinos*)

#### **Legal Status**

Federal: Not listed  
State: Listed Endangered

#### **Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
State: Critically imperiled due to rarity or vulnerability

#### **Description at this Location**

Conservation Rank: Historical records only - current condition unknown.  
Comments on Rank:

Detailed Description: 1972: Area 6596: 1 seen. Adult.

General Area:

General Comments:

Management

Comments:

#### **Location**

Survey Site Name: Watts Brook  
Managed By: The Pathway Common Land

County: Rockingham

Town(s): Londonderry

Size: 7.7 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 1972: Area 6596: Bill Boucher residence, 272 Litchfield Road, 1/2 mile east of Route 3A at the junction of Watts Brook.

#### **Dates documented**

First reported: 1972-07-01

Last reported: 1972-07-01

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### Eastern Meadowlark (*Sturnella magna*)

#### **Legal Status**

Federal: Not listed  
 State: Listed Threatened

#### **Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Not ranked (need more information)

#### **Description at this Location**

Conservation Rank: Not ranked  
 Comments on Rank:

Detailed Description: 2011: 2 observed between 5/24 and 7/5.  
 2005: 2 observed on 5/17, including nest with 5 eggs.  
 2004: 2 observed on 5/27.  
 2003: 5 observed between 5/22 and 7/10, including nest with 5 eggs, juveniles.

General Area:

General Comments:

Management

Comments:

#### **Location**

Survey Site Name: Merrimack River, near Anheuser-Busch Brewery  
 Managed By:

County: Hillsborough

Town(s): Merrimack

Size: 48.7 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

#### **Dates documented**

First reported: 2003-05-22

Last reported: 2011-07-05

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### Grasshopper Sparrow (*Ammodramus savannarum*)

#### Legal Status

Federal: Not listed  
State: Listed Threatened

#### Conservation Status

Global: Demonstrably widespread, abundant, and secure  
State: Not ranked (need more information)

#### Description at this Location

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2011: Searched for, not found.<br />2006: Searched for, not found.<br />2005: Field Polygon: 3 observed on 7/14, including 1 juvenile.<br />2004: 1 adult male, 1 adult female. How observed: heard, seen (Obs\_id 2444).<br />2002: 2 adult males, 1 adult female seen (Obs\_id 147). 2002: 2 adult males, 1 adult female, 2 immature, sex unknown seen (Obs\_id 148).<br />2001: 1 adult male seen, also singing (Obs\_id 253). 2001: 1 adult male, 1 adult, sex unknown seen. Perched on "No Trespassing" sign (Obs\_id 252).<br />1999: 2 adult males seen and heard (Obs\_id 268). 1999: 2 adult males, 1 adult, sex unknown seen. Two birds singing. (Obs\_id 265). 1999: 3 adult males, 2 adult, sex unknown seen. Three birds singing, two non-singing birds probably females (Obs\_id 266). 1999: 1 adult male seen and heard singing, 1 adult female seen (Obs\_id 267).<br />1998: 1 adult male seen, also singing (Obs\_id 255).<br />1996: 1 adult, sex unknown seen on mullien stalk with grub in beak, flew down (Obs\_id 254).

General Area: 2004, 2002, 2001, 1999, 1998, 1996: Terrestrial - Grassland / Field.  
General Comments:  
Management  
Comments:

#### Location

Survey Site Name: Merrimack River, near Anheuser-Busch Brewery  
Managed By:

County: Hillsborough  
Town(s): Merrimack  
Size: 101.2 acres Elevation:

Precision: Within 1.5 miles of the area indicated on the map (location information is vague or uncertain).

Directions: 2004: North end of fields behind Anheuser-Busch [along Merrimack River (Obs\_id 2444)].

#### Dates documented

First reported: 1996-07-10 Last reported: 2005-07-14

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### New England Cottontail (*Sylvilagus transitionalis*)

#### Legal Status

Federal: Not listed  
 State: Listed Endangered

#### Conservation Status

Global: Rare or uncommon  
 State: Critically imperiled due to rarity or vulnerability

#### Description at this Location

Conservation Rank: Not ranked  
 Comments on Rank:

Detailed Description: 2002: Seen (Obs\_id 450).  
 General Area: 2002: (Obs\_id 450).  
 General Comments: 2002: Results from J. Litvaitis Regional NEC survey; small patch (Obs\_id 450). Everett Turnpike. 780 (Obs\_id 450).

Management  
 Comments:

#### Location

Survey Site Name: Bumbo Hill, east of  
 Managed By:

County: Hillsborough  
 Town(s): Merrimack  
 Size: 7.7 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2002: Everett Turnpike (Obs\_id 450).

#### Dates documented

First reported: 2002-01-01                      Last reported: 2002-01-01

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.



## New Hampshire Natural Heritage Bureau - Animal Record

### New England Cottontail (*Sylvilagus transitionalis*)

#### Legal Status

Federal: Not listed  
State: Listed Endangered

#### Conservation Status

Global: Rare or uncommon  
State: Critically imperiled due to rarity or vulnerability

#### Description at this Location

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2002: 1 age and sex unknown (Obs\_id 736).  
General Area: 2002: (Obs\_id 736).  
General Comments: 2002: Results of J. Litvaitis Regional NEC Survey - 2003 (Obs\_id 736).  
Management  
Comments:

#### Location

Survey Site Name: Sebbins Brook, east of  
Managed By:

County: Hillsborough  
Town(s): Bedford  
Size: .4 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2002: Sports complex, [east of] Rte. 3 (Obs\_id 736).

#### Dates documented

First reported: 2002-01-30 Last reported: 2002-01-30

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.



## New Hampshire Natural Heritage Bureau - Animal Record

### New England Cottontail (*Sylvilagus transitionalis*)

**Legal Status**

Federal: Not listed  
State: Listed Endangered

**Conservation Status**

Global: Rare or uncommon  
State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2002: 1+ age and sex unknowns (Obs\_id 742).  
General Area: 2002: (Obs\_id 742).  
General Comments: 2002: Results of J. Litvaitis Regional NEC Survey-2003 (Obs\_id 742).  
Management  
Comments:

**Location**

Survey Site Name: Hillcrest Cemetery, west of  
Managed By:

County: Hillsborough  
Town(s): Litchfield  
Size: .4 acres  
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2002: Rte. 3A and Hillcrest Rd (Obs\_id 742).

**Dates documented**

First reported: 2002-02-02  
Last reported: 2002-02-02

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### New England Cottontail (*Sylvilagus transitionalis*)

**Legal Status**

Federal: Not listed  
 State: Listed Endangered

**Conservation Status**

Global: Rare or uncommon  
 State: Critically imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Not ranked  
 Comments on Rank:

Detailed Description: 2017: Winter observation at 1 point.<br />2016: Winter observations at 3 points.<br />2015: Winter observations at 5 points.<br />2014: Winter observations at 3 points.<br />2013: Winter observations at 13 points.<br />2011: Winter observations at 32 points.<br />2002: 1+ age and sex unknowns (Obs\_id 744).

General Area: 2002: Terrestrial: grassland / field (Obs\_id 744).  
 General Comments: 2002: Results of J. Litvaitis Regional NEC Survey - 2003 (Obs\_id 744).  
 Management  
 Comments:

**Location**

Survey Site Name: Little Cohas Brook, south of  
 Managed By: NHDOT Mitigation

County: Rockingham  
 Town(s): Londonderry  
 Size: 32.6 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2002: Stonyfield Farm (Obs\_id 744).

**Dates documented**

First reported: 2002-02-02 Last reported: 2017

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### New England Cottontail (*Sylvilagus transitionalis*)

#### **Legal Status**

Federal: Not listed  
 State: Listed Endangered

#### **Conservation Status**

Global: Rare or uncommon  
 State: Critically imperiled due to rarity or vulnerability

#### **Description at this Location**

Conservation Rank: Not ranked  
 Comments on Rank:

Detailed Description: 2018: Winter observation of 1 individual (pellet).

General Area:

General Comments:

Management

Comments:

#### **Location**

Survey Site Name: Moores Falls  
 Managed By:

County: Hillsborough

Town(s): Litchfield

Size: .7 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2018: Moores Falls Conservation Area, Litchfield.

#### **Dates documented**

First reported: 2018-01-26

Last reported: 2018-01-26

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

**Northern Black Racer (*Coluber constrictor constrictor*)****Legal Status**

Federal: Not listed  
State: Listed Threatened

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
State: Imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2004: 1 seen. Adult. (Obs\_id 2004.0054).

General Area: 2004: Dirt road next to field with old grass, near beaver pond. Restored gravel pit. Lots of dirt bike/ATV trails. Big housing development nearby. (Obs\_id 2004.0054).

General Comments:  
Management  
Comments:

**Location**

Survey Site Name: Manchester Industrial Park, south of  
Managed By:

County: Rockingham  
Town(s): Londonderry  
Size: 7.7 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2004: Rehabilitated gravel pit on west end of Pettingil Road (Obs\_id 2004.0054).

**Dates documented**

First reported: 2004-04-27                      Last reported: 2004-04-27

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### Northern Black Racer (*Coluber constrictor constrictor*)

#### **Legal Status**

Federal: Not listed  
State: Listed Threatened

#### **Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
State: Imperiled due to rarity or vulnerability

#### **Description at this Location**

Conservation Rank: Extirpated - no longer present at this site.

Comments on Rank: 2011: Habitat destroyed according to herpetologists with NH Fish and Game.

Detailed Description: 2010: R005, R008, R009: 3 radiotracked individuals (later relocated to site in Hopkinton, EO ID 7399). <br />2009: Area 12296: 1 observed. Areas 12418-12422: 1 individual observed at each of 5 sites.

General Area: 2010: R005, R008, R009: Habitat apparently destroyed by development. <br />2009: Area 12296: Forest around cell tower.

General Comments:

Management

Comments:

#### **Location**

Survey Site Name: Industrial Dirve, Merrimack

Managed By:

County: Hillsborough

Town(s): Merrimack

Size: 106.3 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2009: Area 12296: Woods around cell tower north of Industrial Drive.

#### **Dates documented**

First reported: 2009-04-27

Last reported: 2010-08-21

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

**Northern Leopard Frog (*Lithobates pipiens*)****Legal Status**

---

Federal: Not listed  
State: Special Concern

**Conservation Status**

---

Global: Demonstrably widespread, abundant, and secure  
State: Rare or uncommon

**Description at this Location**

---

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2006: Area 11937: 1 observed.  
General Area: 2006: Area 11937: Riverbank adjacent to old field habitat.  
General Comments:  
Management  
Comments:

**Location**

---

Survey Site Name: Merrimack River, Litchfield  
Managed By:

County: Hillsborough  
Town(s): Litchfield  
Size: 7.7 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2006: Area 11937: [Along Merrimack River bank, west of the intersection of Rte.3A and Talent Rd.]

**Dates documented**

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First reported: 2006-10-18                      Last reported: 2006-10-18

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

**Peregrine Falcon (*Falco peregrinus anatum*)****Legal Status**

Federal: Not listed  
State: Listed Threatened

**Conservation Status**

Global: Apparently secure but with cause for concern  
State: Imperiled due to rarity or vulnerability

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2016: Nest 1: 2 chicks fledged.<br />2015: Nest 1: 3 chicks fledged.<br />2014: Nest 1: 2 chicks fledged.

General Area:  
General Comments:  
Management  
Comments:

**Location**

Survey Site Name: Nashua  
Managed By:

County: Hillsborough  
Town(s): Nashua  
Size: .4 acres  
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2014: Nest 1: St. Mary and Archangel Michael Coptic Orthodox Church, Nashua.

**Dates documented**

First reported: 2014  
Last reported: 2016

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

**Redfin Pickerel (*Esox americanus americanus*)****Legal Status**

Federal: Not listed  
State: Special Concern

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
State: Rare or uncommon

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2000: Area 625: 1 individual observed.  
General Area: 2000: Area 625: Freshwater stream.  
General Comments:  
Management  
Comments:

**Location**

Survey Site Name: Nesenkeag Brook  
Managed By: Parker Park

County: Hillsborough  
Town(s): Litchfield  
Size: 2.3 acres                                          Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2000: Area 625: Nesenkeag Brook at Rte. 3A in Litchfield.

**Dates documented**

First reported: 2000-07-03                                          Last reported: 2000-07-03

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.



## New Hampshire Natural Heritage Bureau - Animal Record

### Redfin Pickerel (*Esox americanus americanus*)

#### **Legal Status**

Federal: Not listed  
State: Special Concern

#### **Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
State: Rare or uncommon

#### **Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2000: Area 627: 3 individuals observed.

General Area: 2000: Area 627: Freshwater stream.

General Comments:

Management

Comments:

#### **Location**

Survey Site Name: Second Brook, south of Tate Street  
Managed By:

County: Hillsborough

Town(s): Hudson

Size: 2.2 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2000: Area 627: Second Brook just upstream of crossing at Pelham Road, south of the bend in Tate Street, in Hudson.

#### **Dates documented**

First reported: 2000-07-03

Last reported: 2000-07-03

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

**Sea Lamprey (*Petromyzon marinus*)****Legal Status**

Federal: Not listed  
State: Special Concern

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
State: Rare or uncommon

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2008: 1 observed.

General Area:

General Comments:

Management

Comments:

**Location**

Survey Site Name: Souhegan River  
Managed By:

County: Hillsborough

Town(s): Merrimack

Size: 1.9 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2008: Below Merrimack Village Dam to Merrimack River.

**Dates documented**

First reported: 2008-07-02

Last reported: 2008-07-02

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### Smooth Green Snake (*Opheodrys vernalis*)

#### Legal Status

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Federal: Not listed  
 State: Special Concern

#### Conservation Status

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Global: Demonstrably widespread, abundant, and secure  
 State: Rare or uncommon

#### Description at this Location

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Conservation Rank: Not ranked  
 Comments on Rank:

Detailed Description: 2015: Area 13999: 1 adult male observed.<br />2011: Area 12919: 1 adult observed, 12" long.

General Area: 2015: Area 13999: Consisting of mostly dense shrubs within survey parcel. Small path, slash pile, and wetland areas identified as potential habitat.<br />2011: Area 12919: Residential yard.

General Comments:  
 Management  
 Comments:

#### Location

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Survey Site Name: Nesenkeag Brook  
 Managed By:

County: Rockingham  
 Town(s): Londonderry  
 Size: 2.4 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2015: Area 13999: Powerline between Brickyard Drive and Hamel Circle, Litchfield.<br />2011: Area 12919: 22 Colonial Drive, Londonderry.

#### Dates documented

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First reported: 2011-09-10                      Last reported: 2015-08-28

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

*Sora (Porzana carolina)***Legal Status**

Federal: Not listed  
State: Special Concern

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
State: Not ranked (need more information)

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2010: 4 observed, including copulating pair, between 6/25 and 7/2.

General Area:

General Comments:

Management

Comments:

**Location**

Survey Site Name: Long Hill, east of  
Managed By:

County: Hillsborough

Town(s): Nashua

Size: 5.5 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

**Dates documented**

First reported: 2010-06-25

Last reported: 2010-07-02

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.



## New Hampshire Natural Heritage Bureau - Animal Record

### Spotted Turtle (*Clemmys guttata*)

#### Legal Status

Federal: Not listed  
State: Listed Threatened

#### Conservation Status

Global: Demonstrably widespread, abundant, and secure  
State: Imperiled due to rarity or vulnerability

#### Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).  
Comments on Rank:

Detailed Description: 2015: Area 14083: 1 adult observed, sex unknown.<br />2005: Area 9306: 1 adult male turtle observed.<br />1992: Four adult turtles observed: one 12-14 year old with carapace 114 cm and plastron 92 cm, sex undetermined; one ca. 12 year old very active female with carapace 125 cm and plastron 100 cm; one 11 or 12 year old very inactive female with carapace 127 cm and plastron 100 cm; and one 14-15 year old female with carapace 115 cm and plastron 92 cm.

General Area: 2015: Area 14083: Residential yard [property backs up to wetlands associated with Chase Brook].<br />2005: Area 9306: Residential lot surrounded by some agriculture.<br />1992: Adjacent to a large wetland.

General Comments: 1992: Drawings of each turtle's most distinctive spots and other markings included.  
Management  
Comments:

#### Location

Survey Site Name: Cutler Road, north of  
Managed By:

County: Hillsborough  
Town(s): Litchfield  
Size: 2.6 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2015: Area 14083: In yard at 21 Mayflower Drive, Litchfield.<br />2005: Area 9306: [Rte 3A ca. 2.8 miles north of the junction with Rte. 111 in Nashua.]<br />1992: Adjacent to a large wetland at 19 Woodburn Drive, near Cutler Road, [west of Rte. 102, in the southeast corner of Litchfield.]

#### Dates documented

First reported: 1992-06-08                      Last reported: 2015-06-15

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### Spotted Turtle (*Clemmys guttata*)

#### **Legal Status**

Federal: Not listed  
 State: Listed Threatened

#### **Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
 State: Imperiled due to rarity or vulnerability

#### **Description at this Location**

Conservation Rank: Fair quality, condition and/or landscape context ('C' on a scale of A-D).  
 Comments on Rank:

Detailed Description: 2004: 1 seen, dead on road. Adult. (Obs\_id 2004.0122).

General Area:

General Comments: 2004: Roadkill (Obs\_id 2004.0122).

Management

Comments:

#### **Location**

Survey Site Name: Stebbins Brook  
 Managed By: Reeds Ferry State Forest

County: Hillsborough

Town(s): Bedford

Size: 7.7 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2004: Approximately where Stebbins Brook crosses Everett Turnpike (Obs\_id 2004.0122).

#### **Dates documented**

First reported: 2004-07-07                      Last reported: 2004-07-07

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

**Vesper Sparrow (*Pooecetes gramineus*)****Legal Status**

Federal: Not listed  
State: Special Concern

**Conservation Status**

Global: Demonstrably widespread, abundant, and secure  
State: Not ranked (need more information)

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2002: 1 seen (Obs\_id 149). 1999: 1 adult male heard (Obs\_id 548).

General Area: 2002, 1999: Terrestrial - Grassland / Field (Obs\_id 149, 548).

General Comments:

Management

Comments:

**Location**

Survey Site Name: Merrimack River, near Anheuser-Busch Brewery  
Managed By:

County: Hillsborough

Town(s): Merrimack

Size: 48.6 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Fields behind Anheuser-Busch brewery (Obs\_id 149, 548).

**Dates documented**

First reported: 1999-07-03

Last reported: 2002-06-20

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.





# New Hampshire Natural Heritage Bureau - Animal Record

## Wood Turtle (*Glyptemys insculpta*)

**Legal Status**

Federal: Not listed  
State: Special Concern

**Conservation Status**

Global: Rare or uncommon  
State: Rare or uncommon

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2013: Area 13484: 1 adult observed, sex unknown.  
General Area: 2013: Area 13484: Parking lot near highway. Turtle was emerging from a small water course next to the parking lot which is directly next to Route 3 south.

General Comments:  
Management  
Comments:

**Location**

Survey Site Name: Horseshoe Pond, west of  
Managed By:

County: Hillsborough  
Town(s): Merrimack  
Size: 1.9 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2013: Area 13484: 9 Executive Park Drive, Merrimack. Nashua Regional Planning Commission parking lot.

**Dates documented**

First reported: 2013-08-26 Last reported: 2013-08-26

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

## New Hampshire Natural Heritage Bureau - Animal Record

### Wood Turtle (*Glyptemys insculpta*)

**Legal Status**

Federal: Not listed  
State: Special Concern

**Conservation Status**

Global: Rare or uncommon  
State: Rare or uncommon

**Description at this Location**

Conservation Rank: Not ranked  
Comments on Rank:

Detailed Description: 2015: 1 adult male observed.

General Area: 2015: Residential road.

General Comments:

Management

Comments:

**Location**

Survey Site Name: Belmont Drive, Merrimack  
Managed By:

County: Hillsborough

Town(s): Merrimack

Size: .4 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

**Dates documented**

First reported: 2015-03-31

Last reported: 2015-03-31

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc. (Enel), is the Licensee and operator of the Lowell Hydroelectric Project (FERC No. 2790) (Project), with principal Project facilities located along the Merrimack River in Middlesex County, Massachusetts and a reservoir extending upstream to Hillsborough County, New Hampshire (see attached map). Boott, with assistance from HDR, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Project. Accordingly, Boott is preparing a Pre-Application Document (PAD) that will provide FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project that will be used to prepare documents related to analyzing the relicensing application to be prepared by Boott. To prepare the PAD, Boott will use information in its possession and information obtained from additional sources. This PAD Information Questionnaire will be used by Boott to help identify sources of existing, relevant, and reasonably available information that are not currently in Boott's possession.

1. Information about person completing the questionnaire:

|               |                                                     |
|---------------|-----------------------------------------------------|
| Name & Title  | ROBERT H. RUSSELL, EXECUTIVE DIRECTOR               |
| Organization  | MERRIMACK RIVER WATERSHED COUNCIL                   |
| Address       | 60 ISLAND STREET, SUITE 211-E<br>LAWRENCE, MA 01840 |
| Phone         | 978-655-4742                                        |
| Email Address | RRUSSELL@MERRIMACK.ORG                              |

2. Do you or your organization know of existing, relevant and reasonably available information that describes the existing Project's environment (e.g., information regarding the Merrimack River in or close to the Lowell Hydroelectric Project)?

Yes (If yes, please complete 2a through 2c)     No (If no, go to 3)

a. If yes, please circle the specific resource area(s) that the information relates to:

- |                                                                              |                                                             |
|------------------------------------------------------------------------------|-------------------------------------------------------------|
| <input checked="" type="checkbox"/> Geology and soils                        | <input checked="" type="checkbox"/> Recreation and land use |
| <input checked="" type="checkbox"/> Water resources                          | <input checked="" type="checkbox"/> Aesthetic resources     |
| <input checked="" type="checkbox"/> Fish and aquatic resources               | <input type="checkbox"/> Cultural resources                 |
| <input checked="" type="checkbox"/> Wildlife and botanical resources         | <input type="checkbox"/> Socio-economic resources           |
| <input checked="" type="checkbox"/> Wetlands, riparian, and littoral habitat | <input type="checkbox"/> Tribal resources                   |
| <input checked="" type="checkbox"/> Rare, threatened & endangered species    | <input type="checkbox"/> Other resource information         |

**Lowell Hydroelectric Project (FERC Project No. 2790)  
Relicensing Pre-Application Document Information Questionnaire**

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- b. Please briefly describe the information referenced above or list available documents (additional information may be provided on pages 3 or 4 of this questionnaire).

WE'VE ACCUMULATED INFORMATION ABOUT THE ABOVE TOPICS. IT'S NOT POSSIBLE TO SUMMARIZE IT HERE.

- c. Where can Boott obtain this information? Please include contact information if there is a specific representative that you wish to designate for potential follow-up contact by Boott's or HDR's representative (additional information may be provided on pages 3 or 4 of this questionnaire).

3. Do you or your organization plan to participate in the Lowell Hydroelectric Project relicensing proceeding?

Yes  No

UNCERTAIN

If you answered yes to Question 3, please provide contact information for your organization's representative(s) that can be used for future communications regarding this relicensing:

**Primary Representative Contact Information**

|               |                                                     |
|---------------|-----------------------------------------------------|
| Name          | RUSTY RUSSELL                                       |
| Address       | 60 ISLAND STREET, SUITE 211-E 01840<br>LAWRENCE, MA |
| Phone         | 617-515-9522 (cell)                                 |
| Email Address | RRUSSELL @ MERRIMACK.ORG                            |

UNITED STATES OF AMERICA  
FEDERAL ENERGY REGULATORY COMMISSION

Boott Hydropower, LLC  
Application for New License

Lowell Hydroelectric Project  
Project No. 2790-072 – Massachusetts

AMERICAN WHITEWATER COMMENTS & STUDY REQUESTS IN RESPONSE TO  
NOTICE OF INTENT TO FILE LICENSE APPLICATION, FILING OF PRE-APPLICATION  
DOCUMENT (PAD), COMMENCEMENT OF PRE-FILING PROCESS, AND SCOPING;  
REQUEST FOR COMMENTS ON THE PAD AND SCOPING DOCUMENT, AND  
IDENTIFICATION OF ISSUES AND ASSOCIATED STUDY REQUESTS REGARDING  
THE LOWELL HYDROELECTRIC PROJECT (FERC PROJECT NO 2790-072)

American Whitewater (AW) submits the following Comments and Study Requests in response to the filing of the Pre-Application Document (PAD) filed by Boott Hydropower, LLC for the Lowell Hydroelectric Project, FERC Project No. 2790, located in Lowell, Massachusetts. The project consists of the 1,093 long, 15-foot high Pawtucket Dam that impounds the Merrimack River and diverts flows into the Northern and Pawtucket canals leading to powerhouses with a total installed capacity of 24.8 MW. The 720-acre impoundment extends 23-miles upstream from the project. The project diverts nearly all flows from the Merrimack River into the canal system, bypassing approximately two miles of the natural river channel. Of particular concern is the 0.7-mile reach between the Pawtucket Dam and the E.L. Field Powerhouse that has been nearly completely dewatered by the project, destroying aquatic habitat and eliminating recreation opportunity that would otherwise provide a valuable whitewater boating opportunity under natural flow conditions.

American Whitewater is a national non-profit 501(c)(3) river conservation and recreation organization founded in 1954. With approximately 6,000 members and 100 affiliate clubs, representing tens of thousands of whitewater paddlers across the nation, American Whitewater's mission is to protect and restore our nation's whitewater resources and to enhance opportunities to enjoy them safely. Our members are primarily conservation-oriented kayakers and canoeists, many of whom live and/or engage in recreational boating in the New England region within easy proximity of the Merrimack River. Located in northeastern Massachusetts, the Lowell Hydroelectric Project is easily accessible to large population centers in and around the Boston area with the potential to provide a whitewater recreation experience unique to the area. American Whitewater has long been involved with the FERC licensed hydropower projects in the region, including hydropower projects located on the Deerfield and Connecticut rivers in Massachusetts, as well as other projects on the Kennebec, Rapid, Green, Moose, Black, Beaver,

and Raquette rivers, and are party to settlement agreements that provide for whitewater boating opportunities that partially mitigate for project impacts.

### Comments

From a recreation perspective, the Lowell Hydroelectric Project is problematic due to the lack of flow information, bypassed reach access, and flow alteration. These concerns are generally described below:

#### Issue 1: Flow Information

The Licensee states in the PAD that the project has a hydraulic capacity of 10,000 cfs with up to 8,000 cfs feeding the E.L. Field Powerhouse followed by the other canal units. Flows above the project hydraulic capacity are spilled into bypassed reach via the Pawtucket Dam spillway. There are no minimum flows into the bypassed reach other than the attraction flow for the fishway when operating plus leakage that Enel Green estimates at 300 cfs. For the recreating public, understanding the flow into the bypassed reach is impossible since the Licensee does not provide that information on its website or on Waterline. The Licensee states in the PAD, however, that 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 and the downtown canal system.” At best, flows into the bypassed reach could be estimated by subtracting flows from the Concord River from the Merrimack River below the project minus the hydraulic capacity of the project assuming that all units were operating and then adding the fishway flows and leakage. The Licensee needs to provide the recreating public with instantaneous and accessible information on flows into the bypassed reach.

#### Issue 2: Access & Navigability

Access into the natural river channel bypassed by the project is extremely limited. While there are several access points in the impoundment, access to the bypassed reach is only possible down steep, rugged and overgrown trails. There is no portage around the Pawtucket Dam that would allow a through paddler to navigate the Merrimack River through the project boundary. The Merrimack River is a navigable river subject to FERC jurisdiction, and the public right to navigation is protected under federal law. In addition, Massachusetts law protects the public’s right to boat, fish, and fowl in navigable waters. [Opinion of the Justices, 383 Mass. 895 (1981)]. Even in non-navigable waters, the public still retains the right to “passage up and down the stream in boats or other craft, for purposes of business, convenience, or pleasure.” *Brosnan v. Gage*, 240 Mass. 113 (1921). The Licensee cannot simply obstruct the river and divert all flow through its hydropower operation, eliminating nearly all public access. The FERC license to

operate the project is granted subject to all applicable state laws and regulation. Under Massachusetts law and regulations, any water-dependent use project which interferes with the public's right to free passage over and through water, including "the right to float on, swim in, or otherwise move freely within the water column without touching the bottom," is required to provide "compensation to the public for interfering with its broad rights to use such lands for any lawful purpose ... commensurate with the extent of interference caused, and shall take the form of measures deemed appropriate by the Department to promote public use and enjoyment of the water, at a location on or near the project site if feasible." [310 CMR 9.35]

### Issue 3: Flow Alteration

The Licensee's hydropower operation diverts virtually all flow into the canal system for energy generation, eliminating practically all flow between the Pawtucket Dam and the E.L. Field Powerhouse. With no minimum aquatic base flow to sustain aquatic habitat for resident fish, macroinvertebrates, plants, and other aquatic dependent species, this portion of the bypassed reach is effectively a wasteland in the heart of Lowell. The current project license only requires a minimum flow of 1990 cfs below the project. While the Licensee maintains that the project is operated in run-of-river mode, its operations disrupt the natural flow regime in the bypassed reach, reducing the quantity of suitable aquatic habitat and the benefits of natural flow variability.







Fig. 1: Natural river channel dewatered by the Lowell Hydroelectric Project

The lack of a natural flow variability also eliminates the possibility recreational boating in the natural river channel, assuming access was provided, except during periods of spillage when inflows exceed 10,000 cfs, generally during the spring freshet in April and May. Other recreational uses of the bypassed reach are also impacted by the Licensee's operations including angling. There is evidence of multiple informal access point below the E.L. Field Powerhouse that are used for angling in the bypassed reach.



Fig. 1: Bypassed reach down river view from University Bridge at high water



Fig. 2: Merrimack River across from the outflow of E.L. Field tailrace at high water

Given the lack of portage and access into the bypassed reach below the Pawtucket Dam, little information is available about the quality of whitewater boating on the Merrimack River in the project boundary. The Licensee does cite to the American Whitewater Rivers Database for information on whitewater boating on the Concord River adjacent to the project, and whitewater boating is known to occur on other sections of the Merrimack River in New Hampshire. There is anecdotal information from whitewater boaters who have bushwhacked their way into the bypassed reach below the dam that there is a valuable whitewater boating resource in the bypassed reach when there is sufficient flow. In addition, a visual observation of the bypassed reach from the shoreline and bridges reveals a structure that is suitable for whitewater boating under certain conditions. With approximately 25 feet of gradient between the base of the Pawtucket dam and the E.L. Field Powerhouse tailrace and the presence of extensive rock formations that channelize the flow, it is likely that the Licensee's flow alteration eliminates whitewater boating in the bypassed reach.



Fig. 3: Kayaking the rapids in the bypass downstream of the university street bridge.

In addition, the E.L. Field Powerhouse tailrace releases up to 8,000 cfs into the natural river channel 0.7 miles below the Pawtucket Dam. The tailrace provides sufficient flows to create hydraulics that could be utilized by whitewater boaters for playboating under either current or enhanced conditions that are suitable for playboating, a style of whitewater boating that is frequently enjoyed by whitewater boaters where suitable hydraulic conditions are present.



Fig. 4: Whitewater boating feature in tailrace at Holtwood Hydroelectric Project (FERC Project No. P-1881)

### Study Requests

- Study Request 1: Recreation Facilities, Use, and Aesthetics Study

### Goals and Objectives

#### §5.9(b)(1)

The goals of the Recreation Facilities, Use, and Aesthetics Study are to:

1. Obtain information about the condition of existing recreation facilities and access to project lands and waters at the project; and existing recreation use, and demand at the project;
2. Evaluate the adequacy of existing access to the impoundment, canals, and

bypassed reaches in the project boundary, including formal and informal access areas that are utilized for boating, angling, hiking, and other recreational use;

3. Conduct an assessment of the need to enhance recreation opportunities and access in the project boundary;
4. Determine the minimum acceptable and optimal aesthetic flow in the bypassed reaches below the Pawtucket Dam sufficient to protect aesthetic values; and,
5. Develop a Recreation Management Plan for the implementation of any enhancement measures and long-term monitoring of recreation demand and adequacy of facilities at the project over the term of a new licenses.

#### §5.9(b)(2)

Not applicable.

#### §5.9(b)(3)

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, aesthetics, and other non-developmental values of the project, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses. Recreation and aesthetics have been identified as a legitimate project purpose by the Commission. The Lowell Hydroelectric Project reservoir, bypassed reach, and canals, have the potential to offer recreational opportunities unique to the region provided that sufficient flow and access are provided

#### Background and Existing Information

##### §5.9(b)(4)

Section 6.1.7 provides a general description of public recreation facilities, activities, and demand at the projects. However, the PAD provides no detailed information regarding the condition of existing facilities or type or location of various uses. The PAD provides no project-specific information regarding visitor perceptions and identified needs at the projects. Information on current use and whether existing access to facilities in the area are meeting recreation demand would inform a decision on whether additional designated public access at the projects is necessary to meet existing and future recreation demand at the projects.

Although the Licensee partially describes recreation uses in and near the project boundary, it does not fully describe the current and potential future use or adequacy of recreational opportunities and facilities. The Licensee does not propose to conduct any recreation studies as part of this relicensing process, and is silent on the impact of project operations on boating, angling, and hiking opportunities in the project area. Further, no information is provided in the PAD regarding the impact of project operations on aesthetic values in the bypassed reach.

While the PAD references American Whitewater's Rivers Database for information on whitewater boating opportunities on the Concord River, the PAD contains no information on the impact of the Licensee's flow diversion and power generating activities on potential whitewater boating use in the bypassed reach.

#### Project Nexus

##### §5.9(b)(5)

The project impounds the Merrimack River and diverts natural river inflows into two canal systems leading to a series of powerhouses. The Pawtucket Dam and the Licensee's hydropower operations have a significant impact on recreational opportunities on the Merrimack River in the project boundary including but not limited to whitewater boating by inundating rapids in the impoundment, dewatering the natural river channel, obstructing public access, and preventing the public from navigating the Merrimack River through the project boundary. An analysis of existing recreation use and access at the project would help form the basis for determining the projects' impacts upon, and ability to enhance, public recreation access opportunities. Flow over the dam and in the bypass reach directly impacts aesthetics. Also, an assessment of the current level of recreation use would provide information necessary to develop a Recreation Management Plan for efficient management of the recreational components of the project over the term of a new license.

#### Proposed Methodology

##### §5.8(b)(6)

1. Provide the methods and results of the investigation of the existing recreation facilities conditions, as referenced in the PAD.
2. The facility inventory will include characterization of the suitability of the bypassed reach below the Pawtucket Dam for whitewater boating (e.g., gradient, length, character of potential flows).

3. The use and needs assessment will include all recreation activity types known to occur or potentially occurring in the project area. Specific methods should include visitor observations; on-site visitor intercept surveys at formal and informal public recreation areas at the project reservoirs, bypassed reach, canals, tailraces, and riverine areas; and mail and/or internet surveys targeting unique stakeholder groups that may not be practically accessed through on-site surveys (e.g., adjacent residential land owners, residents of the counties in which the projects are located, rock climbers, whitewater boaters).
4. The needs assessment will include the demand for whitewater boating in the bypassed reach, existing boating opportunities within the project region, feasibility of providing additional public access at the project reservoir and riverine reaches (potential locations, type of facilities and access, and any associated costs), identifying visitor perceptions regarding the adequacy of recreation facilities, need for additional real-time flow information, access in the project area, and assessing future recreation demand and facility needs at the project under different modes of operation..
5. The aesthetic assessment will include a range of alternate spillages that should be videotaped and qualitatively analyzed, and a demonstration study should be arranged for direct observation of flows by a team for subjective grading. A rating form is employed to provide a structure for the individual observations.
6. Assess visitor perceptions of the effects of project operations and management on recreation and recreation opportunities at the project (including fluctuating reservoir levels, minimum flow releases, and anticipated changes) over a new license term. Identify potential measures to alleviate any negative effects as well as to enhance existing recreation opportunities and access.
7. A Recreation Management Plan for the projects should be included in the license application and should include, at a minimum:
  - (1) a description of any proposed protection, mitigation, and enhancement measures, including: location of any proposed facilities and/or access areas (including description and figure depicting the relationship of any proposed facilities to the existing project boundaries), proposed ownership and management of any proposed facilities, associated capital, and operation and maintenance costs; and a timeline for implementation;
  - (2) a description of operation and management measures associated with project-related recreation access and facilities; and
  - (3) a description of measures for future monitoring of recreation demand and adequacy of project-related facilities to meet this demand over the term of new licenses.

## Level of Effort and Cost

### §5.9(b)(7)

The estimated cost of the Recreation Facilities, Use, and Aesthetics Study for the Lowell Hydroelectric Project is about \$60,000, including field studies, study report development, and drafting of a Recreation Management Plan. One field season should be sufficient to collect the required data and prepare the report.

- Study Request 2: Controlled-flow Whitewater Boating and Access Study

## Goals and Objectives

### §5.9(b)(1)

The goals of the Controlled-flow Whitewater Boating and Access Study are to:

- (a) assess the presence, quality, access needs, flow information needs, and preferred flow ranges for river-based boating resources in a stepwise manner;
- (b) assess the effects of a range of optimal and acceptable flows on whitewater recreation opportunities for whitewater paddling in the natural river channel between the Pawtucket Dam and the end of the project boundary;
- (c) assess the frequency, timing, duration and predictability of optimal and acceptable paddling flows under current, proposed, and alternative modes of operation;
- (d) identify the need for, and define adequate put-in and take-out points that promote car-top boating, and also identify the needs for parking areas;
- (e) identify the location, challenge, and other recreational attributes associated with specific rapids and other river features;
- (f) assess the flow information needs of whitewater boating and the current and potential flow information distribution system.
- (g) evaluate the potential for whitewater playboating in the bypassed reach at various flow levels, including but not limited to assessing the potential for developing whitewater boating features below the tailrace of the E.F. Field Powerhouse.

### §5.9(b)(2)

Not applicable.

### §5.9(b)(3)



Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, aesthetics, and other non-developmental values of the project, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Conducting the necessary studies and implementing measures to ensure public access to outdoor recreation is in the public interest. It is widely accepted that outdoor recreation has significant benefits to participants including health, well-being, and quality-of-life. Outdoor recreation also has proven economic benefits for communities located near recreational resources. FERC has concluded elsewhere that to fully evaluate the project's effect on whitewater recreation opportunities and to balance potential enhancement opportunities with their cost, a controlled-flow whitewater boating study is relevant to Commission's public interest determination. The bypassed reach below the Pawtucket Dam has the potential to offer recreational opportunities unique to the region provided that sufficient flow and access are provided.

#### Background and Existing Information

##### §5.9(b)(4)

The Licensee acknowledges in the PAD that whitewater boating is currently an existing recreational use in the Project area, principally on the Concord River at its confluence with the Merrimack River. There is anecdotal information that whitewater boating has occurred in the bypassed reach when project inflows exceed the hydraulic capacity of the project. Beyond limited anecdotal information, little is known about the whitewater boating potential of the bypassed reach at various flow levels, necessitating a controlled-flow whitewater boating study. The PAD contains no information on whitewater boating use in the bypassed reach or the extent to which the Licensee's operations impact on the availability of sufficient flows for whitewater boating in the bypassed reach below the Pawtucket dam.

#### Project Nexus

##### §5.9(b)(5)

Lowell Hydroelectric Project diverts flows from the Merrimack River into the Northern and Pawtucket Canal System, destroying aquatic habitat and valuable whitewater boating opportunity between the Pawtucket Dam and the E.L. Field Powerhouse. There is

currently no meaningful access into the bypassed reach below the Pawtucket Dam making whitewater boating nearly impossible even during periods of high spring flows that exceed the project hydraulic capacity. While the Licensee maintains that this is a run-of-river project, its assertion is inaccurate with respect to the bypassed reach where a large section of the river is effectively dewatered and all natural whitewater boating opportunity has been lost due to project operation. The diversion of natural flows through hydropower operations alters the landscape in the natural river channel, and reduces recreational opportunities that would otherwise be available.

## Study Methodology

### §5.9(b)(6)

The study we request on the Lowell Hydroelectric Projects should follow the standard methodology as described in Whittaker, et. al. (2005). This methodology is designed to assess the presence, quality, and preferred flow ranges for river-based boating resources in a step-wise manner. The process steps are generally 1) desktop analyses, 2) on-land feasibility assessment, 3) on-water single flow assessment, 4) on-water multiple flow assessment. We expect and request the full implementation of this methodology. Because the quality of the resource has not been fully analyzed with current metrics, we request that on-water multiple flow assessments be conducted. The study should focus on the 2-mile bypassed reach below the Pawtucket Dam. The Licensee should work with the boating groups to identify target flows for the evaluation.

Given the limited known information about the boating characteristics of the bypassed reach below the Pawtucket Dam, it will be necessary to conduct an on-land physical inspection of the reach to identify access points and potential hazards. An on-land observation of demonstration flows will also be required to identify a range of flows that should be evaluated, during an on-water controlled flow study following widely accepted protocols. A controlled-flow whitewater boating study will identify the minimum acceptable and optimal boating flows on identified whitewater and recreational boating reaches, analyze the frequency with which boating opportunities at various flow levels are available under current operations, and analyze the extent to which boating opportunities would be available under alternate modes of operation.

The Licensee should also assess the relationship between its discharge from the E.L. Field Powerhouse and the presence of hydraulic features that can be utilized for whitewater playboating, a style of whitewater boating that utilizes a different type of whitewater craft than are used for downriver boating. The Licensee should identify suitable consultants with experience in evaluating the potential for developing hydraulic features suitable for playboating in the bypassed reach, and in particular, in the tailrace of

the E.L. Field Powerhouse.

We will work with the licensee to document the known information regarding the river. We will provide volunteers and technical support for the studies as appropriate. We hope to work collaboratively with the licensee on this study. The whitewater boating study methodology we have requested has been used on dozens of other FERC regulated reaches.

The Licensee PAD proposes no whitewater feasibility analysis. This no-action step would reveal nothing about the current project impacts on whitewater recreation or opportunities for protection, mitigation, or enhancement measures. We currently do not know the relationship between specific low and moderate flows and the paddling experiences they provide. A desktop analysis can't generate this information. Without this information we cannot fully define the project impacts, nor propose and consider provision of releases that provide targeted recreational experiences.

#### Level of Effort and Cost

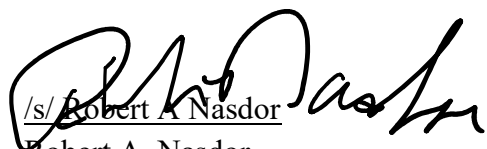
##### §5.9(b)(7)

We are willing to work with the licensee on the whitewater paddling controlled-flow study to keep costs reasonable and the quality of information high. The study will need to integrate any known information with information from the controlled-flow flow study during which several flows are paddled by boaters. Consultants usually employ still image and video documentation, surveys of the boaters, a guided conversation among the boaters, and subsequently a written report. Given the collaborative approach sought by the paddling community, including in-kind contributions of time and expertise, a consultant should be able to complete this study on behalf of the licensee for a very reasonable cost. We estimate that the cost of conducting the controlled flow whitewater boating study will be approximately \$50,000 including the field work and final report preparation.

#### Conclusion

We respectfully request that FERC require the Licensee to complete the above described (1) Recreation Facilities, Use, and Aesthetics Study, and, (2) Controlled-flow Whitewater Boating and Access Study, in order to provide FERC with sufficient information to complete its NEPA analysis of project impacts to determine appropriate license conditions that are protective of recreation values and mitigate project impacts. Thank you for considering these comments.

Respectfully submitted this 8<sup>th</sup> day of August, 2018.

  
/s/ Robert A Nasdor

Robert A. Nasdor

Northeast Stewardship and Legal Director

American Whitewater

365 Boston Post Road, Suite 250

Sudbury, MA 01776

UNITED STATES OF AMERICA  
FEDERAL ENERGY REGULATORY COMMISSION

Boott Hydropower, LLC  
Application for New License

Lowell Hydroelectric Project  
Project No. 2790-072 – Massachusetts

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated this 8<sup>th</sup> day of August 2018.



Carla Miner  
American Whitewater  
Stewardship Assistant

## Service List for P-2790-000 BOOTT HYDROPOWER, INC.

Contacts marked \*\* must be postal served

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MASSWILDLIFE

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August 10, 2018

Kimberly D. Bose, Secretary  
Federal Energy Regulatory Commission  
888 First Street, N.E., Room 1A  
Washington, DC 20426

Lowell Hydropower Project, FERC No. 2790  
Comments of the Massachusetts Division of Fisheries and Wildlife  
Preliminary Application Document  
Study Requests

Dear Secretary Bose:

The Massachusetts Division of Fisheries and Wildlife (MassWildlife) is the agency responsible for the protection and management of the fish and wildlife resources of the Commonwealth. The Division is also responsible for the regulatory protection of imperiled species and their habitats as codified under the Massachusetts Endangered Species Act (M.G.L. c.131A). The Massachusetts Endangered Species Act (MESA) was enacted in December 1990. Implementing regulations (321 CMR 10.00) were promulgated in 1992 and recently revised and implemented as of November 2010. The MESA provides a framework for review of projects or activities that occur within mapped areas of the state, called *Priority Habitat*, and published in the Natural Heritage Atlas. As such, we monitor operations at hydroelectric projects within the Commonwealth, as well as comment on proposed hydroelectric facilities. The Division offers the following comments on the Preliminary Application Document (PAD) for Lowell Hydropower Project (FERC No. 2790) submitted by Boott Hydropower, LLC, (Boott) on April 30, 2018.

**PROJECT DESCRIPTION**

The Lowell Project consists of a 1,093-foot-long, 15-foot-high masonry gravity dam (Pawtucket dam) topped by a 5-foot-high, pneumatic crest gate system, which creates a 720-acre impoundment extending approximately 23 miles upstream. The dam has a gross storage capacity of approximately 3,600 feet between the maximum normal water surface elevation of 92.2 feet National Geodetic Vertical Datum of 1929 (NGVD) and the minimum water surface elevation of 87.2 feet NGVD when all five pneumatic gates are fully lowered. The spillway is 980.5 feet long. The project includes a two-tiered network of man-made canals, totaling approximately 5.5 miles in length, which provide flow to 21 Boott-owned hydroelectric units. Nineteen of the units are located in four powerhouses (Assets, Bridge Street, Hamilton, and John Street) situated in the canal and have various runner speeds and diameters. The remaining two units are located in the main powerhouse (E.L. Field) on the Merrimack River, which uses water from the northern canal to generate power. The units in the E.L. Field powerhouse are identical, 8.6-MW horizontal Kaplan turbine-generator units, each with a maximum hydraulic capacity of 4,000 cfs.

Boott currently operates the project in a run-of-river mode. The current license requires an instantaneous minimum flow of 1,990 cfs or inflow, whichever is less, as measured immediately downstream of the project.

Boott operates both upstream and downstream fish passage facilities at the project. These include a lift at the E.L. Field powerhouse which conveys fish to the northern canal, an upstream anadromous vertical-slot fishway at the Pawtucket dam, and a downstream bypass facility at the E.L. Field powerhouse. The fish ladder has a total operating flow of 500 cfs and acts as the primary source of flow in the 0.7-mile-long bypass reach (other than

**MASSWILDLIFE**

spillage over the Pawtucket dam spillway when inflow exceeds the maximum hydraulic capacity of the project's stations). The current license contains no minimum bypass flow requirement.

In the PAD, Boott has proposed no additional protection, mitigation, or enhancement (PME) measures.

## **FISH AND WILDLIFE RESOURCES**

The Merrimack River provides essential habitats and a migratory corridor for numerous species of fish and wildlife. As the second impassable barrier to upstream migration on the Merrimack River, the Pawtucket Dam has a significant impact on these resources, particularly anadromous and catadromous fish. These species require safe and effective passage past the dam on their upstream and downstream migrations. Likewise the bypass reach below the dam provides a unique riffle area for quality resident fish and macroinvertebrate habitat. Additionally, the dam acts as a passage barrier to resident fishes who act as host-fishes to freshwater mussels located both up and downstream of the dam.

## **COMMENTS**

### **Preliminary Application Document**

#### General

The PAD is comprehensive and provides most of the information necessary.

#### Specific

### **4.0 Project Location, Facilities, and Operations**

Boott provided a detailed description of the project facilities; however, several important pieces of information are missing:

- the minimum hydraulic capacities, runner diameters and runner speeds of the turbines at the project (housed in the E.L. Field, Assets Station, Bridge Street, Hamilton Station, and John Street powerhouses);
- clear spacing of the trashracks at the intakes to all of the turbines; and
- the calculated approach velocity at the trashracks/intakes (based on the wetted trashrack area).

### **4.1 Civil Works**

#### Tailrace

Telemetry studies in 2002, 2011, and 2013 showed emigrating American Shad which approach Lowell via the tailrace have difficulty using the entrance of the fishway (Sprankle 2005; Alden 2011; Blue Leaf Environmental 2013). In 2016, Gomez and Sullivan engineers performed an analysis of upstream passage at the lift and recommended Boott excavate the ledge outcropping in the tailrace channel to approximately 10 feet below normal tailwater level extending 50 to 100 feet downstream from the entrance (Gomez and Sullivan 2016). On July 18, 2017, Boott submitted design plans to the Merrimack River Technical Committee (MRTC; comprised of Federal and State agencies) for review prior to the start of construction. On July 26, 2017, the MRTC submitted their recommendations. On August, 18, 2017, at the request of Boott, the National Oceanic and Atmospheric Administration (NOAA) and the United States Fish and Wildlife Service (Service) provided additional information pertaining to the MRTC's recommendations (Attachment A). The PAD does not contain any information regarding the tailrace excavation project. We recommend Boott update the PAD to include the details we have provided here.

In the PAD, and the Commission's pre-filing milestone timetable included in the scoping document, the first study season is scheduled to begin during the spring of 2019. However, Boott plans to complete the tailrace excavation project during late summer of 2019 (Attachment B). The tailrace excavation project will change flow dynamics in the tailrace channel and therefore the hydraulic conditions fish will likely encounter as they migrate upstream. As such, we ask that the studies requested herein (related to upstream fish migration and flow in the tailrace area) occur after the excavation is complete so the natural resource agencies can properly assess the impacts project operations might have on migratory fish and develop adequate passage and protection measures if necessary.

#### **4.5 Description of Project Operations**

##### **Fish Passage Operations**

Boott states they have provided, and assessed the effectiveness of, American Eel passage at Lowell. The effort to pass eels at the project began in 2014 when temporary eel ramps were deployed near the ladder. However, the effectiveness of these structures has never been quantified. In 2018, Boott agreed to: (1) continue to operate the existing anadromous fish ladder for eels (releasing 30 cfs) until September 30; and (2) perform six, dewatered, visual inspections of the ladder. To date, there have been no siting surveys performed at Lowell. Therefore, it is unknown if eels congregate at other areas within the project boundary (e.g., the outfall of the canal power stations) or if passing eels at the ladder is the most appropriate technique. MassWildlife likely will include, in any fishway prescription issued for the project, a requirement that Boott conduct an upstream eel passage siting survey after a new bypass flow regime has been implemented, to determine areas of eel concentration so permanent upstream passage facilities can be properly sited.

##### **National Park Service Requirements**

In this section of the PAD, Boott states they maintain canal water levels "within appropriate limits during the May 15 to October 15 tour boat operating season," however no additional information is provided. We recommend Boott update the PAD to include further information regarding the water levels maintained in the canal and any additional, relevant, information regarding the operations agreement they have with the National Park Service.

#### **5.4 Fish and Aquatic Resources**

##### **Overview**

The fish ladder at the Pawtucket dam has a total operating flow of 500 cfs and is the primary source of flow in the 0.7-mile-long bypass reach which extends from the Pawtucket dam downstream to the E.L. Field powerhouse. However, there is no information provided in the PAD to support this flow release is adequate to meet the life history requirements of fish and wildlife (including invertebrates such as freshwater mussels). Therefore, MassWildlife recommends Boott undertake a study which evaluates habitat in the bypass reach at a range of flows, including the existing 500 cfs release. The study design should include habitat mapping of the entire bypass reach in addition to collecting hydraulic and habitat measurements (i.e., depth, velocity, wetted perimeter, substrate) along a number of transects to assess the existing flow release and alternative flows.

Boott states "fish are capable of bypassing the Project's entire canal system via the Merrimack River and can use the existing upstream and downstream fish passage facilities at the Pawtucket Dam and the E.L. Field Powerhouse." While fish can potentially avoid entering the canal, despite there being no exclusionary measures in place, a study by Normandeau Associates, Inc., found only 7 percent of juvenile alewives utilized the bypass (Normandeau 1991). A follow up study (Normandeau 1995) performed after the bypass was enlarged found of 1,779 marked fish, only 37 percent utilized the downstream fish passage facilities. While efficiency increased by approximately 30 percent from 1991 to 1995, the bypass remains over 60 percent ineffective at passing fish downstream.

Although bypass effectiveness studies were performed at Lowell in the early 1990s, it is still unclear as to which route American Shad, Alewife, Blueback Herring, and eel select as they move downstream (spillway, fish ladder, canal, turbines, existing bypass), the survival estimates associated with each route, the effect the Pawtucket gatehouse has on downstream movement, the effect the pneumatic crest gates have on emigration, etc. To fill these data gaps and better understand downstream passage at Lowell, especially in relation to the canal, MassWildlife recommends Boott conduct studies which assess: (1) the behavior, approach routes, passage success, survival and delay of adult American Shad and River Herring as they emigrate to the ocean; and (2) the impact project operations have on the downstream migration of juvenile Alewife (which can serve as a proxy for Blueback Herring and American Shad in this instance); and (3) downstream route of passage and survival of adult silver-phase American Eel.

#### Abundance

The Merrimack River supports a variety of migratory fish species, including American Shad, River Herring (Alewife and Blueback Herring), American Eel, and Sea Lamprey. Table 5.4-2 lists the number of river herring, shad, and eel that have passed the Lawrence Project (FERC No. 2800, the first hydroelectric dam on the Merrimack River), and Lowell since 1983. In 2017, Boott claims 177,738 eels swam upstream past Lawrence. However, our records indicate an estimated 8,645 elvers were lifted in the hopper and 17,691 passed the eelway at the dam (26,336 eels total). MassWildlife recommends Boott update Table 5.4-2 to: (1) ensure listed, annual, fish passage counts are accurate; and (2) include sea lamprey passage counts.

#### Other Site-Specific Fisheries Information

In this section of the PAD, Boott states American Shad studies were conducted in 1999 and 2000, which led to significant modifications and upgrades to the E.L. Field powerhouse fish lift, thereby improving passage efficiency. However, it is unclear as to which modifications Boott is referring.

According to our records, a lack of modifications and upgrades to the project coupled with poor fish passage led to a radio-telemetry study of shad migration in 2002 (Sprankle 2005). This study found 55 percent of the shad which passed upstream of Lawrence made their way into the Lowell tailrace near the fishway entrance. However, only 6.2 percent of the tagged shad were actually passed upstream of the project via the fish lift. This was consistent with fish passage counts taken at Lowell in 2002; only 9.7 percent of the shad which passed Lawrence subsequently passed Lowell. These data led to a dye test, also conducted by Ken Sprankle, in June 2003. During this qualitative evaluation, concentrated dye was released into the fishway entrance channel and observed. Results demonstrated the flow field extends downstream from the fishway and stalls approximately 35 feet from the entrance, effectively cutting off the progression of shad moving up the tailrace and into the fishway. Based on fish counts at Lawrence and Lowell, passage efficiencies for American shad have not improved at the project over the past 20 years. From 1996 to 2017, passage efficiency at the project has not exceeded 30 percent. Additionally, the internal fish lift efficiency has remained low. In 1996, fish lift efficiency ranged from 0.5 to 2.4 percent. In 2000, studies conducted by Boott suggested efficiency increased to 42 percent (Boott 2000). While this latest assessment does suggest an improvement in operations compared to previous years, an internal fish lift efficiency of 42 percent is still low as overall passage efficiency is based on the combined near/far field attraction efficiency and internal lift and ladder efficiency. Based on the information above, and considering the ledge removal improvements which will take place in 2019, MassWildlife recommends Boott perform a study assessing American shad upstream route selection passage effectiveness and migratory delay.

Boott goes on to state, "A 1988 acoustic telemetry study performed by RMC Environmental Services (RMC) of adult American shad movement through the Northern canal demonstrated successful passage through the Pawtucket Gatehouse, as well as incidental information regarding downstream passage routes for post-spawning individuals. In a follow-up study in 1991 by Normandeau Associates, Inc., found similar findings as the 1988 adult American

shad telemetry study.” While it is true that 80 percent of the fish successfully exited the canal, it should be noted: (1) the sample size was small, only 25 fish were used in the analysis; and (2) the delay caused by existing infrastructure was substantial, ranging from 1 to 5 days. Also, as a point of clarification, there were two studies conducted in 1991 by Normandeau Associates, Inc., which focused on downstream passage of river herring and shad. The scope and findings of these studies did not include upstream passage through the gatehouse, which was the focus of the RMC 1988 study. To date, the RMC study has been the only evaluation of upstream passage of shad in the northern canal and gatehouse. As a component of the studies provided herein, we recommend Boott track and monitor clupeid behavior in the canal.

#### Major Findings of Fish Passage Studies Since 1988

In the PAD, Boott provides an overview of the fish passage facilities at both projects, when they began operating, and studies which have been conducted to determine their effectiveness at passing target species. We would like to offer some points of clarification, specifically on the information listed in Table 5.4-3.

- 1988: Passage of Radio-Tagged American Shad through the Northern Canal Headgate Structure. Boott states “24 of 25 radio-tagged shad (96%) released at fish lift exit passed the Northern Canal headgate structure with little delay.” However, 19 of the 24 shad (80 percent) which successfully passed did not pass through the headgate structure but rather the adjacent boat lock facility. When the boat lock was closed, delay ranged from 1 to 5 days. Since a majority of the shad were observed reaching the headgate structure within an hour, the delay in migration associated with closing the boat lock was approximately 23-119 hours. The study notes most fish approached the road bridge adjacent to the gatehouse but fell back downstream. The delay experienced by these shad is significant and, from the information provided by Boott, it is unclear how often the boat lock has been open during the upstream migratory season since the 1988 study was performed. We are concerned that the operation and management of the northern canal headgate may contribute to migratory delay and is an issue that will need to be resolved in order to successfully pass fish upstream and achieve a sustainable population of shad in the Merrimack River.
- 1991: An Assessment of the Effectiveness of a Fish Bypass for Passing Juvenile Alewives at the Lowell Hydroelectric Project. The findings listed in the table fail to include two critical results: (1) the bypass effectiveness for juvenile alewife was only percent, even when bypass flows reached 2 percent of the turbine flow; and (2) when the bypass flow was increased by 50 percent, due to the units shutting down, the number of fish using the bypass increased by a significant amount (4,250 alewives in 10 minutes versus 0 in the previous 4.5 hours).
- 1996: Lowell Hydroelectric Project Internal Fish Lift Efficiency Monitoring Program. The internal fish lift efficiencies should be included in the findings, as they were extremely low, ranging from 0.5 percent to 2.4 percent.
- 1999: An Assessment of Internal Fish Lift Efficiency at the Lowell Hydroelectric Project. The study findings section states “The ratio of total shad lifted at the Lowell Project to the total lifted at the downstream Lawrence facility was nearly doubled, reaching approximately 29% in 1999 compared to a historic ratio of 15% since 1986, and in the preceding two years.” While this statistic may technically be correct, it actually represents a decrease from 1992 and 1995, when the ratios of total shad lifted at Lowell were 31 percent and 38 percent, respectively.
- Boott performed two fish lift internal efficiency studies and in the major findings column claims the crowder position has a beneficial impact on fish passage efficiency. However, this contradicts the study findings listed for the 1996 Normandeau Associates, Inc. study. As noted above, MassWildlife suggests Boott include information regarding modifications made to the fish lift which supports its contention of improved internal efficiency.

- A report by Gomez and Sullivan titled “Analysis of Upstream Fish Passage Facilities and Operations” was not included in the PAD. We recommend Boott update Table 5-4.3 to include this study, which identifies specific areas of improvement needed to increase the Lowell fishways reliability and upstream passage efficiency. Recommendations provided in the report include: (1) installing a pivot gate to update the existing vertical gate; (2) excavating the ledge outcrop downstream of the fishway entrance; (3) reopening the street side entrance; and (4) installing an entrance extension. The analysis also highlights the aging infrastructure at the project and the need to replace specific components, along with cost estimates.

## **6.0 Preliminary Issues, Project Effects, and Potential Studies**

### Fish and Aquatic Resources

Boott has not proposed any studies for relicensing at this time, but has identified potential resource issues which include: bypass flows, fish passage, historical resources, boating access, and inundation of upstream floodplains. Relevant to fish and aquatic resources, MassWildlife believes new studies need to be conducted, with sufficient fish sample sizes, to better understand upstream and downstream passage at the project as well as a complete instream flow study in the bypass reach.

### Downstream Passage

MassWildlife recommends Boott conduct new studies to fully understand how post-spawned adult shad and river herring, juvenile shad and river herring, and adult silver phase eels move past the Pawtucket dam, through the canal system, turbine intakes, and the downstream bypass facility. In addition, turbine injury and mortality studies are needed and should be used in conjunction with the results of the passage routing studies, where applicable, to calculate total through-project survival rates. MassWildlife herein provides study requests in order to address these information needs.

### Upstream Passage

Yearly site inspections, performed by MassWildlife, have identified a number of problems with respect to shad at the lift and ladder fishway entrances. MassWildlife believes that a comprehensive radiotelemetry study is needed to understand the relationship between project operations, including spill flows, and shad and river herring movement through the Merrimack River (including attraction to and passage through these facilities). Additionally, a study to define the relationship of the complex hydraulic conditions at the spillway fish ladder entrance and the tailrace fish lift entrance is needed in order to evaluate data on fish behavior and passage at those locations. Therefore, MassWildlife is providing herein study requests to address these information needs.

### Instream Flows in the Lowell Bypass

The bypass reach is 0.7 mile long (from the Pawtucket dam to the E.L. Field powerhouse) and contains diverse habitat. There are approximately 11 miles of free-flowing river downstream of the Pawtucket dam which also contain a diversity of habitat, including important spawning and rearing habitat for migratory fish species such as American Shad. To date, there have not been any empirical studies which assess the adequacy of the existing flow protocols. MassWildlife herein submits study requests intended to address these information gaps.

## **ADDITIONAL INFORMATION**

The following information is needed:



- the minimum hydraulic capacities, runner diameters and speeds of the turbines in each powerhouse associated with the project;
- a more thorough description of how project operations are monitored and recorded;
- hourly data (water surface elevations, dam discharge, generation) for the project in spreadsheet format for the past 5 years;
- a detailed description of modifications made to the existing fish passage facilities, including dates changes were made;
- a detailed description of canal operations; and
- a detailed description of modifications made to the bypass extending from the Pawtucket dam to the E.L. Field powerhouse (weir installation, excavation, etc.).


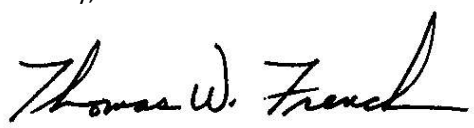
#### RECOMMENDED STUDIES

The pages below contain the studies requested by MassWildlife. They are presented in the format required pursuant to CFR §4.38(b)(5) and therefore each contain the rationale for the request which will not be repeated here. Please note that MassWildlife also supports the study requests provided by the other agencies including, but not limited to, National Marine Fisheries Service, US Fish and Wildlife Service, and Massachusetts Department of Environmental Protection.

#### Massachusetts Division of Fisheries and Wildlife list of requested studies under P-2790

1. In-stream Flow Habitat Assessment
2. Adult Alosine Downstream Passage Assessment and Protection Evaluation
3. Telemetry Study of Upstream and Downstream Migrating Adult American Shad and River Herring
4. Impact of Project Operations on Downstream Migration of Juvenile Alosines
5. Downstream American Eel Passage Assessment
6. Operations Analysis of the Lowell Canal
7. CFD Modeling in the Vicinity of Fishway Entrances and Powerhouse Forebays
8. Bypass Reach Zone of Passage Study
9. Fish Assemblage Assessment

Thank you for this opportunity to comment.

|                                                                                                                                                                     |                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Sincerely,</p>  <p>Caleb Slater, Ph.D.<br/>Anadromous Fish Project Leader</p> | <p>Sincerely,</p>  <p>Thomas W. French, Ph.D.<br/>Assistant Director for the Natural Heritage &amp;<br/>Endangered Species Program</p> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## LITERATURE CITED

Alden. 2011 Shad Upstream Passage Assessment at Lowell Hydroelectric Project. Submitted to Boott Hydro, LLC. Final Report. Alden Research Laboratory, Inc. Andover, Massachusetts. 43 pp.

Blue Leaf Environmental. 2013. Additional Analysis of American Shad Three- Dimensional Behavior in the Tailrace of the Lowell Project. Submitted to Boott Hydro, LLC. Final Report. Blue Leaf Environmental, Inc. Ellensburg, Washington. 4 pp.

Boott. 2000. Assessment of Internal Fish Lift Efficiency at Lowell Hydroelectric Project. Submitted to Boot Hydro, LLC. Final Report. Boott Hydropower, Inc. 16 pp.

Gomez and Sullivan. 2016. Analysis of Upstream Fish Passage Facilities and Operation. Submitted to Boott Hydroelectric Project. Submitted to Boott Hydro, LLC. Final Report. Gomez and Sullivan Engineers, D.P.C. Henniker, New Hampshire. 62 pp.

Normandeau. 1991. An Assessment of the Effectiveness of a Fish Bypass for Passing Juvenile Alewives at the Lowell Hydroelectric Project, Lowell, Massachusetts. Submitted to Consolidated Hydro, Inc. Final Report. Normandeau Associates, Inc. Bedford, New Hampshire. 26 pp.

Normandeau. 1995. Use of the Fish Bypass by Juvenile Clupeids at the Lowell Hydroelectric Project During Fall 1994. Submitted to Consolidated Hydro, Inc. Final Report. Normandeau Associates, Inc. Bedford, New Hampshire. 18 pp.

Sprankle, K. 2005. Interdam movements and passage attraction of American shad in the lower Merrimack River main stem. North American Journal of Fisheries Management, 25, 1456-1466.

## Boott Study Request # 1

### Instream Flow Habitat Assessment of the Lowell Bypassed Reach (Lowell, P-2790)

#### Goals and Objectives

The goal of this study is to determine an appropriate flow regime which will protect and enhance the aquatic resources in the bypass reach between the Pawtucket dam and the E.L. Field powerhouse. Specifically, the objective of this study is to conduct an instream flow habitat study to assess the impacts of a range of project discharges on the wetted area and optimal habitat for key species, including the quantity and location of suitable habitat.

The specific objectives of this field study, at a minimum, include:

1. characterize and map wetted perimeter of the bypass reach over a range of bypass flows;
2. survey and evaluate the water depth and mean channel velocity at transects within the bypass reach over a range of flows; and
3. map and assess the value of aquatic habitat in the bypass reach over a range of flows, focusing on potential habitat for resident species, and spawning and migration habitat or rest/regrouping areas for migratory species.

Target fish species should include American shad, river herring (alewife and blueback herring), fallfish, white sucker, freshwater mussels and benthic macroinvertebrates. The final target species list should be developed in consultation with the fisheries agencies and based on the results of the mesohabitat mapping.

#### Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to aquatic resources within the Lowell bypassed reach, MassWildlife's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide a flow regime in the bypassed reach that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) and diadromous fishes.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and the Federal Power Act (16 U.S.C. §791a, et seq.).

#### Public Interest

The requester is a natural resource agency.

#### Existing Information

The Lowell Project bypasses a 0.7-mile-long section of the Merrimack River, from the Pawtucket dam to the E.L. Field powerhouse. There is presently no required minimum bypass flow. However, during the upstream fish passage season, the bypass reach receives 500 cfs through operation of the spillway fish ladder. In addition, the bypass reach receives flow whenever inflow exceeds the hydraulic capacity of all the project's stations. Pursuant to Article 37, Boott Hydropower, LLC, (Boott) maintains a minimum flow of 1,990 cfs or inflow, whichever is less, as measured immediately downstream of the project.

Available information in the PAD does not indicate how project operations have altered downstream hydrology, habitat quantity and quality, and water quality, which may affect resident and migratory fish, macroinvertebrates, aquatic plants and other biota and natural processes in the Merrimack River. The PAD provides no detailed description of the physical or biological characteristics of the bypassed reach.

An empirical study is needed to provide information on the relationship between flow and habitat in the bypassed reach for MassWildlife to use in determining a flow recommendation.

#### Nexus to Project Operations and Effects

Although the project license requires Boott to maintain a minimum flow of 1,990 cfs or inflow (if less), downstream of the project, Boott states in practice the project operates in a true run-of-river mode. The Department of the Interior is not recommending a below-project flow study based on the assumption that any new license issued for the project will require instantaneous run-of-river operation (essentially codifying current operations).

The project includes a 0.7-mile-long bypassed reach. The current license contains no minimum bypass flow requirement. During the upstream fish passage season, the bypass reach receives 500 cfs via operation of the spillway fish ladder; otherwise, the reach only receives flow when inflow exceeds the hydraulic capacity of the project's generating capacity. To our knowledge, the lack of a required bypass flow was not based on any quantitative, rigorous scientific studies.

This section of the Merrimack River contains habitat which supports native riverine species, including important spawning and rearing habitat for migratory species like American shad and river herring. While the existing license does not require a minimum bypass flow, MassWildlife believes one is needed to sufficiently protect the aquatic resources inhabiting the bypassed reach.

Results of the flow study will be used by MassWildlife to determine an appropriate flow recommendation which will protect and/or enhance the aquatic resources in the bypassed reach for the duration of any new license issued by the Federal Energy Regulatory Commission (Commission).

#### Methodology Consistent with Accepted Practice

Bypass flow habitat assessments are commonly employed in developing flow release protocols which will reduce impacts or enhance habitat conditions in reaches of river bypassed by hydroelectric projects.

Given the size of the bypassed reach (0.7 mile long) and the important resources known to inhabit the reach (i.e., diadromous fishes); we believe a study methodology which utilizes an instream flow incremental methodology (IFIM) approach is appropriate for this site. This same protocol was used during the relicensing of the Housatonic River Project (FERC No. 2576), and has been accepted by the Commission in other licensing proceedings.

The study should have two components. The first component entails mapping habitat within the bypass reach. The number, location, and size (area and linear distance) of each mesohabitat type in the reach should be documented, including qualitative characterizations (e.g., dominant substrate, average depth, overhead and instream cover, etc.). The second component consists of conducting an instream flow study.

At a minimum, the study design should involve collecting wetted perimeter, depth, velocity, and substrate data within a range of discharge levels along transects located in the reach of river between the dam and the E.L. Field powerhouse. The measurements should be taken over a range of test flows, to be agreed upon by the natural resource agencies. This information should then be synthesized to quantify habitat suitability (using mutually agreed upon Habitat Suitability Index curves) of each test flow for target species/life stages identified by the fisheries agencies. We recommend Boott perform habitat modeling using one dimensional modeling techniques to better characterize flows and velocities in this complex channel area.

#### Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

Field work for flow studies can be reasonably extensive but will depend on consultation with Boott on study methodology and on-site decisions on locations for data collection and the number of collection locations. Post-field work data analysis would result in a moderate cost and effort. We anticipate that the level of effort and costs will be comparable to those experienced on similar Commission relicensing projects (e.g., the Glendale Project, FERC No. 2801).

## Boott Study Request # 2

### Adult Alosine Downstream Passage Assessment and Protection Evaluation (Lowell, P-2790)

#### Goals and Objectives

The goal of this study is to assess the adequacy of the turbines at the E.L. Field, Assets, Bridge Street, Hamilton, and John Street powerhouses, to minimize injury, entrainment, and mortality of fishes residing in the Merrimack River, and to recommend appropriate mitigative measures as necessary.

The specific objectives of the field study, at a minimum, are: (1) assess the risk of adult American shad and alewife becoming injured, impinged, or entrained in the E.L. Field, Assets, Bridge Street, Hamilton, and John Street powerhouse units; (2) estimate turbine survival; (3) assess the risk of injury or mortality at the spillway and downstream bypass; and (4) evaluate potential passage and protection measures.

#### Resource Management Goals

The Atlantic States Marine Fisheries Commission has developed several documents related to the management of American shad and river herring:

1. Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. (Report No. 35). April 1999.
2. 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.
3. Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. May 2009.
4. Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.

Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring includes an objective of maximizing the number of juvenile recruits emigrating from freshwater stock complexes and recommends enhancing survival at dams during emigration by evaluating survival of post-spawned adults and juvenile fish passed via each route (e.g., turbines, spillage, bypass facilities, or a combination of the three) at any given facility, and implementing measures to pass fish via the route with the best survival rate.

Specific to resident riverine and migratory fish entrainment, MassWildlife's goals are:

1. Minimize current and potential negative project operation effects such as turbine entrainment that could hinder management goals and objectives.
2. Minimize project-related sources of mortality to resident and migratory fishes in order to restore natural food web interactions and ecosystem functions and values.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and the Federal Power Act (16 U.S.C. §791a, et seq.).

#### Public Interest

The requestor is a natural resource agency.

#### Existing Information and the Need for Additional Information

No project-specific information exists regarding risk of impingement and/or entrainment of adult alosines. In the PAD, Boott provided little information which would inform the relative risk of impingement or entrainment in any of the 21 units associated with the project. Moreover, information regarding fish mortality at the spillway and the downstream bypass was not discussed. While Normandeau Associates, Inc., performed a study in 2003 pertaining to the survival of Atlantic salmon smolts through the turbines, (1) the sample size was small (20 fish); (2) the study was not performed at a full range of gate settings; and (3) salmon are a robust fish species and cannot be used as a proxy for alosines. The 2003 study did shed light on a predation issue, however, in the project's tailrace. Of the salmon that passed downstream, 69 percent were suspected to be preyed upon after using the downstream bypass facility. As Normandeau Associates, Inc., noted in their study results, predators residing in the tailrace can have a large impact on emigrating migratory fish species that use the current bypass facility at the project.

To date, no directed studies of alosine injury, entrainment, or mortality have been conducted at the project's modified spillway, the downstream fish bypass facility, or through the turbines. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on outmigrating adult alosines and develop adequate passage and protection measures to meet management goals and objectives.

#### Nexus to Project Operations and Effects

Hydropower projects generate electricity by moving water through a turbine-generator system. Typically, there are trashracks in front of the intakes leading to the turbines. If the rack spacing is narrow and the velocities at the racks too high (relative to the swim speeds of fish species inhabiting or moving through the headpond), fish may become impinged against the racks and die. If the rack spacing is wide and the velocities too high (relative to the swim speeds of fish species inhabiting or moving through the headpond), fish may become entrained (i.e., pass through the racks) and get injured or die while passing through the turbines.

Lowell's configuration likely presents problems with respect to providing safe, timely, and effective passage for outmigrating alosines. Pre-spawned adult American shad and river herring pass upstream through the Lowell fishways and/or are stocked into upstream habitats. These fish need to be able to migrate back downstream because they are iteroparous in this region. Therefore, it is necessary to understand how alosines move through the project area and the level of injury or mortality caused by entrainment through the project's turbines and/or passage via the dam spillway and downstream bypass facility.

#### Methodology Consistent with Accepted Practice

MassWildlife proposes a phased approach to this study.

##### Phase 1:

Spill, bypass, and turbine mortality should be assessed using a balloon-tag method.

For spill mortality sites (dam spillway and downstream bypass), tagged alosines will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec to minimize the possibility of the fish swimming upstream into the headpond or canal. Passed balloon-tagged alosines will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

For turbine mortality sites, tagged alosines will be injected into the intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec to minimize the possibility of fish swimming back upstream through the intakes. Passed balloon-tagged alosines will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

#### Phase 2:

Boott should investigate existing or potential future operational and/or physical measures that would minimize injury or mortality to outmigrating adult alosines moving past the project. Based on the results of this investigation, we recommend Boott provide a range of potential alternatives (e.g., increasing attraction to the existing downstream bypass, installing exclusionary screening, etc.).

Project operations (flows, levels, gate openings, number of units operating, and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) should be monitored regularly (hourly measurements if possible) throughout the duration of the study.

These methodologies are consistent with accepted practice.

#### Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The cost and effort of each individual phase of this study are expected to be moderate. Based on the scale and scope of the subject study, we estimate the cost to be \$25,000 to \$50,000. In the PAD, Boott proposes no studies to address this issue. MassWildlife is not aware of any previously conducted or ongoing studies related to impingement, entrainment or survival of adult alosines at the project.

#### REFERENCES

Normandeau. 2003. Passage Route Selection and Survival of Atlantic Salmon Smolts Passed through the Lowell Hydroelectric Project. Submitted to Boot Hydro, LLC. Final report. Normandeau Associates, Inc. Westmoreland, New Hampshire. 130 pp.



### Boott Study Request # 3

Telemetry Study of Upstream and Downstream Migrating Adult American Shad and River Herring to Assess Passage Routes, Effectiveness, and Delay  
(Lowell, P-2790)

#### Goals and Objectives

The goal of this study is to assess the behavior, approach routes, passage success, survival, and delay of adult American shad and river herring as they encounter the Lowell Project during their upstream and downstream migrations to determine if project operations negatively impact their survival and production.

The following objectives will address this request:

1. assess project operations effects on the timing, orientation, routes, and migration rates of shad and river herring;
2. determine route selection and behavior of upstream migrating shad and river herring at the project under varied operational conditions, including a range of spill conditions (e.g., movement to the dam, attraction to the E.L. Field station discharge, movement between locations, delay, timing, etc.);
3. determine delay/fallback associated with the northern canal;
4. assess near field attraction to, and entrance efficiency of, the fish lift under a range of spill conditions and with the river-side entrance and street-side entrances open;
5. assess near field attraction to, and entrance efficiency of, the spillway ladder under a range of spill conditions;
6. evaluate the internal efficiency of the Pawtucket dam ladder;
7. collect ladder and lift efficiency data, to include rates of approach to fishway entrances, entry into fishways, and passage under varied operational conditions, including a range of spill conditions;
8. determine the proportion of post-spawned adults that select the power canal as a downstream passage route under varied operation conditions, including a range of spill conditions up to full spill; determine post-spawned adult downstream migration route selection, passage efficiency, and delay associated with the power canal under various operational conditions, including a range of spill conditions; and
9. compare rates and measures of delay and movement among project areas and routes utilized (e.g., spill at dam vs. power canal) under the range of permitted and proposed spill and operational conditions.

If project operations are adversely affecting shad or river herring migration timing or are resulting in other deleterious population effects, we recommend Boott identify operational solutions or other passage measures that will reduce and minimize these impacts within the project area.

This study will require 3 years of field data due to the tailrace ledge excavation project which will be completed in 2019 and to capture inter-annual variability of river discharge, water temperatures, and variability in outmigration timing. We recommend Boott perform the downstream routing portion of the study in 2019 (pre-ledge excavation) and 2020 (post-ledge excavation). In 2020 and 2021, after the ledge has been excavated, we recommend Boott perform the upstream portion of this study.

#### Resource Management Goals

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring, approved in 2010, includes the following objectives:

#### Upstream Passage

1. Fish must be able to locate, enter, and pass the passage facility with little effort and without stress.
2. Where appropriate, upstream fish passage effectiveness should be improved through operational or structural modifications.
3. Fish which have ascended the passage facility should be guided to an appropriate area so they can continue their upstream migration and avoid being swept back downstream.

#### Downstream Passage

1. Enhance survival at dams during emigration.
2. Evaluate survival of post-spawned adults and juvenile fish passed via each project route (e.g., turbines, spillage, bypass facilities, or a combination of the three).
3. Implement measures to pass fish via the route with the least delay and best survival rate.

MassWildlife seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to American shad and river herring movement and migration, MassWildlife's goal is to minimize current and potential negative project operation effects on the safe, timely and effective upstream and downstream passage of adult American shad and river herring.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), the Federal Power Act (16 U.S.C. §791a, et seq.), the Atlantic States Marine Fisheries Compact (P.L. 539, 77th Congress, as amended by P.L. 721, 81st Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

#### Public Interest

The requestor is a natural resource agency.

#### Existing Information and the Need for Additional Information

Several studies pertaining to the fish lift and downstream passage facilities at Lowell have been conducted for American shad. Studies of alewife passage are limited to a single downstream test performed in 1991. Previous studies pertaining to upstream shad migration (listed in Table 5.4-3 of the PAD) demonstrate passage through the existing lift at Lowell is relatively poor. Also, when analyzing annual passage counts for river herring and shad, the number of fish which utilize the Lowell lift versus those that pass at Lawrence is low (from 1996 to 2017 passage efficiency at Lowell has not exceeded 30 percent).

Until 2016, the fish lift has been the primary route of upstream passage at the project. The ladder, located at the Pawtucket dam, has typically only been operated during periods of high flow. Therefore, to date, studies performed at Lowell have not tested the nearfield attraction, entrance efficiency, or internal efficiency of the ladder. Moreover, past studies have had statistically low sample sizes (less than 60 fish) and were all performed prior to the ledge excavation project which will occur in August 2019. Future studies should have a robust sample size (at a minimum, 150 fish per species) and array system. Additionally, to obtain a comprehensive understanding

of fish behavior at Lowell, for both upstream and downstream migration, studies are needed to: (1) determine if project operations affect pre-spawned and post-spawned river herring and shad migration timing; (2) assess fish movement to, and through, the ladder at the Pawtucket dam; and (3) assess passage success at the tailrace fish lift post-ledge removal.

#### Nexus to Project Operations and Effects

Lowell tailrace turbulence (potentially exacerbated by the existing ledge outcropping) creates attraction issues at the entrance of the fish lift. Moreover, a lack of effective protection at the 21 turbines associated with the project increases the risk of entrainment and mortality alosines may experience as they migrate downstream to the ocean. During the upstream fish passage season, the Lowell bypass reach receives 500 cfs during the day and 300 cfs at night via operation of the spillway fish ladder; otherwise, the reach only receives flow when inflow exceeds the hydraulic capacity of the project's generating capacity. The spillway ladder is, therefore, only partially effective due to lack of flow.

Existing project operations and limited bypass flows can have a direct impact on diadromous fish migration. Migration delays, increased predation, mortality during passage over the dam or through turbines, and changes in route selection under different flow conditions are potential influences of the project on shad and river herring populations in the Merrimack River. Effective upstream and downstream passage and successful spawning and juvenile production are necessary to help achieve shad and river herring management restoration goals for the Merrimack River, particularly in the upstream reaches.

#### Methodology Consistent with Accepted Practice

The movement of migratory shad and river herring would be best studied by using radio telemetry, including passive integrated transponder (PIT) tags. Radio telemetry is an accepted technology that has been used for a number of studies associated with hydropower projects, including at the Bellows Falls (FERC No. 1855), Wilder (FERC No. 1892), and Vernon (P-1904) projects.

The study design must specify sample sizes, as well as tag and receiver configurations, to ensure rates of entry and exit to the tailrace, fish lift and fish ladder, downstream bypass, the bypassed reach, and canal, can be calculated with sufficient precision. We recommend Boott capture shad and river herring below Lawrence and tag at least 150 individuals per species. Double-tagged (radio and PIT) shad and river herring should be released upstream of the Lawrence dam and upstream of the Lowell dam. Fish should also be released directly into the Pawtucket canal to adequately assess project conditions likely to be encountered during downstream migration. Additional, tagged, individuals may need to be released farther upstream to ensure enough fish encounter the dam during a sufficient range of turbine and operational conditions to test for project effects (especially in 2020 and 2021). A large array of stationary monitoring stations (radio and PIT) will be needed to provide an appropriate level of resolution for data analyses and to answer the natural resource agencies' questions regarding project operation effects. Additionally, since fish can drift a considerable distance downstream after they have died (Havn et al. 2017); a minimum of 25 dead river herring and 25 dead shad should also be released as a control group in this study. A plan and schedule for spill releases should be developed which provides sufficient periods of spill and various generating levels (treatments will require multiple days of consistent discharge).

Each component of this study will require 2 years of field data collection to attempt to account for inter-annual variability in river discharge, water temperatures, and the ledge excavation project which will be completed in 2019. We recommend Boott perform the downstream routing portion of the study in 2019 (pre-ledge excavation) and 2020 (post-ledge excavation). In 2020 and 2021, after the ledge has been excavated, the upstream portion of this study should be performed.

A related study request on computational fluid dynamics (CFD) modeling in the Lowell tailrace, in and around the fish lift and fish ladder entrances and powerhouse forebay, will complement this study and address related project operational effects.

These methodologies are consistent with accepted practice.

#### Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

Estimated cost for this study is expected to range from \$400,000 to \$500,000, with the majority of costs associated with equipment (radio and PIT tags, radio receivers, and PIT readers) and related field work labor. Since tagged shad and river herring will move throughout the area, to varying degrees, there will be expected cost savings (e.g., radio tags) to Boott, provided cooperation in study planning and implementation occurs.

Boott did not propose any studies to meet this need in the PAD.

#### REFERENCES

Havn, T. B., F. Økland, M.A. Teichert, L. Heermann, J. Borchering, S.A. Sæther, O.H. Tambets and E.B. Thorstad. 2017. Movements of dead fish in rivers. *Animal Biotelemetry*, 5: 7.

#### Boott Study Request # 4

#### Impact of Project Operations on Downstream Migration of Juvenile Alosines (Lowell, P-2790)

##### Goals and Objectives

The goals of this study are: (1) conduct a field study of juvenile alewife outmigration in the Lowell impoundment, the power canal, and at the Pawtucket dam, to determine if project operations negatively impact juvenile alosine survival and production; and (2) determine if project operations affect juvenile alosine outmigration survival, recruitment, and production.

The following objectives will address this request:

1. assess project operations effects of the Pawtucket dam on the timing, orientation, passage routes, migration rates, and survival of juvenile alewife;
2. determine the proportion of juvenile alewife that select the Lowell canal versus the Pawtucket powerhouse, downstream bypass facility, or dam spill as a downstream passage route, under varied operational conditions;
3. determine if there are any delays associated with downstream movement related to either dam spill or the Pawtucket powerhouse due to operations;
4. determine the juvenile downstream passage timing and route selection in the Lowell canal, assess delays associated with the canal, and with project operations (e.g., stockpiling in the canal).

If it is determined the project operations are adversely affecting juvenile alosine survival, migration timing, or other deleterious population effects, identify operational solutions or other passage measures which will reduce and minimize these impacts within the project area. This study will require 2 years of field data to capture inter-annual variability of river discharge and water temperatures.

##### Resource Management Goals

The Atlantic States Marine Fisheries Commission Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, includes the following objective:

Maximize the number of juvenile recruits emigrating from freshwater stock complexes.

To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g., turbines, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the best survival rate.

MassWildlife seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to juvenile American shad and river herring movement and migration, MassWildlife's goal is to minimize current and potential negative project operation effects on the safe, timely and effective downstream passage.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), the Silvio O. Conte National Fish and Wildlife Refuge Act (P.L. 102-212; H.R. 794), the Federal Power Act (16 U.S.C. §791a, et seq.), the Atlantic States Marine Fisheries Compact (P.L. 539, 77th Congress, as amended by P.L. 721, 81st Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

#### Public Interest

The requestor is a natural resource agency.

#### Existing Information and the Need for Additional Information

The seaward migration of juvenile alosines is of great importance to the restoration of alewife, blueback herring, and American shad in the Merrimack River. However, data on the downstream migratory movements and rates of alosines past Lowell is sparse and relatively incomplete. In 1994 and 1995, Normandeau Associates, Inc., documented the use of the bypass facility by downstream migrating alosines via the installation of a removable box trap. Passage efficiencies were 7 percent and 37 percent, respectively. However, to date, no directed studies of downstream alosine passage route selection has been conducted at the Lowell Project. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on outmigrating juvenile alosines and develop adequate passage and protection measures to meet management goals and objectives.

Studies conducted farther upstream on the Merrimack River, at Garvins Falls (FERC No. 1893), have shown it is possible to radio-tag juvenile alewife to evaluate alosine outmigration (Normandeau 2016). Alewife can be used as a proxy, in this instance, for the natural resource agencies to assess blueback herring and shad downstream migration patterns.

#### Nexus to Project Operations and Effects

Adult alosines, passed at Lowell via the fishways and/or stocking efforts, utilize upstream habitat to spawn on an annual basis. Similarly, juvenile alosines require safe and timely downstream passage measures at the project in order to successfully emigrate back to the ocean to contribute to the population. Presently, downstream migrants can easily enter the Lowell canal system, via the Pawtucket canal, as there are no exclusionary measures in place. There are 19 turbines located in the canal, housed at four powerhouses (Assets, Bridge Street, Hamilton, and John Street), none of which have passage or protection measures. There are a variety of unit-types housed in each of the powerhouses, ranging in speed from 100 to 150 rpm. A study is needed to assess the impacts project operations have on outmigrating juvenile alosines.

MassWildlife is not aware of any studies conducted specifically designed to determine:

1. What is the rate of alewife survival under a range of spill and gate configurations?
2. Are there delays in migration/movement at the dam, gatehouse, or in the canal?
3. For juveniles that enter the Pawtucket canal, what proportion subsequently enter the Western, Merrimack, Pawtucket, or Hamilton canals?
4. What is the rate of movement through the canal, what is the delay to juvenile alosine outmigration, and the potential accumulation of juveniles in the canal?
5. What proportion of juvenile alosines use the downstream bypass sluice versus the E.L. Field powerhouse turbines under varied operational conditions?

MassWildlife is concerned project operations are: (1) impacting juvenile alosine outmigration survival; and (2) contributing to the failure of the Merrimack River alosine population to meet management targets.

#### Methodology Consistent with Accepted Practice

The impact of project operations to juvenile alewife outmigration, passage route selection, and migratory delay would be best studied via radio telemetry. This methodology has successfully been tested and employed by Normandeau Associates, Inc., at the Garvins Falls hydroelectric project (FERC No. 1893; Normandeau 2013; Normandeau 2016). Project discharge over a full range of existing and, to the extent possible, potential future operational conditions at the dam (likely increased bypass reach flows in new license), should be examined relative to migration rate and passage route selection of juvenile alosines to, and through, various areas of the project.

In addition, study fish should be collected and balloon-tagged to empirically determine rates of survival for fish passed over or through the dam's bypass sluice, main powerhouse, and 19 canal units under varied operations. For spill mortality sites (dam spillway and downstream bypass), tagged alosines should be injected or released into spill flow at points where water velocity exceeds 10 ft/sec to minimize the possibility of the fish swimming upstream into the headpond or canal. Passed balloon-tagged alosines will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

For turbine mortality sites, tagged alosines will be injected into intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec to minimize the possibility of fish swimming back upstream through the intakes. Passed balloon-tagged alosines will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

Radio-tagged juvenile alewife will be released in areas upstream of the project at multiple release locations, to determine operation effects on migration rates, route, orientation, and entrainment, over a full range of permitted and operational conditions. The release of radio-tagged fish upstream of the project, and induction into the power canal, will provide data on concerns of delay and route selection to the canal, downstream bypass, crest gates, and turbines. Additionally, since fish can drift a considerable distance downstream after they have died (Havn et al. 2017); a minimum of 50 dead alewife should also be released as a control group in this study.

#### Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

Boott does not propose any studies to meet this need. Estimated costs for the study are expected to be moderate to high, between \$100,000 and \$300,000, with the majority of costs associated with equipment (radio tags, radio receivers) and related field work labor.

#### REFERENCES

Havn, T. B., F. Økland, M.A. Teichert, L. Heermann, J. Borcharding, S.A. Sæther, O.H. Tambets and E.B. Thorstad. 2017. Movements of dead fish in rivers. *Animal Biotelemetry*, 5: 7.

Normandeau 2013. Juvenile Alosine Radio Tag Attachment Test. Submitted to Boot Hydro, LLC. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 2 pp.

Normandeau 2016. Garvins Falls Juvenile Alosine Downstream Passage Telemetry Assessment. Submitted to Boot Hydro, LLC. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 13 pp.

## Boott Study Request # 5

### Downstream American Eel Passage Assessment (Lowell, P-2790)

#### Goals and Objectives

The goal of this study is to determine the impact of the Lowell hydroelectric project on the outmigration of silver eels in the Merrimack River. Entrainment in the canal and at the conventional turbines at the project powerhouses (E.L. Field, Assets Station, Bridge Street, Hamilton Station, and John Street) can result in mortality or injury. It is important to understand the passage routes at the project and the potential for delay, injury, and mortality to assess alternative management options to increase survival.

The objectives of this study are:

1. Quantify the movement rates (including delays) and relative proportion of eels passing via various routes at the project (i.e., through the turbines, through the downstream bypass, spilled at the dams, etc.).
2. Evaluate instantaneous and latent mortality and injury of eels passed via each potential route.

#### Resource Management Goals

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance, but may now be absent, by providing access to inland waters for glass eel, elvers, and yellow eel, and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the Commission relicensing process.

MassWildlife seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to downstream passage of American eel, MassWildlife's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.



2. Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and the Federal Power Act (16 U.S.C. §791a, et seq.).

#### Public Interest

The requester is a natural resource agency.

#### Existing Information and the Need for Additional Information

Data on downstream migratory movements and rates of American eels past the project are sparse and relatively incomplete. A single study was performed by Normandeau Associates, Inc., in 2017 (Normandeau 2017). Seventeen silver-phase eels were tagged and released into the Merrimack River upstream of the Garvins Falls project. Of the 17 released individuals, 14 approached the Pawtucket dam. Eight were determined to have passed through the gatehouse and enter the forebay canal upstream of the E.L. Field powerhouse. Five eels passed the project via spill flow. One eel's passage route was classified as unknown. Zero individuals used the downstream bypass. This study had a small sample size, was of a relatively short duration (October 20-November 28, 2017), did not include monitoring stations or antenna arrangements in the canal, and was performed prior to the installation of the pneumatic crest gate system.

To date, no other directed studies of eel entrainment or mortality have been conducted at the Lowell Project. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on outmigrating eels and develop adequate passage and protection measures to meet management goals and objectives.

#### Nexus to Project Operations and Effects

The project configuration presents problems with respect to providing safe, timely, and effective passage for outmigrating eels. The intakes are likely deep and, while no specification for the trashracks were provided in the PAD, it is unlikely they would prevent entrainment of eels. The anadromous downstream passage facility at the project is also not expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. Additionally, there are no data pertaining to eel movements in the Lowell canal. Eels which move into the canal potentially have no alternative but to pass through hydropower turbines at the Assets, Bridge Street, Hamilton, and John Street powerhouses. Eels are known to occur upstream of the dam; therefore, it is necessary to understand how eels move through the project and the level of injury and/or mortality resulting from each potential passage route (i.e., the spillway, the downstream bypass facility, or the 21 turbines associated with the project).

#### Methodology Consistent with Accepted Practice

In order to understand the movements of outmigrating silver eels as they relate to operations at Lowell, radio telemetry technology should be utilized. Radio telemetry is an accepted technology which has been used for a number of studies associated with hydropower projects, including at the Bellows Falls (FERC No. 1855), Wilder (FERC No. 1892), and Vernon (P-1904) projects.

Studies should be designed to investigate route selection (i.e., entrainment vs. spill) independently from estimation of mortality/injury, because these metrics require different methodologies. Studies will also likely benefit from data collected over 2 study years (especially route selection studies, which may be more significantly affected by environmental conditions during a given season than mortality/injury studies). It is also envisioned that the results from route selection studies can guide design of turbine mortality studies. Therefore, it is proposed, at a minimum, route selection studies be conducted in multiple years, but mortality/injury studies may be conducted after the first year of route selection studies have been completed.

#### Objective 1: Route Selection

This study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest, to assess general routes of passage (i.e., via spill, bypass, or turbines). Active downstream migrants should be collected within-basin if possible (i.e., Cabot or Holyoke bypass samplers), but fish sourced from out-of-basin may be acceptable to meet sample size demands. Experimental fish must meet morphometric (e.g., eye diameter relative to body size) criteria to ensure they are migrant silver phase. Collections should be made within the migratory season (late August to mid-October), and eels should be tagged and released within 21 days after capture, but preferably within 7 days (particularly if the test eels are from out-of-basin).

All telemetered eels will be radio- and PIT-tagged. PIT antennas will be installed and monitored continuously to verify passage of eels via bypass channels.

A minimum number of 150 telemetered eels (e.g., five separate groups of approximately 30 eels each) will be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Lowell Project. Groups of eels should be released during spill (if any) and non-spill and during periods of low, moderate, and high generation conditions. Up to 50 additional eels should also be released in the upper canal and allowed to volitionally descend through the canal to assure that a sufficient number of eels are exposed to canal conditions. Groups of eels should be released when the canal units are running and when the canal units are off. Additionally, since fish can drift a considerable distance downstream after they have died (Havn et al. 2017), a minimum of 25 dead eels should also be released as a control group in this study.

Telemetry receivers and antennas should be located upstream and downstream of the spillway, at the canal entrance, within the canal, in the downstream fish bypass entrance, at turbine intakes, the station tailrace, and downstream of the confluence of the Merrimack and Concord rivers. These locations will permit assessment of passage via the following potential routes: the power canal; spillway; downstream fish bypass; station turbines; and upstream fishway attraction water intake. The final placement of receivers and antennas should be developed in consultation with the fisheries agencies.

Mobile tracking (i.e., via boat) in the River and canal between release sites and several km downstream will be performed at regular intervals during and after releases to confirm routes and fates of passed fish or lost fish.

Movement rates (time between release and detection at radio antenna locations, and between radio antenna locations) of eels passing the projects by various routes will also be quantified.

The route selection portion of this study should occur in both study years.

#### Objective 2: Spill, Bypass, and Turbine Mortality/Injury Studies

Spill, bypass, and turbine mortality will be assessed using a balloon-tag method.

For spill mortality sites (dam spillways and downstream bypasses), tagged eels will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec to minimize the possibility of eels swimming upstream into

the headpond or canal. Passed balloon-tagged eels will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

For turbine mortality sites, tagged eels will be injected into intakes of all 21 units associated with the project, operating at a full range of settings where intake water velocity exceeds 10 ft/sec to minimize the possibility of eels swimming back upstream through the intakes. Passed balloon-tagged eels will be recovered in the tailrace(s) and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

If the balloon-tag mortality component of the study occurs in study year one, all possible route selection sites would need to be evaluated. If the balloon-tag mortality component of the study occurs in study year two, results from the route selection study could be used to inform which sites need to be evaluated for mortality. Eels recovered from balloon-tag studies should not be used for route selection studies.

Data analyses of route selection and mortality (instantaneous and latent) will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies and assessed for potential relationships to passage route selection, migratory delay, and/or passage survival.

These methodologies are consistent with accepted practice.

#### Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The level of cost and effort for the downstream eel passage study will be moderate to high; silver eels would need to be collected, tagged, and released in several locations over the course of the migration season. Antennas and receivers would need to be installed throughout the canal, at the intakes of the E.L. Field powerhouse, at the dam spillways and station bypass and monitored regularly. Data would need to be retrieved periodically, then analyzed. A multi-site route selection study conducted by the USGS Conte Lab on the Shetucket River in Connecticut cost approximately \$75,000 for the first year of study. Costs are estimated at \$100,000 per year for the route selection study and \$50,000 to \$75,000 for the spill, bypass, canal, and turbine mortality/injury study.

Boott did not propose any studies to meet this need in the PAD.

#### REFERENCES

Havn, T. B., F. Økland, M.A. Teichert, L. Heermann, J. Borcharding, S.A. Sæther, O.H. Tambets and E.B. Thorstad. 2017. Movements of dead fish in rivers. *Animal Biotelemetry*, 5: 7.

Normandeau Associates, Inc. 2017. Downstream Passage Evaluation for Silver-Phase American Eels at the Lowell Hydroelectric Project. 2017. Submitted to the City of Holyoke Gas and Electric Department. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 17 pp.

## Boott Study Request # 6

### Operations Analysis of the Lowell Canal (Lowell, P-2790)

#### Goals and Objectives

The goal of this study is to understand the operations of the Lowell canal system. The specific objective of this study is to describe the operations of the Lowell canal (how all of the canal units interact with the main units, how the canal units are sequenced, how often each of the units operate, the prioritization sequence of canal unit operations, the amount of time the units are operated during the downstream passage season, etc.).

#### Resource Management Goals

MassWildlife seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to aquatic resources, MassWildlife's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Minimize current and potential negative project operation effects on fish in the project area.

#### Public Interest

The requestor is a natural resource agency.

#### Existing Information and the Need for Additional Information

The Merrimack River supports a variety of migratory fish species. However, there is no information pertaining to fish mortality and population effects resulting from entrainment in the canal and/or the canal units. Since there are no exclusionary measures at the entrance of the project's canal system, fish can easily enter the two-tiered network of man-made canals, which are approximately 5.5 miles in length. These man made canals provide flow to 19 Boott-owned hydroelectric units. Since obtaining the original license for the project, there have been no directed studies of the Pawtucket, Western, Merrimack, or Hamilton canal units. Additionally, the PAD provides little operational information regarding the canal: flows of up to 2,000 cfs are routed into the canal, typically once the E.L. Field station's hydraulic capacity of 8,000 cfs has been reached. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on riverine fishes and migratory alosines which may be moving through, or inhabiting, the canal and develop adequate passage and protection measures to meet management goals and objectives.

#### Nexus to Project Operations and Effects

The Lowell Project consists of a two-tiered, 5.5-mile-long, network of man-made canals which include several small dams and 19 turbine units. Flows enter the canal system upstream of the Pawtucket dam via the Pawtucket canal.

There are no exclusionary measures for fish in place. Therefore, the Lowell canal presents problems with respect to providing safe, timely, and effective passage for fish trying to move past the project through the canal system.

#### Methodology Consistent with Accepted Practice

In order to determine the relative risk the canal units present to riverine and migratory fishes, it is necessary to understand how the canal operates. Therefore, we request Boott provide a detailed description of the operational protocol it uses to determine when and how much water flows into the canal at a time scale relevant to the migratory fish species expected to potentially utilize the canal as a passage route (e.g., May, June, and July for spent alosines; August through November for adult eels and juvenile alosines). Historical operations data should be examined relative to the hydrological data set to determine the percent of time the canal units would be expected to operate during each passage month. This analysis should be used in conjunction with the results of the passage route and turbine mortality studies to estimate total through project mortality for each target fish species/life stage.

#### Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The expected level of effort and anticipated cost will be low. Operations and hydrologic data are readily available and only need to be compiled and analyzed. We estimate the cost to be less than \$10,000.

## Boott Study Request # 7

### Three-Dimensional Computational Fluid Dynamics (CFD) Modeling in the Vicinity of Fishway Entrances and Powerhouse Forebays (Lowell, P-2790)

#### Goals and Objectives

The goal of this study is to determine the flow field conditions which exist in and around fishway entrances and the powerhouse forebay. The information from this request is meant to be coupled with data from the telemetry studies, such that a comprehensive understanding of fish behavior is developed.

The objective of this study is to create a series of color contour maps of velocity magnitude at select discharges agreed upon by the resource agencies and the licensee. With respect to upstream passage, the results will show approach velocities and flow fields that may create a response in fish. This information can be coupled with telemetry data (from the requested shad and river herring telemetry study) and passage counts to understand which conditions are optimal for guiding migrating fish to the fishway entrances and stimulating fishway entry.

With respect to downstream migration, the results will show velocities and flow fields in front of the E.L. Field powerhouse. Additionally, the results will indicate to what degree, if any, flow directs downstream migrating fish towards the downstream bypass facility.

#### Resource Management Goals

The management goals of this study request are to obtain information that will assist in enhancing the effectiveness of the current upstream fish passage facilities for upstream migrating trust species and reduce impingement, entrainment, and delay for downstream migrating fish. CFD models are a relatively cost effective way to analyze existing and future conditions. As such, changes in the amount of attraction water, changes in which turbines are operating, and which spillway gates are releasing water can all be examined. As stated, the results from this study are meant to be used along with the data generated from the requested telemetry study. The combined analysis from these two data sources can help assess which flow conditions are most advantageous for migrating trust species to enter the fishway under current and proposed conditions.

As for downstream migration of adult and juvenile shad, river herring, and adult eel, the results from the models will reveal flow magnitude and direction in front of the powerhouse. Given the limited information that currently exists on survival through the project, our management goal is to direct as many downstream migrating fish as possible towards the downstream bypass facility. With respect to upstream passage, we want to maximize the number of fish that find and enter the fishway entrances.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and the Federal Power Act (16 U.S.C. §791a, et seq.).

#### Public Interest

The requestor is a natural resource agency.

#### Existing Information and the Need for Additional Information

To date, no CFD modeled data exists in front of either the fish ladder or lift, nor do they exist in front of the E.L. Field powerhouse. A comprehensive understanding of fish behavior at the ladder and lift entrance, and the powerhouse forebay, is needed in order to create safe, timely, and effective upstream and downstream passage for American shad, river herring, and eels. Additionally, a better understanding of flow and how it affects fish passage is needed after Boott performs the ledge removal excavation project.

#### Nexus to Project Operations and Effects

The Lowell Project has direct impacts to upstream and downstream migrating shad, river herring, and eel. The development of these models will give resource agencies valuable information into the hydraulic cues which may elicit a response from upstream migrants. For downstream passage, MassWildlife has approach velocity guidelines; the output from these models would inform the resource agencies under what conditions appropriate approach velocities are being met and when they are being exceeded.

With respect to upstream migration, the auxiliary water system (AWS) plays a critical role in determining whether or not fish are attracted to the entrance. The results from this study would allow us to assess how well the AWS is performing and under what conditions it attracts the most fish.

With respect to downstream migration, the development of a CFD model under existing conditions also informs the design of future modifications and improves the survivability of downstream migrating shad, river herring, and eel.

The CFD models for the Pawtucket fishway and fish lift should be developed as part of year two studies, after the ledge excavation project is complete. It would be useful to have the gatehouse area CFD modeling completed in year one. This analysis may provide information on adjustments to canal operations or structures that can subsequently be analyzed.

Understanding the entrance conditions of the Pawtucket fishway under a range of spill conditions would be informative. If developed prior to the year one upstream shad telemetry studies, it would provide information on spill gate settings which would likely best achieve entrance and ultimately passage. Further work with the model can help in evaluating changes in ladder entrance or spill conditions that could improve passage and be tested with telemetry, video, and/or count data.

CFD modeling of the flows leading to the canal would aid in our interpretation of year one downstream passage telemetry results, but would not need to be completed prior to the year one telemetry (downstream juvenile alewife and downstream eel) studies. Those studies will provide the context for how and where shad, river herring, and eels are passing the project and how successful passage is. The CFD modeling could focus on the locations identified as important in the study results and Boott could assess changes to structures or operations and evaluate them in the model. Promising alternatives would then be tested in year three studies.

#### Methodology Consistent with Accepted Practice

A three-dimensional CFD model has become an increasingly common standard of analysis at hydroelectric projects around the nation. Within the northeast region, we have seen these types of models developed at the Holyoke (P-2004), Brunswick (P-2284), Shawmut (P-2322), Milford (P-2534) and Orono (P-2710) projects. We would expect to engage with the licensee in terms of determining the appropriate area and flows to be modeled. We expect the spatial extent of the model at each study site will vary. Given the large number of ways in which output from these models can be presented and the near infinite number of flows which could potentially be modeled, we would expect to consult with the licensee to reach agreed upon modeling efforts and scenarios to be examined.

#### Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The cost of developing, running and testing a CFD model can vary tremendously; one large variable in determining the cost is based on the amount of existing bathymetric data to which Boott currently has access. We roughly estimate that the cost of each CFD model could run as high as \$50,000, assuming no bathymetric data currently exists. Proactive communication with resource agencies will reduce the cost and iterative effort. Given the level of effort that has occurred at other projects that have proposed to amend their license, we see the level of effort requested here as reasonable, given that Boott is seeking a renewal of its license.



## Boott Study Request # 8

### Bypass Reach Zone of Passage Study (Lowell, P-2790)

#### Goals and Objectives

The goal of this study is to determine zone-of-passage flows in the bypass reach which facilitate safe, timely, and effective fish passage through the project.

Specifically, the objectives of this study are:

1. complete a detailed survey of the bypass reach;
2. develop a high-resolution, two-dimensional hydraulic model of the bypass reach;
3. release multiple flows from the dam to collect calibration data for the model;
4. simulate additional flows through the bypass reach with the calibrated model; and
5. determine minimum and optimal zone-of-passage flows for the project.

#### Resource Management Goals

MassWildlife seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to aquatic resources within the Lowell bypassed reach, MassWildlife's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide a flow regime in the bypassed reach that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) and diadromous fishes.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, et seq.), and the Federal Power Act (16 U.S.C. §791a, et seq.).

#### Public Interest

The requester is a natural resource agency.

#### Existing Information and the Need for Additional Information

Article 36 of the original license required the licensee, in consultation with resource agencies, to develop an in-stream flow study plan to determine: (1) 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 (i.e., zone of passage). After completion of the approved studies, the licensee was to file a report

on the results of the studies, and, for Commissions approval, recommendations for the flow releases from the project. The study plan was filed on August 13, 1983, with proof of agency consultation (Accession No. 19830818-0191). However, there are no study reports included in the record. Therefore, we have no quantitative data supporting the agreement that 300 cfs at night and 500 cfs during the day are adequate flows for zone of passage in the bypass reach.

In the Comprehensive Fish Passage Plan filed on March 9, 2000 (Accession No. 20000313-0322), the licensee states “The adequacy of flows for upstream fish passage at the Project was addressed by BHI’s construction of six (6) concrete flow control weirs (with adjustable stoplog sections) in the bypass reach, at the request of U.S. Fish and Wildlife Service and in response to Article 36, section (2) of the Project’s FERC license.” Similar to the study plan, this is an agreement with no supporting information to substantiate the conclusion flows in the bypass reach are adequate for the full suite of diadromous species.

As part of compliance for Article 34 of the original license, the licensee filed as-built drawings of the existing fish passage facilities (Accession No. 19860902-0215). Within this abbreviated drawing set, drawing number 344D-PC001, 3844D-FC001, and 3844D-FC004 show topographic surveys for portions of the bypass reach. However, the drawings do not document the accuracy and precision of the survey, do not show the majority of the bypass reach, and are otherwise illegible.

Since agreeing upon the current zone-of-passage flows during the original license, there have been developments in topographic survey capabilities, a better understanding of the hydraulic requirements of diadromous species, multi-dimensional hydraulic modeling capabilities, and an increased need to pass fish at the spillway ladder.

#### Nexus to Project Operations and Effects

Diadromous fish orient their migration based on the environmental conditions of the river: flow, depth, velocity, and temperature (Goodwin 2014). Project operations affect the environmental conditions in the River, specific to this study request, the bypass reach. Two key hydraulic model outputs from the requested study are depth and depth-averaged velocity, which can be used to determine the likelihood of predation, delay, and the cessation of migration. Evaluating the flow fields in the bypass reach under different spill conditions will assist in the consultation process for determining an appropriate zone-of-passage flow in the bypass reach to optimize fish passage at the project. These data will also contribute to the development of an administrative record in support of a potential settlement agreement, Section 18 fishway prescriptions, or 10(j) recommendations.

#### Methodology Consistent with Accepted Practice

We proposed the following methodology to accomplish the five objectives and ultimately the goal of the study, to determine zone-of-passage flows for the bypass reach.

##### Topographic survey

The bypass reach area is large, making traditional topographic survey methods laborious and costly. We recommend using Light Detection and Ranging (LiDAR) methods with limited traditional surveying. Outside of the fish passage season and during a river flow when the project is in control of the River, the bypass reach will be mostly dewatered. At this time, a licensed surveyor can fly the area to collect LiDAR data. Once this data is processed, traditional methods will fill in the gaps (e.g., pooled water areas, under bridges). The topographic survey shall be of sufficient resolution and quality to complete the remaining objectives.

##### Two-dimensional hydraulic model

There are many two-dimensional hydraulic models that are acceptable for accomplishing the goal of this requested study, many of which are open source. We are not requiring one model over the other, but Boott should understand and document the limitations of the modeling software used. At a minimum, the modeling output should produce depth-average velocity and depth for each cell in the mesh. The modeling domain shall be of sufficient size and mesh to delineate a zone of passage through the entire length and width of the bypass reach.

#### Calibration flows

The licensee should collect calibration data by spilling a minimum of two flows from the Pawtucket dam. The calibration flows should bracket the range of simulated flows in the study. We recommend 300 cfs for the low flow as it represents the current lowest operation flow for the fish ladder. For the high calibration flow, we recommend collecting data near the high fish passage design flow (i.e., the 5 percent exceedance value for the migratory period of record) which is approximately 26,000 cfs in the Merrimack River (bypass flow would be approximately 17,000 cfs with full project operation). Boott should collect calibration data (depth-averaged velocity and depth) with an Acoustic Doppler Current Profiler (ADCP) at a minimum of four cross sections, including the downstream boundary condition and use the ADCP in locations spread evenly throughout the bypass which are less turbulent.

#### Additional flow simulations

After calibrating the model, additional bypass flows should be simulated (and agreed upon with the natural resource agencies), including 500 cfs, 1,000 cfs, and up to the high calibration flow. The additional simulations should represent the full range of hydraulic conditions in the bypass reach from the low to high fish passage design flow.

#### Zone-of-passage determination

The model output should be used to delineate a zone-of-passage pathway for each of the modeled flows. To determine the zone of passage, we recommend Boott use the SprintSwim model developed by U.S. Geological Survey researchers (Haro et al. 2004).

#### Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The licensee should be able to finish the bypass zone-of-passage study in one year depending on seasonal flow conditions. The level of effort and cost is commensurate with a project the size of the Lowell facility and the likely license term. No alternatives are proposed.

#### REFERENCES

Goodwin, R. A., M. Politano, J.W. Garvin, J.M. Nestler, D. Hay, J.J. Anderson and M. Timko. 2014. Fish navigation of large dams emerges from their modulation of flow field experience. *Proceedings of the National Academy of Sciences*. p. 201311874.

Haro, A., T. Castro-Santos, J. Noreika and M. Odeh. 2004. Swimming performance of 716 upstream migrant fishes in open-channel flow: a new approach to predicting passage through velocity barriers. *Canadian Journal of Fish and Aquatic Science*. 61: 1590-1601.

## Boott Study Request # 9

Fish Assemblage Assessment  
(Lowell, P-2790)

### Goals and Objectives

The goal of this study request is to determine the assemblage of fish species present in the areas affected by the Lowell Hydroelectric Project, which potentially includes Species of Greatest Conservation Need (SGCN) for Massachusetts.

Specific objectives include:

- 1) Describe fish assemblage structure, distribution and abundance within the project affected area along spatial and temporal gradients.
- 2) Compare historical records of fish species occurrence in the project area to results of this study.

### Resource Management Goals

The mission of the Massachusetts Division of Fisheries and Wildlife (MassWildlife) is to protect and conserve fish, wildlife and their habitats. Anadromous, Catadromous, and Riverine fish species are important components of the river's ecology and are the basis for the sport fishery.

Our study requests are intended to facilitate the collection of information necessary to conduct impact analyses and develop reasonable conservation, protection, mitigation and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 et seq.), the Federal Power Act (16 U.S.C. §791a, et seq.), the Clean Water Act (33 U.S.C. §1251 et seq.), and the WPA.

Determining species occurrence, distribution, and abundance of fish species more generally will better clarify what species occur in the project area both spatially and temporally relative to habitats which may be affected by Project operations. This information will better inform results from other study requests that will be examining the effects of Project operation on various aquatic habitats, water quality and other related concerns. This information will be used to make recommendations and enable full consideration for all species, including those that might not otherwise be known to occur in the Project-affected area and impacts that may affect their population status through direct or indirect effects of Project operations.

### Public Interest

The requestor is a fish and wildlife resource agency, with regulatory authority under the MESA and the WPA.

### Existing Information

The PAD cites general information on the fish community found in the Lower Merrimack River Management Plan which is 10 years old (Lower Merrimack River Local Advisory Committee [LMRLAC] 2008) and is unclear on where the information come from.

### Nexus to Project Operations and Effects

Project operations have the potential to directly impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, headpond and tailwater water level fluctuations could dewater important spawning areas, limiting productivity of fish species by direct impacts to their spawning success and indirectly limiting the spawning success of forage fish species. Accordingly, a thorough understanding of the current fish assemblage structure and associated metrics are needed in order to examine potential Project impacts. Determining species distribution and abundance will better clarify what species occur in the Project area, spatially and temporally, relative to habitats that may be affected by Project operations.

The information requested through this study will help assess how the Project has and will affect the structure, distribution and abundance of fish species, and help the Division develop recommendations that will protect and/or enhance populations of these species.

#### Methodology Consistent with Accepted Practice

An accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting fish species likely to be present in the project-affected areas (Bonar et al. 2009) should be used to conduct field surveys. Fish sampling, measuring length and weight, and calculating associated metrics are commonly used methods to determine fish assemblages and assess fish populations (Bonar et al. 2009). Randomly sampling multiple habitat types using a multi-gear approach will be required to ensure that all fish species present are sampled. The spatial scope of the study will be from the upstream extent of the impoundment downstream to the head of the Lawrence Projects impoundment, including the bypassed reach. Sampling should occur at each selected site across multiple seasons (spring, summer, and fall). Digital photographs should be taken to avoid misidentification of certain species such as Cyprinids.

This will be a one-year study, provided river discharge conditions fall within the 25<sup>th</sup> to 75<sup>th</sup> percentile for weekly averages.

#### Specific Methodology

The study will employ a stratified-random sampling design. The study area will be divided into strata based on mesohabitat type. Each mesohabitat type will be further stratified into two broad microhabitat types. Proposed sampling methods include daytime boat/barge electrofishing, nighttime boat electrofishing, gill nets, seine nets, and minnow traps. Sampling should be performed during in the spring, summer and fall.

The stratified random sampling design will randomly assign sampling stations within particular mesohabitat types in proportion to their linear habitat distance. Multiple methods of fish capture will be used in each stratum, and both near-shore (shallow) and mid-channel (deep) habitats will be sampled to evaluate the potential differential effect of hydropeaking on the fish species and life stages that utilize these two habitat types (Bain 1985). Selected locations within each station will be sampled either by day and nighttime boat/barge electrofishing (shoreline and littoral habitat), gill nets (deeper, benthic areas), seine net (wadeable shoreline and littoral habitat), minnow traps, and eel pots. The exact number of sampling locations will be dependent on the weighted stratification of the study area by mesohabitat and sampling within each station will be further stratified by depth and proximity to shore.

In addition to biological data, supporting data also will be collected for each sample site including: location (GPS), sampling gear type, sampling effort, mesohabitat type, average depth, average velocity, river flow, water temperature, turbidity, predominant substrate, time of day, day of year, presence of cover, and proportion of vegetation cover. All data will be recorded on dedicated data sheets.

All data will be standardized by effort expended (seconds of electrofishing, net/trap-hours, and number of seine hauls). Catch per unit effort (CPUE) and standard errors will be calculated for each species, station, and sampling technique. Data will also be separated into groups by size and a CPUE per size group will be calculated. Values of CPUE for each segment and gear type will be calculated as the sum of catch from all samples within a station divided by the sum effort expended within that station. The Shannon-Weiner index of diversity, which is a function of species richness and evenness, will also be calculated.

Information collected during this study will be compiled and presented in a final report. The report will include tabular data summarizing length, weight, and size class of fish captured, a map of the study area to depict the location of sample stations, and overall results including occurrence, distribution and relative abundance. Comparisons will be made with historical records. Results will be described in relation to other studies. Raw data should be provided to stakeholders in digital format upon request.

This study design is similar to the one detailed in Study 3.3.11 of FirstLight Power Resources Revised Study Plan for the relicensing of its Turners Falls Project (FERC No. 1889),<sup>1</sup> which was approved by the Commission (with modifications) in its Study Plan Determination letter dated February 21, 2014; therefore, the methodology is consistent with accepted practice.

### Task 1: Sampling Location Selection

During this assessment, a stratified-random sampling design will be utilized to provide unbiased and precise fish assemblage data. The proposed design incorporates general river morphology along with mesohabitat through the use of strata and sub-strata. To accomplish this, the underlying strata allow for delineation of the study area spatially, based on locations where changes in river morphology occur.

Due to inherent variability of flows, water levels, and likely fish movements within the study area, different sampling locations will be selected for each sampling event; this statistically valid practice will avoid bias. Prior to field sampling, stations to be sampled will be selected to ensure all mesohabitat types are adequately represented. Mesohabitat types include:

- **Riffle:** shallow, moderate velocity, turbulent, high gradient, moderate to large substrates (cobble/gravel)
- **Rapid:** shallow, moderate to high velocity, turbulent, chutes and eddies present, high gradient, large substrates or bedrock
- **Run:** moderately deep to deep, well defined non-turbulent laminar flow, low to moderate velocity, well defined thalweg, typically concave stream geometry, varying substrates, gentle slope
- **Glide:** moderately shallow, well defined non-turbulent laminar flow, low velocity, well defined thalweg, typically flat stream geometry, typically finer substrates, transitional from pool
- **Pool:** deep, low velocity, well defined hydraulic control at outlet
- **Backwater:** varying depth, minimal or no velocity, long backwatered reaches
- **Impounded:** varying depth, low velocity influenced by the presence of a dam
  - **Nearshore/Shallow:** less than 8ft in depth
  - **Mid-Channel**
  - **Deep water:** depths greater than 20ft

Alternative sampling locations will also be identified by mesohabitat in case a selected sampling station is inaccessible. Furthermore, within each mesohabitat type, each of two general microhabitats will be sampled (Bain 1985):

- Nearshore areas: shallow water and lower flow velocities
- Mid-channel areas: deeper water and higher flow velocities

### Task 2: Fish Capture

A variety of techniques will be used to sample the various habitat types within the study area, including day and night boat/barge electrofishing, gill netting, seining, and minnow traps as described below. The type of gear utilized will be largely dictated by habitat type. In addition to biological data, supporting data will also be collected for each sample site including: location (GPS), sampling gear type, sampling effort, mesohabitat type, average depth, average velocity, river flow, water temperature, turbidity, predominant substrate, time of day, day of year, presence of cover, and proportion of vegetation cover. All data will be recorded on dedicated data sheets. Upon return from the field, data sheets will be reviewed for quality assurance and archived.

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<sup>1</sup> Study 3.3.11 of the Revised Study Plan for the Turners Falls Hydroelectric Project (No. 1889) and Northfield Mountain Pumped Storage Project (No. 2485). August 14, 2013. FirstLight Power Resources.

### *Boat/barge Electrofishing*

Boat electrofishing will occur during the day and at night. Barge electrofishing will be day only. All electrofishing transects will be standardized by time (500 seconds fished) such that a catch per unit effort (CPUE) may be calculated. Boat/barge electrofishing can effectively sample fish from most near-shore littoral habitats present within the Deerfield River (typically 10 feet deep or less).

Electrofishing will be accomplished with the use of a boat electrofisher with the capacity to adjust the pulse rates between 30 - 120 pulses/second and vary voltage to accommodate ambient conductivity. A barge capable of negotiating riffles and shoals, similarly rigged with an electrofishing unit may be deployed for sampling in the shallower riverine habitats.

Electrofishing will be conducted in a downstream manner, following standardized methods developed specifically for large river quantitative electrofishing surveys (MBI, 2002, Yoder and Kulik, 2003). The start point, end point, and boat track for each sampling station will be geo-referenced using a handheld GPS and transposed to corresponding topographic mapping software program to produce maps of areas sampled.

All stunned fish will be collected with ¼-inch mesh dip nets and deposited into a live-well filled with aerated ambient river water. At the conclusion of each sample, all captured fish will be identified to species, classified as adult, juvenile or Young-of-Year (YOY), enumerated, weighed, measured for total length, and then released. If large numbers ( $n > 25$ ) of small fish (YOY fish or cyprinids less than 100 mm) are captured, they will be grouped by size class, enumerated, and batch-weighed with length measurements only taken from one large and one small representative specimen within each group. Fish that are not able to be identified in the field, such as small cyprinids, will be brought back to the lab for identification.

### *Gill Netting*

For sampling deeper habitat sub-strata (Depth 12-25 feet; Depth 25-40 feet; Depth > 40 feet), where electrofishing will not be effective, sampling will be conducted with experimental gill nets consistent with standardized methods for fish capture from rivers (Bonar, Hubert, & Willis, 2009). The nets will be 12-foot high by 100-foot in length and will be constructed of 4 to 5 panels of increasing mesh size (e.g., 1.5, 2, 2.5, 3, 3.5-inch stretched mesh) to accommodate collection of the various sized fish in the project waters.

The nets will be deployed to maximize capture area where water depths are greater than net height. Nets will be set in selected locations and allowed to fish for at least 4 hours prior to retrieval.

The exact locations of each net set will be recorded using a handheld GPS and the time of deployment and retrieval will also be recorded. Fish processing will occur as described above for electrofishing.

### *Seining*

In shallow shoreline locations where boat access may not be feasible sampling will be performed via seining with a 100-ft long, 6-ft deep, 1/4-inch mesh bag seine net.

Seine samples will be collected by extending the net parallel to shore and then pulling the upstream end of the net into the water and in a downstream direction for a 180 degree sweep while the opposite end of the net is held in place (Bonar, Hubert, & Willis, 2009). The start point and end point for each sweep will be geo-referenced using a handheld GPS and transposed to corresponding topographic mapping software program to produce maps of areas sampled. Total fish catch will be processed following each haul in the same manner as described above for electrofishing and gill netting.

### *Minnow traps/eel pots*

For sampling deeper habitat sub-strata (Depth 12-25 feet; Depth 25-40 feet; Depth > 40 feet), where electrofishing will not be effective, sampling will be conducted with minnow traps and eel pots to sample fish too small to be captured by gill nets (minnows) and to determine presence of American Eel. The exact locations of each trap will be recorded using a handheld GPS and the time of deployment and retrieval will also be recorded. Fish processing will occur as described above for electrofishing.

### Task 3: Data Analysis and Reporting

All data will be standardized by effort expended (seconds of electrofishing, net/trap-hours, and number of seine hauls. Catch per unit effort (CPUE) and standard errors will be calculated for each species, station, and sampling technique. Data will also be separated into groups by size and a CPUE per size group will be calculated. Values of CPUE for each segment and gear type will be calculated as the sum of catch from all samples within a station divided by the sum effort expended within that station. The Shannon-Weiner index of diversity, which is a function of species richness and evenness, will also be calculated.

Information collected during this study will be compiled and presented in a final report. The report will include tabular data summarizing length, weight, and size class of fish captured, a map of the study area to depict the location of sample stations, and overall results including occurrence, distribution and relative abundance. Comparisons will be made with historical records. Raw data will be provided to stakeholders in digital format upon request.

#### Level of Effort/Cost, and Why Alternative Studies will not suffice

This study will require sampling of the Project-affected areas of during spring, summer, and fall. Sampling multiple mesohabitat types and from several microhabitat types (including shallow, near-shore microhabitats and deeper, mid-channel microhabitats), and using a multi-gear approach will be required to ensure that all fish species present are sampled. The cost of the study would be moderate to high. Based on first year study results, a second year of sampling or specific studies examining impacts of Project Operations on specific fish species may be requested. MassWildlife estimates the cost of this study to be \$50,000 to \$75,000, based on the estimated cost to conduct a similar study at the Turners Falls Project (FERC No. 1889).<sup>2</sup>

Boott did not propose any studies to meet this need in the PAD.

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<sup>2</sup> Ibid.



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Document Content(s)

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Glenn Normandeau  
Executive Director

## New Hampshire Fish and Game Department

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August 13, 20018

Kimberly D. Bose, Secretary  
Federal Energy Regulatory Commission  
888 First Street, N.E., Room 1A  
Washington, DC 20426

RE: Study Requests for FERC Hydroelectric Projects P-2790 Lowell Hydropower Project located on the Merrimack River in Middlesex County, Massachusetts

Dear Secretary Bose:

As the agency responsible for protecting fish and wildlife resources in New Hampshire, the New Hampshire Fish and Game Department (NHFGD) monitors and attempts to reduce the impacts of hydroelectric facilities on fish and wildlife species and their habitats. The mission of the NHFGD is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources. The NHFGD's 1998-2010 Strategic Plan contains four goals relevant to the relicensing process under the Federal Energy Regulatory Commission (FERC). These goals are to ensure that New Hampshire:

- 1) has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
- 2) has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
- 3) has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
- 4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Also, the New Hampshire Wildlife Action Plan identifies a number of fish and wildlife species of concern, which may be impacted by the project under review. The complete New Hampshire Wildlife Action Plan is available online at: [http://www.wildlife.state.nh.us/Wildlife/wildlife\\_plan.htm](http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm).

Although the Lowell project is not located in the State of New Hampshire, we feel it is prudent to comment on this project and support all study requests because the Lowell hydropower project has the potential to impact fish migrating to and from New Hampshire waters within the Merrimack River watershed. For example, American eel, American shad, River herring, and sea lamprey all have to successfully migrate upstream past the Lowell hydropower facility; in order to reach New Hampshire waters. Additionally, fish that are reared (American shad and sea lamprey), spawn (American shad), and grow to maturity (American eel) in New Hampshire portions of the Merrimack River watershed all have to successfully migrate downstream past the Massachusetts hydropower projects; in order to complete their life cycle.

Boott has not proposed any studies for relicensing at this time, but has identified potential resource issues which include: bypass flows, fish passage, historical resources, boating access, and inundation of upstream floodplains. Relevant to fish and aquatic resources, the Department believes new studies need to be conducted, with sufficient fish sample sizes, to better understand upstream and downstream passage at the project; as well as instream flows in the bypass reach.

### Fish and Aquatic Resources

#### *Downstream Passage*

The Department recommends Boott conduct new studies to fully understand how post-spawned adult shad and river herring, juvenile shad and river herring, and adult silver phase eels move past the Pawtucket dam, through the canal system, turbine intakes, and the downstream bypass facility. In addition, turbine injury and mortality studies are needed and should be used in conjunction with the results of the passage routing studies, where applicable, to calculate total through-project survival rates. The Department herein provides study requests in order to address these information needs.

#### *Upstream Passage*

Yearly site inspections, performed by the USFWS, have identified a number of problems with respect to American shad at the lift and ladder fishway entrances. The Department believes that a comprehensive radiotelemetry study is needed to understand the relationship between project operations, including spill flows, and shad and river herring movement through the Merrimack River (including attraction to and passage through these facilities). Additionally, a study to define the relationship of the complex hydraulic conditions at the spillway fish ladder entrance and the tailrace fish lift entrance is needed in order to evaluate data on fish behavior and passage at those locations. Therefore, the Department is providing herein study requests to address these information needs.

#### *Instream Flows in the Lowell Bypass*

The bypass reach is 0.7 mile long (from the Pawtucket dam to the E.L. Field powerhouse) and contains diverse habitat. There are approximately 11 miles of free-flowing river downstream of the Pawtucket dam which also contain a diversity of habitat, including important spawning and rearing habitat for migratory fish species, such as American shad. To date, there have not been any empirical studies, which assess the adequacy of the existing flow protocols. The Department herein submits study requests intended to address these information gaps.

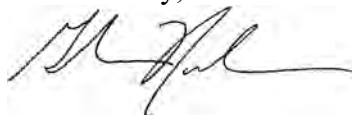
*RECOMMENDED STUDIES*

The following formal study requests will expand on the information presented in the Pre-Application Document (PAD) and lead to informed management decisions intended to reduce impacts on fish and wildlife. It is understood that there is overlap between some of the requested studies, and where appropriate, the NHFGD supports the combination of studies to reduce cost and effort as long as the goals and objectives within each individual study proposal are still achieved.

Enclosed please find our formal study requests (Attachment A) in the format required pursuant to 18 CFR §4.38(b)(5). In addition to the study requests provided herein, please note that NHFGD also supports the study requests submitted by other natural resource agencies, including but not limited to, the Massachusetts Division of Environmental Protection, New Hampshire Department of Environmental Services (NHDES), the Massachusetts Department of Fish and Game (MADFG), National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS).

Thank you for this opportunity to comment.

Sincerely,

A handwritten signature in black ink, appearing to read "Glenn Normandeau", is written over a light gray rectangular background.

Glenn Normandeau  
Executive Director

## **Attachment A**

### Study Request # 1

## **Instream Flow Habitat Assessment of the Lowell Bypassed Reach (Lowell, P-2790)**

### ***Goals and Objectives***

The goal of this study is to determine an appropriate flow regime which will protect and enhance the aquatic resources in the bypass reach between the Pawtucket dam and the E.L. Field powerhouse. Specifically, the objective of this study is to conduct an instream flow habitat study to assess the impacts of a range of project discharges on the wetted area and optimal habitat for key species, including the quantity and location of suitable habitat.

The specific objectives of this field study, at a minimum, include:

1. characterize and map wetted perimeter of the bypass reach over a range of bypass flows;
2. survey and evaluate the water depth and mean channel velocity at transects within the bypass reach over a range of flows; and
3. map and assess the value of aquatic habitat in the bypass reach over a range of flows, focusing on potential habitat for resident species, and spawning and migration habitat or rest/regrouping areas for migratory species.

Target fish species should include American shad, river herring (alewife and blueback herring), fallfish, white sucker, freshwater mussels and benthic macroinvertebrates. The final target species list should be developed in consultation with the fisheries agencies and based on the results of the mesohabitat mapping.

### ***Resource Management Goals***

The Department seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to aquatic resources within the Lowell bypassed reach, the Department's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide a flow regime in the bypassed reach that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) and diadromous fishes.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

### ***Public Interest***

The requester is a natural resource agency.

### ***Existing Information***

The Lowell Project bypasses a 0.7-mile-long section of the Merrimack River, from the Pawtucket dam to the E.L. Field powerhouse. There is presently no required minimum bypass flow. However, during the upstream fish passage season, the bypass reach receives 500 cfs. through operation of the spillway fish ladder. In addition, the bypass reach receives flow whenever inflow exceeds the hydraulic capacity of all the project's stations. Pursuant to Article 37, Boott Hydropower, LLC, (Boott) maintains a minimum flow of 1,990 cfs. or inflow, whichever is less, as measured immediately downstream of the project.

Available information in the PAD does not indicate how project operations have altered downstream hydrology, habitat quantity and quality, and water quality, which may affect resident and migratory fish, macroinvertebrates, aquatic plants and other biota and natural processes in the Merrimack River. The PAD provides no detailed description of the physical or biological characteristics of the bypassed reach.

An empirical study is needed to provide information on the relationship between flow and habitat in the bypassed reach for the Department to use in determining a flow recommendation.

### ***Nexus to Project Operations and Effects***

Although the project license requires Boott to maintain a minimum flow of 1,990 cfs. or inflow (if less), downstream of the project, Boott states in practice the project operates in a true run-of-river mode. The Department is not recommending a below-project flow study based on the assumption that any new license issued for the project will require instantaneous run-of-river operation (essentially codifying current operations).

The project includes a 0.7-mile-long bypassed reach. The current license contains no minimum bypass flow requirement. During the upstream fish passage season, the bypass reach receives 500 cfs. via operation of the spillway fish ladder; otherwise, the reach only receives flow when inflow exceeds the hydraulic capacity of the project's generating capacity. To our knowledge, the lack of a required bypass flow was not based on any quantitative, rigorous scientific studies.

This section of the Merrimack River contains habitat which supports native riverine species, including important spawning and rearing habitat for migratory species like American shad and river herring. While the existing license does not require a minimum bypass flow, the Department believes one is needed to sufficiently protect the aquatic resources inhabiting the bypassed reach.

Results of the flow study should be used to determine an appropriate flow recommendation, which will protect and/or enhance the aquatic resources in the bypassed reach for the duration of any new license issued by the Federal Energy Regulatory Commission (Commission).

### ***Methodology Consistent with Accepted Practice***

Bypass flow habitat assessments are commonly employed in developing flow release protocols which will reduce impacts or enhance habitat conditions in reaches of river bypassed by hydroelectric projects.

Given the size of the bypassed reach (0.7 mile long) and the important resources known to inhabit the reach (i.e., diadromous fishes); we believe a study methodology which utilizes an instream flow incremental methodology (IFIM) approach is appropriate for this site. This same protocol was used during the relicensing of the Housatonic River Project (FERC No. 2576),<sup>1</sup> and has been accepted by the Commission in other licensing proceedings.<sup>2</sup>

The study should have two components. The first component entails mapping habitat within the bypass reach. The number, location, and size (area and linear distance) of each mesohabitat type in the reach should be documented, including qualitative characterizations (e.g., dominant substrate, average depth, overhead and instream cover, etc.). The second component consists of conducting an instream flow study.

At a minimum, the study design should involve collecting wetted perimeter, depth, velocity, and substrate data within a range of discharge levels along transects located in the reach of river between the dam and the E.L. Field powerhouse. The measurements should be taken over a range of test flows, to be agreed upon by the natural resource agencies. This information should then be synthesized to quantify habitat suitability (using mutually agreed upon Habitat Suitability Index curves) of each test flow for target species/life stages identified by the fisheries agencies. We recommend Boott perform habitat modeling using one dimensional modeling techniques to better characterize flows and velocities in this complex channel area.

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

Field work for flow studies can be reasonably extensive but will depend on consultation with Boott on study methodology and on-site decisions on locations for data collection and the number of collection locations. Post-field work data analysis would result in a moderate cost and effort. We anticipate that the level of effort and costs will be comparable to those experienced on similar Commission relicensing projects (e.g., the Glendale Project, FERC No. 2801).

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<sup>1</sup> Housatonic River Project License Application, Volume 4, Appendix F. Connecticut Light and Power Company, August 1999.

<sup>2</sup> Glendale Project (FERC No. 2801) Final Bypass Reach Aquatic Habitat and Instream Flow Study in Glendale Hydroelectric Project Application for Subsequent License (FERC No. 2801), Volume 2, Appendix B, pp. 7-8, October 2007.



## Study Request # 2

### **Adult Alosine Downstream Passage Assessment and Protection Evaluation (Lowell, P-2790)**

#### ***Goals and Objectives***

The goal of this study is to assess the adequacy of the turbines at the E.L. Field, Assets, Bridge Street, Hamilton, and John Street powerhouses, to minimize injury, entrainment, and mortality of fishes residing in the Merrimack River, and to recommend appropriate mitigative measures as necessary.

The specific objectives of the field study, at a minimum, are: (1) assess the risk of adult American shad and alewife becoming injured, impinged, or entrained in the E.L. Field, Assets, Bridge Street, Hamilton, and John Street powerhouse units; (2) estimate turbine survival; (3) assess the risk of injury or mortality at the spillway and downstream bypass; and (4) evaluate potential passage and protection measures.

#### ***Resource Management Goals***

The Atlantic States Marine Fisheries Commission has developed several documents related to the management of American shad and river herring:

1. Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. (Report No. 35). April 1999.
2. 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.
3. Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. May 2009.
4. Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.

Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring includes an objective of maximizing the number of juvenile recruits emigrating from freshwater stock complexes and recommends enhancing survival at dams during emigration by evaluating survival of post-spawned adults and juvenile fish passed via each route (e.g., turbines, spillage, bypass facilities, or a combination of the three) at any given facility, and implementing measures to pass fish via the route with the best survival rate.

Specific to resident riverine and migratory fish entrainment, the Department's goals are:

1. Minimize current and potential negative project operation effects such as turbine entrainment that could hinder management goals and objectives.
2. Minimize project-related sources of mortality to resident and migratory fishes in order to restore natural food web interactions and ecosystem functions and values.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and

protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

### ***Public Interest***

The requestor is a natural resource agency.

### ***Existing Information and the Need for Additional Information***

No project-specific information exists regarding risk of impingement and/or entrainment of adult alosines. In the PAD, Boott provided little information, which would inform the relative risk of impingement or entrainment in any of the 21 units associated with the project. Moreover, information regarding fish mortality at the spillway and the downstream bypass was not discussed. While Normandeau Associates, Inc., performed a study in 2003 pertaining to the survival of Atlantic salmon smolts through the turbines, (1) the sample size was small (20 fish); (2) the study was not performed at a full range of gate settings; and (3) salmon are a robust fish species and cannot be used as a proxy for alosines. The 2003 study did shed light on a predation issue, however, in the project's tailrace. Of the salmon that passed downstream, 69 percent were suspected to be preyed upon after using the downstream bypass facility. As Normandeau Associates, Inc., noted in their study results, predators residing in the tailrace can have a large impact on emigrating migratory fish species that use the current bypass facility at the project.

To date, no directed studies of alosine injury, entrainment, or mortality have been conducted at the project's modified spillway, the downstream fish bypass facility, or through the turbines. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on outmigrating adult alosines and develop adequate passage and protection measures to meet management goals and objectives.

### ***Nexus to Project Operations and Effects***

Hydropower projects generate electricity by moving water through a turbine-generator system. Typically, there are trashracks in front of the intakes leading to the turbines. If the rack spacing is narrow and the velocities at the racks too high (relative to the swim speeds of fish species inhabiting or moving through the headpond), fish may become impinged against the racks and die. If the rack spacing is wide and the velocities too high (relative to the swim speeds of fish species inhabiting or moving through the headpond), fish may become entrained (i.e., pass through the racks) and get injured or die while passing through the turbines.

Lowell's configuration likely presents problems with respect to providing safe, timely, and effective passage for outmigrating alosines. Pre-spawned adult American shad and river herring pass upstream through the Lowell fishways and/or are stocked into upstream habitats. These fish need to be able to migrate back downstream because they are iteroparous in this region. Therefore, it is necessary to understand how alosines move through the project area and the level of injury or mortality caused by entrainment through the project's turbines and/or passage via the dam spillway and downstream bypass facility.

### ***Methodology Consistent with Accepted Practice***

The Department proposes a phased approach to this study.

### Phase 1:

Spill, bypass, and turbine mortality should be assessed using a balloon-tag method. For spill mortality sites (dam spillway and downstream bypass), tagged alosines will be injected or released into spill flow at points where water velocity exceeds 10 ft./sec to minimize the possibility of the fish swimming upstream into the headpond or canal. Passed balloon-tagged alosines will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

For turbine mortality sites, tagged alosines will be injected into the intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft./sec to minimize the possibility of fish swimming back upstream through the intakes. Passed balloon-tagged alosines will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

### Phase 2:

Boott should investigate existing or potential future operational and/or physical measures that would minimize injury or mortality to outmigrating adult alosines moving past the project. Based on the results of this investigation, we recommend Boott provide a range of potential alternatives (e.g., increasing attraction to the existing downstream bypass, installing exclusionary screening, etc.).

Project operations (flows, levels, gate openings, number of units operating, and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) should be monitored regularly (hourly measurements if possible) throughout the duration of the study.

These methodologies are consistent with accepted practice.

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

The cost and effort of each individual phase of this study are expected to be moderate. Based on the scale and scope of the subject study, we estimate the cost to be \$25,000 to \$50,000. In the PAD, Boott proposes no studies to address this issue. The Department is not aware of any previously conducted or ongoing studies related to impingement, entrainment or survival of adult alosines at the project.

### **REFERENCES**

Normandeau. 2003. Passage Route Selection and Survival of Atlantic Salmon Smolts Passed through the Lowell Hydroelectric Project. Submitted to Boot Hydro, LLC. Final report. Normandeau Associates, Inc. Westmoreland, New Hampshire. 130 pp.

## Study Request # 3

# **Telemetry Study of Upstream and Downstream Migrating Adult American Shad and River Herring to Assess Passage Routes, Effectiveness, and Delay (Lowell, P-2790)**

### *Goals and Objectives*

The goal of this study is to assess the behavior, approach routes, passage success, survival, and delay of adult American shad and river herring as they encounter the Lowell Project during their upstream and downstream migrations to determine if project operations negatively impact their survival and production.

The following objectives will address this request:

1. assess project operations effects on the timing, orientation, routes, and migration rates of shad and river herring;
2. determine route selection and behavior of upstream migrating shad and river herring at the project under varied operational conditions, including a range of spill conditions (e.g., movement to the dam, attraction to the E.L. Field station discharge, movement between locations, delay, timing, etc.);
3. determine delay/fallback associated with the northern canal;
4. assess near field attraction to, and entrance efficiency of, the fish lift under a range of spill conditions and with the river-side entrance and street-side entrances open;
5. assess near field attraction to, and entrance efficiency of, the spillway ladder under a range of spill conditions;
6. evaluate the internal efficiency of the Pawtucket dam ladder;
7. collect ladder and lift efficiency data, to include rates of approach to fishway entrances, entry into fishways, and passage under varied operational conditions, including a range of spill conditions;
8. determine the proportion of post-spawned adults that select the power canal as a downstream passage route under varied operation conditions, including a range of spill conditions up to full spill; determine post-spawned adult downstream migration route selection, passage efficiency, and delay associated with the power canal under various operational conditions, including a range of spill conditions; and
9. compare rates and measures of delay and movement among project areas and routes utilized (e.g., spill at dam vs. power canal) under the range of permitted and proposed spill and operational conditions.

If project operations are adversely affecting shad or river herring migration timing or are resulting in other deleterious population effects, we recommend Boott identify operational solutions or other passage measures that will reduce and minimize these impacts within the project area.

This study will require 3 years of field data due to the tailrace ledge excavation project which will be completed in 2019 and to capture inter-annual variability of river discharge, water temperatures, and variability in outmigration timing. We recommend Boott perform the downstream routing portion of the study in 2019 (pre-ledge excavation) and 2020 (post-ledge excavation). In 2020 and 2021, after the ledge has been excavated, we recommend Boott perform the upstream portion of this study.

## ***Resource Management Goals***

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring, approved in 2010, includes the following objectives:

### Upstream Passage

1. Fish must be able to locate, enter, and pass the passage facility with little effort and without stress.
2. Where appropriate, upstream fish passage effectiveness should be improved through operational or structural modifications.
3. Fish which have ascended the passage facility should be guided to an appropriate area so they can continue their upstream migration and avoid being swept back downstream.

### Downstream Passage

1. Enhance survival at dams during emigration.
2. Evaluate survival of post-spawned adults and juvenile fish passed via each project route (e.g., turbines, spillage, bypass facilities, or a combination of the three).
3. Implement measures to pass fish via the route with the least delay and best survival rate.

The Department seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to American shad and river herring movement and migration, the Department's goal is to minimize current and potential negative project operation effects on the safe, timely and effective upstream and downstream passage of adult American shad and river herring.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), the Atlantic States Marine Fisheries Compact (P.L. 539, 77<sup>th</sup> Congress, as amended by P.L. 721, 81<sup>st</sup> Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

## ***Public Interest***

The requestor is a natural resource agency.

## ***Existing Information and the Need for Additional Information***

Several studies pertaining to the fish lift and downstream passage facilities at Lowell have been conducted for American shad. Studies of alewife passage are limited to a single

downstream test performed in 1991. Previous studies pertaining to upstream shad migration (listed in Table 5.4-3 of the PAD) demonstrate passage through the existing lift at Lowell is relatively poor. Also, when analyzing annual passage counts for river herring and shad, the number of fish which utilize the Lowell lift versus those that pass at Lawrence is low (from 1996 to 2017 passage efficiency at Lowell has not exceeded 30 percent).

Until 2016, the fish lift has been the primary route of upstream passage at the project. The ladder, located at the Pawtucket dam, has typically only been operated during periods of high flow. Therefore, to date, studies performed at Lowell have not tested the near field attraction, entrance efficiency, or internal efficiency of the ladder. Moreover, past studies have had statistically low sample sizes (less than 60 fish) and were all performed prior to the ledge excavation project which will occur in August 2019. Future studies should have a robust sample size (at a minimum, 150 fish per species) and array system. Additionally, to obtain a comprehensive understanding of fish behavior at Lowell, for both upstream and downstream migration, studies are needed to: (1) determine if project operations affect pre-spawned and post-spawned river herring and shad migration timing; (2) assess fish movement to, and through, the ladder at the Pawtucket dam; and (3) assess passage success at the tailrace fish lift post-ledge removal.

### ***Nexus to Project Operations and Effects***

Lowell tailrace turbulence (potentially exacerbated by the existing ledge outcropping) creates attraction issues at the entrance of the fish lift. Moreover, a lack of effective protection at the 21 turbines associated with the project increases the risk of entrainment and mortality alosines may experience as they migrate downstream to the ocean. During the upstream fish passage season, the Lowell bypass reach receives 500 cufs. during the day and 300 cfs. at night via operation of the spillway fish ladder; otherwise, the reach only receives flow when inflow exceeds the hydraulic capacity of the project's generating capacity. The spillway ladder is, therefore, only partially effective due to lack of flow.

Existing project operations and limited bypass flows can have a direct impact on diadromous fish migration. Migration delays, increased predation, mortality during passage over the dam or through turbines, and changes in route selection under different flow conditions are potential influences of the project on shad and river herring populations in the Merrimack River. Effective upstream and downstream passage and successful spawning and juvenile production are necessary to help achieve shad and river herring management restoration goals for the Merrimack River, particularly in the upstream reaches.

### ***Methodology Consistent with Accepted Practice***

The movement of migratory shad and river herring would be best studied by using radio telemetry, including passive integrated transponder (PIT) tags. Radio telemetry is an accepted technology that has been used for a number of studies associated with hydropower projects, including at the Bellows Falls (FERC No. 1855), Wilder (FERC No. 1892), and Vernon (P-1904) projects.

The study design must specify sample sizes, as well as tag and receiver configurations, to ensure rates of entry and exit to the tailrace, fish lift and fish ladder, downstream bypass, the bypassed reach, and canal, can be calculated with sufficient precision. We recommend Boott capture shad and river herring below Lawrence and tag at least 150 individuals per species. Double-tagged (radio and PIT) shad and river herring should be released upstream of the Lawrence dam and upstream of the Lowell dam. Fish should also be released directly into the Pawtucket canal to adequately assess project conditions likely to be encountered during

downstream migration. Additional, tagged, individuals may need to be released farther upstream to ensure enough fish encounter the dam during a sufficient range of turbine and operational conditions to test for project effects (especially in 2020 and 2021). A large array of stationary monitoring stations (radio and PIT) will be needed to provide an appropriate level of resolution for data analyses and to answer the natural resource agencies' questions regarding project operation effects. Additionally, since fish can drift a considerable distance downstream after they have died (Havn et al. 2017); a minimum of 25 dead river herring and 25 dead shad should also be released as a control group in this study. A plan and schedule for spill releases should be developed which provides sufficient periods of spill and various generating levels (treatments will require multiple days of consistent discharge).

Each component of this study will require 2 years of field data collection to attempt to account for inter-annual variability in river discharge, water temperatures, and the ledge excavation project which will be completed in 2019. We recommend Boott perform the downstream routing portion of the study in 2019 (pre-ledge excavation) and 2020 (post-ledge excavation). In 2020 and 2021, after the ledge has been excavated, the upstream portion of this study should be performed.

A related study request on computational fluid dynamics (CFD) modeling in the Lowell tailrace, in and around the fish lift and fish ladder entrances and powerhouse forebay, will complement this study and address related project operational effects.

These methodologies are consistent with accepted practice.

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

Estimated cost for this study is expected to range from \$400,000 to \$500,000, with the majority of costs associated with equipment (radio and PIT tags, radio receivers, and PIT readers) and related field work labor. Since tagged shad and river herring will move throughout the area, to varying degrees, there will be expected cost savings (e.g., radio tags) to Boott, provided cooperation in study planning and implementation occurs.

Boott did not propose any studies to meet this need in the PAD.

### **REFERENCES**

Havn, T. B., F. Økland, M.A. Teichert, L. Heermann, J. Borcharding, S.A. Sæther, O.H. Tambets and E.B. Thorstad. 2017. Movements of dead fish in rivers. *Animal Biotelemetry*, 5: 7.

## Study Request # 4

### **Impact of Project Operations on Downstream Migration of Juvenile Alosines (Lowell, P-2790)**

#### ***Goals and Objectives***

The goals of this study are: (1) conduct a field study of juvenile alewife outmigration in the Lowell impoundment, the power canal, and at the Pawtucket dam, to determine if project operations negatively impact juvenile alosine survival and production; and (2) determine if project operations affect juvenile alosine outmigration survival, recruitment, and production.

The following objectives will address this request:

1. assess project operations effects of the Pawtucket dam on the timing, orientation, passage routes, migration rates, and survival of juvenile alewife;
2. determine the proportion of juvenile alewife that select the Lowell canal versus the Pawtucket powerhouse, downstream bypass facility, or dam spill as a downstream passage route, under varied operational conditions;
3. determine if there are any delays associated with downstream movement related to either dam spill or the Pawtucket powerhouse due to operations;
4. determine the juvenile downstream passage timing and route selection in the Lowell canal, assess delays associated with the canal, and with project operations (e.g., stockpiling in the canal).

If it is determined the project operations are adversely affecting juvenile alosine survival, migration timing, or other deleterious population effects, identify operational solutions or other passage measures which will reduce and minimize these impacts within the project area. This study will require 2 years of field data to capture inter-annual variability of river discharge and water temperatures.

#### ***Resource Management Goals***

The Atlantic States Marine Fisheries Commission Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, includes the following objective:

Maximize the number of juvenile recruits emigrating from freshwater stock complexes.

To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g., turbines, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the best survival rate.

The Department seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.



2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to juvenile American shad and river herring movement and migration, the Department's goal is to minimize current and potential negative project operation effects on the safe, timely and effective downstream passage.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), the Silvio O. Conte National Fish and Wildlife Refuge Act (P.L. 102-212; H.R. 794), the Federal Power Act (16 U.S.C. §791a, *et seq.*), the Atlantic States Marine Fisheries Compact (P.L. 539, 77<sup>th</sup> Congress, as amended by P.L. 721, 81<sup>st</sup> Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

### ***Public Interest***

The requestor is a natural resource agency.

### ***Existing Information and the Need for Additional Information***

The seaward migration of juvenile alosines is of great importance to the restoration of alewife, blueback herring, and American shad in the Merrimack River. However, data on the downstream migratory movements and rates of alosines past Lowell is sparse and relatively incomplete. In 1994 and 1995, Normandeau Associates, Inc., documented the use of the bypass facility by downstream migrating alosines via the installation of a removable box trap. Passage efficiencies were 7 percent and 37 percent, respectively. However, to date, no directed studies of downstream alosine passage route selection has been conducted at the Lowell Project. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on outmigrating juvenile alosines and develop adequate passage and protection measures to meet management goals and objectives.

Studies conducted farther upstream on the Merrimack River, at Garvins Falls (FERC No. 1893), have shown it is possible to radio-tag juvenile alewife to evaluate alosine outmigration (Normandeau 2016). Alewife can be used as a proxy, in this instance, for the natural resource agencies to assess blueback herring and shad downstream migration patterns.

### ***Nexus to Project Operations and Effects***

Adult alosines, passed at Lowell via the fishways and/or stocking efforts, utilize upstream habitat to spawn on an annual basis. Similarly, juvenile alosines require safe and timely downstream passage measures at the project in order to successfully emigrate back to the ocean to contribute to the population. Presently, downstream migrants can easily enter the Lowell canal system, via the Pawtucket canal, as there are no exclusionary measures in place. There are 19 turbines located in the canal, housed at four powerhouses (Assets, Bridge Street, Hamilton, and John Street), none of which have passage or protection measures. There are a variety of unit-types housed in each of the powerhouses, ranging in speed from 100 to 150 rpm. A study is needed to assess the impacts project operations have on outmigrating juvenile alosines.

The Department is not aware of any studies conducted specifically designed to determine:

1. What is the rate of alewife survival under a range of spill and gate configurations?
2. Are there delays in migration/movement at the dam, gatehouse, or in the canal?
3. For juveniles that enter the Pawtucket canal, what proportion subsequently enter the Western, Merrimack, Pawtucket, or Hamilton canals?
4. What is the rate of movement through the canal, what is the delay to juvenile alosine outmigration, and the potential accumulation of juveniles in the canal?
5. What proportion of juvenile alosines use the downstream bypass sluice versus the E.L. Field powerhouse turbines under varied operational conditions?

The Department is concerned project operations are: (1) impacting juvenile alosine outmigration survival; and (2) contributing to the failure of the Merrimack River alosine population to meet management targets.

### ***Methodology Consistent with Accepted Practice***

The impact of project operations to juvenile alewife outmigration, passage route selection, and migratory delay would be best studied via radio telemetry. This methodology has successfully been tested and employed by Normandeau Associates, Inc., at the Garvins Falls hydroelectric project (FERC No. 1893; Normandeau 2013; Normandeau 2016). Project discharge over a full range of existing and, to the extent possible, potential future operational conditions at the dam (likely increased bypass reach flows in new license), should be examined relative to migration rate and passage route selection of juvenile alosines to, and through, various areas of the project.

In addition, study fish should be collected and balloon-tagged to empirically determine rates of survival for fish passed over or through the dam's bypass sluice, main powerhouse, and 19 canal units under varied operations. For spill mortality sites (dam spillway and downstream bypass), tagged alosines should be injected or released into spill flow at points where water velocity exceeds 10 ft./sec to minimize the possibility of the fish swimming upstream into the headpond or canal. Passed balloon-tagged alosines will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

For turbine mortality sites, tagged alosines will be injected into intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft./sec to minimize the possibility of fish swimming back upstream through the intakes. Passed balloon-tagged alosines will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

Radio-tagged juvenile alewife will be released in areas upstream of the project at multiple release locations, to determine operation effects on migration rates, route, orientation, and entrainment, over a full range of permitted and operational conditions. The release of radio-tagged fish upstream of the project, and induction into the power canal, will provide data on concerns of delay and route selection to the canal, downstream bypass, crest gates, and turbines. Additionally, since fish can drift a considerable distance downstream after they have died (Havn et al. 2017); a minimum of 50 dead alewife should also be released as a control group in this study.

***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

Boott does not propose any studies to meet this need. Estimated costs for the study are expected to be moderate to high, between \$100,000 and \$300,000, with the majority of costs associated with equipment (radio tags, radio receivers) and related field work labor.

**REFERENCES**

- Havn, T. B., F. Økland, M.A. Teichert, L. Heermann, J. Borcharding, S.A. Sæther, O.H. Tambets and E.B. Thorstad. 2017. Movements of dead fish in rivers. *Animal Biotelemetry*, 5: 7.
- Normandeau 2013. Juvenile Alosine Radio Tag Attachment Test. Submitted to Boot Hydro, LLC. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 2 pp.
- Normandeau 2016. Garvins Falls Juvenile Alosine Downstream Passage Telemetry Assessment. Submitted to Boot Hydro, LLC. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 13 pp.

## Study Request # 5

### **Downstream American Eel Passage Assessment (Lowell, P-2790)**

#### ***Goals and Objectives***

The goal of this study is to determine the impact of the Lowell hydroelectric project on the outmigration of silver eels in the Merrimack River. Entrainment in the canal and at the conventional turbines at the project powerhouses (E.L. Field, Assets Station, Bridge Street, Hamilton Station, and John Street) can result in mortality or injury. It is important to understand the passage routes at the project and the potential for delay, injury, and mortality to assess alternative management options to increase survival.

The objectives of this study are:

1. Quantify the movement rates (including delays) and relative proportion of eels passing via various routes at the project (i.e., through the turbines, through the downstream bypass, spilled at the dams, etc.).
2. Evaluate instantaneous and latent mortality and injury of eels passed via each potential route.

#### ***Resource Management Goals***

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance, but may now be absent, by providing access to inland waters for glass eel, elvers, and yellow eel, and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the Commission relicensing process.

The Department seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to downstream passage of American eel, the Department's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

### ***Public Interest***

The requester is a natural resource agency.

### ***Existing Information and the Need for Additional Information***

Data on downstream migratory movements and rates of American eels past the project are sparse and relatively incomplete. A single study was performed by Normandeau Associates, Inc., in 2017 (Normandeau 2017). Seventeen silver-phase eels were tagged and released into the Merrimack River upstream of the Garvins Falls project. Of the 17 released individuals, 14 approached the Pawtucket dam. Eight were determined to have passed through the gatehouse and enter the forebay canal upstream of the E.L. Field powerhouse. Five eels passed the project via spill flow. One eel's passage route was classified as unknown. Zero individuals used the downstream bypass. This study had a small sample size, was of a relatively short duration (October 20-November 28, 2017), did not include monitoring stations or antenna arrangements in the canal, and was performed prior to the installation of the pneumatic crest gate system.

To date, no other directed studies of eel entrainment or mortality have been conducted at the Lowell Project. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on outmigrating eels and develop adequate passage and protection measures to meet management goals and objectives.

## ***Nexus to Project Operations and Effects***

The project configuration presents problems with respect to providing safe, timely, and effective passage for outmigrating eels. The intakes are likely deep and, while no specification for the trashracks were provided in the PAD, it is unlikely they would prevent entrainment of eels. The anadromous downstream passage facility at the project is also not expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. Additionally, there are no data pertaining to eel movements in the Lowell canal. Eels which move into the canal potentially have no alternative but to pass through hydropower turbines at the Assets, Bridge Street, Hamilton, and John Street powerhouses. Eels are known to occur upstream of the dam; therefore, it is necessary to understand how eels move through the project and the level of injury and/or mortality resulting from each potential passage route (i.e., the spillway, the downstream bypass facility, or the 21 turbines associated with the project).

## ***Methodology Consistent with Accepted Practice***

In order to understand the movements of outmigrating silver eels as they relate to operations at Lowell, radio telemetry technology should be utilized. Radio telemetry is an accepted technology which has been used for a number of studies associated with hydropower projects, including at the Bellows Falls (FERC No. 1855), Wilder (FERC No. 1892), and Vernon (P-1904) projects.

Studies should be designed to investigate route selection (i.e., entrainment vs. spill) independently from estimation of mortality/injury, because these metrics require different methodologies. Studies will also likely benefit from data collected over 2 study years (especially route selection studies, which may be more significantly affected by environmental conditions during a given season than mortality/injury studies). It is also envisioned that the results from route selection studies can guide design of turbine mortality studies. Therefore, it is proposed, at a minimum, route selection studies be conducted in multiple years, but mortality/injury studies may be conducted after the first year of route selection studies have been completed.

### **Objective 1: Route Selection**

This study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest, to assess general routes of passage (i.e., via spill, bypass, or turbines). Active downstream migrants should be collected within-basin if possible (i.e., Cabot or Holyoke bypass samplers), but fish sourced from out-of-basin may be acceptable to meet sample size demands. Experimental fish must meet morphometric (e.g., eye diameter relative to body size) criteria to ensure they are migrant silver phase. Collections should be made within the migratory season (late August to mid-October), and eels should be tagged and released within 21 days after capture, but preferably within 7 days (particularly if the test eels are from out-of-basin).

All telemetered eels will be radio- and PIT-tagged. PIT antennas will be installed and monitored continuously to verify passage of eels via bypass channels.

A minimum number of 150 telemetered eels (e.g., five separate groups of approximately 30 eels each) will be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Lowell Project. Groups of eels should be released during spill (if any) and non-spill and during periods of low,

moderate, and high generation conditions. Up to 50 additional eels should also be released in the upper canal and allowed to voluntarily descend through the canal to assure that a sufficient number of eels are exposed to canal conditions. Groups of eels should be released when the canal units are running and when the canal units are off. Additionally, since fish can drift a considerable distance downstream after they have died (Havn et al. 2017), a minimum of 25 dead eels should also be released as a control group in this study.

Telemetry receivers and antennas should be located upstream and downstream of the spillway, at the canal entrance, within the canal, in the downstream fish bypass entrance, at turbine intakes, the station tailrace, and downstream of the confluence of the Merrimack and Concord rivers. These locations will permit assessment of passage via the following potential routes: the power canal; spillway; downstream fish bypass; station turbines; and upstream fishway attraction water intake. The final placement of receivers and antennas should be developed in consultation with the fisheries agencies.

Mobile tracking (i.e., via boat) in the River and canal between release sites and several km downstream will be performed at regular intervals during and after releases to confirm routes and fates of passed fish or lost fish.

Movement rates (time between release and detection at radio antenna locations, and between radio antenna locations) of eels passing the projects by various routes will also be quantified.

The route selection portion of this study should occur in both study years.

## **Objective 2: Spill, Bypass, and Turbine Mortality/Injury Studies**

Spill, bypass, and turbine mortality will be assessed using a balloon-tag method.

For spill mortality sites (dam spillways and downstream bypasses), tagged eels will be injected or released into spill flow at points where water velocity exceeds 10 ft./sec to minimize the possibility of eels swimming upstream into the headpond or canal. Passed balloon-tagged eels will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

For turbine mortality sites, tagged eels will be injected into intakes of all 21 units associated with the project, operating at a full range of settings where intake water velocity exceeds 10 ft/sec to minimize the possibility of eels swimming back upstream through the intakes. Passed balloon-tagged eels will be recovered in the tailrace(s) and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

If the balloon-tag mortality component of the study occurs in study year one, all possible route selection sites would need to be evaluated. If the balloon-tag mortality component of the study occurs in study year two, results from the route selection study could be used to inform which sites need to be evaluated for mortality. Eels recovered from balloon-tag studies should not be used for route selection studies.

Data analyses of route selection and mortality (instantaneous and latent) will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies and assessed for potential relationships to passage route selection, migratory delay, and/or passage survival.

These methodologies are consistent with accepted practice.

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

The level of cost and effort for the downstream eel passage study will be moderate to high; silver eels would need to be collected, tagged, and released in several locations over the course of the migration season. Antennas and receivers would need to be installed throughout the canal, at the intakes of the E.L. Field powerhouse, at the dam spillways and station bypass and monitored regularly. Data would need to be retrieved periodically, then analyzed. A multi-site route selection study conducted by the USGS Conte Lab on the Shetucket River in Connecticut cost approximately \$75,000 for the first year of study. Costs are estimated at \$100,000 per year for the route selection study and \$50,000 to \$75,000 for the spill, bypass, canal, and turbine mortality/injury study.

Boott did not propose any studies to meet this need in the PAD.

### **REFERENCES**

Havn, T. B., F. Økland, M.A. Teichert, L. Heermann, J. Borcharding, S.A. Sæther, O.H. Tambets and E.B. Thorstad. 2017. Movements of dead fish in rivers. *Animal Biotelemetry*, 5: 7.

Normandeau Associates, Inc. 2017. Downstream Passage Evaluation for Silver-Phase American Eels at the Lowell Hydroelectric Project. 2017. Submitted to the City of Holyoke Gas and Electric Department. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 17 pp.



## Study Request # 6

### **Operations Analysis of the Lowell Canal (Lowell, P-2790)**

#### ***Goals and Objectives***

The goal of this study is to understand the operations of the Lowell canal system. The specific objective of this study is to describe the operations of the Lowell canal (how all of the canal units interact with the main units, how the canal units are sequenced, how often each of the units operate, the prioritization sequence of canal unit operations, the amount of time the units are operated during the downstream passage season, etc.).

#### ***Resource Management Goals***

The Department seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to aquatic resources, the Department's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Minimize current and potential negative project operation effects on fish in the project area.

#### ***Public Interest***

The requestor is a natural resource agency.

#### ***Existing Information and the Need for Additional Information***

The Merrimack River supports a variety of migratory fish species. However, there is no information pertaining to fish mortality and population effects resulting from entrainment in the canal and/or the canal units. Since there are no exclusionary measures at the entrance of the project's canal system, fish can easily enter the two-tiered network of man-made canals, which are approximately 5.5 miles in length. These man made canals provide flow to 19 Boott-owned hydroelectric units. Since obtaining the original license for the project, there have been no directed studies of the Pawtucket, Western, Merrimack, or Hamilton canal units. Additionally, the PAD provides little operational information regarding the canal: flows of up to 2,000 cfs. are routed into the canal, typically once the E.L. Field station's hydraulic capacity of 8,000 cfs. has been reached. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on riverine fishes and migratory alosines which may be moving through, or inhabiting, the canal and develop adequate passage and protection measures to meet management goals and objectives.

### ***Nexus to Project Operations and Effects***

The Lowell Project consists of a two-tiered, 5.5-mile-long, network of man-made canals which include several small dams and 19 turbine units. Flows enter the canal system upstream of the Pawtucket dam via the Pawtucket canal. There are no exclusionary measures for fish in place. Therefore, the Lowell canal presents problems with respect to providing safe, timely, and effective passage for fish trying to move past the project through the canal system.

### ***Methodology Consistent with Accepted Practice***

In order to determine the relative risk the canal unit's present to riverine and migratory fishes, it is necessary to understand how the canal operates. Therefore, we request Boott provide a detailed description of the operational protocol it uses to determine when and how much water flows into the canal at a time scale relevant to the migratory fish species expected to potentially utilize the canal as a passage route (e.g., May, June, and July for spent alosines; August through November for adult eels and juvenile alosines). Historical operations data should be examined relative to the hydrological data set to determine the percent of time the canal units would be expected to operate during each passage month. This analysis should be used in conjunction with the results of the passage route and turbine mortality studies to estimate total through project mortality for each target fish species/life stage.

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

The expected level of effort and anticipated cost will be low. Operations and hydrologic data are readily available and only need to be compiled and analyzed. We estimate the cost to be less than \$10,000.

## Study Request # 7

### **Three-Dimensional Computational Fluid Dynamics (CFD) Modeling in the Vicinity of Fishway Entrances and Powerhouse Forebays (Lowell, P-2790)**

#### ***Goals and Objectives***

The goal of this study is to determine the flow field conditions which exist in and around fishway entrances and the powerhouse forebay. The information from this request is meant to be coupled with data from the telemetry studies, such that a comprehensive understanding of fish behavior is developed.

The objective of this study is to create a series of color contour maps of velocity magnitude at select discharges agreed upon by the resource agencies and the licensee. With respect to upstream passage, the results will show approach velocities and flow fields that may create a response in fish. This information can be coupled with telemetry data (from the requested shad and river herring telemetry study) and passage counts to understand which conditions are optimal for guiding migrating fish to the fishway entrances and stimulating fishway entry.

With respect to downstream migration, the results will show velocities and flow fields in front of the E.L. Field powerhouse. Additionally, the results will indicate to what degree, if any, flow directs downstream migrating fish towards the downstream bypass facility.

#### ***Resource Management Goals***

The management goals of this study request are to obtain information that will assist in enhancing the effectiveness of the current upstream fish passage facilities for upstream migrating trust species and reduce impingement, entrainment, and delay for downstream migrating fish. CFD models are a relatively cost effective way to analyze existing and future conditions. As such, changes in the amount of attraction water, changes in which turbines are operating, and which spillway gates are releasing water can all be examined. As stated, the results from this study are meant to be used along with the data generated from the requested telemetry study. The combined analysis from these two data sources can help assess which flow conditions are most advantageous for migrating trust species to enter the fishway under current and proposed conditions.

As for downstream migration of adult and juvenile shad, river herring, and adult eel, the results from the models will reveal flow magnitude and direction in front of the powerhouse. Given the limited information that currently exists on survival through the project, our management goal is to direct as many downstream migrating fish as possible towards the downstream bypass facility. With respect to upstream passage, we want to maximize the number of fish that find and enter the fishway entrances.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

### ***Public Interest***

The requestor is a natural resource agency.

### ***Existing Information and the Need for Additional Information***

To date, no CFD modeled data exists in front of either the fish ladder or lift, nor do they exist in front of the E.L. Field powerhouse. A comprehensive understanding of fish behavior at the ladder and lift entrance, and the powerhouse forebay, is needed in order to create safe, timely, and effective upstream and downstream passage for American shad, river herring, and eels. Additionally, a better understanding of flow and how it affects fish passage is needed after Boott performs the ledge removal excavation project.

### ***Nexus to Project Operations and Effects***

The Lowell Project has direct impacts to upstream and downstream migrating shad, river herring, and eel. The development of these models will give resource agencies valuable information into the hydraulic cues which may elicit a response from upstream migrants. For downstream passage, the Department has approach velocity guidelines; the output from these models would inform the resource agencies under what conditions appropriate approach velocities are being met and when they are being exceeded.

With respect to upstream migration, the auxiliary water system (AWS) plays a critical role in determining whether or not fish are attracted to the entrance. The results from this study would allow us to assess how well the AWS is performing and under what conditions it attracts the most fish.

With respect to downstream migration, the development of a CFD model under existing conditions also informs the design of future modifications and improves the survivability of downstream migrating shad, river herring, and eel.

The CFD models for the Pawtucket fishway and fish lift should be developed as part of year two studies, after the ledge excavation project is complete. It would be useful to have the gatehouse area CFD modeling completed in year one. This analysis may provide information on adjustments to canal operations or structures that can subsequently be analyzed.

Understanding the entrance conditions of the Pawtucket fishway under a range of spill conditions would be informative. If developed prior to the year one upstream shad telemetry studies, it would provide information on spill gate settings which would likely best achieve entrance and ultimately passage. Further work with the model can help in evaluating changes in ladder entrance or spill conditions that could improve passage and be tested with telemetry, video, and/or count data.

CFD modeling of the flows leading to the canal would aid in our interpretation of year one downstream passage telemetry results, but would not need to be completed prior to the year one telemetry (downstream juvenile alewife and downstream eel) studies. Those studies will provide the context for how and where shad, river herring, and eels are passing the project and how successful passage is. The CFD modeling could focus on the locations identified as important in the study results and Boott could assess changes to structures or operations and evaluate them in the model. Promising alternatives would then be tested in year three studies.

***Methodology Consistent with Accepted Practice***

A three-dimensional CFD model has become an increasingly common standard of analysis at hydroelectric projects around the nation. Within the northeast region, we have seen these types of models developed at the Holyoke (P-2004), Brunswick (P-2284), Shawmut (P-2322), Milford (P-2534) and Orono (P-2710) projects. We would expect to engage with the licensee in terms of determining the appropriate area and flows to be modeled. We expect the spatial extent of the model at each study site will vary. Given the large number of ways in which output from these models can be presented and the near infinite number of flows which could potentially be modeled, we would expect to consult with the licensee to reach agreed upon modeling efforts and scenarios to be examined.

***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

The cost of developing, running and testing a CFD model can vary tremendously; one large variable in determining the cost is based on the amount of existing bathymetric data to which Boott currently has access. We roughly estimate that the cost of each CFD model could run as high as \$50,000, assuming no bathymetric data currently exists. Proactive communication with resource agencies will reduce the cost and iterative effort. Given the level of effort that has occurred at other projects that have proposed to amend their license, we see the level of effort requested here as reasonable, given that Boott is seeking a renewal of its license.

## Study Request # 8

### **Bypass Zone of Passage (Lowell, P-2790)**

#### ***Goals and Objectives***

The goal of this study is to determine zone-of-passage flows in the bypass reach which facilitate safe, timely, and effective fish passage through the project.

Specifically, the objectives of this study are:

1. complete a detailed survey of the bypass reach;
2. develop a high-resolution, two-dimensional hydraulic model of the bypass reach;
3. release multiple flows from the dam to collect calibration data for the model;
4. simulate additional flows through the bypass reach with the calibrated model; and
5. determine minimum and optimal zone-of-passage flows for the project.

#### ***Resource Management Goals***

The Department seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to aquatic resources within the Lowell bypassed reach, the Department's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide a flow regime in the bypassed reach that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) and diadromous fishes.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

### ***Public Interest***

The requester is a natural resource agency.

### ***Existing Information and the Need for Additional Information***

Article 36 of the original license required the licensee, in consultation with resource agencies, to develop an in-stream flow study plan to determine: (1) 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 (i.e., zone of passage). After completion of the approved studies, the licensee was to file a report on the results of the studies, and, for Commissions approval, recommendations for the flow releases from the project. The study plan was filed on August 13, 1983, with proof of agency consultation (Accession No. 19830818-0191). However, there are no study reports included in the record. Therefore, we have no quantitative data supporting the agreement that 300 cfs. at night and 500 cfs. during the day are adequate flows for zone of passage in the bypass reach.

In the Comprehensive Fish Passage Plan filed on March 9, 2000 (Accession No. 20000313-0322), the licensee states “The adequacy of flows for upstream fish passage at the Project was addressed by BHI’s construction of six (6) concrete flow control weirs (with adjustable stoplog sections) in the bypass reach, at the request of U.S. Fish and Wildlife Service and in response to Article 36, section (2) of the Project’s FERC license.” Similar to the study plan, this is an agreement with no supporting information to substantiate the conclusion flows in the bypass reach are adequate for the full suite of diadromous species.

As part of compliance for Article 34 of the original license, the licensee filed as-built drawings of the existing fish passage facilities (Accession No. 19860902-0215). Within this abbreviated drawing set, drawing number 344D-PC001, 3844D-FC001, and 3844D-FC004 show topographic surveys for portions of the bypass reach. However, the drawings do not document the accuracy and precision of the survey, do not show the majority of the bypass reach, and are otherwise illegible.

Since agreeing upon the current zone-of-passage flows during the original license, there have been developments in topographic survey capabilities, a better understanding of the hydraulic requirements of diadromous species, multi-dimensional hydraulic modeling capabilities, and an increased need to pass fish at the spillway ladder.

### ***Nexus to Project Operations and Effects***

Diadromous fish orient their migration based on the environmental conditions of the river: flow, depth, velocity, and temperature (Goodwin 2014). Project operations affect the environmental conditions in the River, specific to this study request, the bypass reach. Two key hydraulic model outputs from the requested study are depth and depth-averaged velocity, which can be used to determine the likelihood of predation, delay, and the cessation of migration. Evaluating the flow fields in the bypass reach under different spill conditions will assist in the consultation process for determining an appropriate zone-of-passage flow in the bypass reach to optimize fish passage at the project. These data will also contribute to the development of an administrative record in support of a potential settlement agreement, Section 18 fishway prescriptions, or 10(j) recommendations.

### ***Methodology Consistent with Accepted Practice***

We proposed the following methodology to accomplish the five objectives and ultimately the goal of the study, to determine zone-of-passage flows for the bypass reach.

#### *Topographic survey*

The bypass reach area is large, making traditional topographic survey methods laborious and costly. We recommend using Light Detection and Ranging (LiDAR) methods with limited traditional surveying. Outside of the fish passage season and during a river flow when the project is in control of the River, the bypass reach will be mostly dewatered. At this time, a licensed surveyor can fly the area to collect LiDAR data. Once this data is processed, traditional methods will fill in the gaps (e.g., pooled water areas, under bridges). The topographic survey shall be of sufficient resolution and quality to complete the remaining objectives.

#### *Two-dimensional hydraulic model*

There are many two-dimensional hydraulic models that are acceptable for accomplishing the goal of this requested study, many of which are open source. We are not requiring one model over the other, but Boott should understand and document the limitations of the modeling software used. At a minimum, the modeling output should produce depth-average velocity and depth for each cell in the mesh. The modeling domain shall be of sufficient size and mesh to delineate a zone of passage through the entire length and width of the bypass reach.

#### *Calibration flows*

The licensee should collect calibration data by spilling a minimum of two flows from the Pawtucket dam. The calibration flows should bracket the range of simulated flows in the study. We recommend 300 cfs. for the low flow as it represents the current lowest operation flow for the fish ladder. For the high calibration flow, we recommend collecting data near the high fish passage design flow (i.e., the 5 percent exceedance value for the migratory period of record) which is approximately 26,000 cfs. in the Merrimack River (bypass flow would be approximately 17,000 cfs. with full project operation). Boott should collect calibration data (depth-averaged velocity and depth) with an Acoustic Doppler Current Profiler (ADCP) at a minimum of four cross sections, including the downstream boundary condition and use the ADCP in locations spread evenly throughout the bypass which are less turbulent.



### *Additional flow simulations*

After calibrating the model, additional bypass flows should be simulated (and agreed upon with the natural resource agencies), including 500 cfs., 1,000 cfs., and up to the high calibration flow. The additional simulations should represent the full range of hydraulic conditions in the bypass reach from the low to high fish passage design flow.

### *Zone-of-passage determination*

The model output should be used to delineate a zone-of-passage pathway for each of the modeled flows. To determine the zone of passage, we recommend Boott use the SprintSwim model developed by U.S. Geological Survey researchers (Haro et al. 2004).

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

The licensee should be able to finish the bypass zone-of-passage study in one year depending on seasonal flow conditions. The level of effort and cost is commensurate with a project the size of the Lowell facility and the likely license term. No alternatives are proposed.

### **REFERENCES**

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- Haro, A., T. Castro-Santos, J. Noreika and M. Odeh. 2004. Swimming performance of 716 upstream migrant fishes in open-channel flow: a new approach to predicting passage through velocity barriers. Canadian Journal of Fish and Aquatic Science. 61: 1590-1601.

Document Content(s)

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# United States Department of the Interior

OFFICE OF THE SECRETARY  
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August 14, 2018

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Kimberly D. Bose, Secretary  
Federal Energy Regulatory Commission  
888 First Street, N.E.  
Washington, DC 20426

**RE: COMMENTS ON PRE-APPLICATION DOCUMENT  
COMMENTS ON SCOPING DOCUMENT 1  
STUDY REQUESTS  
Boott Hydropower, LLC  
Lowell Hydroelectric Project, FERC No. 2790-072  
Merrimack River, Middlesex County, MA, and Hillsborough County, NH**

Dear Secretary Bose:

This responds to the Pre-Application Document (PAD) for the Lowell Hydroelectric Project, (Project) located on the Merrimack River in Middlesex County, Massachusetts and in Hillsborough County, New Hampshire. The PAD is being provided in preparation of an application for a new Federal license for the project. The U.S. Department of the Interior (Department) offers the following comments based on the PAD (submitted to us by Boott Hydropower, LLC, [Boott] on April 30, 2018) and additional information obtained at the Federal Energy Regulatory Commission (Commission, FERC) scoping meeting held on July 17, 2018, and the site visit held on July 18, 2018. The comments represent contributions from the Department's U.S. Fish and Wildlife Service (Service) and the Lowell National Historical Park, National Park Service (NPS).

## U.S. FISH and WILDLIFE SERVICE

### *PRE-APPLICATION DOCUMENT*

### **PROPOSAL**

The Lowell Project consists of a 1,093-foot-long, 15-foot-high masonry gravity dam (Pawtucket dam) topped by a 5-foot-high, pneumatic crest gate system,<sup>1</sup> which creates a 720-acre

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<sup>1</sup> On April 18, 2013, the Commission amended the project license authorizing Boott to replace the wooden flashboards on the Pawtucket dam with a pneumatic crest gate system (143 FERC ¶ 61,048). Installation of the crest gate system is currently in progress.

impoundment extending approximately 23 miles upstream. The dam has a gross storage capacity of approximately 3,600 feet between the maximum normal water surface elevation of 92.2 feet National Geodetic Vertical Datum of 1929 (NGVD) and the minimum water surface elevation of 87.2 feet NGVD when all five pneumatic gates are fully lowered. The spillway is 980.5 feet long. The project includes a two-tiered network of man-made canals, totaling approximately 5.5 miles in length, which provide flow to 21 Boott-owned hydroelectric units.<sup>2</sup> Nineteen of the units are located in four powerhouses (Assets, Bridge Street, Hamilton, and John Street) situated in the canal and have various runner speeds and diameters. The remaining two units are located in the main powerhouse (E.L. Field) on the Merrimack River, which uses water from the northern canal to generate power. Units in the E.L. Field powerhouse are identical, 8.6-MW horizontal Kaplan turbine-generator units, each with a maximum hydraulic capacity of 4,000 cfs.

Boott currently operates the project in a run-of-river mode. The current license requires an instantaneous minimum flow of 1,990 cfs or inflow, whichever is less, as measured immediately downstream of the project.

Boott operates both upstream and downstream fish passage facilities at the project. These include a lift at the E.L. Field powerhouse that conveys fish to the northern canal, an upstream anadromous vertical-slot fishway at the Pawtucket dam, and a downstream bypass facility at the E.L. Field powerhouse. The fish ladder has a total operating flow of 500 cfs and acts as the primary source of flow in the 0.7-mile-long bypass reach (other than spillage over the Pawtucket dam spillway when inflow exceeds the maximum hydraulic capacity of the project's stations). The current license contains no minimum bypass flow requirement.

In the PAD, Boott has proposed no additional protection, mitigation, or enhancement (PME) measures.

## COMMENTS

### 4.0 Project Location, Facilities, and Operations

Boott provided a detailed description of the project facilities. However, several important pieces of information are missing:

- the minimum hydraulic capacities, runner diameters and runner speeds of turbines at the project (housed in the E.L. Field, Assets Station, Bridge Street, Hamilton Station, and John Street powerhouses);
- clear trashrack spacing at intakes to all of the turbines; and,
- the calculated approach velocity at the trashracks/intakes (based on the wetted trashrack area).

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<sup>2</sup> Boott submitted an Application for Amendment of License to the Commission on March 16, 2017. The amendment of license proposes the removal of four of the project's currently authorized generating units from the license. These units include Bridge Street 1, 2, 3, and 12.

## 4.1 Civil Works

### Tailrace Channel

Telemetry studies in 2002, 2011, and 2013, showed emigrating American shad that approach the Project via the tailrace have difficulty using the fishway entrance (Sprankle 2005; Alden 2011; Blue Leaf Environmental 2013). In 2016, Gomez and Sullivan engineers performed an analysis of upstream passage at the lift and recommended that Boott excavate the ledge outcropping in the tailrace channel to approximately 10 feet below normal tailwater level extending 50 to 100 feet downstream from the entrance (Gomez and Sullivan 2016). On July 18, 2017, Boott submitted design plans to the Merrimack River Technical Committee (MRTC; comprised of Federal and State agencies) for review prior to the start of construction. On July 26, 2017, the MRTC submitted their recommendations. On August, 18, 2017, at the request of Boott, the National Oceanic and Atmospheric Administration (NOAA) and the United States Fish and Wildlife Service (Service) provided additional information pertaining to the MRTC's recommendations (Attachment A). The PAD does not contain any information regarding the tailrace excavation project. We recommend Boott update the PAD to include the details we have provided here.

In the PAD, and the Commission's pre-filing milestone timetable included in the scoping document, the first study season is scheduled to begin during spring of 2019. However, Boott plans to complete the tailrace excavation project during late summer of 2019 (Attachment B). The tailrace excavation project will change flow dynamics in the tailrace channel and therefore the hydraulic conditions fish will likely encounter as they migrate upstream. As such, we ask that the studies requested herein related to upstream fish migration and flow in the tailrace area occur after the excavation is complete (second study season, or 2020) so natural resource agencies can properly assess the impacts project operations might have on migratory fish and develop adequate passage and protection measures if necessary.

## 4.5 Description of Project Operations

### Fish Passage Operations

Boott states it has provided, and assessed the effectiveness of, American eel (*Anguilla rostrata*) passage at Lowell. The effort to pass eels at the project began in 2014 when temporary eel ramps were deployed near the ladder. However, the effectiveness of these structures has never been quantified. In 2018, Boott agreed to: (1) continue to operate the existing anadromous fish ladder for eels (releasing 30 cfs) until September 30; and, (2) perform six, dewatered, visual inspections of the ladder. To date, there have been no siting surveys performed at Lowell. Therefore, it is unknown if eels congregate at other areas within the project boundary (e.g., the outfall of the canal power stations) or if passing eels at the ladder is the most appropriate technique. The Department likely will include, in any fishway prescription issued for the project, a requirement that Boott conduct an upstream eel passage siting survey after a new bypass flow regime has been implemented to determine areas of eel concentration so permanent upstream passage facilities can be properly sited.

## National Park Service Requirements

In this section of the PAD, Boott states that it maintains canal water levels “within appropriate limits during the May 15 to October 15 tour boat operating season,” however no additional information is provided. We recommend Boott update the PAD to include further information regarding water levels maintained in the canal and any additional, relevant, information regarding the operations agreement they have with the National Park Service.

## **5.4 Fish and Aquatic Resources**

### Overview

The fish ladder at the Pawtucket dam has a total operating flow of 500 cfs and is the primary source of flow in the 0.7-mile-long bypass reach which extends from the Pawtucket dam downstream to the E.L. Field powerhouse. However, there is no information provided in the PAD to support this flow release is adequate to meet the life history requirements of fish and wildlife (including invertebrates such as freshwater mussels). Therefore, the Department recommends that Boott undertake a study that evaluates habitat in the bypass reach at a range of flows, including the existing 500 cfs release. The study design should include habitat mapping of the entire bypass reach in addition to collecting hydraulic and habitat measurements (i.e., depth, velocity, wetted perimeter, substrate) along a number of transects to assess the existing flow release and alternative flows.

Boott states, “fish are capable of bypassing the Project’s entire canal system via the Merrimack River and can use the existing upstream and downstream fish passage facilities at the Pawtucket Dam and the E.L. Field Powerhouse.” While downstream-migrating fish can potentially avoid entering the canal, despite there being no exclusionary measures in place, a study by Normandeau Associates, Inc., found only 7 percent of juvenile alewives utilized the bypass (Normandeau 1991). A follow up study (Normandeau 1995) performed after the bypass was enlarged found that of 1,779 marked fish, only 37 percent utilized the downstream fish passage facilities. While efficiency increased by approximately 30 percent from 1991 to 1995, the bypass remains less than 40 percent effective at passing fish downstream.

Although bypass effectiveness studies were performed at Lowell in the early 1990s, it is still unclear as to which route American shad (*Alosa sapidissima*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), and eel select as they move downstream (spillway, fish ladder, canal, turbines, existing bypass), the survival estimates associated with each route, the effect the Pawtucket gatehouse has on downstream movement, the effect the pneumatic crest gates have on emigration, etc. To fill these data gaps and better understand downstream passage at Lowell, especially in relation to the canal, the Department recommends that Boott conduct studies which assess: (1) the behavior, approach routes, passage success, survival and delay of adult American shad and river herring as they emigrate to the ocean; (2) the impact project operations have on the downstream migration of juvenile alewife which can serve as a proxy for blueback herring and American shad in this instance; and (3) downstream route of passage and survival of adult silver-phase American eel.

### Abundance

The Merrimack River supports a variety of migratory fish species, including American shad, river herring (alewife and blueback herring), American eel, and sea lamprey (*Petromyzon marinus*). Table 5.4-2 lists the number of river herring, shad, and eel that have passed the Lawrence Project (FERC No. 2800, the first hydroelectric dam on the Merrimack River), and Lowell since 1983. In 2017, Boott claims that 177,738 eels swam upstream past Lawrence. However, our records indicate an estimated 8,645 elvers were lifted in the hopper and 17,691 passed the eelway at the dam (26,336 eels total). The Department recommends that Boott update Table 5.4-2 to: (1) ensure listed, annual, fish passage counts are accurate; and (2) include sea lamprey passage counts.

### Other Site-Specific Fisheries Information

In this section of the PAD, Boott states that American shad studies were conducted in 1999 and 2000, which led to significant modifications and upgrades to the E.L. Field powerhouse fish lift, thereby improving passage efficiency. However, it is unclear as to which modifications Boott is referring.

According to our records, a lack of modifications and upgrades to the project coupled with poor fish passage led to a radio-telemetry study of shad migration in 2002 (Sprankle 2005). This study found 55 percent of the shad that passed upstream of Lawrence made their way into the Project tailrace near the fishway entrance. However, only 6.2 percent of the tagged shad were actually passed upstream of the project via the fish lift. This was consistent with fish passage counts taken at Lowell in 2002; only 9.7 percent of the shad which passed Lawrence subsequently passed Lowell. These data led to a dye test, also conducted by Ken Sprankle, in June 2003. During this qualitative evaluation, concentrated dye was released into the fishway entrance channel and observed. Results demonstrated the flow field extends downstream from the fishway and stalls approximately 35 feet from the entrance, effectively cutting off the progression of shad moving up the tailrace and into the fishway. Based on fish counts at Lawrence and Lowell, passage efficiencies for American shad have not improved at the project over the past 20 years. From 1996 to 2017, passage efficiency at the project has not exceeded 30 percent. Additionally, the internal fish lift efficiency has remained low. In 1996, fish lift efficiency ranged from 0.5 to 2.4 percent. In 2000, studies conducted by Boott suggested efficiency increased to 42 percent (Boott 2000). While this latest assessment does suggest an improvement in operations compared to previous years, an internal fish lift efficiency of 42 percent is still low as overall passage efficiency is based on the combined near/far field attraction efficiency and internal lift and ladder efficiency. Based on the information above, and considering the ledge removal improvements which will take place in 2019, the Department recommends that Boott perform a study assessing American shad upstream route selection passage effectiveness and migratory delay after the ledge is removed.

Boott goes on to state, “A 1988 acoustic telemetry study performed by RMC Environmental Services (RMC) of adult American shad movement through the Northern canal demonstrated successful passage through the Pawtucket Gatehouse, as well as incidental information regarding downstream passage routes for post-spawning individuals. In a follow-up study in 1991 by Normandeau Associates, Inc., found similar findings as the 1988 adult American shad telemetry study.” While it is true that 80 percent of the fish successfully exited the canal, it should be

noted: (1) the sample size was small, only 25 fish were used in the analysis; and (2) the delay caused by existing infrastructure was substantial, ranging from 1 to 5 days. Also, as a point of clarification, there were two studies conducted in 1991 by Normandeau Associates, Inc., which focused on downstream passage of river herring and shad. The scope and findings of these studies did not include upstream passage through the gatehouse, which was the focus of the RMC 1988 study. To date, the RMC study has been the only evaluation of upstream passage of shad in the northern canal and gatehouse. As a component of the studies provided herein, we recommend that Boott track and monitor clupeid behavior in the canal.

### Major Findings of Fish Passage Studies Since 1988

In the PAD, Boott provides an overview of the fish passage facilities at both projects, when they began operating, and studies which have been conducted to determine their effectiveness at passing target species. We would like to offer some points of clarification, specifically on information listed in Table 5.4-3.

- 1988: Passage of Radio-Tagged American Shad through the Northern Canal Headgate Structure. Boott states that “24 of 25 radio-tagged shad (96%) released at fish lift exit passed the Northern Canal headgate structure with little delay.” However, 19 of the 24 shad (80 percent) which successfully passed did not pass through the headgate structure but rather the adjacent boat lock facility. When the boat lock was closed, delay ranged from 1 to 5 days. Since a majority of the shad were observed reaching the headgate structure within an hour, the delay in migration associated with closing the boat lock was approximately 23-119 hours. The study notes that most fish approached the road bridge adjacent to the gatehouse but fell back downstream. The delay experienced by these shad is significant and, from the information provided by Boott, it is unclear how often the boat lock has been open during the upstream migratory season since the 1988 study was performed. We are concerned that the operation and management of the northern canal headgate may contribute to migratory delay and is an issue that will need to be resolved in order to successfully pass fish upstream and achieve a sustainable population of shad in the Merrimack River.
- 1991: An Assessment of the Effectiveness of a Fish Bypass for Passing Juvenile Alewives at the Lowell Hydroelectric Project. The findings listed in the table fail to include two critical results: (1) the bypass effectiveness for juvenile alewife was only 7 percent, even when bypass flows reached 2 percent of the turbine flow; and (2) when the bypass flow was increased by 50 percent, due to the units shutting down, the number of fish using the bypass increased by a significant amount (4,250 alewives in 10 minutes versus 0 in the previous 4.5 hours)
- 1996: Lowell Hydroelectric Project Internal Fish Lift Efficiency Monitoring Program. The internal fish lift efficiencies should be included in the findings, as they were extremely low, ranging from 0.5 percent to 2.4 percent.
- 1999: An Assessment of Internal Fish Lift Efficiency at the Lowell Hydroelectric Project. The study findings section states, “The ratio of total shad lifted at the Lowell Project to the total lifted at the downstream Lawrence facility was nearly doubled, reaching approximately 29% in 1999 compared to a historic ratio of 15% since 1986, and in the



preceding two years.” While this statistic may technically be correct, it actually represents a decrease from 1992 and 1995, when the ratios of total shad lifted at Lowell were 31 percent and 38 percent, respectively.

- Boott performed two fish lift internal efficiency studies and in the major findings column claims the crowder position has a beneficial impact on fish passage efficiency. However, this contradicts the study findings listed for the 1996 Normandeau Associates, Inc. study. As noted above, the Department suggests that Boott include information regarding modifications made to the fish lift which supports its contention of improved internal efficiency.
- A report by Gomez and Sullivan (2016) titled “Analysis of Upstream Fish Passage Facilities and Operations” was not included in the PAD. We recommend Boott update Table 5-4.3 to include this study, which identifies specific areas of improvement needed to increase the Lowell fishways reliability and upstream passage efficiency. Recommendations provided in the report include: (1) installing a pivot gate to update the existing vertical gate; (2) excavating the ledge outcrop downstream of the fishway entrance; (3) reopening the street side entrance; and (4) installing an entrance extension. The analysis also highlights the aging infrastructure at the project and the need to replace specific components, along with cost estimates.

## **6.0 Preliminary Issues, Project Effects, and Potential Studies**

### Fish and Aquatic Resources

Boott has not proposed any studies for relicensing at this time, but has identified potential resource issues which include: bypass flows, fish passage, historical resources, boating access, and inundation of upstream floodplains. Relevant to fish and aquatic resources, the Department believes new studies need to be conducted, with sufficient fish sample sizes, to better understand upstream and downstream passage at the project as well as instream flows in the bypass reach.

#### *Downstream Passage*

The Department recommends that Boott conduct new studies to fully understand how post-spawned adult shad and river herring, juvenile shad and river herring, and adult silver phase eels move past the Pawtucket dam, through the canal system, turbine intakes, and the downstream bypass facility. In addition, turbine injury and mortality studies are needed and should be used in conjunction with results of the passage routing studies, where applicable, to calculate total through-project survival rates. The Department herein provides study requests in order to address these information needs.

#### *Upstream Passage*

Yearly site inspections, performed by the Service, have identified a number of problems with respect to American shad at the lift and ladder fishway entrances. The Department believes that a comprehensive radiotelemetry study is needed to understand the relationship between project operations, including spill flows, and shad and river herring movement through the Merrimack River, including attraction to and passage through these facilities. Additionally, a study to define

the relationship of the complex hydraulic conditions at the spillway fish ladder entrance and the tailrace fish lift entrance is needed in order to evaluate data on fish behavior and passage at those locations. Therefore, the Department is providing herein study requests to address these information needs.

#### *Instream Flows in the Lowell Bypass*

The bypass reach is 0.7 mile long (from the Pawtucket dam to the E.L. Field powerhouse) and contains diverse habitat. There are approximately 11 miles of free-flowing river downstream of the Pawtucket dam which also contain a diversity of habitat, including important spawning and rearing habitat for migratory fish species such as American shad. To date, there have not been any empirical studies which assess the adequacy of the existing flow protocols. The Department herein submits study requests intended to address these information gaps.

### **ADDITIONAL INFORMATION**

The following information is needed:

- the minimum hydraulic capacities, runner diameters and speeds of the turbines in each powerhouse associated with the project;
- a more thorough description of how project operations are monitored and recorded;
- hourly data (water surface elevations, dam discharge, generation) for the project in spreadsheet format for the past 5 years;
- a detailed description of modifications made to the existing fish passage facilities, including dates changes were made;
- a detailed description of canal operations; and
- a detailed description of modifications made to the bypass extending from the Pawtucket dam to the E.L. Field powerhouse (weir installation, excavation, etc.).

### **RECOMMENDED STUDIES**

Boott is not proposing to undertake any studies as part of this relicense proceeding. Enclosed please find formal study requests (Attachment C) by the Service in the format required pursuant to 18 CFR §4.38(b)(5). Please note the Service also supports the study requests provided by the other agencies including, but not limited to, National Marine Fisheries Service, Massachusetts Division of Fish and Wildlife, and Massachusetts Department of Environmental Protection.

#### *SCOPING DOCUMENT 1*

### **3.6.3 Project Decommissioning**

The Commission proposes to eliminate this alternative from detailed study in the environmental analysis, because no party has suggested project decommissioning would be appropriate in this case. The Commission asserts that there would be significant costs involved with decommissioning the project, including lost energy production.

We recommend that the Commission include project decommissioning in the environmental analysis. Although no party has suggested this alternative, up to this point in the Integrated

Licensing Process, there has been no formal opportunity to provide such a recommendation. Further, the Commission has supplied no supporting information to justify the contention of significant decommissioning costs (which could run the gamut from “locking the door” to full dam removal at the Lowell Project). Given the substantial increase in the numbers of proposed renewable energy projects, it is possible that there may be no net loss of energy production when viewed on a regional basis. Also, we are requesting a number of studies to understand the impacts of the project. Study results could identify impacts which either cannot be mitigated or would be prohibitively expensive to mitigate. In light of that possibility, decommissioning of the Lowell Project should be retained as a potential alternative that the Commission may need to address.

#### **4.1.2 Geographic Scope**

The Service recommends the geographic scope of the Commission’s environmental analysis (pertaining to impacts to cumulatively affected fishery, water quantity, and water quality resources) extend from the Eastman Falls dam (FERC No. 2457) and Lake Winnepesaukee to the confluence of the Pemigewasset and Winnepesaukee Rivers, downstream to the Atlantic Ocean, as this represents the extent in which river herring and American eel are managed in the basin.

#### **4.2.1 Aquatic Resources**

Effects of project facilities and operations on fish migration should be analyzed cumulatively as well as for individual projects. Additionally, effects of entrainment should not be limited to fish populations, but should include impacts to food web interactions and overall ecosystem productivity.

### LOWELL NATIONAL HISTORICAL PARK, NATIONAL PARK SERVICE

#### **COMMENTS**

#### **PAD Section 1.0 Introduction and Background**

The 5.6 miles of historic canals are wholly within the boundary of Lowell National Historical Park and are a principle resource that Congress directed the Park to protect. Additionally, the canal system and support buildings are designated as a National Historic Landmark, offering the highest provision of historic preservation protection under the National Historical Policy Act of 1966. The canal system is also located within the boundaries of:

- Lowell Locks and Canals National Historic Landmark District;
- Lowell Water Power System National Historic Civil Engineering Landmark; and
- Lowell Power Canal System and Pawtucket Gatehouse National Historic Mechanical Engineering Landmark.

The first mention of historic resources in the PAD is located on Page 28, section 4.9 following the description of all resources. These significant designations should be inserted into the Intro/Background Section.

#### **PAD Section 4.0 Project Location, Facilities, and Operations**

Nearly all of the Civil Works described in Section 4.1 are historically significant structures, listed as contributing features within the National Historic Landmark District. Please include date of construction for each of the Civil Works referenced on pages 10-15 or Sections 4.1.1 through 4.1.11. Please also include, where applicable, a reference to significant historical resources in this section. For example, “Constructed in 1847, the Pawtucket Gatehouse is located at the southern abutment of the Pawtucket Dam...The Pawtucket Gatehouse is the site of origin for the historically significant Francis Turbine which is still intact within the building.”

The following table cross-references PAD names with the language produced by Proprietors of Locks and Canals on Merrimack River (PLC) as recorded in the “Lowell Canal Survey” by the 1976 Historic American Engineering Record (HAER). The current PAD names of certain Civil Works do not match the naming convention used in the National Register Nomination or by the National Historical Park and should be revised accordingly.

| <b>PAD ID</b> | <b>PAD name</b>                                   | <b>Historic Name (construction dates) [alternate names]</b>                                                          |
|---------------|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| 4.1-1         | Pawtucket Dam                                     | Pawtucket Dam (1826, 1830, 1847,1875)                                                                                |
| 4.1.2         | Northern Canal                                    | Northern Canal (1848)                                                                                                |
| 4.1.2a        |                                                   | Great River Wall (1848)                                                                                              |
| 4.1.2b        |                                                   | Northern Canal Waste Gates (1848,1872)                                                                               |
| 4.1.3         | Pawtucket Gatehouse                               | Pawtucket Gatehouse (1848) [a.k.a. Northern Canal Gatehouse]                                                         |
| 4.1.4         | Pawtucket and Downtown Canals                     |                                                                                                                      |
| 4.4.4a        |                                                   | Pawtucket Canal (1796, 1823)                                                                                         |
| 4.4.4b        |                                                   | Merrimack Canal (1823)                                                                                               |
| 4.4.4c        |                                                   | Lowell Canal (1828)                                                                                                  |
| 4.4.4d        |                                                   | Hamilton Canal (1828)                                                                                                |
| 4.4.4e        |                                                   | Western Canal (1831)                                                                                                 |
| 4.4.4f        |                                                   | Lawrence Canal (c. 1831)                                                                                             |
| 4.4.4g        |                                                   | Eastern Canal (1836)                                                                                                 |
| 4.4.4h        |                                                   | Moody Street Feeder (1848) [see 4.1.5.2 below]                                                                       |
| 4.1.5         | Miscellaneous Canal Structures                    |                                                                                                                      |
| 4.1.5.1       | Guard Lock and Gates Facility                     |                                                                                                                      |
| 4.1.5.1a      |                                                   | Guard Locks (1824, 1850) [Gatehouse over upper lock gates constructed 1881]                                          |
| 4.1.5.1b      |                                                   | Francis Gate (1850)                                                                                                  |
| 4.1.5.1c      |                                                   | Pawtucket Canal Gatehouse (1870)                                                                                     |
| 4.1.5.2       | Moody Street Feeder Gatehouse                     | Moody Street Feeder Gatehouse (1848)                                                                                 |
| 4.1.5.3       | Lawrence Dam                                      | Lawrence Dam (1831) [at junction of Western and Lawrence Canals]                                                     |
| 4.1.5.4       | Hall Street Dam                                   | [on Western Canal]                                                                                                   |
| 4.1.5.5       | Tremont Wasteway [Tremont on map – PAD fig 4.0.2] | [at confluence of Western and Northern canals]                                                                       |
| 4.1.5.6       | Lower Locks and Dam                               | Lower Locks (1824, 1843) [includes two chamber navigation lock, dam, gatehouse, spillway, and associated structures] |

|          |                                                                                                     |                                                                                                                                                                                                                                                                 |
|----------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4.1.5.7  | Swamp Locks and Dam                                                                                 | Swamp Locks (1824, 1841) [Where the upper Pawtucket Canal splits into the Western, Merrimack, Lower Pawtucket, and Hamilton canals. Swamp Locks complex includes two chamber navigation lock, dam, spillway, control house, and associated structures]          |
| 4.1.5.8  | Merrimack Dam and Merrimack Gate                                                                    | [at foot of Merrimack Canal]                                                                                                                                                                                                                                    |
| 4.1.5.9  | Rolling Dam                                                                                         | [controls flow from Merrimack Canal into Boott Mill arm of the Eastern Canal]                                                                                                                                                                                   |
| 4.1.5.10 | Boott Dam                                                                                           |                                                                                                                                                                                                                                                                 |
| 4.1.5x   | [Historic canal water control structures not identified in PAD of concern to National Park Service] |                                                                                                                                                                                                                                                                 |
|          |                                                                                                     | Western Canal Guard Gates [between Merrimack and Moody streets]                                                                                                                                                                                                 |
|          |                                                                                                     | Hamilton Canal Guard Gates [at head of Hamilton Canal near Swamp Locks]                                                                                                                                                                                         |
|          |                                                                                                     | Hamilton Wasteway and Gatehouse [at foot of Hamilton Canal near Central St]                                                                                                                                                                                     |
|          |                                                                                                     | Massachusetts Wasteway Gatehouse [at Bridge St, where Eastern Canal bents to feed Boott Mills/John Street Powerhouse]                                                                                                                                           |
| 4.1.6    | Mill Buildings                                                                                      | The PAD notes that only the turbines and associated equipment are included in the project boundary, not the buildings that surround them. Nonetheless, it would be useful to cross reference generating facilities and the mill complexes where they are housed |
|          | John Street Power Station                                                                           | Boott Mills                                                                                                                                                                                                                                                     |
|          | Bridge Street Power Station                                                                         | Massachusetts Mills (unit numbers?) and Prescott Mills (unit numbers?)                                                                                                                                                                                          |
|          | Hamilton Power Station                                                                              | Hamilton Mills (unit numbers?) and Appleton Mills (unit numbers)                                                                                                                                                                                                |
|          | Assets Power Station                                                                                | Market Mills Powerhouse                                                                                                                                                                                                                                         |
| 4.1.7    | Tailrace Channel                                                                                    |                                                                                                                                                                                                                                                                 |
| 4.1.8    | Bypass Reach                                                                                        |                                                                                                                                                                                                                                                                 |
| 4.1.9    | Control Structures                                                                                  | [across Northern Canal at EL Field powerhouse. Colloquially called “Hydro Lock” by National Park Service staff. Need more precise name to avoid confusion with 4.1.3 Pawtucket Gatehouse, a.k.a. Northern Canal Gatehouse.]                                     |
| 4.1.10   | Fish Passage Structures                                                                             |                                                                                                                                                                                                                                                                 |
| 4.1.11   | Eldred L. Field Powerhouse                                                                          |                                                                                                                                                                                                                                                                 |

## PAD Section 5.8 Recreation and Land Use

In Section 5.8.1 – Please include canal-adjacent walkways and NPS boat tours as recreational resources.

On Page 108, please revise “Portions of the Lowell National Historical Park are within the project boundary” to “The entire 5.6 mile power canal system and supporting historic structures and equipment along with paved recreational trails constructed immediately adjacent to the canals are recreational resources within the Project Area and boundary of the National Historical Park. Additionally, the 5.6 mile power canal system is located within the boundary of the Lowell Locks and Canals National Historic Landmark District, Lowell Water Power System National Historic Civil Engineering Landmark; and Lowell Power Canal System and Pawtucket Gatehouse National Historic Mechanical Engineering Landmark.”

Please add in the system of interconnected walkways/multi-use trails located along the canal and river edge as existing recreational facilities. Lowell National Historical Park has worked for decades, together with our partners, to build a system of interconnected river and canal adjacent trails. Boott has helped facilitate the construction of some trails by providing necessary easements. As key links in the trail network are constructed, we’ve witnessed increases in both recreational and transportation use by park visitors and the local community. Trails are an essential component of the Park’s alternative transportation system – which also includes trolleys and tour boats – designed to link the Park’s scattered sites located throughout the densely developed city. The vision for the trail system is outlined in the Park’s 1980 General Management Plan and sister documents, the Preservation Plan (1980) and the Preservation Plan Amendment (1990). Because Lowell was developed as a textile factory town, with industrial efficiency as the most important factor in determining historical land uses, very few parks exist. These linear trails connect residents to waterfronts and offer a reprieve from the industrial city. In addition, trail systems have been an economic engine for the City with \$54 million in public investments toward trail development resulting in over \$527M in private investment in the development of adjacent properties. With strong support from our partners and local community, developing the missing links and connecting to other regional trails, increasing public access, and maintaining trails in good condition continues to be a priority of the national park.



The National Park Service offers seasonal ranger-guided canal and river boat tours which provide unprecedented access to the historic canals. Each summer, thousands of visitors experience the canals and learn about their history in NPS-led boat tours, <https://www.nps.gov/lowe/planyourvisit/guidedtours.htm>.

### **PAD Section 5.9 Aesthetic Resources**

Please include mention of trash accumulation and vegetation in the Aesthetic Resources as an existing condition. One of the top public complaints/concerns regarding aesthetics relates to the presence of trash and the overgrowth of vegetation which collects additional trash. (See photo, August 2018 near Hamilton Gatehouse).



### **PAD Section 5.10 Cultural Resources**

The section on Historic Resources is only 3 pages long, does not reference the Congressional mandate for the National Park Service to protect and preserve the historic 5.6 mile canal system for this and future generations, and does not include any photos. Many of the resources listed as “Key Components” of the Locks and Canals Historic District on pages 135-136 are also described in Section 4.1 “Civil Works.” The historical significance of these structures and date of construction should be described in further detail in this section of the report given their national significance, location within the boundary of multiple protected areas, and because the resources contribute to the significance of the Lowell National Historical Park; Lowell Locks and Canals National Historic Landmark District; Lowell Water Power System National Historic Civil Engineering Landmark; and Lowell Power Canal System and Pawtucket Gatehouse National Historic Mechanical Engineering Landmark.

Please find and replace reference to National Historic Park to the correct naming convention Lowell National Historical Park throughout the document.

“The Lowell National Historical Park” Section contains numerous inaccuracies. Please reference PL 95-290, Lowell Canal System Cultural Resources Inventory, and subsequent plans and studies referenced in this letter to correct, or to incorporate text below:

Lowell National Historical Park was established by Congress June 5, 1978 (PL 95-290). Although the area within the park boundary is 142 acres and the larger Lowell Historic Preservation District encompasses 583 acres, only 19 acres are in federal ownership. The Park is by design a partnership park in which federal, state, and local governments as well as the private sector and local community carry out the legislative intent of the park unit. Physical resources protected by the park include the original 5.6-mile power canal system, a nationally recognized engineering marvel with its sophisticated dams, locks, and gatehouses; 7 of the original 10 textile mill complexes (5.3 million square feet); significant examples of early housing types, institutions, and transportation facilities; and diverse museum collections. In addition to the industrial artifacts, Lowell retains much of its rich cultural heritage, as reflected in the ethnic diversity and preserved traditions of its citizens.

Lowell National Historical Park’s museum collection includes the Proprietors of Locks and Canals (PLC) Records from 1747 through 2008 which document the original construction and on-going maintenance of the canal system and includes 9,304 architectural / engineering drawings, 6,770 original photographic prints, 79 film

negatives, 9 glass-plate negatives, and 39 glass lantern-slides produced by PLC between the years 1883 and 1956.

PLC Volume I <https://www.nps.gov/lowe/learn/historyculture/upload/LOWE-ARCHIV-FindingAid-0908-PL-CI.pdf>

PLC Volume II <https://www.nps.gov/lowe/learn/historyculture/upload/LOWE-ARCHIV-FindingAid-0908-PL-CII.pdf>

Lowell National Historical Park together with the University of Massachusetts Lowell College of Education facilitate education programs at the Tsongas Industrial History Center at the Boott Mills that reach approximately 40,000 students and teachers annually. These programs use the resources of the National Park including the historic canals, industrial mills powered by the canals, and the Merrimack River.

Lowell National Historical Park would not be a unit of the national park system if the historic canal system were not present. Continued preservation of and public access to the 5.6 mile historic canal system and supporting historic structures are essential to meet Lowell National Historical Park's Congressional intent.

There is no reference to the Lowell Heritage State Park in the Historic Resources section of the PAD. A summary description of the state park should be included in the Historic Resources Section. The Massachusetts Department of Conservation and Recreation (DCR) issued a comprehensive Resource Management Plan in 2014, that describes its complex rights on the canal system, including gatehouse structures and other elements.

Page 137 – The current condition of buildings in the historic district is not up to date and requires additional research and revision. As of August 2018, the collaboration between Lowell National Historical Park and its partners has resulted in the rehabilitation of over 98% of the 5.3 million square feet of historic mill space adjacent to the canals and hundreds of additional buildings in the downtown historic district.

#### **PAD Section 6.2.1 – Preliminary List of Resource Issues Table**

Please add **“Historic Resources”** as a “Resource Area” and **“Ownership and maintenance responsibilities / obligations of the 5.6 mile historic canal system and supporting historic buildings and mechanical equipment, Impacts of High/Low Water Levels, Vegetation”** as “Issues pertaining to Specific Resource Areas.”

Please add **“Aesthetic Resources”** as a resource area and **“Vegetation and Trash”** as “Issues...”

Under **Recreation**, please also include **“Flow rates, water levels, and functional lock chambers”** under “Issues.”

In April 2008, FERC initiated a request to Lowell National Historical Park for information regarding compliance and status of the license agreement. NPS enumerated several on-going license issues in a response letter. The NPS letter was forwarded to Enel/Boott Hydropower, Inc. and an additional response was provided by Enel/Boott Hydropower, Inc. These letters illuminate many on-going issues and areas of concern between the national park and licensee and are attached as Attachment D for reference.



Additionally, preliminary discussions with staff and partners following the July 17 Scoping Meeting revealed the following specific issues which are directly related to Boott Hydropower Inc.'s (Boott's) current license / project operations.

## **IMPACT OF PROJECT OPERATIONS ON CULTURAL RESOURCES**

### **Cultural Resource Issues Requiring Repair**

1. **Great River Wall Maintenance:** The structural integrity of the Great River Wall and public safety are issues of highest concern to the NPS, given a past collapse of a portion of the wall. Vegetation management, water levels, and other factors related to Boott's operation may affect the structural integrity of this National Historic Landmark District feature as well as the life and safety of trail and canal users.
2. **Repair Hydro Locks:** This set of locks was installed by Boott as part of the mitigation for their 1983 FERC license and remains under the applicant's ownership. The Park has been unable to use the lock chamber because the gates need repair and are mired in mud. This needed repair is also a high priority for the NPS.
3. **Repair Northern Canal Waste Gatehouse:** The water level in the Northern Canal runs high and damages some of the wood structure under this gatehouse at the Great River Wall. The National Park hired EYP Architects to assess the repair needs which are now substantial (See Attachment E, 2017 Northern Canal Waste Gatehouse Project Scoping Report). Plans and specifications can be provided. The damage is directly attributable to Boott operations and should be repaired.
4. **Replace/Repair of Moody St Feeder Gatehouse Gate:** Boott cut a hole in a portion of one of the gates some years ago to install a high voltage power line and never replaced the gate materials. If the hole in the gate was filled, the Park could continue using its historic water turbine for student and visitor programs at Suffolk Mill when the system is drained. This will also be an essential issue if partner organizations would like to move forward with plans to activate ice skating or other recreational activities in the Merrimack Canal.
5. **Lower Locks Fill Valve:** The Lower Locks Fill Valve is owned by Boott while DCR owns the adjacent lock chambers and gatehouse superstructure. Boott does not use the valve in its canal system control operations and no longer maintains it. The valve, which is no longer operable, is needed for the operation of the locks, which are most often used for recreational purposes by the Lowell Parks and Conservation Trust for its whitewater rafting program. In addition, the above-water part of the valve mechanism, the granite platform, and its railing are a focal point of the Lower Locks site, forming a part of the historic scene. The valve is in failure mode because of the deterioration of the section of canal wall on which the mechanism and its operating platform are set. The National Park had 50% construction documents prepared by a consultant in 2012 for the rehabilitation of the valve, which would consist of reconstruction of the section of failing wall beneath and the resetting of the valve operating mechanism and its granite platform slab atop the wall. Those documents can be shared with Boott, but would have to be finalized to be used as contract documents. The NPS consultant's contract has since expired. The full repairs were not completed because that contract was modified due to funding limitations

to instead provide documents for a temporary stabilization of the valve mechanization, which was exhibiting signs of potential catastrophic failure. In 2012, the National Park contracted the stabilization of the valve platform as a temporary stopgap measure. However, that stabilization was presumed to be a temporary fix to last 2 or 3 years because it could not address the root problem of the deterioration of the wall supporting the valve. Permanent repairs are needed.

6. **Hall Street Dam & Lawrence Dam:** This is a scenic area beside the arena and Lawrence Mills. There is a lot of vegetation that has grown on and around the dam so that the point may be lost on a visitor that it is a dam. The vegetation is further damaging the existing stone work. Rebuilding the dam would allow the water to cascade over the stepped dam as it did in the past and refill the pond that existed behind the dam. The nearby Lawrence Dam needs rehabilitation work so that the gates will allow the basin between Hall Street Dam and the Lawrence Dam to be maintained at a higher water level more regularly. The reconstruction of the missing gatehouse structure on the dam is a long term goal.
7. **Western Canal Sectional Gates:** Repairs are needed to many gates which isolate water levels within the system. If the Western Canal Sectionalized Gates are repaired, areas of the canals could be de-watered without interrupting power production while keeping the optimal water levels in other areas throughout construction duration.

## **IMPACT OF PROJECT OPERATIONS ON RECREATIONAL, LAND USE, AND AESTHETIC RESOURCES**

### **Recreational, Land Use, and Aesthetic Resource Issues Requiring Repair**

1. **Repair Hydro Locks:** This set of locks was installed by Boott as part of the mitigation for its FERC license. They have not been transferred to NPS and remain owned by Boott. The Park has been unable to use the lock chamber because the gates need repair and are mired in mud. NPS cannot operate boat tours along the Northern Canal without repair to the locks.
2. **Replace/Repair of Moody St Feeder Gatehouse Gate:** Boott cut a hole in a portion of one of the gates some years ago to install a high voltage power lines and never replaced the gate materials. Water leaks through the whole cut in the gate for the cable and as a result water levels cannot be controlled. This could prohibit future on-water recreation proposed by partners due to lack of water control.
3. **Trash removal:** One of the top public complaints Lowell NHP hears is regarding trash floating in the canal. Trash accumulation can result in negative impacts to recreational users as well as aesthetic resources. A plan for optimal trash removal should be documented in a formal agreement among parties.

### **PAD Section 7.1 Qualifying Comprehensive Plans Deemed Applicable**

The NPS intends to file a number of the plans listed below with FERC for certification as Comprehensive Plans pursuant to Section 10(a)(2)(A) of the Federal Power Act.

## **Legislative History of the Lowell National Historical Park (LOWE) and Associated Planning and Management Documents.**

In 1976, the Lowell Locks and Canals National Historic District (the District) was listed on the National Register of Historic Places (NR). It was included as part of Lowell National Historical Park's designation as a National Historic Landmark (NHL) in 1977. The NHL District encompasses approximately 125 acres of land including canals, gates, locks, dams and associated structures. The first canal dates to 1796 and was initially used for transportation of goods around Pawtucket Falls. The canal system was adapted in 1822 to provide waterpower for the developing textile industry. The District also included several mill yards and worker housing associated with the textile industry that were constructed in the early 19<sup>th</sup> century.

On June 5, 1978, Congress established Lowell National Historical Park. The enabling legislation states that the purpose of the park is to "preserve and interpret the nationally significant historical and cultural sites, structures, and districts in Lowell, Massachusetts, for the benefit and inspiration of present and future generation by implementing to the extent practicable the recommendations in the Report of the Lowell Historic Canal District Commission." The "five-and-sixth-tenths-mile power canal system" is named specifically as a historical resource to be protected and preserved by the NPS and is located wholly within the 142 acre boundary of the National Historical Park and the 583 acre Preservation District established under the 1978 Act.

**The Lowell Canal Survey by the Historic American Engineering Record (1976)** documented the history of the development of the canal system in Lowell and includes detailed narrative, photographs, drawings, and maps of the historic canal system.

**The Brown Book (1977) entitled *Report of the Lowell Historic Canal District Commission to the Ninety Fifth Congress of the United States of America***

[https://www.nps.gov/lowe/learn/management/upload/1977\\_-Brown-Book-\\_reduced.pdf](https://www.nps.gov/lowe/learn/management/upload/1977_-Brown-Book-_reduced.pdf) provided the justification for the establishment of the Lowell National Historical Park (LOWE) in 1978. PL 95-290 June 5, 1978 <https://www.gpo.gov/fdsys/pkg/STATUTE-92/pdf/STATUTE-92-Pg290.pdf> established LOWE and tasked the Commission with develop what became the **Preservation Plan in 1980**

[https://www.nps.gov/lowe/learn/management/upload/LOWE\\_475\\_D5\\_A\\_0001-18-0613.pdf](https://www.nps.gov/lowe/learn/management/upload/LOWE_475_D5_A_0001-18-0613.pdf).

That plan set out the primary themes and responsibilities for LOWE which are listed at page 5 as 1. "Preserving the 19<sup>th</sup> Century Setting," 2. Encouraging the Varieties of Cultural Expression," and 3. Projects Mandated by the enabling legislation. ***Details of the Preservation Plan*** was issued shortly afterward.

[https://www.nps.gov/lowe/learn/management/upload/LOWE\\_475\\_D5\\_18-0612.pdf](https://www.nps.gov/lowe/learn/management/upload/LOWE_475_D5_18-0612.pdf).

**The 1981 General Management Plan for Lowell National Historical Park (LOWE)**

<https://www.nps.gov/lowe/learn/management/upload/1981-LOWE-GMP.pdf> was the initial long term planning document for LOWE. Included in the GMP at page 37 is a discussion on Canal System Management which identifies the initial parties to the cooperative agreement that formed the basis for future MOU's, the most recent of which was signed 1991 in association with the original licensing of the hydro project in 1983. Those parties included the NPS, the City of Lowell and the Commonwealth of Massachusetts. The NPS, along with the City of Lowell and the Commonwealth of Massachusetts (DCR) intend to work with the applicant to develop a new MOU to address canal operations and management.

**LOWE and its associated canal system was designated a National Historic Landmark in 1977.** The Commonwealth of Massachusetts effected a Taking (see Middlesex North Registry of Deeds Book 3830 Page 70) in 1986 whereby the Commonwealth took ownership of various canal resources in order to consolidate ownership. This gave the Commonwealth the right to provide public access to the canal system and adjacent walkways, and provided authority to spend money to improve and maintain various historic structures.

**In 1987, Congress (PL 100-143) reauthorized the Lowell Historic Preservation Commission** <http://uscode.house.gov/statutes/pl/100/134.pdf> and directed them to prepare a **Preservation Plan Amendment which was submitted to the Secretary of the Interior on May 19, 1990.** [https://www.nps.gov/lowe/learn/management/upload/LOWE\\_475\\_D5\\_A\\_0001-18-0613.pdf](https://www.nps.gov/lowe/learn/management/upload/LOWE_475_D5_A_0001-18-0613.pdf). The Amendment focuses on development, management and use of the canal system and adjacent properties, many of which were developed into public walkways which remain an integral part of the park and the visitor experience.

In 1995, the Commonwealth granted an easement, assigning the Commonwealth's non-fee interests to the NPS for the purpose of developing canal resources, preservation of historic resources associated with the canal and providing continued and additional public access. The 1978 enabling legislation provided for the NPS to manage resources associated with the District without fee ownership, in what is now referred to as a Partnership Park.

In 2003, the NPS completed the **Addendum to the 1981 General Management Plan for LOWE** <https://www.nps.gov/lowe/learn/management/upload/2003-LOWE-2003-GMP-Addendum.pdf>, focused primarily on re-establishing roles and responsibilities following the sunset of the Commission. Most of the Commission's responsibilities were transferred to NPS staff at LOWE.

The most recent NPS prepared document is the **September 2017 Foundation Document** [https://www.nps.gov/lowe/learn/management/upload/2017\\_LOW-FOUNDATION-DOC\\_Email-Size.pdf](https://www.nps.gov/lowe/learn/management/upload/2017_LOW-FOUNDATION-DOC_Email-Size.pdf) for LOWE, outlines why LOWE was established, which resources are nationally significant, and updates our management priorities. The Foundation Document (FD) reaffirms our Legislative Purpose, National Significance and Fundamental Resources and Values. As part of the FD, NPS prepares Significance Statements (P.6) that express why a park's resources and values are important enough to merit designation as a unit of the National Park System. Among those are The Lowell Canal System<sup>3</sup> and Integrity of Historical Urban Landscape.<sup>4</sup> The plan identified LOWE's Fundamental Resources and Values, those resources or values essential to meeting the legislated purpose of the park and warrant primary consideration for future planning and management decisions including maintenance and operations.

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<sup>3</sup> The Lowell canal system is nationally recognized as one of the most impressive civil and mechanical engineering achievements of the 19th century because of its grand scale and technological complexity, and is the site of origin for the famed "Francis" turbine. The canal system, used as both a transportation corridor and power source, facilitated the growth of the industrial city. Lowell NHP Foundation Document (Lowell, MA: NPS, 2017) p6.

<sup>4</sup> A very large proportion of original buildings, structures, and urban landscapes have survived in Lowell's park and preservation district and now are recognized as important historical artifacts. These include the entire 5.6-mile power canal system with its sophisticated dams, locks, and gatehouses, 7 of the original 10 mill complexes, and significant examples of early housing types, institutions, and transportation facilities. Lowell NHP Foundation Document (Lowell, MA: NPS, 2017) p7.

Fundamental Resources and Values (P.7) include the **Water Power System/Canal System**<sup>5</sup> and the **Immersive Experience**<sup>6</sup> provided to visitors, including water-based tours of the canal system and hands on interpretive and educational opportunities that provide insights into Lowell's industrial past and that of the nation as a whole. Significance Statements outlined current conditions and trends, and identified key threats to NPS resources as well as opportunities to protect and enhance those resources. NPS developed a fundamental resources and values table in the 2017 Foundation Document that provides details on data and planning needs associated with the **Water Power System/Canal System** (P.12-14) and for the **Immersive Experience** (P.18-20). Key Issues and Associated Data Needs were identified at pages 33-35 and the associated tables at pages 36-41. Among them are the Renewal of the Enel Green Power License, Jurisdictional Challenges (land rights and ownership), and Private Ownership in the Park and Preservation District. See Attachment F for further detail.

## RECOMMENDED STUDIES

Please see Attachment G for study requests recommended by NPS.

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<sup>5</sup> **Water Power System / Canal System.** The Lowell National Historical Park boundary includes 9.6 miles of major riverbanks and all 5.6 miles of historic canals in Lowell, all of which comprise the waterpower system that harnessed waters of the Merrimack River to power the city's mills. In fact, the Merrimack River and its natural attributes dictated the location of the city itself. The water power and canal system includes the Pawtucket, Merrimack, Hamilton, Western, Eastern, Lowell, and Northern Canals and canal banks, as well as several associated locks, gatehouses and dams, and Pawtucket Falls. This system, which still operates as a source of hydroelectric power, provides an opportunity to interpret both the historic significance of water in industry, as well as the engineering of a waterpower system. Public access has been expanded over the years to support these interpretive opportunities, including creation of a pedestrian canalway and riverwalk and the development of related exhibits and programs such as the Suffolk Mill Turbine Exhibit.

<sup>6</sup> **Immersive Experience.** Lowell National Historical Park provides a variety of hands-on interpretive and educational opportunities that allow visitors to immerse themselves in Lowell's industrial past. Key park experiences include exhibits that feature a working turbine and weave room, as well as boat tours of the canal system and rides through the park on historic replica trolleys, which are among the most popular and unique experiences in the park. The Tsongas Industrial History Center, a partnership between Lowell National Historical Park and the University of Massachusetts Lowell College of Education, is a hands-on center where students can learn about the American Industrial Revolution through interactive activities such as weaving, working on an assembly line, creating canal systems and testing water wheels, and measuring water quality.

Thank you for the opportunity to review and comment on this project. If you have questions regarding these comments, please contact Julianne Rosset, U.S. Fish and Wildlife Service at [julianne\\_rosset@fws.gov](mailto:julianne_rosset@fws.gov), (603) 227-6436 or Kevin Mendik, National Park Service at [kevin\\_mendik@nps.gov](mailto:kevin_mendik@nps.gov), (617) 223-5299. Please contact me at (617) 223-8565 if I can be of further assistance.

Sincerely,

A handwritten signature in blue ink, appearing to read "Andrew L. Raddant", is displayed on a light blue rectangular background.

Andrew L. Raddant  
Regional Environmental Officer

#### **ATTACHMENTS**

CC: Enel ([kevin.webb@enel.com](mailto:kevin.webb@enel.com))

**LITERATURE CITED**

- Alden. 2011 Shad Upstream Passage Assessment at Lowell Hydroelectric Project. Submitted to Boott Hydro, LLC. Final Report. Alden Research Laboratory, Inc. Andover, Massachusetts. 43 pp.
- Blue Leaf Environmental. 2013. Additional Analysis of American Shad Three- Dimensional Behavior in the Tailrace of the Lowell Project. Submitted to Boott Hydro, LLC. Final Report. Blue Leaf Environmental, Inc. Ellensburg, Washington. 4 pp.
- Boott. 2000. Assessment of Internal Fish Lift Efficiency at Lowell Hydroelectric Project. Submitted to Boott Hydro, LLC. Final Report. Boott Hydropower, Inc. 16 pp.
- Gomez and Sullivan. 2016. Analysis of Upstream Fish Passage Facilities and Operation. Submitted to Boott Hydroelectric Project. Submitted to Boott Hydro, LLC. Final Report. Gomez and Sullivan Engineers, D.P.C. Henniker, New Hampshire. 62 pp.
- Normandeau. 1991. An Assessment of the Effectiveness of a Fish Bypass for Passing Juvenile Alewives at the Lowell Hydroelectric Project, Lowell, Massachusetts. Submitted to Consolidated Hydro, Inc. Final Report. Normandeau Associates, Inc. Bedford, New Hampshire. 26 pp.
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- Sprankle, K. 2005. Interdam movements and passage attraction of American shad in the lower Merrimack River main stem. North American Journal of Fisheries Management, 25, 1456-1466.

## ATTACHMENT A





# United States Department of the Interior



## FISH AND WILDLIFE SERVICE

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

September 26, 2017

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

Dear Mr. Bartlett:

Ref: Lowell Hydro Project – FERC No. 2790  
Ledge Excavation Design Comments and Recommendations

This responds to the Lowell Ledge Excavation Designs that you submitted to us via email on July 18, 2017. We have been working with ENEL Green Power North America, Inc. (ENEL) for many years to enhance upstream fish passage, and the proposed ledge removal is part of a larger effort to address upstream fish passage performance at the Lowell Hydroelectric Project (FERC No. 2790). Thus far, progress has been made to improve internal fish lift operations protocols, fish lift entrance evaluations, and fish ladder repairs and maintenance. However, the U.S. Fish and Wildlife Service (Service), along with other agencies, have indicated in prior meetings and correspondence that additional measures are necessary at both the tailrace fish lift and spillway fish ladder in order to achieve adequate American shad and river herring passage effectiveness.

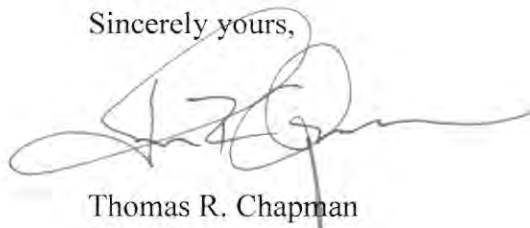
At a meeting on August 15, 2017, ENEL's proposed ledge removal designs were discussed and the Service and other agency representatives outlined our recommendations on the proposed designs. As agreed to at the meeting, the Service's Bryan Sojkowski and Bjorn Lake (of the National Marine Fisheries Service) prepared the attached memo which provides more explanation and details regarding our recommendations.

Mr. Randal Bartlett  
September 26, 2017

2

Thank you for meeting with us and providing us the opportunity to comment on the designs. If you have any questions, please contact John Warner at 603-227-6420 or Julianne Rosset at 603-227-6436.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'T. Chapman', with a large, stylized flourish extending to the right.

Thomas R. Chapman  
Supervisor  
New England Field Office

Enclosure

Mr. Randal Bartlett  
September 26, 2017

3

cc: CNEFRO - Joe McKeon, Mike Bailey (via email)  
RO/Fisheries - Bryan Sojkowski (via email)  
NHFGD - Matt Carpenter (via email)  
MDFW- Caleb Slater (via email)  
MDMF- Gloucester - Ben Gahagan (via email)  
NMFS - Sue Tuxbury (via email)  
NMFS - Bjorn Lake (via email)  
FERC - Division of Hydropower Administration and Compliance  
Reading File

ES: JRosset: 9-26-17:603-227-6436

## Technical Memorandum

**To:** Randal Bartlett, P.E., Senior Operations Manager – Northeast, ENEL Green Power North America, Inc.

**From:** Bjorn Lake, P.E., PhD, NOAA Fisheries; Bryan Sojkowski, P.E., USFWS

**Re:** P-2790 Lowell Ledge Removal Project

**Date:** August 18, 2017

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### OBJECTIVE

The purpose of this project is to remove a ledge outcropping that is a potential deterrent to immigrating diadromous fish readily detecting and entering the fish lift entrance at the Lowell Hydroelectric Project (P-2790). Telemetry studies in 2002, 2011, and 2013 have shown that immigrating American shad that approach the project via the tailrace have difficulty utilizing the entrances of the fishway (Sprankle 2005; Alden 2011; 2013). In 2016, Gomez and Sullivan Engineers completed an analysis of the upstream passage system and recommended excavation of the ledge outcropping to approximately 10 feet below normal tailwater level extending 50 to 100 feet downstream from the entrance. During the March 30, 2017, Merrimack River Technical Committee meeting, we all agreed that the ledge removal project should move forward.

On July 18, 2017, the Merrimack River Technical Committee received the design plans for review before the commencement of construction. We sent a technical memorandum to ENEL Green Power North America, Inc., on July 26, 2017, providing our recommendations. Upon the request of ENEL, Julianne Rosset, Bryan Sojkowski, and Bjorn Lake met with ENEL representatives on August 15, 2017, at their Andover, Massachusetts office to discuss our recommendation. At that meeting, it was determined that the agencies should provide updated information on the low design flow for the upstream fishway and the corresponding tailwater elevation. This technical memorandum provides those updates.

### RECOMMENDATION

The provided design drawings show a vertical excavation limit at an elevation of 48 feet (NAVD 88), extending approximately 80 feet downstream from the centerline of the fishway entrance. This excavation limit elevation roughly corresponds with the existing floor elevation of the fishway entrance chamber of 48.2 feet (NAVD 88), not including the 1-foot-high concrete lip at the entrance gate. Our criteria (both NOAA Fisheries and USFWS) for fishways is to be operational between the 5-95 percent flow exceedance values. Therefore, we recommend that the fishway be operational at tailwater elevations down to approximately 50 feet (NAVD 88), which corresponds to the tailwater elevation at the 95 percent exceedance flow.

Additionally, we recommend that the minimum water depth above the entrance channel floor sit at 4 feet. Typically, gate structures are utilized to constrict the flow at the entrance in order to achieve an attraction jet with a 4-6-foot-per-second velocity. Lowell currently operates a vertical gate that varies from 0.3-3 feet above the lip of concrete at the downstream end of the entrance floor. An ancillary criterion to the minimum of 4 feet of depth is that the water surface elevation of the tailwater is recommended to be, at a minimum, two times the body depth of the largest target species. An American shad with a body depth of 10" would require a minimum of 1.5 feet of depth. The current entrance at Lowell does not meet this criterion for the full range of fish passage flows and tailwater fluctuations. Therefore, only excavating the ledge to an elevation of 48 feet (NAVD88) will necessitate additional future ledge excavation, when modifications to the gate and entrance channel are made to meet our design criteria. We understand that those entrance modifications are outside the scope of work for the ledge removal project, however, we recommend altering the ledge removal design such that additional excavation is not necessary in the future.

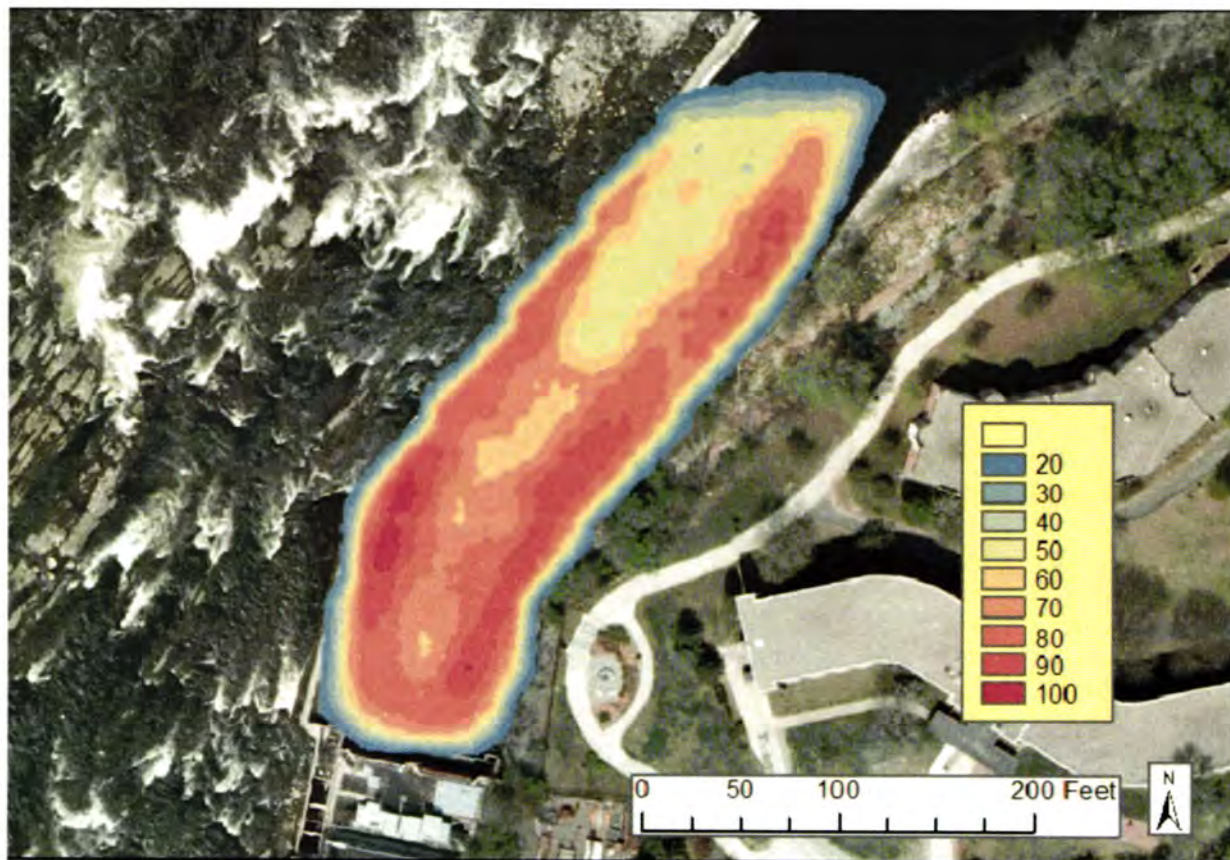
In support of our flow and tailwater elevation recommendation, we conducted a hydrologic analysis of the project flows. We downloaded daily average flow data from the U.S. Geological Survey gauges on the Merrimack River below the confluence with the Concord River (USGS #01100000) and the Concord River immediately upstream from the Lowell canal system (USGS #01099500). The difference between these average daily flow values is the flow in the Merrimack River that passes through the Lowell Project. We downloaded the last 30 years of record (1987 to 2016) and calculated a flow duration curve for the upstream migration season (April 15-July 15). In addition, to predict corresponding tailwater elevations at the upstream fishway operational flow range, we used the updated tailwater rating curve provided in the recent upstream fish passage assessment (Gomez and Sullivan 2016). We fit a logarithmic function to the provided tailwater data ( $R^2 = 0.9991$ ) such that we could use the resulting equation ( $y = 2.786\ln[x] + 29.824$ ) to predict the corresponding tailwater elevation for the flow exceedance values. Table 1 shows the results of this analysis providing the justification for a design tailwater elevation of approximately 50 feet (NAVD 88).

**Table 1.** Flow duration exceedance values and predicted tailwater elevations for the Lowell Project.

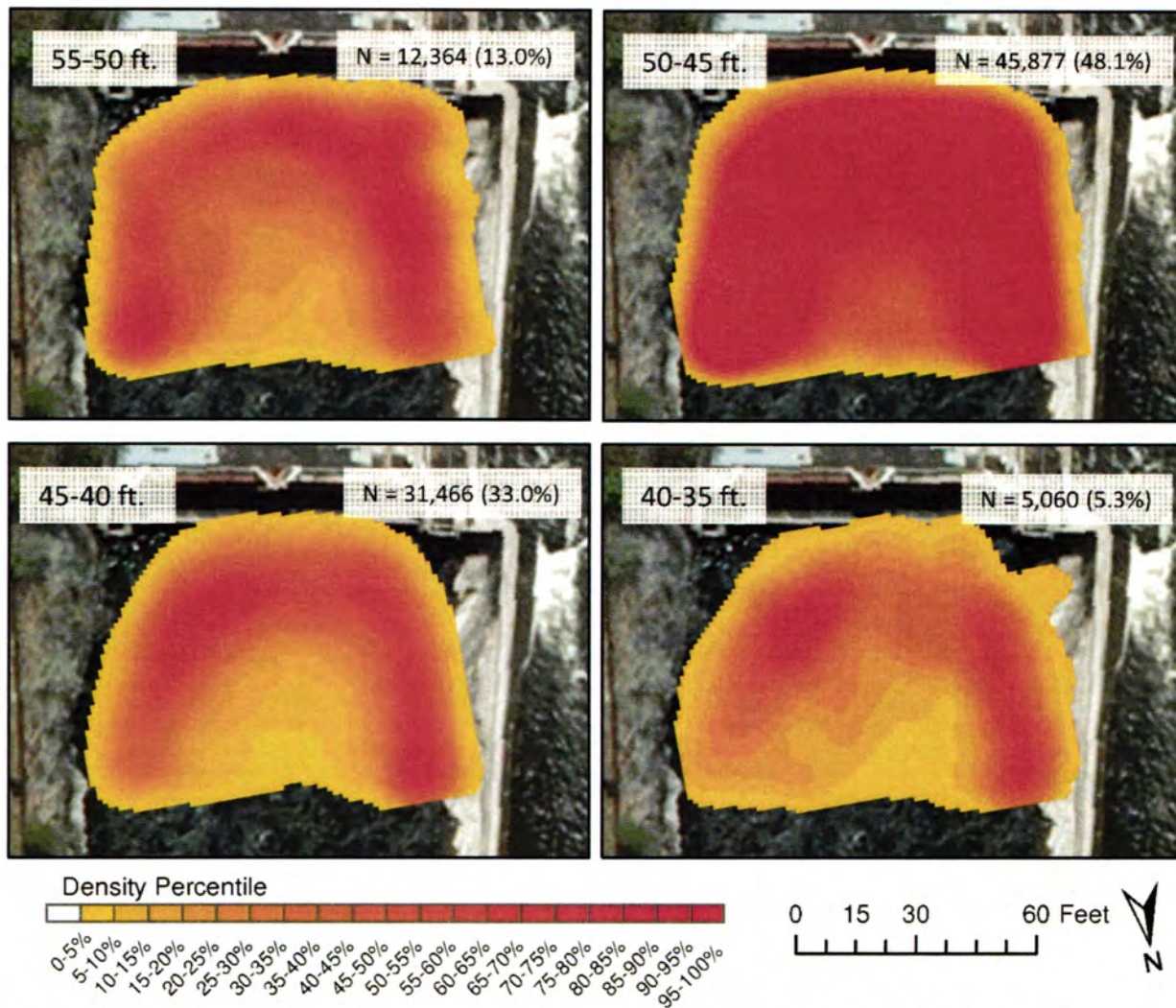
| Flow Exceedance Value | Project Flow (cfs) | Tailwater Elevation (ft) |
|-----------------------|--------------------|--------------------------|
| 5%                    | 26,210             | 58.17                    |
| 10%                   | 19,870             | 57.40                    |
| 25%                   | 12,470             | 56.10                    |
| 35%                   | 9,752              | 55.41                    |
| 50%                   | 6,912              | 54.46                    |
| 65%                   | 4,938              | 53.52                    |
| 75%                   | 3,830              | 52.81                    |
| 85%                   | 2,851              | 51.99                    |
| 95%                   | 1,735              | 50.60                    |

The three-dimensional telemetry studies conducted by Alden Labs in 2011 generated fish density plots that showed where immigrating American shad congregated in the tailrace (Figure 1 and Figure 2). The 80-foot length of the proposed ledge excavation appropriately reaches the zone of highest density at the turn in the tailrace (Figure 1). However, the proposed elevation of ledge excavation does not match the highest density of fish depth-wise (Figure 2). Over 80 percent of the fish detections occurred between the tailwater elevations of 40-50 feet with the highest density in the 45- to 50-foot bin (Figure 2). During the 2011 study period, the flow in the River was at or above the median for the period of record with the exception of one week in June when flow was lower than normal, suggesting that the density plots represent conditions during normal flow conditions, not low flow conditions (Figure 3). This provides further evidence that the entrance elevation needs to be lower than the existing 49.2 feet (NAVD 88), and only excavating the ledge to an elevation of 48 feet (NAVD 88) would not provide appropriate conditions for optimal entrance efficiency for the Lowell fish lift.

There are likely many ways to modify the entrance conditions at Lowell to improve fish passage performance. As the Technical Committee continues working with ENEL to improve passage at the Lowell Project, we can discuss various options that satisfy our fisheries management goals. At this time, we believe it is appropriate to excavate ledge down to an elevation of 44 feet (NAVD 88), as this provides more flexibility for future fishway entrance modifications.



**Figure 1.** Bin density of tagged American shad during the study period (May 27-June 21) in the Lowell tailrace (Alden 2011).



**Figure 2.** Bin density of tagged American shad within 65 feet of the Lowell powerhouse during the study period (May 27-June 21). Data are presented in 5-foot elevation bins (Alden 2013).

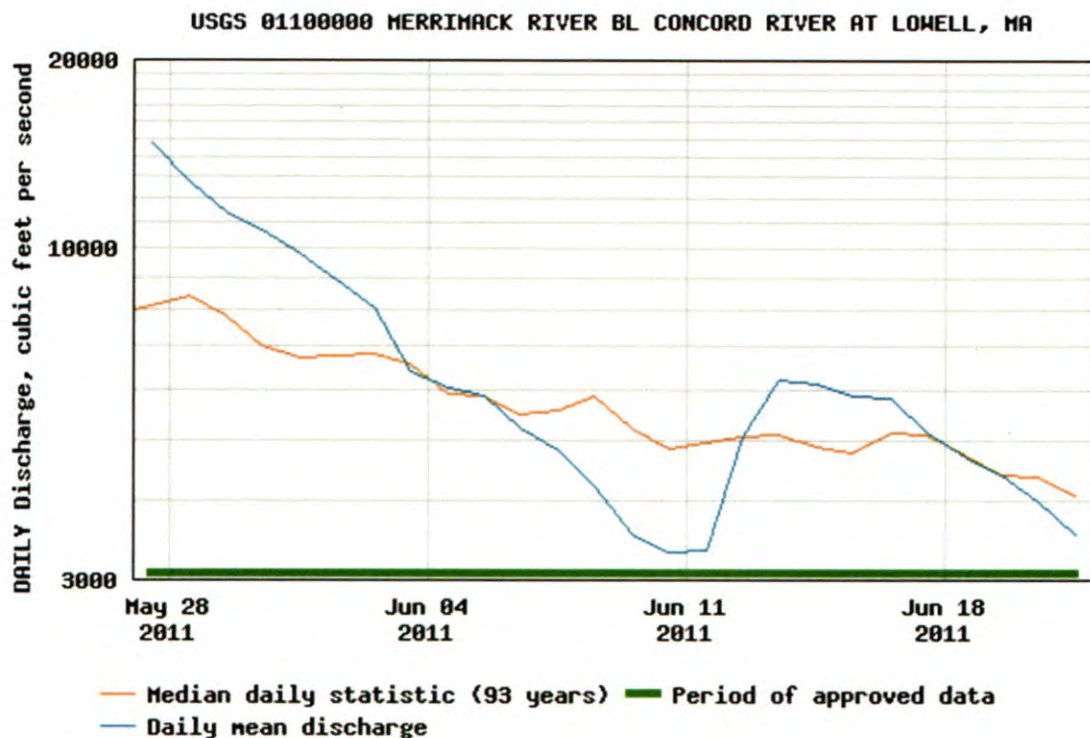


Figure 3. Hydrograph during the 2011 study period.



Document Content(s)

ltr to enel re lowell hydro ledge excavation.PDF.....1-3

lowell ledge removal attachment-tech memo.PDF.....4-8

## ATTACHMENT B



Rosset, Julianne <julianne\_rosset@fws.gov>

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## [EXTERNAL] Lawrence and Lowell 2018 Action Items List

1 message

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**St Pierre, Conrad (EGP North America)** <Conrad.StPierre@enel.com>

Tue, Jun 19, 2018 at 2:37 PM

To: "Rosset, Julianne" <julianne\_rosset@fws.gov>

Cc: "Smithwood, Doug" <doug\_smithwood@fws.gov>, Bryan Sojkowski <Bryan\_Sojkowski@fws.gov>, Michael\_bailey <Michael\_bailey@fws.gov>, Matthew A Carpenter <Matthew.Carpenter@wildlife.nh.gov>, "Donahue, Pat (EGP North America)" <Pat.Donahue@enel.com>, "Medford, Skip (EGP North America)" <Skip.Medford@enel.com>, "Fournier, Scott (EGP North America)" <Scott.Fournier@enel.com>, "ben.gahagan" <ben.gahagan@state.ma.us>, Bjorn Lake - NOAA Federal <bjorn.lake@noaa.gov>, "claudia\_hernandez@fws.gov" <claudia\_hernandez@fws.gov>, Caleb Slater <caleb.slater@state.ma.us>, "Tuxbury, Sue" <Susan.Tuxbury@noaa.gov>

To All—Per our meeting in March, we now have an update on the Lowell tailrace excavation project. Early in 2018, Enel permitting staff submitted applications for the project to local, state and federal agencies for approval. Unfortunately, some of these approval processes now appear to approach or exceed 9 months in duration. Also, after receiving only a single initial bid for the 2018 work, we received several competitive proposals in a second RFP, when the schedule was extended to summer, 2019. Because of these factors, Boott plans to complete the tailrace excavation project during late summer of 2019.

We appreciate your understanding and patience on this important but long-awaited improvement. Please feel free to contact me or anyone on the team with questions.

Thank you,

Conrad St. Pierre, PE.  
Sr. Director of Hydro North America  
Operations and Maintenance



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## ATTACHMENT C

### U.S. Fish and Wildlife Study Requests

## Boott Study Request # 1

### **Instream Flow Habitat Assessment of the Lowell Bypassed Reach (Lowell, P-2790)**

#### ***Goals and Objectives***

The goal of this study is to determine an appropriate flow regime that will protect and enhance the aquatic resources in the bypass reach (Northern Canal) between the Pawtucket dam and the E.L. Field powerhouse. Specifically, the objective of this study is to conduct an instream flow habitat study to assess the impacts of a range of project discharges on the wetted area and optimal habitat for key species, including the quantity and location of suitable habitat.

The specific objectives of this field study, at a minimum, include:

1. Characterize and map wetted perimeter of the bypass reach over a range of bypass flows;
2. Survey and evaluate the water depth and mean channel velocity at transects within the bypass reach over a range of flows; and
3. Map and assess the value of aquatic habitat in the bypass reach over a range of flows, focusing on potential habitat for resident species, and spawning and migration habitat or rest/regrouping areas for migratory species.

Target fish species should include American shad, river herring (alewife and blueback herring), fallfish, white sucker, freshwater mussels and benthic macroinvertebrates. The final target species list should be developed in consultation with the fisheries agencies and based on the results of the mesohabitat mapping.

#### ***Resource Management Goals***

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to aquatic resources within the Lowell bypassed reach, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide a flow regime in the bypassed reach that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) and diadromous fishes.

3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

These study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

### ***Public Interest***

The requester is a natural resource agency.

### ***Existing Information***

The Lowell Project bypasses a 0.7-mile-long section of the Merrimack River, from the Pawtucket dam to the E.L. Field powerhouse. There is presently no required minimum bypass flow. However, during the upstream fish passage season, the bypass reach receives 500 cfs through operation of the spillway fish ladder. In addition, the bypass reach receives flow whenever inflow exceeds the hydraulic capacity of all the project's stations. Pursuant to Article 37, Boott Hydropower, LLC, (Boott) maintains a minimum flow of 1,990 cfs or inflow, whichever is less, as measured immediately downstream of the project.

Available information in the PAD does not indicate how project operations have altered downstream hydrology, habitat quantity and quality, and water quality, which may affect resident and migratory fish, macroinvertebrates, aquatic plants and other biota and natural processes in the Merrimack River. The PAD provides no detailed description of the physical or biological characteristics of the bypassed reach.

An empirical study is needed to provide information on the relationship between flow and habitat in the bypassed reach for the Service to use in determining a flow recommendation.

### ***Nexus to Project Operations and Effects***

Although the project license requires Boott to maintain a minimum flow of 1,990 cfs or inflow (if less), downstream of the project, Boott states that in practice the project operates in a true run-of-river mode. The Department of the Interior is not recommending a below-project flow study, based on the assumption that any new license issued for the project will require instantaneous run-of-river operation (essentially codifying current operations).

The project includes a 0.7-mile-long bypassed reach. The current license contains no minimum bypass flow requirement. During the upstream fish passage season, the bypass reach receives 500 cfs via operation of the spillway fish ladder; otherwise, the reach only receives flow when inflow exceeds the hydraulic capacity of the project's generating capacity. To our knowledge, the lack of a required bypass flow was not based on any quantitative, rigorous scientific studies.

This section of the Merrimack River contains habitat which supports native riverine species, including important spawning and rearing habitat for migratory species like American shad and river herring (MRTC 2010). While the existing license does not require a minimum bypass flow, the Service believes one is needed to sufficiently protect the aquatic resources inhabiting the bypassed reach.

Results of the flow study will be used by the Service to determine an appropriate flow recommendation which will protect and/or enhance the aquatic resources in the bypassed reach for the duration of any new license issued by the Federal Energy Regulatory Commission (Commission).

### ***Methodology Consistent with Accepted Practice***

Bypass flow habitat assessments are commonly employed in developing flow release protocols that will reduce impacts or enhance habitat conditions in reaches of river bypassed by hydroelectric projects.

Given the size of the bypassed reach (0.7 mile long) and the important resources known to inhabit the reach (i.e., diadromous fishes); we believe a study methodology which utilizes an instream flow incremental methodology (IFIM) approach is appropriate for this site. This same protocol was used during the relicensing of the Housatonic River Project (FERC No. 2576),<sup>1</sup> and has been accepted by the Commission in other licensing proceedings.<sup>2</sup>

The study should have two components. The first component entails mapping habitat within the bypass reach. The number, location, and size (area and linear distance) of each mesohabitat type in the reach should be documented, including qualitative characterizations (e.g., dominant substrate, average depth, overhead and instream cover, etc.). The second component consists of conducting an instream flow study.

At a minimum, the study design should involve collecting wetted perimeter, depth, velocity, and substrate data within a range of discharge levels along transects located in the reach of river between the dam and the E.L. Field powerhouse. The measurements should be taken over a range of test flows, to be agreed upon by the natural resource agencies. This information should then be synthesized to quantify habitat suitability (using mutually agreed upon Habitat Suitability Index curves) of each test flow for target species/life stages identified by the fisheries agencies. We recommend Boott perform habitat modeling using one dimensional modeling techniques to better characterize flows and velocities in this complex channel area.

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

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<sup>1</sup> Housatonic River Project License Application, Volume 4, Appendix F. Connecticut Light and Power Company, August 1999.

<sup>2</sup> Glendale Project (FERC No. 2801) Final Bypass Reach Aquatic Habitat and Instream Flow Study in Glendale Hydroelectric Project Application for Subsequent License (FERC No. 2801), Volume 2, Appendix B, pp. 7-8, October 2007.

Field work for flow studies can be reasonably extensive but will depend on consultation with Boott on study methodology and on-site decisions on locations for data collection and the number of collection locations. Post-field work data analysis would result in a moderate cost and effort. We anticipate that the level of effort and costs will be comparable to those experienced on similar Commission relicensing projects (e.g., the Glendale Project, FERC No. 2801).

## **REFERENCES**

MRTC, 2010. A Plan for the restoration of American shad, Merrimack River Watershed. Prepared by the Technical Committee for Anadromous Fish Management of the Merrimack River Basin. 12 pp.



## Boott Study Request # 2

### **Adult Alosine Downstream Passage Assessment and Protection Evaluation (Lowell, P-2790)**

#### ***Goals and Objectives***

The goal of this study is to assess the adequacy of the turbines at the E.L. Field, Assets, Bridge Street, Hamilton, and John Street powerhouses, to minimize injury, entrainment, and mortality of fishes residing in the Merrimack River, and to recommend appropriate mitigative measures as necessary.

The specific objectives of the field study, at a minimum, are: (1) assess the risk of adult American shad and alewife becoming injured, impinged, or entrained in the E.L. Field, Assets, Bridge Street, Hamilton, and John Street powerhouse units; (2) estimate turbine survival; (3) assess the risk of injury or mortality at the spillway and downstream bypass; and (4) evaluate potential passage and protection measures.

#### ***Resource Management Goals***

The Atlantic States Marine Fisheries Commission has developed several documents related to the management of American shad and river herring:

1. Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. (Report No. 35). April 1999.
2. 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.
3. Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. May 2009.
4. Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.

Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring includes an objective of maximizing the number of juvenile recruits emigrating from freshwater stock complexes and recommends enhancing survival at dams during emigration by evaluating survival of post-spawned adults and juvenile fish passed via each route (e.g., turbines, spillage, bypass facilities, or a combination of the three) at any given facility, and implementing measures to pass fish via the route with the best survival rate.

Specific to resident riverine and migratory fish entrainment, the Service's goals are:

1. Minimize current and potential negative project operation effects such as turbine entrainment that could hinder management goals and objectives.

2. Minimize project-related sources of mortality to resident and migratory fishes in order to restore natural food web interactions and ecosystem functions and values.

These study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

### ***Public Interest***

The requestor is a natural resource agency.

### ***Existing Information and the Need for Additional Information***

No project-specific information exists regarding risk of impingement and/or entrainment of adult alosines. In the PAD, Boott provided little information that would inform the relative risk of impingement or entrainment in any of the 21 units associated with the project. Moreover, information regarding fish mortality at the spillway and the downstream bypass was not discussed. While Normandeau Associates, Inc., performed a study in 2003 pertaining to the survival of Atlantic salmon smolts through the turbines, (1) the sample size was small (20 fish); (2) the study was not performed at a full range of gate settings; and (3) salmon are a robust fish species and cannot be used as a proxy for alosines. The 2003 study did shed light on a predation issue, however, in the project's tailrace. Of the salmon that passed downstream, 69 percent were suspected to be preyed upon after using the downstream bypass facility. As Normandeau Associates, Inc., noted in their study results, predators residing in the tailrace can have a large impact on emigrating migratory fish species that use the current bypass facility at the project.

To date, no directed studies of alosine injury, entrainment, or mortality have been conducted at the project's modified spillway, the downstream fish bypass facility, or through the turbines. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on outmigrating adult alosines and develop adequate passage and protection measures to meet management goals and objectives.

### ***Nexus to Project Operations and Effects***

Hydropower projects generate electricity by moving water through a turbine-generator system. Typically, there are trashracks in front of the intakes leading to the turbines. If the rack spacing is narrow and velocities at the racks too high (relative to the swim speeds of fish species inhabiting or moving through the headpond), fish may become impinged against the racks and die. If rack spacing is wide and the velocities too high (relative to the swim speeds of fish species inhabiting or moving through the headpond), fish may become entrained (i.e., pass through the racks) and get injured or die while passing through the turbines.

Lowell's configuration likely presents problems with respect to providing safe, timely, and effective passage for outmigrating alosines. Pre-spawned adult American shad and river herring pass upstream through the Lowell fishways and/or are stocked into upstream habitats. These fish

need to be able to migrate back downstream because they are iteroparous in this region (McBride et al. 2016). Therefore, it is necessary to understand how alosines move through the project area and the level of injury or mortality caused by entrainment through the project's turbines and/or passage via the dam spillway and downstream bypass facility.

### ***Methodology Consistent with Accepted Practice***

The Service proposes a phased approach to this study.

#### **Phase 1:**

Spill, bypass, and turbine mortality should be assessed using a balloon-tag method.

For spill mortality sites (dam spillway and downstream bypass), tagged alosines will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec to minimize the possibility of the fish swimming upstream into the headpond or canal. Passed balloon-tagged alosines will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

For turbine mortality sites, tagged alosines will be injected into the intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec to minimize the possibility of fish swimming back upstream through the intakes. Passed balloon-tagged alosines will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

#### **Phase 2:**

Boott should investigate existing or potential future operational and/or physical measures that would minimize injury or mortality to outmigrating adult alosines moving past the project. Based on the results of this investigation, we recommend Boott provide a range of potential alternatives (e.g., increasing attraction to the existing downstream bypass, installing exclusionary screening, etc.).

Project operations (flows, levels, gate openings, number of units operating, and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) should be monitored and recorded regularly (hourly measurements if possible) throughout the duration of the study to establish a more comprehensive understanding of how migration patterns are influenced by these parameters.

These methodologies are consistent with accepted practice.

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

The cost and effort of each individual phase of this study are expected to be moderate. Based on the scale and scope of the subject study, we estimate the cost to be \$25,000 to \$50,000. In the

PAD, Boott proposes no studies to address this issue. The Service is not aware of any previously conducted or ongoing studies related to impingement, entrainment or survival of adult alosines at the project.

## **REFERENCES**

- McBride, R. S., Ferreri, R., Towle, E. K., Boucher, J. M., & Basilone, G. 2016. Yolked oocyte dynamics support agreement between determinate-and indeterminate-method estimates of annual fecundity for a northeastern United States Population of American Shad. PloS one, 11:e0164203.
- Normandeau. 2003. Passage Route Selection and Survival of Atlantic Salmon Smolts Passed through the Lowell Hydroelectric Project. Submitted to Boot Hydro, LLC. Final report. Normandeau Associates, Inc. Westmoreland, New Hampshire. 130 pp.

## Boott Study Request # 3

### **Telemetry Study of Upstream and Downstream Migrating Adult American Shad and River Herring to Assess Passage Routes, Effectiveness, and Delay (Lowell, P-2790)**

#### *Goals and Objectives*

The goal of this study is to assess the behavior, approach routes, passage success, survival, and delay of adult American shad and river herring as they encounter the Lowell Project during their upstream and downstream migrations to determine if project operations negatively impact their survival and production.

The following objectives will address this request:

1. Assess project operations effects on the timing, orientation, routes, and migration rates of shad and river herring;
2. Determine route selection and behavior of upstream migrating shad and river herring at the project under varied operational conditions, including a range of spill conditions (e.g., movement to the dam, attraction to the E.L. Field station discharge, movement between locations, delay, timing, etc.);
3. Determine delay/fallback associated with the northern canal;
4. Assess near field attraction to, and entrance efficiency of, the fish lift under a range of spill conditions and with the river-side entrance and street-side entrances open;
5. Assess near field attraction to, and entrance efficiency of, the spillway ladder under a range of spill conditions;
6. Evaluate the internal efficiency of the Pawtucket dam ladder;
7. Collect ladder and lift efficiency data, to include rates of approach to fishway entrances, entry into fishways, and passage under varied operational conditions, including a range of spill conditions;
8. Determine the proportion of post-spawned adults that select the power canal as a downstream passage route under varied operation conditions, including a range of spill conditions up to full spill; determine post-spawned adult downstream migration route selection, passage efficiency, and delay associated with the power canal under various operational conditions, including a range of spill conditions; and
9. Compare rates and measures of delay and movement among project areas and routes utilized (e.g., spill at dam vs. power canal) under the range of permitted and proposed spill and operational conditions.

If project operations are adversely affecting shad or river herring migration timing or are resulting in other deleterious population effects, we recommend Boott identify operational solutions or other passage measures that will reduce and minimize these impacts within the project area.

This study will require 3 years of field data due to the tailrace ledge excavation project which will be completed in 2019 and to capture inter-annual variability of river discharge, water temperatures, and variability in outmigration timing. We recommend that Boott perform the downstream routing portion of the study in 2019 (pre-ledge excavation) and 2020 (post-ledge excavation). In 2020 and 2021, after the ledge has been excavated, we recommend Boott perform the upstream portion of this study.

### ***Resource Management Goals***

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring, approved in 2010, includes the following objectives:

#### Upstream Passage

1. Fish must be able to locate, enter, and pass the passage facility with little effort and without stress.
2. Where appropriate, upstream fish passage effectiveness should be improved through operational or structural modifications.
3. Fish which have ascended the passage facility should be guided to an appropriate area so they can continue their upstream migration and avoid being swept back downstream.

#### Downstream Passage

1. Enhance survival at dams during emigration.
2. Evaluate survival of post-spawned adults and juvenile fish passed via each project route (e.g., turbines, spillage, bypass facilities, or a combination of the three).
3. Implement measures to pass fish via the route with the least delay and best survival rate.

The Service seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to American shad and river herring movement and migration, the Service's goal is to minimize current and potential negative project operation effects on the safe, timely and effective upstream and downstream passage of adult American shad and river herring.

These study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), the Atlantic States Marine Fisheries Compact (P.L. 539, 77<sup>th</sup> Congress, as amended by P.L. 721, 81<sup>st</sup> Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

### ***Public Interest***

The requestor is a natural resource agency.

### ***Existing Information and the Need for Additional Information***

Several studies pertaining to the fish lift and downstream passage facilities at Lowell have been conducted for American shad. Studies of alewife passage are limited to a single downstream test performed in 1991. Previous studies pertaining to upstream shad migration (listed in Table 5.4-3 of the PAD) demonstrate passage through the existing lift at Lowell is relatively poor. Also, when analyzing annual passage counts for river herring and shad, the number of fish that utilize the Lowell lift versus those that pass at Lawrence is low (from 1996 to 2017 passage efficiency at Lowell has not exceeded 30 percent).

In 2016, for the first time since the issuance of the original license for the project, Boott agreed to operate the fish ladder at the Pawtucket dam for the duration of the anadromous fish upstream passage season, consistent with the operating timeframes defined for the powerhouse fish lift in the project's Commission-approved Comprehensive Fish Passage Plan. Therefore, to date, studies performed at Lowell have not tested the nearfield attraction, entrance efficiency, or internal efficiency of the ladder. Moreover, past studies have had statistically low sample sizes (less than 60 fish) and were all performed prior to the ledge excavation project which will occur in August 2019. Future studies should have a robust sample size (at a minimum, 150 fish per species) and array system. Additionally, to obtain a comprehensive understanding of fish behavior at Lowell, for both upstream and downstream migration, studies are needed to: (1) determine if project operations affect pre-spawned and post-spawned river herring and shad migration timing; (2) assess fish movement to, and through, the ladder at the Pawtucket dam; and (3) assess passage success at the tailrace fish lift post-ledge removal.

### ***Nexus to Project Operations and Effects***

Lowell tailrace turbulence, potentially exacerbated by the existing ledge outcropping, creates attraction issues at the entrance of the fish lift. Moreover, a lack of effective protection at the 21 turbines associated with the project increases the risk of entrainment and mortality alosines may experience as they migrate downstream to the ocean. During the upstream fish passage season, the Lowell bypass reach receives 500 cfs during the day and 300 cfs at night via operation of the spillway fish ladder; otherwise, the reach only receives flow when inflow exceeds the hydraulic capacity of the project's generating capacity. The spillway ladder is, therefore, only partially effective due to lack of flow.

Existing project operations and limited bypass flows can have a direct impact on diadromous fish migration. Migration delays, increased predation, mortality during passage over the dam or through turbines, and changes in route selection under different flow conditions are potential influences of the project on shad and river herring populations in the Merrimack River. Effective upstream and downstream passage and successful spawning and juvenile production are necessary to help achieve shad and river herring management restoration goals for the Merrimack River, particularly in the upstream reaches.

### ***Methodology Consistent with Accepted Practice***

The movement of migratory shad and river herring would be best studied by using radio telemetry, including passive integrated transponder (PIT) tags. Radio telemetry is an accepted technology that has been used for a number of studies associated with hydropower projects, including at the Bellows Falls (FERC No. 1855), Wilder (FERC No. 1892), and Vernon (P-1904) projects.

The study design must specify sample sizes, as well as tag and receiver configurations, to ensure rates of entry and exit to the tailrace, fish lift and fish ladder, downstream bypass, the bypassed reach, and canal, can be calculated with sufficient precision. We recommend that Boott capture shad and river herring below Lawrence and tag at least 150 individuals per species. Double-tagged (radio and PIT) shad and river herring should be released upstream of the Lawrence dam and upstream of the Lowell dam. Fish should also be released directly into the Pawtucket canal to adequately assess project conditions likely to be encountered during downstream migration. Additional, tagged, individuals may need to be released farther upstream to ensure enough fish encounter the dam during a sufficient range of turbine and operational conditions to test for project effects (especially in 2020 and 2021). A large array of stationary monitoring stations (radio and PIT) will be needed to provide an appropriate level of resolution for data analyses and to answer the natural resource agencies' questions regarding project operation effects. Additionally, since fish can drift a considerable distance downstream after they have died (Havn et al. 2017); a minimum of 25 dead river herring and 25 dead shad should also be released as a control group in this study. A plan and schedule for spill releases should be developed which provides sufficient periods of spill and various generating levels (treatments will require multiple days of consistent discharge).

Each component of this study will require 2 years of field data collection to attempt to account for inter-annual variability in river discharge, water temperatures, and the ledge excavation project which will be completed in 2019. We recommend Boott perform the downstream routing portion of the study in 2019 (pre-ledge excavation) and 2020 (post-ledge excavation). In 2020 and 2021, after the ledge has been excavated, the upstream portion of this study should be performed.

A related study request on computational fluid dynamics (CFD) modeling in the Lowell tailrace, in and around the fish lift and fish ladder entrances and powerhouse forebay, will complement this study and address related project operational effects.

These methodologies are consistent with accepted practice.

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

Estimated cost for this study is expected to range from \$400,000 to \$500,000, with the majority of costs associated with equipment (radio and PIT tags, radio receivers, and PIT readers) and related field work labor. Since tagged shad and river herring will move throughout the area, to varying degrees, there will be expected cost savings (e.g., radio tags) to Boott, provided cooperation in study planning and implementation occurs.



Boott did not propose any studies to meet this need in the PAD.

**REFERENCES**

Havn, T. B., F. Økland, M.A. Teichert, L. Heermann, J. Borcharding, S.A. Sæther, O.H. Tambets and E.B. Thorstad. 2017. Movements of dead fish in rivers. *Animal Biotelemetry*, 5: 7.

## Boott Study Request # 4

### **Impact of Project Operations on Downstream Migration of Juvenile Alosines (Lowell, P-2790)**

#### ***Goals and Objectives***

The goals of this study are: (1) conduct a field study of juvenile alewife outmigration in the Lowell impoundment, the power canal, and at the Pawtucket dam, to determine if project operations negatively impact juvenile alosine survival and production; and (2) determine if project operations affect juvenile alosine outmigration survival, recruitment, and production.

The following objectives will address this request:

1. Assess project operations effects of the Pawtucket dam on the timing, orientation, passage routes, migration rates, and survival of juvenile alewife;
2. Determine the proportion of juvenile alewife that select the Lowell canal versus the Pawtucket powerhouse, downstream bypass facility, or dam spill as a downstream passage route, under varied operational conditions;
3. Determine if there are any delays associated with downstream movement related to either dam spill or the Pawtucket powerhouse due to operations;
4. Determine the juvenile downstream passage timing and route selection in the Lowell canal, assess delays associated with the canal, and with project operations (e.g., stockpiling in the canal).

If it is determined the project operations are adversely affecting juvenile alosine survival, migration timing, or causing other deleterious population effects, identify operational solutions or other passage measures which will reduce and minimize these impacts within the project area. This study will require 2 years of field data to capture inter-annual variability of river discharge and water temperatures.

#### ***Resource Management Goals***

The Atlantic States Marine Fisheries Commission Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, includes the following objective:

Maximize the number of juvenile recruits emigrating from freshwater stock complexes. To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g., turbines, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the best survival rate.

The Service seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to juvenile American shad and river herring movement and migration, the Service's goal is to minimize current and potential negative project operation effects on the safe, timely and effective downstream passage.

These study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), the Silvio O. Conte National Fish and Wildlife Refuge Act (P.L. 102-212; H.R. 794), the Federal Power Act (16 U.S.C. §791a, *et seq.*), the Atlantic States Marine Fisheries Compact (P.L. 539, 77<sup>th</sup> Congress, as amended by P.L. 721, 81<sup>st</sup> Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

### ***Public Interest***

The requestor is a natural resource agency.

### ***Existing Information and the Need for Additional Information***

The seaward migration of juvenile alosines is of great importance to the restoration of alewife, blueback herring, and American shad in the Merrimack River. However, data on the downstream migratory movements and rates of alosines past Lowell is sparse and relatively incomplete. In 1994 and 1995, Normandeau Associates, Inc., documented use of the bypass facility by downstream migrating alosines via the installation of a removable box trap. Passage efficiencies were 7 percent and 37 percent, respectively. However, to date, no directed studies of downstream alosine passage route selection has been conducted at the Lowell Project. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on outmigrating juvenile alosines and develop adequate passage and protection measures to meet management goals and objectives.

Studies conducted farther upstream on the Merrimack River, at Garvins Falls (FERC No. 1893), have shown it is possible to radio-tag juvenile alewife to evaluate alosine outmigration (Normandeau 2016). Alewife can be used as a proxy, in this instance, for the natural resource agencies to assess blueback herring and shad downstream migration patterns.

### ***Nexus to Project Operations and Effects***

Adult alosines, passed at Lowell via the fishways and/or stocking efforts, utilize upstream habitat to spawn on an annual basis. Similarly, juvenile alosines require safe and timely downstream passage measures at the project in order to successfully emigrate back to the ocean to contribute to the population. Presently, downstream migrants can easily enter the Lowell canal system, via

the Pawtucket canal, as there are no exclusionary measures in place. There are 19 turbines located in the canal, housed at four powerhouses (Assets, Bridge Street, Hamilton, and John Street), none of which have passage or protection measures. There are a variety of unit-types housed in each of the powerhouses, ranging in speed from 100 to 150 rpm. A study is needed to assess the impacts project operations have on outmigrating juvenile alosines.

The Service is not aware of any studies conducted specifically designed to answer the following questions:

1. What is the rate of alewife survival under a range of spill and gate configurations?
2. Are there delays in migration/movement at the dam, gatehouse, or in the canal?
3. For juveniles that enter the Pawtucket canal, what proportion subsequently enter the Western, Merrimack, Pawtucket, or Hamilton canals?
4. What is the rate of movement through the canal, what is the delay to juvenile alosine outmigration, and the potential accumulation of juveniles in the canal?
5. What proportion of juvenile alosines use the downstream bypass sluice versus the E.L. Field powerhouse turbines under varied operational conditions?

The Service is concerned project operations are: (1) impacting juvenile alosine outmigration survival; and (2) contributing to the failure of the Merrimack River alosine population to meet management targets.

#### ***Methodology Consistent with Accepted Practice***

The impact of project operations to juvenile alewife outmigration, passage route selection, and migratory delay would be best studied via radio telemetry. This methodology has successfully been tested and employed by Normandeau Associates, Inc., at the Garvins Falls hydroelectric project (FERC No. 1893; Normandeau 2013; Normandeau 2016). Project discharge over a full range of existing and, to the extent possible, potential future operational conditions at the dam (likely increased bypass reach flows in new license), should be examined relative to migration rate and passage route selection of juvenile alosines to, and through, various areas of the project.

In addition, study fish should be collected and balloon-tagged to empirically determine rates of survival for fish passed over or through the dam's bypass sluice, main powerhouse, and 19 canal units under varied operations. For spill mortality sites (dam spillway and downstream bypass), tagged alosines should be injected or released into spill flow at points where water velocity exceeds 10 ft/sec to minimize the possibility of the fish swimming upstream into the headpond or canal. Passed balloon-tagged alosines will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

For turbine mortality sites, tagged alosines will be injected into intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec to minimize the possibility of fish swimming back upstream through the intakes. Passed balloon-tagged alosines will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged alosines will be censored from the data.

Radio-tagged juvenile alewife will be released in areas upstream of the project at multiple release locations, to determine operation effects on migration rates, route, orientation, and entrainment, over a full range of permitted and operational conditions. The release of radio-tagged fish upstream of the project, and induction into the power canal, will provide data on concerns of delay and route selection to the canal, downstream bypass, crest gates, and turbines. Additionally, since fish can drift a considerable distance downstream after they have died (Havn et al. 2017); a minimum of 50 dead alewife should also be released as a control group in this study.

### *Level of Effort/Cost, and Why Alternative Studies Will Not Suffice*

Boott does not propose any studies to meet this need. Estimated costs for the study are expected to be moderate to high, between \$100,000 and \$300,000, with the majority of costs associated with equipment (radio tags, radio receivers) and related field work labor.

### **REFERENCES**

- Havn, T. B., F. Økland, M.A. Teichert, L. Heermann, J. Borcharding, S.A. Sæther, O.H. Tambets and E.B. Thorstad. 2017. Movements of dead fish in rivers. *Animal Biotelemetry*, 5: 7.
- Normandeau 2013. Juvenile Alosine Radio Tag Attachment Test. Submitted to Boot Hydro, LLC. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 2 pp.
- Normandeau 2016. Garvins Falls Juvenile Alosine Downstream Passage Telemetry Assessment. Submitted to Boot Hydro, LLC. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 13 pp.

## Boott Study Request # 5

### **Downstream American Eel Passage Assessment (Lowell, P-2790)**

#### ***Goals and Objectives***

The goal of this study is to determine the impact of the Lowell hydroelectric project on the outmigration of silver eels in the Merrimack River. Entrainment in the canal and at the conventional turbines at the project powerhouses (E.L. Field, Assets Station, Bridge Street, Hamilton Station, and John Street) can result in mortality or injury. It is important to understand the passage routes at the project and the potential for delay, injury, and mortality to assess alternative management options to increase survival.

The objectives of this study are:

1. Quantify the movement rates (including delays) and relative proportion of eels passing via various routes at the project (i.e., through the turbines, through the downstream bypass, spilled at the dams, etc.).
2. Evaluate instantaneous and latent mortality and injury of eels passed via each potential route.

#### ***Resource Management Goals***

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance, but may now be absent, by providing access to inland waters for glass eel, elvers, and yellow eel, and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the Commission relicensing process.

The Service seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to downstream passage of American eel, the Service's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

These study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

### ***Public Interest***

The requester is a natural resource agency.

### ***Existing Information and the Need for Additional Information***

Data on downstream migratory movements and rates of American eels past the project are sparse and relatively incomplete. A single study was performed by Normandeau Associates, Inc., in 2017 (Normandeau 2017). Seventeen silver-phase eels were tagged and released into the Merrimack River upstream of the Garvins Falls project. Of the 17 released individuals, 14 approached the Pawtucket dam. Eight were determined to have passed through the gatehouse and enter the forebay canal upstream of the E.L. Field powerhouse. Five eels passed the project via spill flow. One eel's passage route was classified as unknown. Zero individuals used the downstream bypass. This study had a small sample size, was of a relatively short duration (October 20-November 28, 2017), did not include monitoring stations or antenna arrangements in the canal, and was performed prior to the installation of the pneumatic crest gate system.

To date, no other directed studies of eel entrainment or mortality have been conducted at the Lowell Project. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on outmigrating eels and develop adequate passage and protection measures to meet management goals and objectives.

### ***Nexus to Project Operations and Effects***

The project configuration presents problems with respect to providing safe, timely, and effective passage for outmigrating eels. The intakes are likely deep and, while no specification for the trashracks were provided in the PAD, it is unlikely they would prevent entrainment of eels. The anadromous downstream passage facility at the project is also not expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. Additionally, there are no data pertaining to eel movements in the Lowell canal. Eels that move into the canal potentially have no alternative but to pass through hydropower turbines at the Assets, Bridge Street, Hamilton, and John Street powerhouses. Eels are known to occur upstream of the dam; therefore, it is necessary to understand how eels move through the project and the level of injury and/or mortality resulting from each potential passage route (i.e., the spillway, the downstream bypass facility, or the 21 turbines associated with the project).

### ***Methodology Consistent with Accepted Practice***

In order to understand the movements of outmigrating silver eels as they relate to operations at Lowell, radio telemetry technology should be utilized. Radio telemetry is an accepted technology which has been used for a number of studies associated with hydropower projects, including at the Bellows Falls (FERC No. 1855), Wilder (FERC No. 1892), and Vernon (P-1904) projects.

Studies should be designed to investigate route selection (i.e., entrainment vs. spill) independently from estimation of mortality/injury, because these metrics require different methodologies. Studies will also likely benefit from data collected over 2 study years (especially route selection studies, which may be more significantly affected by environmental conditions during a given season than mortality/injury studies). It is also envisioned that results from route selection studies can guide design of turbine mortality studies. Therefore, it is proposed, at a minimum, route selection studies be conducted in multiple years, but mortality/injury studies may be conducted after the first year of route selection studies have been completed.

### **Objective 1: Route Selection**

This study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest, to assess general routes of passage (i.e., via spill, bypass, or turbines). Active downstream migrants should be collected within-basin if possible (i.e., Cabot or Holyoke bypass samplers), but fish sourced from out-of-basin may be acceptable to meet sample size demands. Experimental fish must meet morphometric (e.g., eye diameter relative to body size) criteria to ensure they are migrant silver phase. Collections should be made within the migratory season (late August to mid-October), and eels should be tagged and released within 21 days after capture, but preferably within 7 days (particularly if the test eels are from out-of-basin).

All telemetered eels will be radio- and PIT-tagged. PIT antennas will be installed and monitored continuously to verify passage of eels via bypass channels.



A minimum number of 150 telemetered eels (e.g., five separate groups of approximately 30 eels each) will be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Lowell Project. Groups of eels should be released during spill (if any) and non-spill and during periods of low, moderate, and high generation conditions. Up to 50 additional eels should also be released in the upper canal and allowed to volitionally descend through the canal to assure that a sufficient number of eels are exposed to canal conditions. Groups of eels should be released when the canal units are running and when the canal units are off. Additionally, since fish can drift a considerable distance downstream after they have died (Havn et al. 2017), a minimum of 25 dead eels should also be released as a control group in this study.

Telemetry receivers and antennas should be located upstream and downstream of the spillway, at the canal entrance, within the canal, in the downstream fish bypass entrance, at turbine intakes, the station tailrace, and downstream of the confluence of the Merrimack and Concord rivers. These locations will permit assessment of passage via the following potential routes: the power canal, spillway, downstream fish bypass, station turbines, and upstream fishway attraction water intake. The final placement of receivers and antennas should be developed in consultation with the fisheries agencies.

Mobile tracking (i.e., via boat) in the River and canal between release sites and several km downstream will be performed at regular intervals during and after releases to confirm routes and fates of passed fish or lost fish.

Movement rates (time between release and detection at radio antenna locations, and between radio antenna locations) of eels passing the projects by various routes will also be quantified.

The route selection portion of this study should occur in both study years.

## **Objective 2: Spill, Bypass, and Turbine Mortality/Injury Studies**

Spill, bypass, and turbine mortality will be assessed using a balloon-tag method.

For spill mortality sites (dam spillways and downstream bypasses), tagged eels will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec to minimize the possibility of eels swimming upstream into the headpond or canal. Passed balloon-tagged eels will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

For turbine mortality sites, tagged eels will be injected into intakes of all 21 units associated with the project, operating at a full range of settings where intake water velocity exceeds 10 ft/sec to minimize the possibility of eels swimming back upstream through the intakes. Passed balloon-tagged eels will be recovered in the tailrace(s) and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

If the balloon-tag mortality component of the study occurs in study year one, all possible route selection sites would need to be evaluated. If the balloon-tag mortality component of the study occurs in study year two, results from the route selection study could be used to inform which sites need to be evaluated for mortality. Eels recovered from balloon-tag studies should not be used for route selection studies.

Data analyses of route selection and mortality (instantaneous and latent) will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies and assessed for potential relationships to passage route selection, migratory delay, and/or passage survival.

These methodologies are consistent with accepted practice.

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

The level of cost and effort for the downstream eel passage study will be moderate to high; silver eels would need to be collected, tagged, and released in several locations over the course of the migration season. Antennas and receivers would need to be installed throughout the canal, at the intakes of the E.L. Field powerhouse, at the dam spillways and station bypass and monitored regularly. Data would need to be retrieved periodically, then analyzed. A multi-site route selection study conducted by the USGS Conte Lab on the Shetucket River in Connecticut cost approximately \$75,000 for the first year of study. Costs are estimated at \$100,000 per year for the route selection study and \$50,000 to \$75,000 for the spill, bypass, canal, and turbine mortality/injury study.

Boott did not propose any studies to meet this need in the PAD.

### **REFERENCES**

- Havn, T. B., F. Økland, M.A. Teichert, L. Heermann, J. Borcharding, S.A. Sæther, O.H. Tambets and E.B. Thorstad. 2017. Movements of dead fish in rivers. *Animal Biotelemetry*, 5: 7.
- Normandeau Associates, Inc. 2017. Downstream Passage Evaluation for Silver-Phase American Eels at the Lowell Hydroelectric Project. 2017. Submitted to the City of Holyoke Gas and Electric Department. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 17 pp.

## Boott Study Request # 6

### **Operations Analysis of the Lowell Canal** (Lowell, P-2790)

#### ***Goals and Objectives***

The goal of this study is to understand the operations of the Lowell canal system. The specific objective of this study is to describe the operations of the Lowell canal which include, but are not limited to: how all of the canal units interact with the main units, how the canal units are sequenced, how often each of the units operate, the prioritization sequence of canal unit operations, the amount of time the units are operated during the downstream passage season, etc.

#### ***Resource Management Goals***

The Service seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to aquatic resources, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Minimize current and potential negative project operation effects on fish in the project area.

#### ***Public Interest***

The requestor is a natural resource agency.

#### ***Existing Information and the Need for Additional Information***

The Merrimack River supports a variety of migratory fish species. However, there is no information pertaining to fish mortality and population effects resulting from entrainment in the canal and/or the canal units. Since there are no exclusionary measures at the entrance of the project's canal system, fish can easily enter the two-tiered network of man-made canals, which are approximately 5.5 miles in length. These man made canals provide flow to 19 Boott-owned hydroelectric units. Since the issuance of the original license for the project, there have been no directed studies of the Pawtucket, Western, Merrimack, or Hamilton canal units. Additionally, the PAD provides little operational information regarding the canal: flows of up to 2,000 cfs are routed into the canal, typically once the E.L. Field station's hydraulic capacity of 8,000 cfs has

been reached. These information gaps need to be filled so the natural resource agencies can assess the relative and cumulative impacts of project operations on riverine fishes and migratory alosines which may be moving through, or inhabiting, the canal and develop adequate passage and protection measures to meet management goals and objectives.

### ***Nexus to Project Operations and Effects***

The Lowell Project consists of a two-tiered, 5.5-mile-long, network of man-made canals which include several small dams and 19 turbine units. Flows enter the canal system upstream of the Pawtucket dam via the Pawtucket canal. There are no exclusionary measures for fish in place. Therefore, the Lowell canal presents problems with respect to providing safe, timely, and effective passage for fish trying to move past the project through the canal system.

### ***Methodology Consistent with Accepted Practice***

In order to determine the relative risk the canal units present to riverine and migratory fishes, it is necessary to understand how the canal operates. Therefore, we request Boott provide a detailed description of the operational protocol it uses to determine when and how much water flows into the canal at a time scale relevant to the migratory fish species expected to potentially utilize the canal as a passage route (e.g., May, June, and July for spent alosines; August through November for adult eels and juvenile alosines). Historical operations data should be examined relative to the hydrological data set to determine the percent of time the canal units would be expected to operate during each passage month. This analysis should be used in conjunction with the results of the passage route and turbine mortality studies to estimate total through project mortality for each target fish species/life stage.

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

The expected level of effort and anticipated cost will be low. Operations and hydrologic data are readily available and only need to be compiled and analyzed. We estimate the cost to be less than \$10,000.

## Boott Study Request # 7

### **Three-Dimensional Computational Fluid Dynamics (CFD) Modeling in the Vicinity of Fishway Entrances and Powerhouse Forebays** (Lowell, P-2790)

#### *Goals and Objectives*

The goal of this study is to determine the flow field conditions that exist in and around fishway entrances and the powerhouse forebay. The information from this request is meant to be coupled with data from the telemetry studies, such that a comprehensive understanding of fish behavior is developed.

The objective of this study is to create a series of color contour maps of velocity magnitude at select discharges agreed upon by the resource agencies and the licensee. With respect to upstream passage, the results will show approach velocities and flow fields that may create a response in fish. This information can be coupled with telemetry data (from the requested shad and river herring telemetry study) and passage counts to understand which conditions are optimal for guiding migrating fish to the fishway entrances and stimulating fishway entry.

With respect to downstream migration, the results will show velocities and flow fields in front of the E.L. Field powerhouse. Additionally, the results will indicate to what degree, if any, flow directs downstream migrating fish towards the downstream bypass facility.

#### *Resource Management Goals*

The management goals of this study request are to obtain information that will assist in enhancing the effectiveness of the current upstream fish passage facilities for upstream migrating trust species and reduce impingement, entrainment, and delay for downstream migrating fish. CFD models are a relatively cost effective way to analyze existing and future conditions. As such, changes in the amount of attraction water, changes in which turbines are operating, and which spillway gates are releasing water can all be examined. As stated, the results from this study are meant to be used along with the data generated from the requested telemetry study. The combined analysis from these two data sources can help assess which flow conditions are most advantageous for migrating trust species to enter the fishway under current and proposed conditions.

As for downstream migration of adult and juvenile shad, river herring, and adult eel, the results from the models will reveal flow magnitude and direction in front of the powerhouse. Given the limited information that currently exists on survival through the project, our management goal is to direct as many downstream migrating fish as possible towards the downstream bypass facility. With respect to upstream passage, we want to maximize the number of fish that find and enter the fishway entrances. These study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and

Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

### ***Public Interest***

The requestor is a natural resource agency.

### ***Existing Information and the Need for Additional Information***

To date, no CFD modeled data exists in front of either the fish ladder or lift, nor do they exist in front of the E.L. Field powerhouse. A comprehensive understanding of fish behavior at the ladder and lift entrance, and the powerhouse forebay, is needed in order to create safe, timely, and effective upstream and downstream passage for American shad, river herring, and eels. Additionally, a better understanding of flow and how it affects fish passage is needed after Boott performs the ledge removal excavation project.

### ***Nexus to Project Operations and Effects***

The Lowell Project has direct impacts to upstream and downstream migrating shad, river herring, and eel. The development of these models will give resource agencies valuable information into the hydraulic cues which may elicit a response from upstream migrants. For downstream passage, the Service has approach velocity guidelines; the output from these models would inform the resource agencies under what conditions appropriate approach velocities are being met and when they are being exceeded.

With respect to upstream migration, the auxiliary water system (AWS) plays a critical role in determining whether or not fish are attracted to the entrance. The results from this study would allow an assessment of how well the AWS is performing and under what conditions it attracts the most fish.

With respect to downstream migration, the development of a CFD model under existing conditions also informs the design of future modifications and improves the survivability of downstream migrating shad, river herring, and eel.

The CFD models for the Pawtucket fishway and fish lift should be developed as part of year two studies, after the ledge excavation project is complete. It would be useful to have the gatehouse area CFD modeling completed in year one. This analysis may provide information on adjustments to canal operations or structures that can subsequently be analyzed.

Understanding the entrance conditions of the Pawtucket fishway under a range of spill conditions would be informative. If developed prior to the year one upstream shad telemetry studies, it would provide information on spill gate settings which would likely best achieve entrance and ultimately passage. Further work with the model can help in evaluating changes in ladder entrance or spill conditions that could improve passage and be tested with telemetry, video, and/or count data.

CFD modeling of the flows leading to the canal would aide in our interpretation of year one downstream passage telemetry results, but would not need to be completed prior to the year one telemetry (downstream juvenile alewife and downstream eel) studies. Those studies will provide the context for how and where shad, river herring, and eels are passing the project and how successful passage is. The CFD modeling could focus on the locations identified as important in the study results and Boott could assess changes to structures or operations and evaluate them in the model. Promising alternatives would then be tested in year three studies.

### ***Methodology Consistent with Accepted Practice***

A three-dimensional CFD model has become an increasingly common standard of analysis at hydroelectric projects around the nation. Within the northeast region, we have seen these types of models developed at the Holyoke (P-2004), Brunswick (P-2284), Shawmut (P-2322), Milford (P-2534) and Orono (P-2710) projects. We would expect to engage with the licensee in terms of determining the appropriate area and flows to be modeled. We expect the spatial extent of the model at each study site will vary. Given the large number of ways in which output from these models can be presented and the near infinite number of flows which could potentially be modeled, we would expect to consult with the licensee to reach agreed upon modeling efforts and scenarios to be examined.

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

The cost of developing, running and testing a CFD model can vary tremendously; one large variable in determining the cost is based on the amount of existing bathymetric data to which Boott currently has access. We roughly estimate that the cost of each CFD model could run as high as \$50,000, assuming no bathymetric data currently exists. Proactive communication with resource agencies will reduce the cost and iterative effort. Given the level of effort that has occurred at other projects that have proposed to amend their license, we see the level of effort requested here as reasonable and in line with frequent modern industry practice.

## Boott Study Request # 8

### **Bypass Zone of Passage** (Lowell, P-2790)

#### ***Goals and Objectives***

The goal of this study is to determine zone-of-passage flows in the bypass reach that facilitate safe, timely, and effective fish passage through the project.

Specifically, the objectives of this study are:

1. Complete a detailed survey of the bypass reach;
2. Develop a high-resolution, two-dimensional hydraulic model of the bypass reach;
3. Release multiple flows from the dam to collect calibration data for the model;
4. Simulate additional flows through the bypass reach with the calibrated model; and
5. Determine minimum and optimal zone-of-passage flows for the project.

#### ***Resource Management Goals***

The Service seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to aquatic resources within the Lowell bypassed reach, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide a flow regime in the bypassed reach that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) and diadromous fishes.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

These study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661, *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).



### ***Public Interest***

The requester is a natural resource agency.

### ***Existing Information and the Need for Additional Information***

Article 36 of the original license required the licensee, in consultation with resource agencies, to develop an in-stream flow study plan to determine: (1) 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 (i.e., zone of passage). After completion of the approved studies, the licensee was to file a report on the results of the studies, and, for Commissions approval, recommendations for the flow releases from the project. The study plan was filed on August 13, 1983, with proof of agency consultation (Accession No. 19830818-0191). However, there are no study reports included in the record. Therefore, we have no quantitative data supporting the agreement that 300 cfs at night and 500 cfs during the day are adequate flows for zone of passage in the bypass reach.

In the Comprehensive Fish Passage Plan filed on March 9, 2000 (Accession No. 20000313-0322), the licensee states “The adequacy of flows for upstream fish passage at the Project was addressed by BHI’s construction of six (6) concrete flow control weirs (with adjustable stoplog sections) in the bypass reach, at the request of U.S. Fish and Wildlife Service and in response to Article 36, section (2) of the Project’s FERC license.” Similar to the study plan, this is an agreement with no supporting information to substantiate the conclusion flows in the bypass reach are adequate for the full suite of diadromous species.

As part of compliance for Article 34 of the original license, the licensee filed as-built drawings of the existing fish passage facilities (Accession No. 19860902-0215). Within this abbreviated drawing set, drawing number 344D-PC001, 3844D-FC001, and 3844D-FC004 show topographic surveys for portions of the bypass reach. However, the drawings do not document the accuracy and precision of the survey, do not show the majority of the bypass reach, and are otherwise illegible.

Since agreeing upon the current zone-of-passage flows during the original license, there have been developments in topographic survey capabilities, a better understanding of the hydraulic requirements of diadromous species, multi-dimensional hydraulic modeling capabilities, and an increased need to pass fish at the spillway ladder.

### ***Nexus to Project Operations and Effects***

Diadromous fish orient their migration based on the environmental conditions of the river: flow, depth, velocity, and temperature (Goodwin 2014). Project operations affect the environmental conditions in the River, specific to this study request, the bypass reach. Two key hydraulic model outputs from the requested study are depth and depth-averaged velocity, which can be used to determine the likelihood of predation, delay, and the cessation of migration. Evaluating the flow fields in the bypass reach under different spill conditions will assist in the consultation process for determining an appropriate zone-of-passage flow in the bypass reach to optimize fish passage

at the project. These data will also contribute to the development of an administrative record in support of a potential settlement agreement, Section 18 fishway prescriptions, or 10(j) recommendations.

### ***Methodology Consistent with Accepted Practice***

We proposed the following methodology to accomplish the five objectives and ultimately the goal of the study, to determine zone-of-passage flows for the bypass reach.

#### *Topographic survey*

The bypass reach area is large, making traditional topographic survey methods laborious and costly. We recommend using Light Detection and Ranging (LiDAR) methods with limited traditional surveying. Outside of the fish passage season and during a river flow when the project is in control of the River, the bypass reach will be mostly dewatered. At this time, a licensed surveyor can fly the area to collect LiDAR data. Once this data is processed, traditional methods will fill in the gaps (e.g., pooled water areas, under bridges). The topographic survey shall be of sufficient resolution and quality to complete the remaining objectives.

#### *Two-dimensional hydraulic model*

There are many two-dimensional hydraulic models that are acceptable for accomplishing the goal of this requested study, many of which are open source. We are not requiring one model over the other, but Boott should understand and document the limitations of the modeling software used. At a minimum, the modeling output should produce depth-average velocity and depth for each cell in the mesh. The modeling domain shall be of sufficient size and mesh to delineate a zone of passage through the entire length and width of the bypass reach.

#### *Calibration flows*

The licensee should collect calibration data by spilling a minimum of two flows from the Pawtucket dam. The calibration flows should bracket the range of simulated flows in the study. We recommend 300 cfs for the low flow as it represents the current lowest operation flow for the fish ladder. For the high calibration flow, we recommend collecting data near the high fish passage design flow (i.e., the 5 percent exceedance value for the migratory period of record) which is approximately 26,000 cfs in the Merrimack River (bypass flow would be approximately 17,000 cfs with full project operation). Boott should collect calibration data (depth-averaged velocity and depth) with an Acoustic Doppler Current Profiler (ADCP) at a minimum of four cross sections, including the downstream boundary condition and use the ADCP in locations spread evenly throughout the bypass which are less turbulent.

### *Additional flow simulations*

After calibrating the model, additional bypass flows should be simulated (and agreed upon with the natural resource agencies), including 500 cfs, 1,000 cfs, and up to the high calibration flow. The additional simulations should represent the full range of hydraulic conditions in the bypass reach from the low to high fish passage design flow.

### *Zone-of-passage determination*

The model output should be used to delineate a zone-of-passage pathway for each of the modeled flows. To determine the zone of passage, we recommend Boott use the SprintSwim model developed by U.S. Geological Survey researchers (Haro et al. 2004).

### ***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

The licensee should be able to finish the bypass zone-of-passage study in one year depending on seasonal flow conditions. The level of effort and cost is commensurate with a project the size of the Lowell facility and the likely license term. No alternatives are proposed.

### **REFERENCES**

- Goodwin, R. A., M. Politano, J.W. Garvin, J.M. Nestler, D. Hay, J.J. Anderson and M. Timko. 2014. Fish navigation of large dams emerges from their modulation of flow field experience. Proceedings of the National Academy of Sciences. p. 201311874.
- Haro, A., T. Castro-Santos, J. Noreika and M. Odeh. 2004. Swimming performance of 716 upstream migrant fishes in open-channel flow: a new approach to predicting passage through velocity barriers. Canadian Journal of Fish and Aquatic Science. 61: 1590-1601.

## ATTACHMENT D

**FEDERAL ENERGY REGULATORY COMMISSION**  
**Office of Energy Projects**  
Division of Dam Safety and Inspections – New York Regional Office  
19 West 34<sup>th</sup> Street, Suite 400  
New York, NY 10001

Telephone No. (212) 273-5900

Fax No. (212) 631-8124

April 30, 2008

**Re: Hydropower Projects Inspection  
and Compliance**

**To the Party Addressed:**

Staff from this office conduct periodic inspections to ensure that hydropower projects licensed or exempted by the Federal Energy Regulatory Commission (FERC) are properly operated and maintained in compliance with license and exemption terms and conditions.

During FERC staff dam safety inspections, the project's structural features are inspected and all matters of dam safety, operations, maintenance and compliance are reviewed and discussed with the licensee or exemptee. During FERC Environmental and Public Use Inspections (EPUI), recreation, fish, and wildlife requirements are specifically addressed. Any concerns or questions resulting from the inspections are discussed at the projects, with follow-up letters as necessary.

Since an important part of these inspections includes an assessment as to whether the projects are being operated and maintained in compliance with their license or exemption terms and conditions, it is requested that you provide this office with information relative to any project-specific concerns within 45 days from the date of this letter. Following receipt of this information, we will contact your staff as appropriate.

To help ensure that projects are operating in compliance with the licenses and exemptions, and to improve liaison among the licensees, exemptees, FERC staff, and

- 2 -

resource agencies, we will continue to notify you of each EPUI and dam safety inspection, as appropriate, by forwarding a copy of our inspection confirmation letter to your agency. Because of our workload and the necessity to maintain tight scheduling during the inspection season, the scheduled time and dates for the inspections cannot be changed. If your representatives plan to accompany our staff on the inspection, they should contact our inspector sufficiently in advance of the scheduled inspection so that arrangements can be made to accommodate all participants, and they should arrive at the site at the scheduled time. We also wish to emphasize that, should your representative have any questions about matters of compliance or project operations during the inspections, these questions or concerns should be directed to the FERC representative who has the responsibility to ensure compliance with the license or exemption. We will then take whatever action is appropriate to resolve any problems or answer your questions. We appreciate your continued cooperation in our inspection program and look forward to working with you. If you have any questions, please call me at (212) 273-5930.

Sincerely,



Peter R. Valeri  
Acting Regional Engineer

F.L. : FERC  
Boott Hydro



IN REPLY REFER TO:

## United States Department of the Interior

NATIONAL PARK SERVICE  
Lowell National Historical Park  
67 Kirk Street  
Lowell, Massachusetts 01852-1029

June 12, 2008

Peter R. Valeri  
Acting Regional Engineer  
Office of Energy Projects  
Division of Dam Safety and Inspections  
Federal Energy Regulatory Commission  
19 West 34<sup>th</sup> Street, Suite 400  
New York, NY 10001

Re: FERC Project no. 2790-000, Lowell, MA

Dear Mr. Valeri:

Thank you for the opportunity to comment on the above referenced hydropower project located on the Lowell Canal System in Lowell, MA by Enel/Boott Hydropower, Inc.

We do work with this licensee on a regular basis to accommodate the canal tours offered by the Lowell National Historical Park and on protection of the historic resources that make up the Lowell Canal System, which is a National Engineering Landmark and on the National Register of Historic Places, as well as being located fully within the Lowell National Historical Park, a unit of the National Park Service, as designated by P. L. 95-290, Title I § 103.

First and foremost, we wish to reinforce the requirements enacted in the law establishing the National Park in Lowell, which are applicable to FERC actions:

§ 410cc-12. **Consultations, cooperation, and conduct of activities by Federal entities;**  
**issuance of licenses or permits by Federal entities**

(a) "Any federal entity conducting of supporting activities directly affecting the park or preservation district shall-

- (1) Consult with, cooperate with, and to the maximum extent practicable, coordinate its activities with the Secretary and the Commission; and
- (2) Conduct or support such activities in a manner which (A) to the maximum extent practicable is consistent with the standards and criteria established pursuant to section 410cc-32(e) of this title, and (B) will not have an adverse effect on the resources of the park or preservation district.

(b) No Federal entity may issue any license or permit to any person to conduct an activity within the park or preservation district unless such entity determines that the proposed activity will be conducted in a manner consistent with the standards and criteria established pursuant to section 410cc-32(e) of this title and will not have an adverse effect on the resources of the park or preservation district.

The Commission referenced in the law is the Lowell Historic Preservation Commission which is defunct, but whose legal obligations have been assumed by the Lowell National Historical Park. The Secretary reference is the Secretary of the Interior, under which the Lowell National Historical Park operates.

The National Park's primary concerns fall within two categories:

1. Operation of National Park canal-related programs in a safe manner and allow for consistent public programming based on the Park's annual operating program.
2. Preservation of the Canal and related structures that make up the Lowell Canal system.

### **1. Operation of National Park canal related programs in a safe and responsive manner.**

Article 33, Section 7 of the License calls for "the Advisory Council on Historic Preservation to review and comment upon any future actions related to the project that would change the mean seasonal water levels in the canal system or that would impair navigability in the system."

**a. Maintaining appropriate water levels for tour operations:** The National Park Service has made considerable public investment in the development of the Canalway that includes public walkways and boat tour operations. The main attraction for visitors to come to Lowell National Historical Park is to experience Lowell by boat via the canals. The park collects a fee for the general public boat tours as well as a school group fee that is charged for school's participating in our daylong programs. The school programs in particular, are programmed well in advance. The inability to use the canals because of unexpected water levels drops causes great concern due to the loss of revenue and credibility to a nationally recognized education experience.

At the current level of the river (June 2008) National Park tour boats cannot enter the river pond for two reasons: 1) because of the removal of the flashboards, the water level is too low to operate above the guard lock chambers of both the Northern and Pawtucket Canals and in the Merrimack River above the Pawtucket Dam, and 2) the trash boom is still across the mouth of the Pawtucket Canal. Because the water is so low, National Park Maintenance crews cannot get a work boat into the river to open up the boom. If the water levels are not raised soon this will have a major impact in the park tour operation for the beginning of our full summer season.

**b. Timely Communication of Changing Water Levels for Safe Tour Operations:** The park is respectful of the operational requirements for Boott Hydro but there needs to be a more formalized agreement/plan in place to ensure that changes in operation that effect water levels are communicated to the park to ensure that there will not be damage to property,



injury to park visitors that use the canals, and a loss of revenue and integrity to the visitor's experience. As boat tours expand in the canal system, as they have by the restoration of the Swamp Locks this year, certain bridge clearances have become tighter which requires slower more deliberate changes in the canal surface elevations to help assure the safety of the boat passengers. Unsafe operational procedures which quickly change canal levels without proper notice need to be reduced to a minimum with continual effort made to eliminate them.

**c. Impairing Navigability:** Many of the Boott Hydro owned bridges that the Park visitors pass under are in poor condition. This year the Pawtucket Street Bridge over the Northern Canal by the Hydro Plant is in particularly rough shape with the reinforced concrete walkways on each side sending concrete chunks falling to the lock chamber below. This condition makes it unsafe for the Park to exercise its right to run boat tours and open the walkway under the bridge without some protective scaffolding type structure or heavy duty netting to protect Park visitors from the falling concrete. Similarly, the Pawtucket Street Bridge over the Upper Pawtucket Canal has some exposed reinforcing and deteriorating concrete although not to the extent of the bridge over the Northern Canal. Lastly, the Broadway Street Bridge over the Pawtucket Canal requires constant vigilance in order to prevent an unsafe condition for Park visitors.

**d. Accommodating Public Use; Operation of Surge Gate:** The Commonwealth of Massachusetts acquired Recreation and Transportation Rights to sections of the Lowell Canal System, which have been made available to the National Park by easements provided by acts of the State Legislature. The National Park and other city and state agencies concurred with installation of a surge gate in the Northern Canal by the Licensee based on a stated, if not written, understanding that adding this structure would increase recreation access. However, Licensee's policy of locking down the surge gate "for safety reasons" whenever there are tours scheduled or walkway access is occurring along that canal negates what we were given to believe was the purpose of the surge gate. In other words, "Why did the surge gate get built if it's not operational when the public has access?" We understood that boating and pedestrian safety would be enhanced by having the surge gate operational at the times of public use and that the time of pedestrian access could potentially be extended as well.

## **2. Preservation of the Canal and related structures that make up the Lowell Canal system.**

In the Cultural Resources section of the FERC License, mitigation is defined in order to address potential adverse effects of the original plant development to the Locks and Canal Historic District. However, this mitigation does not allow inconsistent actions after the date of the license that could result in adverse effects to the historic resources of the Lowell Canal System. Several past and proposed actions should be subjected to appropriate reviews:

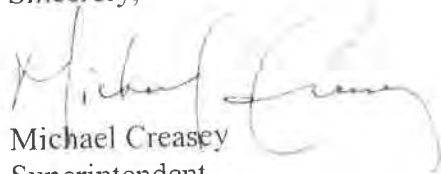
**a. Overtopping The Great River Wall:** As a result of running the water at high levels within the Northern Canal, overtopping, extended surcharge loading, and lack of maintenance of the Great River Wall resulted in a failure of a section of that wall March 15, 1994. While repairs were accomplished with historical sensitivity, the National Park Service continues to be concerned that practice could result in further wall failures that would constitute an adverse effect to the historic district. There is a need to adjust the

operating levels in this canal to assure that overtopping does not occur and historic resources are protected.

- b. Pawtucket Dam:** Preservation of the historic Pawtucket Dam is a major preservation objective of the Lowell National Historical Park. We have communicated on several occasions with the Licensee in response to proposals to install a Bladder Dam system. The Pawtucket Dam is the reason the city of Lowell, MA exists and a fundamental element of the historic resources that justified the creation of a National Park here. The National Park will continue to oppose a Bladder Dam solution on this historic site.
- c. Flashboards & Pins:** As FERC is aware, there are great concerns in the community that the flashboard system is not working in the same manner as in the past and there is a belief that the pins and/or the flashboard system have been strengthened to prevent the purposeful bending over of the flashboards to reduce upstream flooding. We note that Boott Hydro was issued a permit by the Lowell Historic Board in 2000 to drill a new row of flashboard pin holes in the capstones, which Boott Hydro represented in that permit application as "moving the hole location" so as "to decrease or eliminate capstone breaking problems." As actually carried out, it now appears that many more pin holes were made in the new row than in the earlier two rows closer to the face of the dam. In addition to other problems this situation has been causing, we are especially concerned that this practice of more closely spaced pins could result in damage to the capstones of the Pawtucket Dam. The National Park has not been included in any correspondence on this issue locally and request that FERC not take any action to finalize an agreement with regard to the pins and flashboards without consultation with us and a determination as to whether further Section 106 action is needed. We are also concerned that the unilateral change from using smaller boards to plywood sheets as flashboards some years ago occurred without such consultation and may have resulted in higher water levels and the risk of additional damage to historic resources.

On behalf of the Lowell National Historical Park, I would like to thank you for consideration of these issues and would respectfully request a meeting to review them with you or your staff so that proper procedures will be in place going forward to assure that the power generation can occur without the impacts described above. I look forward to hearing from you at your earliest convenience. I may be reached at 978-275-1700 or [Michael\\_creasey@nps.gov](mailto:Michael_creasey@nps.gov)

Sincerely,

  
Michael Creasey  
Superintendent

cc: Bernard Lynch, City Manager  
U. S. Rep. Niki Tsongas  
ENEL/Boott Hydropower, Inc.



Energy in tune with you.

Enel North America, Inc.

One Tech Drive, Suite 220, Andover, MA 01810  
Tel. 978 681 1900 Fax 978 681 7727

**BOOTT HYDROPOWER, INC.**  
A SUBSIDIARY OF ENEL NORTH AMERICA, INC.

**Via eFiling**

August 4, 2008

Peter R. Valeri, P.E.  
Regional Engineer  
Federal Energy Regulatory Commission  
19 West 34th Street, Suite 400  
New York, NY 10001

Re: Lowell Hydroelectric Project (FERC No. 2790-MA);  
Response to National Park Service letter.

Dear Mr. Valeri:

We are in receipt of your letter of June 20, 2008 in which you requested our response to a letter from the National Park Service (NPS) dated June 12, 2008, which raised a number of issues regarding the perceived impact of the Lowell Hydroelectric Project on the NPS' operations at the Lowell National Historical Park. For the record, we note that the NPS' letter is dated the day before the June 13 Operations Inspection of the project by your staff, which inspection was attended by an NPS representative. None the concerns listed in the NPS' letter were voiced by the NPS representative during the inspection.

Our response to each of the concerns raised by the NPS follow:

**1. Operation of National Park canal related programs in a safe and responsive manner.**

*Article 33, Section 7 of the License calls for "the Advisory Council on Historic Preservation to review and comment upon any future actions related to the project that would change the mean seasonal water levels in the canal system or that would impair navigability in the system."*

**Response:** There presently are no future actions proposed by BHI which would change the mean seasonal water levels in the canal system, that would impair navigability, or which would otherwise invoke review and comment by the Advisory Council on Historic Preservation under Article 33.

**a. Maintaining appropriate water levels for tour operations:**

*The National Park Service has made considerable public investment in the development of the Canalway that includes public walkways and boat tour operations. The main attraction for visitors to come to Lowell National Historical Park is to experience Lowell by boat via the canals. The park collects a fee for the general public boat tours as well as a school group fee that is charged for school's participating in our daylong programs. The school programs in particular, are programmed well in advance. The inability to use the canals because of unexpected water levels drops causes great concern due to the loss of revenue and credibility to a nationally recognized education experience.*

*At the current level of the river (June 2008) National Park tour boats cannot enter the river pond for two reasons: 1) because of the removal of the flashboards, the water level is too low to operate above the guard lock chambers of both the Northern and Pawtucket Canals and in the Merrimack River above the Pawtucket Dam, and 2) the trash boom is still across the mouth of the Pawtucket Canal. Because the water is so low, National Park Maintenance crews cannot get a work boat into the river to open up the boom. If the water levels are not raised soon this will have a major impact in the park tour operation for the beginning of our full summer season.*

**Response:** The Lowell canal system has multiple uses and operating conditions based on river flows and corresponding river elevations which are neither predictable nor constant. BHI manages and maintains canal system water levels to the best of its ability within the limits as agreed to with the NPS. In many cases the target operating band is relatively narrow, constrained by the minimum level necessary to pass tour boats through the locks and the maximum level necessary to allow for safe passage of tour boats under bridges. Any adjustments necessary to maintain the proper water levels and system water balance typically take time to achieve and must be done gradually.

BHI has the right to maintain its project works, including the flashboards, and to the extent feasible attempts to accommodate the needs of other water and canal users, including the NPS, in its operations and maintenance planning. BHI provides ample prior notice of all water level changes to the NPS and other affected parties.

With respect to the low water levels experienced during 2008, BHI removed the flashboards from the crest of the Pawtucket Dam on May 30, 2008 in direct response to a Commission order. BHI expeditiously undertook the necessary corrective measures, and after gaining Commission approval and purchasing new flashboard pins, completed reinstallation of the flashboards on June 20, 2008. BHI immediately began to refill the headpond while maintaining the project's downstream minimum flow requirement, and restored the headpond to normal levels on June 25, 2008. Shortly after refilling the impoundment, damage to the flashboards occurred as a result of elevated river flows and debris impact. Had BHI not repaired the flashboards quickly, the impoundment could not have been maintained near normal levels, due to low river inflows, likely resulting in impacts to recreational use upstream of the Pawtucket Dam. Notifications were made that the impoundment was to be lowered again for the repairs which were accomplished on July 10, 2008.

**b. *Timely Communication of Changing Water Levels for Safe Tour Operations:***

*The park is respectful of the operational requirements for Boott Hydro but there needs to be a more formalized agreement/plan in place to ensure that changes in operation that effect water levels are communicated to the park to ensure that there will not be damage to property, injury to park visitors that use the canals, and a loss of revenue and integrity to the visitor's experience. As boat tours expand in the canal system, as they have by the restoration of the Swamp Locks this year, certain bridge clearances have become tighter which requires slower more deliberate changes in the canal surface elevations to help assure the safety of the boat passengers. Unsafe operational procedures which quickly change canal levels without proper notice need to be reduced to a minimum with continual effort made to eliminate them.*

**Response:** BHI keeps the NPS and other affected parties informed of any planned changes in operations that would impact river or canal water levels. Other than for emergencies or in unusual circumstances, BHI provides at least a 24 to 48 hour advance notification of any major water level changes (e.g., drawdowns) by email or telephone. For planning purposes, BHI has requested and obtained the NPS' anticipated event schedule which, to the extent possible, BHI attempts to accommodate by postponing scheduled maintenance canal draw downs to avoid conflicts.

Canal water surface elevations and bridge clearances are addressed in BHI's Revised Report on Recreational Resources, filed pursuant to license Article 38, which included a

canal system water elevation maintenance plan. BHI's Article 38 filing was approved by the Commission on September 12, 1984. As noted above, in many cases the target operating band for the lower canal system is relatively narrow, constrained by the minimum level necessary to pass tour boats through the locks and the maximum level necessary to allow for safe passage of tour boats under bridges. The lower canal system below the Swamp Locks has siphon outlets to assist in maintaining the water surface elevations within this narrow elevation band.

c. **Impairing Navigability:**

*Many of the Boott Hydro owned bridges that the Park visitors pass under are in poor condition. This year the Pawtucket Street Bridge over the Northern Canal by the Hydro Plant is in particularly rough shape with the reinforced concrete walkways on each side sending concrete chunks falling to the lock chamber below. This condition makes it unsafe for the Park to exercise its right to run boat tours and open the walkway under the bridge without some protective scaffolding type structure or heavy duty netting to protect Park visitors from the falling concrete. Similarly, the Pawtucket Street Bridge over the Upper Pawtucket Canal has some exposed reinforcing and deteriorating concrete although not to the extent of the bridge over the Northern Canal. Lastly, the Broadway Street Bridge over the Pawtucket Canal requires constant vigilance in order to prevent an unsafe condition for Park visitors.*

**Response:** BHI owns and maintains several bridges which provide public access across the canal system throughout downtown Lowell. All of these bridges are specifically excluded from the project boundary as shown on the approved Exhibit G-2, and furthermore are not described as project features within the Lowell Project's license. These bridges are therefore not subject to the Commission's jurisdiction.

Nevertheless, BHI has a program of continually monitoring, performing engineering evaluations of and repairing its bridges. As was discussed during a meeting with the NPS in early June, BHI anticipates that repair work will be performed on each of the bridges referenced above during 2008. As it has recently done during previous work on its bridges, BHI will provide the NPS with ample advance notice of its anticipated work schedule, and will ensure that its bridge repair contractors make special provisions to not impede tour boat operations and canal navigability during construction activities.

d. **Accommodating Public Use; Operation of Surge Gate:**

*The Commonwealth of Massachusetts acquired Recreation and Transportation Rights to sections of the Lowell Canal System, which have been made available to the National Park by easements provided by acts of the State Legislature. The National Park and other city and state agencies concurred with installation of a surge gate in the Northern Canal by the Licensee based on a stated, if not written, understanding that adding this structure would increase recreation access. However, Licensee's policy of locking down the surge gate "for safety reasons" whenever there are tours scheduled or walkway access is occurring along that canal negates what we were given to believe was the purpose of the surge gate. In other words, "Why did the surge gate get built if it's not operational when the public has access?" We understood that boating and pedestrian safety would be enhanced by having the surge gate operational at the times of public use and that the time of pedestrian access could potentially be extended as well.*

**Response:** Following the partial failure of the bayboard section of the canal wall in 1994, BHI undertook feasibility studies to determine the best option for surge suppression in the Northern Canal. A hydraulically-activated surge control gate was installed in January, 1997 and was fully automated in 1999. The surge gate is designed to automatically open when the E.L. Field station is tripped off-line to mitigate overtopping of the Great River Wall to provide safe pedestrian access to the wall and island areas, to prevent flooding of the historic Northern Gatehouse, and to prevent undermining and/or weakening of the gatehouse and portions of the Northern Canal. The gate was never intended to enhance boating in the Northern Canal, and in fact raises the safety concern that should the station trip off-line while the NPS is operating tour boats on the Northern Canal, the boat and passengers could be drawn through the open surge gate. Because it has been

demonstrated that the transient wave produced on unit trip is not large enough to overtop the Great River Wall when the Northern Canal flow is less than 3,500 cfs, the gate may be temporarily deactivated under such conditions. Thus, NPS and BHI have agreed that boating tour operations can occur on the Northern Canal only if the canal flow is less than 3,500 cfs and if the surge gate is locked out and tagged out to prevent automatic opening. This lock-out/tag-out procedure is jointly undertaken by BHI and NPS personnel.

There are also circumstances under which BHI can not deactivate the surge gate in order to protect worker safety and/or to ensure compliance with the project's minimum flow requirement. For example, during any work on the crest of the Pawtucket Dam, such as during flashboard maintenance, the surge gate must remain active to prevent spillage from occurring in the event of a unit trip. Likewise, while the impoundment is being refilled following flashboard repairs the gate must remain active to ensure minimum flow compliance should the E.L. Field Station trip off-line. In such situations BHI notifies the NPS and advises against any boat access to the Northern Canal until normal operations resume. BHI has never denied pedestrian access to the Canal Walkway due to inactivation of the surge gate, and has only recommended that the NPS restrict such access due to general safety concerns not related to the surge gate (e.g., lack of appropriate safety fencing).

## **2. Preservation of the Canal and related structures that make up the Lowell Canal system.**

*In the Cultural Resources section of the FERC License, mitigation is defined in order to address potential adverse effects of the original plant development to the Locks and Canal Historic District. However, this mitigation does not allow inconsistent actions after the date of the license that could result in adverse effects to the historic resources of the Lowell Canal System. Several past and proposed actions should be subjected to appropriate reviews:*

### **a. Overtopping The Great River Wall:**

*As a result of running the water at high levels within the Northern Canal, overtopping, extended surcharge loading, and lack of maintenance of the Great River Wall resulted in a failure of a section of that wall March 15, 1994. While repairs were accomplished with historical sensitivity, the National Park Service continues to be concerned that practice could result in further wall failures that would constitute an adverse effect to the historic district. There is a need to adjust the operating levels in this canal to assure that overtopping does not occur and historic resources are protected.*

**Response:** There is no need to adjust the water level in the Northern Canal to prevent overtopping, because overtopping is prevented by the surge gate. Following the 1994 Northern Canal wall failure, BHI installed the surge gate, as described above, to prevent to overtopping of the Great River Wall when the two generating units at the E.L. Field Station are suddenly tripped offline. During normal operations BHI maintains the water level within the Northern Canal at or near El. 91.5 with the surge gate engaged in automatic mode. The only time the Great River Wall can become overtopped is when the Northern Canal flow is greater than 3,500 cfs (i.e., more than the capacity of one unit at the E.L. Field Station) while the surge gate is disengaged from automatic mode. Overtopping of the Great River Wall may also occur when NPS personnel inadvertently leave the lock chamber open at the Northern Gatehouse, which allows the Northern Canal to rise to the same level as the project impoundment.

### **b. Pawtucket Dam:**

*Preservation of the historic Pawtucket Dam is a major preservation objective of the Lowell National Historical Park. We have communicated on several occasions with the Licensee in response to proposals to install a Bladder Dam system. The Pawtucket Dam is the reason the city of Lowell, MA exists and a fundamental element of the historic resources that justified the creation of a National Park here. The National Park will continue to oppose a Bladder Dam solution on this historic site.*

**Response:** Historical preservation is but one of many resource areas which would need to be considered in any assessment of installing a "Bladder Dam" or inflatable crest gate system on the crest of the Pawtucket Dam. Such a system would have positive benefits for a wide range of resource areas including water management, fish passage, upstream recreation, reduction of upstream backwatering impacts, worker safety, and most importantly with respect to the NPS' concerns, protection of the historical structure from debris and ice.

BHI does not agree that an inflatable crest gate system would be inconsistent with the historical nature of the Pawtucket Dam. The history of Lowell is founded on continual innovation in hydropower technology, most notably the numerous developments by James B. Francis. The construction of the E.L. Field powerhouse along the historic canal system juxtaposes these historic technologies with more modern technologies. If determined to be feasible, installation of a crest gate system on the Pawtucket Dam would be in keeping with this line of innovation. The compatibility of an inflatable crest gate system mounted on a historic dam is clearly demonstrated immediately downstream at the historic Great Stone Dam at the Lawrence Project (P-2800).

Should BHI actively pursue the installation of an inflatable crest gate system on the Pawtucket Dam in the future, an application for amendment of license would be filed with the Commission. In preparing any such application BHI would conduct the necessary consultation with all appropriate agencies, including the Advisory Council on Historic Preservation, the Lowell Historic Board and the NPS. BHI has already consulted with the NPS on this subject on two separate occasions.

**c. Flashboards & Pins:**

*As FERC is aware, there are great concerns in the community that the flashboard system is not working in the same manner as in the past and there is a belief that the pins and/or the flashboard system have been strengthened to prevent the purposeful bending over of the flashboards to reduce upstream flooding. We note that Boott Hydro was issued a permit by the Lowell Historic Board in 2000 to drill a new row of flashboard pin holes in the capstones, which Boott Hydro represented in that permit application as "moving the hole location" so as "to decrease or eliminate capstone breaking problems." As actually carried out, it now appears that many more pin holes were made in the new row than in the earlier two rows closer to the face of the dam. In addition to other problems this situation has been causing, we are especially concerned that this practice of more closely spaced pins could result in damage to the capstones of the Pawtucket Dam. The National Park has not been included in any correspondence on this issue locally and request that FERC not take any action to finalize an agreement with regard to the pins and flashboards without consultation with us and a determination as to whether further Section 106 action is needed. We are also concerned that the unilateral change from using smaller boards to plywood sheets as flashboards some years ago occurred without such consultation and may have resulted in higher water levels and the risk of additional damage to historic resources.*

**Response:** BHI has previously submitted evidence to the Commission demonstrating that the flashboard and pin materials in use today are the same as those used prior to commercial operation of the Lowell Project in 1985. Furthermore, the NPS' charge that the use of plywood flashboards instead of "smaller boards" may have resulted in higher water levels and damage to the Pawtucket Dam is without basis. The strength of the flashboard system and the height of failure are controlled by the spacing and strength of the supporting pins and have little, if anything to do with the material used for flashboard panels. We note that in their review of BHI's updated flashboard design specifications, Commission staff did not raise any concerns over the use of plywood flashboards on the Pawtucket Dam, and in fact approved same in the Commission's order authorizing re-installation of the flashboards dated June 4, 2008.

Contrary to the NPS's claim there are **fewer**, not more, holes in the row of flashboard pin holes now used by BHI than exist in the original alignment. The flashboard pin socket holes have been re-drilled several times over the dam's 150+ year history as the original holes

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have become worn or broken. These holes are generally aligned in three rows running along the dam's axis: 1) the original alignment of 776 holes drilled approximately 6 inches upstream from the downstream face of the capstones; 2) a row of 333 more widely spaced holes drilled approximately 12 inches back from the downstream face of the capstones, which were historically used as a safety measure to tie off workboats when working on the dam crest; and 3) a total of 723 holes in the row currently used by BHI which are drilled approximately 16 inches upstream from the downstream face of the capstones. As noted by the NPS, this latter alignment of pin socket holes includes the 660 holes drilled by BHI in 2000, to prevent damage to the capstones and to preserve the dam. As now installed, BHI has selectively eliminated flashboard pins such that only 588 of the holes in the back row are being used, in order to achieve the 20-inch average pin spacing approved by the Commission.

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Thank you for this opportunity to clarify and address the issues raised by the National Park Service. Please do not hesitate to contact me at (978) 681-1900, extension 809 if you have any questions concerning any of the topics addressed above.

Sincerely,  
**Boott Hydropower, Inc.**

/S/

Kevin M. Webb  
Environmental Affairs Coordinator

cc: M. Creasey, NPS  
V. Engel, BHI



## ATTACHMENT E

# Project Scoping Report

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Task Order #P17PD03094; Contract #P15PC00036; PMIS #225866

## Northern Canal Waste Gatehouse



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13 November 2017

# EYP/

EYP Architecture & Engineering, PC  
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T 617 305 9800  
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## Introduction

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On 17 August 2017, architects and engineers from EYP (Eric Ward, RA; Rebecca Young, RA; and Mark Kanonik, PE) visited the site to observe the general condition of the Northern Canal Waste Gatehouse. On 19 and 20 October 2017, Mark Kanonik and Chuck Volans of EYP again visited the site to observe the general condition of the building. The Gatehouse is a single-story, heavy-timber-framed building that measures approximately 70' by 15' in plan. The building was built circa 1872 atop a dam that was built circa 1847 and houses the canal gates, including the machinery that operates the gates. Refer to Photograph 1 for additional information.

We understand that the canals and gatehouse structure are owned by the Commonwealth of Massachusetts but maintained by Lowell National Historical Park and that the operational machinery within the gatehouse is controlled and maintained by Enel Green Power North America, Inc. It is our understanding that the wood siding, the roofing membrane, and a portion of the sill at the northeast corner of the building were replaced in the 1980s by NPS staff. At an unknown time in the past, supplemental steel shoring was installed to support both the south and north walls of the building.

Please note that no calculations were performed to determine the load-carrying capacity of any of the elements of the gatehouse building; furthermore, no destructive tests were performed, and no material samples were collected. Lastly, no evaluations of any of the utilities inside or outside of the building were made.

## Observations

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The Northern Canal Waste Gatehouse is a single-story, heavy-timber-framed, building that measures approximately 70' by 15' in plan. The gatehouse building is built atop a horizontally-curved masonry dam that separates the Northern Canal above from the Merrimack River below. The sills of the sidewalls do not bear directly on the dam; the sill of the north (downstream) wall bears on iron posts which are themselves bolted into the masonry dam, and the sill on the south (upstream) side bears on a wooden ledger that was bolted into the masonry dam. The sills of the endwalls bear directly on the dam.

The roofing is not original and is estimated to be about 30 years old; while it appears to be generally watertight, the edges of the roof membrane are delaminating around the perimeter of the roof. Refer Photograph 2 for additional information. The roofing has reached the end of its useful life and should be replaced. The siding appears to be original, but some siding boards at the eastern end of the north wall were replaced about 30 years ago. The siding is in remarkably good condition except for a few missing siding boards at the eastern end of the north wall. Refer to Photograph 3 for additional information. The paint is reaching the end of its useful life, and the siding should be repainted.

Except for the sills under the north and south walls, the wood framing is in very good condition. The sills themselves are in very poor condition. The eastern end of the north sill was replaced about 30 years ago, but it is now completely missing in some areas. Refer to Photographs 3 and 4 for additional information.

It appears that the normal operating elevation of the Northern Canal was raised when the hydroelectric power plant was installed to the east of the gatehouse building. Photograph 5 (Historic American Engineering Record [HAER] Photograph MA-8C-2, taken in either 1974 or 1975) shows the south face of the dam and gatehouse when the Northern Canal was dewatered and the walkway decking was removed. Photograph 6 is a close-up of the southeast corner of the building, showing the heavy timber ledger which supports the south (upstream) sidewall. Staining of the large masonry units under the gatehouse, as well as vegetation growing in a few masonry joints, indicate that the elevation of the Northern Canal was typically about 4 feet below the top of the dam. However, it appears that the “normal” canal elevation is now only a few inches below the top of the dam, and the heavy timber ledger is now nearly constantly partially submerged. Refer to Photograph 5 for additional information. Not surprisingly, the heavy timber ledger and the wall sill plate atop the ledger are badly deteriorated and are completely missing in some areas. Refer to Photographs 7 and 8 for additional information. At an unknown time in the recent past, 12 shoring posts (with shoring beams and cable ties) were installed throughout the gatehouse building, presumably to redistribute the load away from the deteriorated walls. Given the level of deterioration of the wood framing, it is possible that the building would have partially collapsed if these shoring posts were not installed. Please note that it is impossible to repair the deteriorated heavy timber ledger and south wall sill to match the original design without permanently lowering the elevation of the canal; we assume that this is not feasible, so an alternate method to repair / restore the south (upstream) sidewall will be detailed in the construction documents that are currently progressing.

HAER Photograph MA-8C-2 (Photograph 5) appears to indicate several open joints in the larger masonry units at the top of the dam, directly underneath the eastern half of the gatehouse building. Inside the gatehouse building, the capping stones atop the dam are separated and have settled a couple of inches, and water can be both seen and heard flowing through the open joints. At some time in the recent past, steel staples were installed in the capping stones, presumably to stop the stones from separating further. Refer to Photograph 9 for additional information. Vegetation is growing on the north face of the dam, and a significant quantity of water can be seen flowing through the side of the dam. Refer to Photograph 10 for additional information. It seems very likely that the water flowing through the dam is eroding the mortar joints, thus causing both the lateral movement and the settlement seen in the capping stones at the top of the dam. It seems very unlikely that the issues in the capping stones are caused by uneven settlement of the dam as a whole since bedrock is visible throughout the bed of the Merrimack River. We understand that NPS does not “own” the dam and is not, therefore, responsible for maintaining and/or repairing the dam; however, we recommend that NPS share our concerns expressed in this Report with the Enel Green Power North America, Inc., at which point they may choose to commission a detailed engineering study. Our concerns expressed in this Report are based solely on very limited information; it should be noted that we did not perform an analysis of the dam to determine its load-carrying capacity, nor did we perform any destructive tests or any investigations of the dam.

## Recommendations

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The deterioration noted in the bases of the walls is adversely affecting the structural stability of the gatehouse building, although it is not yet affecting the operation of the gates. If no action is taken to address these areas of deterioration, the deterioration will continue to worsen until the building settles

Lowell National Historical Park  
Northern Canal Waste Gatehouse



or shifts to such an extent that the operation of the canal gates is compromised. Consequently, we recommend the following:

1. Shore the building until all loads are removed from the wall framing and/or the temporary shoring posts.
2. Remove all deteriorated sections of the wall framing (such as wall studs, sill plates, etc.) at the north and south walls, estimated to be about 6 to 12" above the top of the dam.
3. Install new steel framing to support the north wall.
4. Install additional steel framing to support the south wall.
5. Provide wood decking atop the steel framing along both the south and north walls.
6. Remove all temporary shoring posts, beams, and cables.
7. Remove and replace the roofing with an adhered EPDM roof membrane.
8. Repair all windows on the north wall so that the windows may be opened if desired.

No work will be performed to the gates or the gate-operating machinery, including active utilities serving the gate-operating machinery.

Refer to Appendix A for a Class C cost estimate corresponding to the recommended work listed above.

## Photographs

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Lowell National Historical Park  
Northern Canal Waste Gatehouse



Photograph 1 – Northern Canal Waste Gatehouse, viewed from the southeast.



Photograph 2 – Delaminated edge of roof membrane at northeast corner of roof.



Photograph 3 – Deteriorated / missing sill and missing siding boards at eastern end of north wall; entire building has settled in this area, as evidenced by the downward curvature of the siding boards under the left-most window.



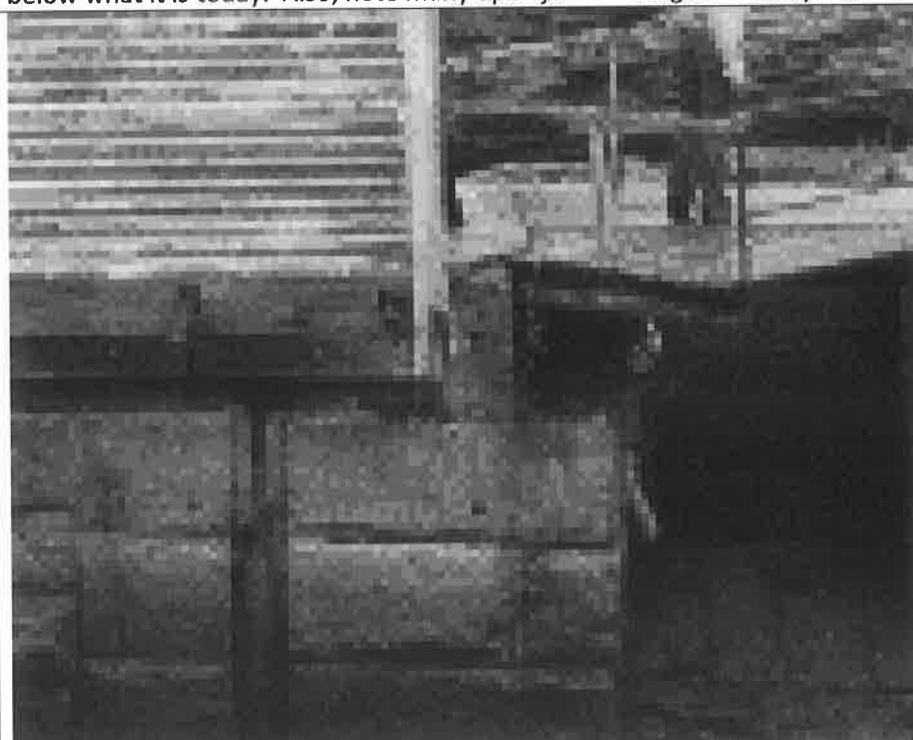
Photograph 4 – Deteriorated / missing sill under eastern edge of north wall; note large gap between dam and wall.

Lowell National Historical Park  
Northern Canal Waste Gatehouse

EYP/



Photograph 5 – HAER Photograph MA-8C-2, taken in 1974 or 1975; note staining in wall and vegetation in joints below gatehouse, indicating that the normal elevation of the Northern Canal was several feet below what it is today. Also, note many open joints in larger masonry units at the top of the dam.



Photograph 6 – Close-up of HAER Photograph MA-8C-2, taken from Photograph 5, showing heavy timber ledger and wall sill.





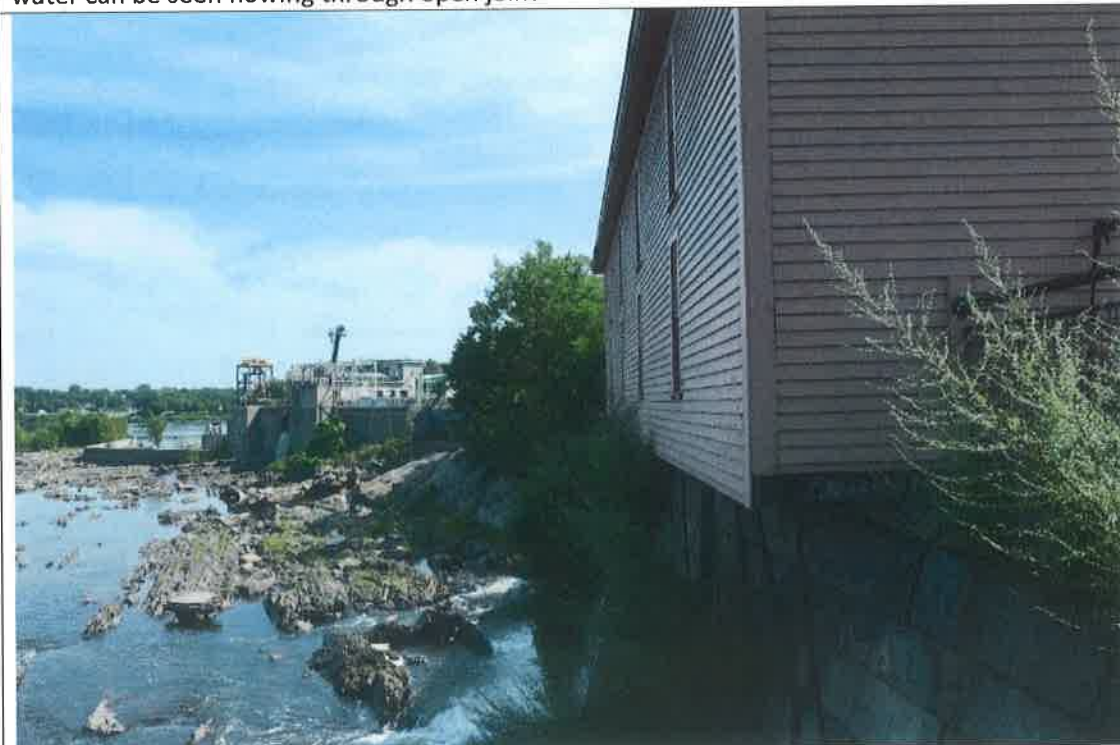
Photograph 7 – Underside of walkway along south side of gatehouse; the deteriorated sill that is now partially submerged in water is visible in Photographs 5 and 6.



Photograph 8 – Deteriorated heavy timber ledger and wall sill plate at eastern end of south wall.



Photograph 9 – Capping stones atop dam, inside gatehouse building; several units have separated, and water can be seen flowing through open joints.



Photograph 10 – North face of dam and gatehouse building; note vegetation growing on face of dam and significant water flowing through dam.

## ATTACHMENT F

## PARK PURPOSE

The purpose statement identifies the specific reason(s) for establishment of a particular park. The purpose statement for Lowell National Historical Park was drafted through a careful analysis of its enabling legislation and the legislative history that influenced its development. The park was established when the enabling legislation adopted by Congress was signed into law on June 5, 1978 (see appendix A for enabling legislation and legislative acts). The purpose statement lays the foundation for understanding what is most important about the park.

*Lowell National Historical Park preserves and interprets the historic structures and stories of the Industrial Revolution and its legacies in Lowell, serving as a catalyst for revitalization of the city's physical and economic environment and promoting cultural heritage and community programming.*

## PARK SIGNIFICANCE

Significance statements express why a park's resources and values are important enough to merit designation as a unit of the national park system. These statements are linked to the purpose of Lowell National Historical Park, and are supported by data, research, and consensus. Statements of significance describe the distinctive nature of the park and why an area is important within a global, national, regional, and systemwide context. They focus on the most important resources and values that will assist in park planning and management.

The following significance statements have been identified for Lowell National Historical Park. (Please note that the sequence of the statements does not reflect the level of significance.)

1. Lowell's (economic) success was based in innovation, from manufacturing technology and processes, to new business models, to city planning designed to benefit both industry and the worker. Unique industrial concepts were implemented and demonstrated at a massive scale at the Lowell mills, which served as a model for textile production and industrial cities.
2. A very large proportion of original buildings, structures, and urban landscapes have survived in Lowell's park and preservation district and now are recognized as important historical artifacts. These include the entire 5.6-mile power canal system with its sophisticated dams, locks, and gatehouses, 7 of the original 10 mill complexes, and significant examples of early housing types, institutions, and transportation facilities.
3. The Lowell canal system is nationally recognized as one of the most impressive civil and mechanical engineering achievements of the 19th century because of its grand scale and technological complexity, and is the site of origin for the famed "Francis" turbine. The canal system, used as both a transportation corridor and power source, facilitated the growth of the industrial city.

4. Lowell National Historical Park preserves and interprets the stories and heritage of the people of Lowell, including the early female workforce (aka “mill girls”) and those who came from across the globe seeking opportunities. Today, Lowell’s residents continue to shape the culture of the city and contribute to its revitalization.
5. The collaboration between Lowell National Historical Park and its partners has resulted in the rehabilitation of almost all of the 5.3 million square feet of historic mill space and hundreds of additional buildings in the downtown historic district. This effort continues to serve as a successful example of leveraging public-private partnerships for economic development through historic preservation.
6. Lowell National Historical Park embraces partnerships as an integral approach to accomplishing park and community goals. Lowell National Historical Park serves as a model for leveraging collaborative public-private partnerships and community engagement.

## FUNDAMENTAL RESOURCES AND VALUES

Fundamental resources and values (FRVs) are those features, systems, processes, experiences, stories, scenes, sounds, smells, or other attributes determined to warrant primary consideration during planning and management processes because they are essential to achieving the purpose of the park and maintaining its significance. Fundamental resources and values are closely related to a park’s legislative purpose and are more specific than significance statements.

Fundamental resources and values help focus planning and management efforts on what is truly significant about the park. One of the most important responsibilities of NPS managers is to ensure the conservation and public enjoyment of those qualities that are essential (fundamental) to achieving the purpose of the park and maintaining its significance. If fundamental resources and values are allowed to deteriorate, the park purpose and/or significance could be jeopardized.

The following fundamental resources and values have been identified for Lowell National Historical Park:

**Water Power System / Canal System.** The Lowell National Historical Park boundary includes 9.6 miles of major riverbanks and all 5.6 miles of historic canals in Lowell, all of which comprise the waterpower system that harnessed waters of the Merrimack River to power the city’s mills. In fact, the Merrimack River and its natural attributes dictated the location of the city itself. The water power and canal system includes the Pawtucket, Merrimack, Hamilton, Western, Eastern, Lowell, and Northern Canals and canal banks, as well as several associated locks, gatehouses and dams, and Pawtucket Falls. This system, which still operates as a source of hydroelectric power, provides an opportunity to interpret both the historic significance of water in industry, as well as the engineering of a waterpower system. Public access has been expanded over the years to support these interpretive opportunities, including creation of a pedestrian canalway and riverwalk and the development of related exhibits and programs such as the Suffolk Mill Turbine Exhibit.

**Boott Cotton Mills Complex.** This complex is architecturally and historically the most significant mill site in the city, and the only one with buildings owned and managed by the National Park Service. The millyard was constructed and then adapted over a 100-year period by the Boott Cotton Mills company, one of the 10 major textile corporations in Lowell. Of the city’s original millyards, the Boott Cotton Mills complex is the most intact example of Lowell’s historic

mill complexes. Changes in technology and production capability influenced the development and appearance of the millyard over time. Its clock tower, completed about 1865, survives today as one of the most distinctive architectural monuments in Lowell and has become a symbol of the park. Today, the restored mill complex houses the park's Boott Cotton Mills Museum, the Tsongas Industrial History Center, and several NPS Northeast Region offices.

**Immersive Experience.** Lowell National Historical Park provides a variety of hands-on interpretive and educational opportunities that allow visitors to immerse themselves in Lowell's industrial past. Key park experiences include exhibits that feature a working turbine and weave room, as well as boat tours of the canal system and rides through the park on historic replica trolleys, which are among the most popular and unique experiences in the park. The Tsongas Industrial History Center, a partnership between Lowell National Historical Park and the University of Massachusetts Lowell Graduate School of Education, is a hands-on center where students can learn about the American Industrial Revolution through interactive activities such as weaving, working on an assembly line, creating canal systems and testing water wheels, and measuring water quality.

**Cultural Heritage and Arts Programming.** Immigration and cultural expression were a part of Lowell's story from the beginning—from the Yankee "mill girls" who flocked to the city in search of economic independence to the Irish, French-Canadians, Greeks, Poles, Portuguese, and other ethnic groups that came in search of the American Dream. This cultural heritage, its evolution over time, and its impacts on the cultural character of Lowell today are expressed through programming and exhibitions at the park, including the Mill Girls & Immigrant Exhibit at the Patrick J. Mogan Cultural Center, the Lowell Folk Festival, and the Lowell Summer Music Series. Cultural heritage and arts events are among the most well known and best attended at the park, and feature a range of activities that appeal to local and nonlocal visitors alike.

**Historic Urban Industrial Landscape.** Lowell is often recognized as one of America's most significant industrial cities, and, as such, the assemblage of buildings, structures, and public spaces that comprise its historic urban industrial landscape are critical to telling the story of the mills and the Industrial Revolution in America. Lowell was an innovative mill town where the focus was on both industry and the worker, and it includes not only extensive mill space and supporting structures but also boardinghouses, churches, and parks. Although the landscape is central to the story of Lowell, many of the buildings, structures, and greenscapes are owned and managed by other entities. Lowell National Historical Park works with the community and partner organizations as well as private owners and developers to ensure continued preservation of the historic urban industrial landscape, including mill buildings and smokestacks. This collaborative preservation effort is fundamental and will continue to be a central focus for Lowell National Historical Park into the future.

**Partnerships.** Since its establishment Lowell National Historical Park has embraced partnerships as an integral tool for accomplishing park and community goals. Partnerships with entities such as the City of Lowell, the state, and community organizations have allowed the leverage of funds for historic preservation and supported the economic growth of the city. These partners have been critical to meeting the mission of the park, assisting with interpretation, education, and resource stewardship. Through strong, mutually beneficial relationships with its partners, the park has not only succeeded but thrives as a model for community cooperation in the National Park Service.

**Museum Collections.** The museum collections at Lowell National Historical Park contain more than one-half million artifacts and historical documents, spanning from the early 19th century to

the present. These objects and documents provide a tangible link to the Industrial Revolution in Lowell and its enduring legacies.

## INTERPRETIVE THEMES

Interpretive themes are often described as the key stories or concepts that visitors should understand after visiting a park—they define the most important ideas or concepts communicated to visitors about a park unit. Themes are derived from, and should reflect, park purpose, significance, resources, and values. The set of interpretive themes is complete when it provides the structure necessary for park staff to develop opportunities for visitors to explore and relate to all park significance statements and fundamental resources and values.

Interpretive themes are an organizational tool that reveal and clarify meaning, concepts, contexts, and values represented by park resources. Sound themes are accurate and reflect current scholarship and science. They encourage exploration of the context in which events or natural processes occurred and the effects of those events and processes. Interpretive themes go beyond a mere description of the event or process to foster multiple opportunities to experience and consider the park and its resources. These themes help explain why a park story is relevant to people who may otherwise be unaware of connections they have to an event, time, or place associated with the park.

The following interpretive themes have been identified for Lowell National Historical Park:

The creation of the Waltham-Lowell system helped to change the nature and meaning of work by revolutionizing labor relations in the United States and transforming gender, racial, and ethnic identities ultimately leading to socioeconomic opportunity and inequity.

The accumulation of capital led to new investment opportunities in the United States centered on industrialization. Innovations in large-scale production systems in Lowell affected society in social, political, and economic ways and became a model for the future.

Through innovations in textile production, transportation, waterpower, and canal engineering, Lowell became a premier industrial city and helped propel the United States into a new industrial age. Cycles of innovation and technological development shaped, and continue to shape, the city and Lowell's influence on the world.

The commodification and use of abundant natural resources in Lowell, as part of a global Industrial Revolution, changed human relationships with the environment and modernized societies throughout the world but resulted in environmental damage that presents challenges today.

Lowell is a microcosm of the historical and contemporary shifting of cultural identities and tensions brought about by broader social changes such as industrialization, urbanization, and globalization.

From its earliest days as a planned industrial city, through boom and bust economic cycles to today's historic preservation renaissance, Lowell's urban landscape has evolved and now serves as a model of development and revitalization.

## Analysis of Fundamental Resources and Values

The fundamental resource or value analysis table includes current conditions, potential threats and opportunities, planning and data needs, and selected laws and NPS policies related to management of the identified resource or value.

| Fundamental Resource or Value                 | Water Power System / Canal System                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Related Significance Statements</b></p> | <p>Lowell's (economic) success was based in innovation, from manufacturing technology and processes, to new business models, to city planning designed to benefit both industry and the worker. Unique industrial concepts were implemented and demonstrated at a massive scale at the Lowell mills, which served as a model for textile production and industrial cities.</p> <p>A very large proportion of original buildings, structures, and urban landscapes have survived in Lowell's park and preservation district and now are recognized as important historical artifacts. These include the entire 5.6-mile power canal system with its sophisticated dams, locks, and gatehouses, 7 of the original 10 mill complexes, and significant examples of early housing types, institutions, and transportation facilities.</p> <p>The Lowell canal system is nationally recognized as one of the most impressive civil and mechanical engineering achievements of the 19th century because of its grand scale and technological complexity, and is the site of origin for the famed "Francis" turbine. The canal system, used as both a transportation corridor and power source, facilitated the growth of the industrial city.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p><b>Current Conditions and Trends</b></p>   | <p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>▪ The canal system is in fairly good condition overall.</li> <li>▪ The canal system actively generates power and houses high-voltage submarine cables.</li> <li>▪ All canals are within the park boundary. The canal system comprises roughly half of the overall park acreage.</li> <li>▪ Elements of the canal system are owned and operated by a variety of entities that are responsible for the overall condition of the system. The canal walls and floor and waterpower equipment are owned by Enel Green Power, whereas the buildings and gatehouses, with the exception of the Moody Street Feeder Gatehouse, are owned by the Massachusetts Department of Conservation and Recreation.</li> <li>▪ The park has easements associated with properties owned by the state and hydropower company, such as the gatehouses, canal walls, and much of the canal margins. These easements enable the park to create walkways, install railings, support trolley tracks, and perform related maintenance.</li> <li>▪ The public walkways along the canal are in fairly good condition.</li> <li>▪ Water flow through the canal affects the overall condition of the canal infrastructure, including walls that support NPS-owned assets (e.g., walkways, trolley, Boott Mill).</li> <li>▪ There are 52 interpretive waysides. As areas are added to the park, additional waysides will be needed.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>▪ Use of the canalway system is increasing as additional disparate segments are connected.</li> <li>▪ Visitation to the canalway system is increasing as community efforts to bring new events to the canalway increase.</li> <li>▪ Use of the canalway system will increase as downtown development continues.</li> </ul> |



| Fundamental Resource or Value    | Water Power System / Canal System                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  | <ul style="list-style-type: none"> <li>▪ Activation of a new canal lighting system by the City of Lowell has increased attention to the canalway. If proposals by the public to expand the lighting system are implemented, visitation could increase.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Threats and Opportunities</b> | <p><b>Threats</b></p> <ul style="list-style-type: none"> <li>▪ There is a negative public response to trash in and around the canal system. The cleanup of debris remains a challenge due to the active power generation function and subsequent limitations on access authorized by Enel Green Power.</li> <li>▪ Some perceive the canalways to be unsafe, particularly at night, and poor lighting is often identified as a concern.</li> <li>▪ Gatehouses are sometimes broken into and vandalized.</li> <li>▪ Clear lines of jurisdictional law enforcement authority have not been defined for much of the canal's resources (see key issue on "Jurisdictional Challenges").</li> <li>▪ Lack of maintenance of the canal walls, which are not owned by the National Park Service, can threaten the stability of canal walkways and the trolley system, much of which runs adjacent to the canalway.</li> <li>▪ Vegetation growing along the canal walls can cause structural deterioration over time and poses an ongoing maintenance challenge, especially as NPS staff levels decrease.</li> <li>▪ The park is monitoring environmental containment efforts to manage the lasting effects of prior industrial uses along the canal. These effects are most prominent along the Upper Pawtucket Canal adjacent to the former location of a coal/gas plant.</li> <li>▪ Water flow and levels are controlled by Enel Green Power. Fluctuating water levels directly affect public access, historic structures, the natural environment, and the overall visitor experience (e.g., presence of visible debris).</li> <li>▪ Modernization of the historic dam, approved by the Federal Energy Regulatory Commission, has changed a system used for more than 200 years. The effects of the new crestgate system on water levels in the canal system, and on the scenic wonder of the falls over the dam, remain to be seen.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>▪ Continue dialogue with Enel Green Power on how it could work with the park and its partners to allow for increased public use and/or interpretation.</li> <li>▪ Work with independent volunteer groups to clean up the canal system.</li> <li>▪ Expand recreational access through walkways along all of the canal system.</li> <li>▪ Explore new recreational opportunities through increased use of surface water, such as kayaking and paddle boating and ice skating in the winter.</li> <li>▪ Expand signage along walkways, which could increase visitation.</li> <li>▪ Consider offering science-based programming along the canals. This programming could include expanded discussions about the tradeoffs between industrial uses and the environment and the effects of climate change.</li> <li>▪ Collaborate with community partners on an anti-litter campaign to discourage littering along and in the canalway.</li> <li>▪ Engage the community in discussions related to safety along the canals. Explore opportunities to install LED lighting along canalways as that technology improves.</li> <li>▪ Install additional lighting and retrofit existing lighting to LED to reduce energy footprint. Additional lighting would probably attract visitors and improve public perception of threats to safety.</li> <li>▪ Advocate for an overlook at Pawtucket Falls within the preservation district.</li> <li>▪ Advocate for completion of the final section of the canalway along the Upper Pawtucket Canal.</li> </ul> |
| <b>Data and/or GIS Needs</b>     | <ul style="list-style-type: none"> <li>▪ Visitor surveys.</li> <li>▪ Visitor counts.</li> <li>▪ Population survey.</li> <li>▪ GIS data for jurisdictional inventory and cooperative management.</li> <li>▪ Customized high-water study.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

| Fundamental Resource or Value                                                                       | Water Power System / Canal System                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                     | <ul style="list-style-type: none"> <li>▪ Mapping of List of Classified Structures data related to the canal system.</li> <li>▪ Wayfinding study.</li> <li>▪ List of roles and responsibilities related to maintenance, leasing agreements, special events, and jurisdiction.</li> <li>▪ Administrative history.</li> <li>▪ Historic resource study.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Planning Needs</b>                                                                               | <ul style="list-style-type: none"> <li>▪ Updated Downtown Lowell Historic District Design Review Standards (in collaboration with Lowell Historic Board).</li> <li>▪ Lighting plan for canalways.</li> <li>▪ Comprehensive interpretive and education plan.</li> <li>▪ Planning for adaptation to climate change.</li> <li>▪ Accessibility self-evaluation and transition plan.</li> <li>▪ Preservation advocacy and funding strategy.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance</b> | <p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>▪ Clean Air Act (42 USC 7401 et seq.)</li> <li>▪ Clean Water Act (33 USC 1251-1387, 33 USC 1151)</li> <li>▪ Historic Sites Act of 1935 (54 USC 320101 et seq.)</li> <li>▪ National Environmental Policy Act of 1969 (42 USC 4321)</li> <li>▪ National Historic Preservation Act of 1966, as amended (54 USC 300101 et seq.)</li> <li>▪ Secretarial Order 3289, "Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources"</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director's Orders)</b></p> <ul style="list-style-type: none"> <li>▪ NPS Management Policies 2006 (§4.1) "General Management Concepts"</li> <li>▪ NPS Management Policies 2006 (§4.1.4) "Partnerships"</li> <li>▪ NPS Management Policies 2006 (§4.7.2) "Weather and Climate"</li> <li>▪ NPS Management Policies 2006 (chapter 7) "Interpretation and Education"</li> <li>▪ NPS Management Policies 2006 (chapter 8) "Use of the Parks"</li> <li>▪ NPS Management Policies 2006 (chapter 9) "Park Facilities"</li> <li>▪ Director's Policy Memorandum 12-02, "Applying National Park Service Management Policies in the Context of Climate Change"</li> <li>▪ Director's Policy Memorandum 15-01, "Addressing Climate Change and Natural Hazards for Facilities"</li> </ul> |

| Fundamental Resource or Value          | Immersive Experience                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Related Significance Statements</b> | <p>A very large proportion of original buildings, structures, and urban landscapes have survived in Lowell's park and preservation district and now are recognized as important historical artifacts. These include the entire 5.6-mile power canal system with its sophisticated dams, locks, and gatehouses, 7 of the original 10 mill complexes, and significant examples of early housing types, institutions, and transportation facilities.</p> <p>The Lowell canal system is nationally recognized as one of the most impressive civil and mechanical engineering achievements of the 19th century because of its grand scale and technological complexity, and is the site of origin for the famed "Francis" turbine. The canal system, used as both a transportation corridor and power source, facilitated the growth of the industrial city.</p> |

| Fundamental Resource or Value               | Immersive Experience                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                             | <p>Lowell National Historical Park preserves and interprets the stories and heritage of the people of Lowell, including the early female workforce (aka “mill girls”) and those who came from across the globe seeking opportunities. Today, Lowell’s residents continue to shape the culture of the city and contribute to its revitalization.</p> <p>The collaboration between Lowell National Historical Park and its partners has resulted in the rehabilitation of almost all of the 5.3 million square feet of historic mill space and hundreds of additional buildings in the downtown historic district. This effort continues to serve as a successful example of leveraging public-private partnerships for economic development through historic preservation.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <p><b>Current Conditions and Trends</b></p> | <p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>▪ A wide variety of well-received, full-sensory experiences are offered at the park, including canal boat tours, Lowell Folk Festival, Tsongas Industrial History Center programs, weave room, and Lowell Summer Music Series.</li> <li>▪ The Tsongas Industrial History Center provides popular programs targeted at providing students with curriculum-based, place-based immersive experiences.</li> <li>▪ Overall, visitors report consistently high levels of satisfaction with immersive experiences at the park.</li> <li>▪ Existing signage does not provide consistent or adequate direction to visitors navigating to and through the park.</li> <li>▪ Educational offerings at the Tsongas Industrial History Center continue to be responsive to changing curriculum standards.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>▪ Visitation by different grade levels varies at the Tsongas Industrial History Center because of changing curriculums and educational standards. For example, visitation by fourth grade classes has increased because of the current framework for social studies education, whereas visitation by eighth grade classes has decreased because the topic of industrialization is now addressed in the high school curriculum.</li> <li>▪ Visitation for external partner-led/coordinated programs is increasing.</li> <li>▪ The need for science, technology, engineering, and mathematics educational programs is increasing.</li> <li>▪ The park’s immersive experiences meet the needs of 21st-century learners who desire more engaging, free-choice, and self-directed learning environments.</li> </ul> |
| <p><b>Threats and Opportunities</b></p>     | <p><b>Threats</b></p> <ul style="list-style-type: none"> <li>▪ Immersive experiences are generally staff intensive, requiring more personnel with specialized skills than other interpretive experiences. Thus, these experiences can be difficult to sustain as employees retire and staff levels decrease.</li> <li>▪ Immersive experiences have high operating costs and require ongoing infrastructure improvements and maintenance.</li> <li>▪ Hiring uniquely skilled employees (e.g., trolley operators and maintenance staff, weavers and loom fixers, museum curators, bilingual interpreters) can be challenging.</li> <li>▪ Immersive experiences require attention to safety and related training, staffing, and equipment, including the operation of heavy equipment and machinery (e.g., boats, trolleys, looms) and the movement and management of large numbers of people during bigger events (e.g., Tsongas Industrial History Center programs, Lowell Summer Music Series, Lowell Folk Festival).</li> <li>▪ There are challenges associated with offering immersive experiences in an urban environment such as traffic, noise, etc.</li> <li>▪ Immersive experiences are considered the primary driver for attracting audiences, but their use is not up to date with trends in delivering immersive and other interpretive experiences to new and diverse audiences.</li> </ul>                                                                                                                                                                                                                                                                                                                                            |

| Fundamental Resource or Value                                                                       | Immersive Experience                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                     | <ul style="list-style-type: none"> <li>▪ Fluctuations in canal levels, which are managed by the power company, limit the park’s ability to use the canals for immersive experiences.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>▪ Continue to update and evolve programming to ensure relevancy. Examples include updating exhibits using 21st-century practices, co-leading programs with community members to explore contemporary topics, and conducting evening programming that uses park resources in creative ways (e.g., open-mic nights based on park themes and tied to community-relevant topics).</li> <li>▪ Continue to explore and evolve business models and partnerships that support operational costs, needs, and staffing required by immersive programming.</li> <li>▪ Continue to develop community engagement and partner-led initiatives that use immersive experiences to attract new audiences and build the next generation of park stewards.</li> <li>▪ Research and institute new techniques to improve current immersive experiences and develop new experiences at Lowell National Historical Park and the Tsongas Industrial History Center. These could include greater emphasis on audience-centered learning, family learning, audio tours and experiences, and bilingual offerings.</li> <li>▪ Leverage assistance of nonprofit groups, partners, and volunteers to help meet staffing needs.</li> <li>▪ Adapt programs and facilities at the Tsongas Industrial History Center to engage nonstudent visitors.</li> <li>▪ Develop succession plan and training opportunities to maintain skilled staffing levels necessary to offer immersive experiences.</li> <li>▪ Pursue phased design and funding strategy to introduce 21st century immersive experiences to park exhibits.</li> <li>▪ Engage with partners to expand awareness of park’s immersive experiences and attract new audiences.</li> <li>▪ Continue to develop creative programming in response to shifts in visitation and/or other trends.</li> <li>▪ Consider ways in which the National Park Service might certify canal boat operators for watercraft use as an alternative to the U.S. Coast Guard certification process.</li> </ul> |
| <b>Data and/or GIS Needs</b>                                                                        | <ul style="list-style-type: none"> <li>▪ Visitor surveys.</li> <li>▪ Visitor counts.</li> <li>▪ Wayfinding study.</li> <li>▪ Customized high-water study.</li> <li>▪ Population survey.</li> <li>▪ Administrative history.</li> <li>▪ Trolley system condition assessment.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Planning Needs</b>                                                                               | <ul style="list-style-type: none"> <li>▪ Marketing plan and visitation/tourism plan.</li> <li>▪ Comprehensive interpretive and education plan.</li> <li>▪ Wayfinding/sign plan.</li> <li>▪ Succession plan.</li> <li>▪ Collection management plan (update).</li> <li>▪ Accessibility self-evaluation and transition plan.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance</b> | <p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>▪ Americans with Disabilities Act (42 USC 12101 et seq.)</li> <li>▪ Architectural Barriers Act (42 USC 4151 et seq.)</li> <li>▪ Rehabilitation Act of 1973 (29 USC 701 et seq.)</li> <li>▪ “Architectural Barriers Act Accessibility Guidelines” (36 CFR1191.1)</li> </ul> <p><b>NPS Policy-level Guidance (NPS <i>Management Policies 2006</i> and Director’s Orders)</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

| Fundamental Resource or Value | Immersive Experience                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | <ul style="list-style-type: none"> <li>▪ NPS <i>Management Policies 2006</i> (chapter 7) "Interpretation and Education"</li> <li>▪ NPS <i>Management Policies 2006</i> (chapter 8) "Use of the Parks"</li> <li>▪ NPS <i>Management Policies 2006</i> (chapter 9) "Park Facilities"</li> <li>▪ Director's Order 6: <i>Interpretation and Education</i></li> <li>▪ Director's Order 42: <i>Accessibility for Visitors with Disabilities in National Park Service Programs and Services</i></li> </ul> |

## Identification of Key Issues and Associated Planning and Data Needs

This section considers key issues to be addressed in planning and management and therefore takes a broader view over the primary focus of part 1. A key issue focuses on a question that is important for a park. Key issues often raise questions regarding park purpose and significance and fundamental resources and values. For example, a key issue may pertain to the potential for a fundamental resource or value in a park to be detrimentally affected by discretionary management decisions. A key issue may also address crucial questions that are not directly related to purpose and significance, but that still affect them indirectly. Usually, a key issue is one that a future planning effort or data collection needs to address and requires a decision by NPS managers.

The following are key issues for Lowell National Historical Park and the associated planning and data needs to address them:

**Jurisdictional Challenges.** Lowell National Historical Park has complicated boundaries and multiple jurisdictions. As a result, there can be confusion regarding ownership, boundaries, and law enforcement jurisdiction. It can be difficult to determine ownership of key parcels and identify areas lacking lands processing. Continued collaboration with partners to update agreements specifically regarding law enforcement and maintenance jurisdictions is needed. The park should continue to work with the NPS Northeast Region to advocate that the state legislature update designated national park lands in Massachusetts to concurrent law enforcement jurisdiction.

*Associated data needs:*

Updating and digitization of park segment maps  
 GIS data for jurisdictional inventory and cooperative management  
 Jurisdictional inventory (update)

**Outreach and Relevancy.** Lowell National Historical Park has evolved with the city of Lowell, and it is a challenge to effectively communicate that changing story in an inclusive and relevant way. Conveying the historic context of Lowell and the national historical park to community members is particularly challenging because some exhibits are outdated. It is essential to connect with people and their stories more effectively, including updating interpretative media to provide information to nonnative English speakers. Tourism should be promoted more broadly to increase visitation and overcome the negative perception of Lowell that began during the city's post-industrial decline.

*Associated planning needs:*

Marketing plan and visitation/tourism plan  
 Wayfinding/sign plan

Comprehensive interpretive and education plan  
Exhibit plan for Mill Girls & Immigrant Exhibit and Boott Cotton Mills Museum

*Associated data needs:*

Visitor surveys  
Visitor counts  
Population survey  
Wayfinding study  
Historic resources study: *Lowell, A City of Spindles* (update)

**Maintenance/Preservation of Park-Owned Resources and Facilities.** The park owns and operates a variety of resources and assets that require significant staffing and funding, including historic mill buildings, boardinghouses, boats, trolleys, and associated infrastructure. Collaboration with park partners to identify ways to leverage funding for maintenance is essential. Reclassification of maintenance positions would allow greater flexibility within the park's diminishing workforce (e.g., maintenance mechanics vs. specialists). Continued creative thinking about appropriate paths for hiring, as well as effective ways to attract and retain maintenance staff, is necessary, including using University of Massachusetts Lowell work-study students and partnering with the local vocational technical high school, social services agencies, and the Student Conservation Association.

*Associated planning need:*

Comprehensive management and maintenance plan

*Associated data needs:*

List of roles and responsibilities related to maintenance, leasing agreements, special events, and jurisdiction  
Trolley system condition assessment

**Loss of Specialized Skills and Knowledge.** The nature of the resources of the park requires a large number of staff having specialized skills, such as loom fixers, masons, and woodworkers. Many staff members have worked with the park since its establishment or were part of the Lowell Historic Preservation Commission. They have knowledge of the park and city that is irreplaceable, including the history of preservation and changes in park management over time. As those individuals retire or otherwise move on from the park, specialized skills and knowledge will be lost and must be replaced if possible or somehow captured.

*Associated planning needs:*

Succession plan  
Record management plan  
Collection management plan (update)

*Associated data needs:*

Administrative history  
Oral history project on development/preservation

**Private Ownership in the Park and Preservation District.** Many lands and buildings within the park and preservation district are privately owned but are major components of the historic urban industrial landscape. Their preservation, maintenance, and integrity of design are critically important to the park. Although there are certain mechanisms in place to ensure historic and new buildings in the district meet design and preservation standards, such as city design review

processes, maintaining historic integrity is a continual challenge. As the economy has improved and development pressures have increased, challenges increase. The City of Lowell and the commonwealth are exempt from the Lowell Historic Board standards and controls. Additionally, development of structures on nonpark land could encroach on historic resources (e.g., gatehouses and canalways) and diminish the visitor experience. Review of the Lowell Historic Board standards and new, creative approaches to preservation and design control might provide new solutions to these challenges.

*Associated planning needs:*

Updated Downtown Lowell Historic District Design Review Standards (in collaboration with Lowell Historic Board)  
Preservation advocacy and funding strategy

**Renewal of Enel Green Power License.** The water power license, issued by the Federal Energy Regulatory Commission to Enel Green Power, is near its renewal date. Use of the canal system, a major component of the park experience and interpretation, is subject to terms in that agreement, and the National Park Service should be involved in renewal conversations. Terms should be sought that allow for expanded recreational use of the canalways. Through proactive NPS involvement, the needs of both Enel Green Power and the National Park Service could be met.

*Associated data need:*

Customized high-water study

**Climate Change.** Some parts of the park, including the Boott Mill No. 6 building and Counting House, are within a designated floodplain that primarily is related to the canal system surrounding the central part of the city of Lowell. As a result, a majority of park buildings, structures, and other resources are at risk to the effects of climate change, with the threat of increased storm incidents and more regular flooding. Resources most at risk include those associated with the water power system / canal system, which is identified as a fundamental resource. Planning is needed to determine potential impacts and provide mitigation strategies.

*Associated planning need:*

Planning for adaptation to climate change

*Associated data need:*

Customized high-water study

## ATTACHMENT G

### National Park Service Study Requests



## **NPS Boott Study Request #1**

### **Resources, Ownership, Boundaries and Land Rights Study (Lowell, P-2790)**

#### ***Goals and Objectives***

Ownership and use of the canal system in Lowell is very complex. In any given area, there could be several entities with land rights or other entitlements granting authority to access, maintain, or utilize the canal system. The objectives of a boundary study would be to determine current ownership of resources within the canal system in a comprehensive manner, record maintenance responsibilities and obligations to those resources, clarify FERC jurisdiction, and document recreational, educational, or other land access rights to resources within the canal system. The study should also project future conditions for the terms of the license. Decommissioning downtown power stations could result in impairment to historic resources. The large historic water power infrastructure will continue to require costly maintenance, but risks disinvestment if it is no longer needed for on-going project operations and remains under the licensee's ownership. Decommissioning of canal infrastructure and other reasonably foreseeable changes in project operations that could result in changes in ownership or maintenance liabilities should also be considered within the study.

The ultimate goal of this study would be to denote which entity is ultimately responsible for specific resources, in light of overlapping jurisdictions and to serve as a factual baseline document to update the MOU for Canal Maintenance Responsibilities in the Project Area with Boott Hydropower Inc., Lowell National Historical Park, the Department of Conservation and Recreation, and the City of Lowell as signatories.

#### ***Resources Management Goals***

See Attachment E from September 2017 Foundation Document.

#### ***Public Interest***

Requester is a Federal Resource Agency.

#### ***Existing Information***

NPS has a complete record of its land rights and can provide this for the study. Land rights obtained by Boott Hydropower Inc., Massachusetts Department of Conservation and Recreation, City of Lowell, and private entities would also need to be accessed for this study.

#### ***Nexus to Project Operations and Effects***

Property ownership and less than fee easement rights are directly related to the ongoing maintenance and preservation of the historic canal system. Identifying which parties have authority to maintain and use and/or an obligation/right to maintain/use the canal system will inform the development of license requirements as well as roles and responsibilities of any future MOUs for the historic canals. Boott also needs the rights necessary to comply with license requirements; a firm understanding of what rights Boott has or may need to acquire will be essential to the licensing determination.

***Methodology Consistent with Accepted Practice***

The information from this study can be pulled from title and land records, existing legislation, and other legal documents.

***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

This type of study can be completed at a reasonable cost within the FERC study period.

## **NPS Boott Study Request #2**

### **Water Level and Flow Effects on Historic Resources (Lowell, P-2790)**

#### ***Goals and Objectives***

Changes to the elevation of water or flow rates throughout the system directly affect the condition of historic resources. Abnormally high water levels in the Northern Canal, for example, have caused damage to wooden structural elements of the Northern Canal Waste Gatehouse and structural undermining of the Great River Wall. Conversely, extended drain downs and low water levels have caused damage to historic turbines and waterwheels made of wood and leather elsewhere in the system. The effects of the Crest Gate operation are unstudied and may include acute or prolonged impacts to historic resources throughout the system. Decommissioning downtown power stations may also result in changes to water levels and flows in some areas of the canal system and the effects are unstudied and unknown.

The objectives of this study should include evaluating how project operations, including manipulation of the newly installed Crest Gate, canal headgates, spillways, locks, fish passage structures, and generating units will change water levels in any location within the canal, and determine the extent to which water flows or elevations can be modified and or controlled to diminish loss of historic resources. The study would:

- Document impacts of current project operations on nationally significant historic resources, including a structural engineering assessment of the Great River Wall.
- Project future water levels and flows as a result of reasonably foreseeable changes to the project operation such as operating the Crest Gate system, decommissioning certain facilities, or modifying operations for fish passage.
- Evaluate impact of on-going and future project operations on nationally significant historic resources.
- Develop 100 and 500-year flood plans to protect nationally significant historic resources.

#### ***Resources Management Goals***

See Attachment E from September 2017 Foundation Document.

#### ***Public Interest***

Requester is a Federal Resource Agency.

***Existing Information***

NPS can provide an architectural and engineering evaluations of historic structures at multiple locations as well as maintenance records for previous repairs. Boott Hydro Power may have existing data on the impacts high and low water flows and elevations have on historic resources, but new data demonstrating how the new Crest Gate System effects water levels and flows would also need to be analyzed.

***Nexus to Project Operations and Effects***

Understanding the impacts water levels and flows will have on nationally significant historic resources will directly inform the development of license requirements and will inform future MOUs. The study data can also be used to better understand public and dam safety threats.

***Methodology Consistent with Accepted Practice***

The study would compare existing conditions of structures associated with canal operations and identify potential changes in conditions that may result from changes in project operations and resulting water and flow levels. This study would require an engineering assessment of the Great River Wall and may require additional structural assessment of other historic properties damaged by current project operations.

***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

This type of study can be conducted within the study period.

## **NPS Boott Study Request #3**

### **Water Level and Flow Effects on Recreation Study: (Lowell, P-2790)**

#### ***Goals and Objectives***

Water levels and flows directly affect public recreational access to and within the canals. The elevation and flow rates currently limit the number of days canal walkways are safely accessible to the public, particularly the Northern Canal Walkway which opens seasonally when flow rates are lower than 3,500 cubic feet per second (cfs). For years, NPS has received numerous complaints regarding the walkway's closure and the public has repeatedly requested increased access to the Northern Canal Island and Great River Wall. This study would assess if changes to project operations can be made to increase recreational access and whether 3,500 cfs is an appropriate threshold for the walkway's closure.

NPS boat passage is another recreational issue affected by water level and flows. NPS boats barely pass under the Pawtucket Street Bridge over Pawtucket Canal and the Central Street Bridge over the Lower Pawtucket Canal. With even 1 foot elevation rise to the crest pool, NPS boats would be unable to pass under the Pawtucket Street Bridge. A study is needed to determine the effects the Crest Gate system on on-going project operations will have on NPS tour boats and other potential future on-water recreational uses.

Additionally, NPS partners and the public have expressed interest in new, different, and expanded recreational access to and within the canals. The canal system should be evaluated to determine which segments are most suitable for various recreational opportunities (paddle boarding, ice skating, kayaking, etc.) so that recreational and economic development partners develop plans only where deemed compatible with on-going project operations and preservation of nationally significant historic resources.

The objectives of this study should include evaluating how project operations, including manipulation of the newly installed Crest Gate, canal headgates, spillways, locks, fish passage structures, and generating units will change water levels in any location within the canal, determine the extent to which water flows or elevations can be modified and or controlled to diminish public access restrictions to recreational amenities. Information to be obtained would come from photos, videos and direct observations of flows under different levels, magnitude and duration. The study would address the following issues:

- Effect of water levels and flow rates on existing recreational facilities and activities, including the Northern Canal Walkway and NPS Boat Operations
- Potential for future recreation within or adjacent to the canal system.

***Resources Management Goals***

See Attachment F from September 2017 Foundation Document.

***Public Interest***

Requester is a Federal Resource Agency.

***Existing Information***

Boott Hydro Power may have existing data on the impacts high and low water flows and elevations have on historic resources and recreation, but new data demonstrating how the new Crest Gate System effects water levels and flows would also need to be analyzed.

***Nexus to Project Operations and Effects***

Understanding the impacts water levels and flows will have on recreational opportunities and nationally significant historic resources will directly inform the development of license requirements and will inform future MOUs.

***Methodology Consistent with Accepted Practice***

The study would compare existing conditions on structures associated with canal operations and identify potential changes in conditions that may result from changes in project operations and resulting water and flow levels.

***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

This type of study can be conducted within the study period.

## **NPS Boott Study Request #4**

### **Vegetation and Aquatic Trash Management Study (Lowell, P-2790)**

#### ***Goals and Objectives***

Study the impact of vegetation growth on historic canal walls and propose appropriate techniques and schedules for vegetation removal to prevent deterioration and obviate long term capital needs. Review the current waterborne trash removal operation, determine the extent to which the operation can be changed to prevent damage to historic resources, improve access to recreation, aesthetics, and public safety.

#### ***Resources Management Goals***

See Attachment E from September 2017 Foundation Document.

#### ***Public Interest***

Requester is a Federal Resource Agency.

#### ***Existing Information***

The study could pull maintenance records from stakeholders to determine the baseline cyclical vegetation and trash management activities and use condition assessment data to determine asset condition. The study could also involve a public feedback component to better understand areas of particular concern.

#### ***Nexus to Project Operations and Effects***

The results of the study will have a direct impact on the terms of the license agreement and corresponding updates to the canal maintenance MOU among stakeholders.

#### ***Methodology Consistent with Accepted Practice***

The study would use baseline vegetation and trash removal activities as a no action alternative and develop at least two alternatives to demonstrate how changes in frequency or level of effort would result in changes to the condition of historic resources, the total dollar amount of deferred maintenance, access to recreation, canal aesthetics, and public safety. Results of the study will enable stakeholders to determine an optimal and appropriate maintenance reoccurring maintenance schedule for clearing vegetation and trash which would hopefully result in fewer major capital investments towards stabilizing canal walls and increased protection of the historic resources, and increased public safety.

***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

This type of study can be conducted within the study period.



## **NPS Boott Study Request #5**

### **Historically Significant Water Power Equipment Study (Lowell, P-2790)**

#### ***Goals and Objectives***

The objectives of this study are to identify historically significant water power equipment and develop plans to preserve the equipment and provide public access for their future enjoyment or make use of scrap parts from the equipment. The ultimate goal of this study is to diminish loss of historic property. Protection of historically significant water power equipment is complicated by boundary issues. Vertical ownership is current set at 101 ft. MSL. Historic hoisting equipment, gates, and control equipment that are not used for modern operations fall into a state of disrepair and can be abandoned or thrown away without communication. For example, two hydraulic cylinders at Guard Locks were discarded and NPS would have liked to interpret them to visitors. As power buildings are decommissioned, NPS may want to evaluate equipment for exhibit potential or for scrap equipment to maintain and operate other historic machinery.

#### ***Resources Management Goals***

See Attachment E from September 2017 Foundation Document.

#### ***Public Interest***

Requester is a Federal Resource Agency.

#### ***Existing Information***

The study could reference Lowell National Historical Park's Scope of [Museum] Collections.

#### ***Nexus to Project Operations and Effects***

The results of the study will have a direct impact on the terms of the license agreement and corresponding updates to the canal maintenance MOU among stakeholders. It will also be essential information in the Commission's consultation under the NHPA.

#### ***Methodology Consistent with Accepted Practice***

The study would photograph existing mechanical equipment, provide documentation of the history of that equipment, and document current equipment ownership. This information would be used in subsequent meetings between the applicant and the National Park Service so that historical equipment worthy of preservation and interpretation may be saved for the enjoyment of current and future generations.

***Level of Effort/Cost, and Why Alternative Studies Will Not Suffice***

This type of study can be conducted within the study period.

Document Content(s)

DOI comments-LowellHydroelectric-PAD-SD1-StudyRequests.PDF.....1-112



August 14, 2018

Kimberly D. Bose, Secretary  
Federal Energy Regulatory Commission  
888 First Street, N.E. Room 1A  
Washington, D.C. 20246

RE: Lowell Hydroelectric Project (P-2790-072)

Dear Secretary Bose:

The Department of Conservation and Recreation (“DCR” or the “Department”) is pleased to submit the following comments in response to the Scoping Document 1 for the Lowell Hydroelectric Project (the “Project”). The Scoping Document is the first formal submission to FERC by Boott Hydropower LLC (“Boott” or the “Proponent”) to relicense the Project. The current license for the project expires on April 30, 2023. The Project consists of the Pawtucket Dam, located on the Merrimack River, and other assets within nearby canals that include several small dams, gatehouses, power stations, and other associated infrastructure.

Overseeing one of the largest state parks agencies in the country, DCR manages 450,000 acres that includes a wealth of natural, cultural, and recreational resources including forests, parks, greenways, historic sites and landscapes, seashores, lakes, ponds, reservoirs and watersheds.

In 1986, a predecessor agency to DCR (the Department of Environmental Management or “DEM”) took land along the Merrimack River and certain canal systems in Lowell that created the majority of Lowell Heritage State Park (the “State Park”) and its holdings in the vicinity of the Project. Under the terms of the acquisition, DEM acquired fee interest in land and structures near the Pawtucket Dam, including the Pawtucket Gatehouse, the Gatekeeper’s House and Barn, the Blacksmith Shop and a parcel between Varnum Avenue and the Merrimack River where the Pawtucket Dam meets the northern Merrimack River shoreline. DCR understands that it has care and control of assets used by the Proponent for its hydropower activities including the Northern Great Wall, Guard Locks and Gates Facility, Swamp Locks Dam, and Lower Locks Dam, from the terms of the 1986 taking.

In 1996, a Memorandum of Agreement lapsed between DEM, the National Park Service, and Boott that, when active, arranged roles and responsibilities for maintenance of the various overlapping infrastructure among the entities. DCR collaborates closely with the National Park Service in maintaining the infrastructure related to the canal system and interpreting the historic resources of the canal system.

In addition to historic resources, DCR also oversees recreational infrastructure upstream from the Project including the Michael Rynne Bathhouse, located at 160 Pawtucket Boulevard approximately one-half mile westerly from the Pawtucket Dam; and the Rourke Brothers Boat Ramp (approximately two miles westerly from the Pawtucket Dam).

### Memorandum of Agreement

As part of the relicensing process, DCR requests that the Proponent be required to undergo a process to develop a joint agreement with DCR and the National Park Service that outlines agreed rights and responsibilities of properties in Lowell related to the Project. Items should include all dams, waterway training walls, trash racks, gates, valves, pipes, conduits, locks, canal walls, canal bottoms or floors, canal wall capstones, appurtenances that abut canal walls, and gate houses (including the interior and exterior

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Charles D. Baker  
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Karyn E. Polito  
Lt. Governor

Matthew A. Beaton, Secretary, Executive  
Office of Energy & Environmental Affairs

Leo Roy, Commissioner  
Department of Conservation & Recreation

space, abutting grounds, and water control devices in the gatehouses). DCR believes such an agreement is necessary to ensure proper ongoing maintenance and repair of the resources that comprise the Project, as the lack of a current agreement among the parties leaves corresponding roles and responsibilities undefined, and, consequently, subject to neglect.

### **Recreational Resources**

The Proponent is in the final stages of improving the Pawtucket Dam with a pneumatic crest gate system that will allow rapid raising and lowering of the water level above the dam. DCR notes that ongoing operation of the dam could potentially affect water levels at the Rynne Bathhouse and the Rourke Brothers Boat Ramp (located upstream from the dam) during the prime recreational season (between late May and early October). As part of the scoping, DCR requests that the Proponent evaluate whether and how upstream recreational facilities will be affected with water level changes during the prime recreational season, resulting from ongoing use of the Pawtucket Dam.

As part of this study, DCR requests that the Proponent predict the range of anticipated water levels at the Rynne Bathhouse and Rourke Brothers Boat Ramp under normal conditions and extreme weather events. DCR requests that the Proponent commit to communicating any anticipated water level changes with the Department prior to execution of those changes. DCR further requests that the Proponent describe any existing agreements regarding water levels that will affect the Proponent's operation of its hydroelectric infrastructure.

As part of the Environmental Assessment, DCR requests that the Proponent develop and implement a plan to install a dam safety barrier upstream to prevent boaters from going over the Pawtucket Falls Dam. The current safety barrier is maintained and installed seasonally by others. DCR believes dam safety should be the responsibility of the Proponent and the upstream barrier should be installed and removed seasonally by the Proponent.

### **Access to DCR Property**

Under the Environmental Assessment process, DCR requests that the Proponent map protected recreational lands in the vicinity of the Project, and identify the locations where DCR property needs to be accessed for routine or emergency maintenance. This section should include a narrative that discusses the recreational lands, how they are used by the public, how traditionally under the No-Action Alternative these lands are accessed including size and weight of equipment and the duration of access. DCR notes that Construction and Access permits are required for any construction access on DCR property. As part of the Environmental Assessment, the Proponent should make the commitment to repair any damage to recreational assets resulting from their use.

During extreme flooding, the Proponent's plan to access the Francis Gate lock (to install a steel barrier by crane) is through the rear of DCR property at 719 Broadway. DCR notes that the 719 Broadway property may be sold and developed by a private party, as legislation has been filed to authorize the conveyance of this property to the City of Lowell. If this conveyance occurs, the rear access could be limited or removed. To help plan for future contingencies, DCR requests that the Proponent evaluate alternative methods of access for the Francis Gate lock. As part of its evaluation, DCR notes that the Proponent could consider installing a wide curb cut and multi-use paved path at 719 Broadway that would facilitate visitor access to the Francis Gate lock.

DCR also requests that the Proponent identify the anticipated maintenance activities for the Pawtucket Dam and associated infrastructure over the course of a new license agreement, and evaluate alternatives for accessing sites required for ongoing maintenance. DCR notes that its nearby Gatekeeper's House, Barn and Blacksmith Shop and landscape features such as retaining wall and fences have been adversely impacted by ongoing activities over the course of the existing license, with heavy construction equipment

impacting landscaping. DCR leases the Gatekeeper's House to a curator, under a long term (15 years) agreement, who resides at the property while providing labor to rehabilitate, manage and maintain the property. The ongoing access has been problematic at times for the lessee/curator to adequately care for the property. Accordingly, the use of barges should be included in the analysis for any routine maintenance activities that requires heavy machinery, such as cranes.

For the alternative exploring maintaining existing access from the road, DCR requests that the license require certain protocols to protect the structures and grounds. For instance, all grounds and property should be repaired each time the crane accesses the site, including the repair of any displaced soil, and loaming and seeding the area. Prior to access, the Proponent should meet with a DCR arborist on site to plan for the pruning and dead-limbing of all trees on the property impacted by the crane's activity. The Proponent should avoid any damage to the buildings and landscape features on the site, including the house, barn and fences. If damage does occur, the Proponent should be required to coordinate repairs with the Lessee and with DCR and perform any repairs, once approved, in a timely manner. DCR encourages alternative treatments to the southeast corner of the house that would allow crane access without requiring the installation and removal of the gravel and steel plates. DCR also encourages a less destructive solution for the removal of the fence section. Possibilities include hinging a section of the gate to swing clear of the entry path. Lastly, the Proponent and/or its contractors should directly contact the lessee prior to accessing the Gatekeeper's House property. DCR is available for consultation on this request.

#### **Recreational Use Data**

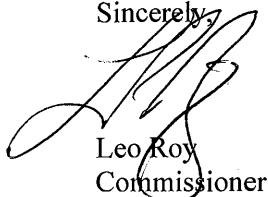
As part of the Environmental Assessment, DCR requests that the Proponent study how visitors currently use the project areas, including the Visitor Center at the E.L Field Powerhouse, including number of visitors, type of recreation, time of year, etc. A number of the project facilities are an important part of the recreational network in Lowell and the applicant should develop a plan to maintain and improve those opportunities.

#### **American Disabilities Act (ADA)**

As part of the recreational uses study of the project area, DCR requests that the Proponent assess required improvements to recreational or educational facilities within the Project area to meet current ADA (Americans with Disabilities Act) requirements for access.

Thank you for the opportunity to comment on the first Scoping Document. Should you have any questions, please do not hesitate to contact Kevin Hollenbeck, Metrowest District Manager at 617-828-1634 or [kevin.hollenbeck@state.ma.us](mailto:kevin.hollenbeck@state.ma.us). Questions regarding access near the Gatekeeper's House can be directed to Kevin Allen at 617-626-1361 or [kevin.allen@state.ma.us](mailto:kevin.allen@state.ma.us).

Sincerely,



Leo Roy  
Commissioner

Document Content(s)

P-2790-072 Lowell Hydroelectric SD1 - MassDCR.PDF.....1-3



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric**  
**Administration**  
NATIONAL MARINE FISHERIES SERVICE  
GREATER ATLANTIC REGIONAL FISHERIES OFFICE  
55 Great Republic Drive  
Gloucester, MA 01930-2276

August 14, 2018

Kimberly D. Bose, Secretary  
Federal Energy Regulatory Division  
888 First Street, N.E.  
Washington, D.C. 20426

**RE: Comments on Enel's Notice of Intent to File License Application and Filing of Pre-Application Document for the Lowell Hydro Electric Project (No. 2790)**

Dear Secretary Bose,

On June 15, 2018, you issued a *Notice of Intent to file a license application, filing of Pre-Application Document (PAD), commencement of pre-filing process, and scoping; request for comments on the PAD and Scoping Document*, and identification of issues and associated study requests by Enel (P-2790). The PAD contains information about the project itself and the environmental resources affected by the project. As part of the Integrated Licensing Process, we (National Marine Fisheries Service (NMFS)) have an opportunity to comment on the PAD and to submit study requests.

Attached for filing, please find our comments regarding the PAD. In addition, we are including six requested studies. If you have any questions or need additional information, please contact Sean McDermott ([sean.mcdermott@noaa.gov](mailto:sean.mcdermott@noaa.gov)) or 978-281-9113.

Sincerely,

Louis A. Chiarella  
Assistant Regional Administrator  
for Habitat Conservation

cc: Service List



# National Marine Fisheries Service's Comments and Study Requests on Enel Pre-Application Document for the Lowell Hydro Electric Project (FERC No.2790)

August 14, 2018

## 1 PROJECT BACKGROUND

Boott Hydropower, LLC (Licensee) owns and operates the Lowell Hydroelectric Project (FERC No. 2790) on the Merrimack River in the City of Lowell, Massachusetts. The project is located at river mile 41 and has a 23-mile long impoundment extending into New Hampshire. The project has an authorized capacity of 24.8 megawatts (MW) operating in run-of-river mode with no useable storage capacity. The major project components include:

- the 1,090-foot long, stone masonry Pawtucket Dam with 5-foot tall pneumatic crest gates,
- an upstream fish ladder at the apex of the Pawtucket Dam,
- a two-tiered, 5.5-mile long canal system through downtown Lowell with various hydraulic control structures including 19 Francis units housed in four powerhouses,
- a main powerhouse containing two 8.6 MW Kaplan units, and
- an upstream fish lift and downstream bypass system at the main powerhouse.

The Federal Energy Regulatory Commission (FERC) issued the existing license on April 13, 1983 and it expires on April 30, 2023. The Licensee must file an application for a new license with FERC no later than April 30, 2018. The Licensee filed their Notice of Intent and Pre-Application Document electing to pursue a new license using the Integrated Licensing Process with FERC. On June 15, 2018, FERC issued the Scoping Document 1 commencing the licensing proceeding.

## 2 NOAA TRUST RESOURCES

As NOAA's National Marine Fisheries Service (NMFS), under the U.S. Department of Commerce (DOC), we are responsible for the stewardship of the nation's living marine resources, fisheries and their habitat. Estuaries and coastal riverine habitat systems, including rivers such as the Merrimack River, provide an integral component of significant ecological functions for the larger marine environment. Many living marine resources are supported by estuaries and coastal rivers throughout their life cycles. Species such as the endangered shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) the endangered Atlantic salmon (*Salmo salar*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), American shad (*Alosa sapidissima*), American eel (*Anguilla rostrata*), and sea lamprey (*Petromyzon marinus*) rely on these coastal systems for refuge, spawning, rearing and nursery habitat. NOAA's 2009-2014 National Strategic Plan (Strategic Plan) recognizes the significance of these resources in its mission goals, which include "Protect,

restore, and manage the use of coastal and ocean resources through an ecosystem approach to management.” Historically, these species were present within the Lowell project boundary. Currently, there is no critical habitat for shortnose sturgeon, Atlantic sturgeon or Atlantic salmon designated in this reach of the Merrimack River. Our primary goal in carrying out our trust responsibilities in the Merrimack River watershed is to rebuild and ultimately maintain self-sustaining diadromous fish runs in the Merrimack River basin and to fully use the available habitat and production potential.

Atlantic salmon are present in the project area. However, the project area is not designated critical habitat nor is the species actively managed in the Merrimack River.

### 3 FEDERAL STATUTORY REQUIREMENTS

We are responsible for conservation, management, and protection of America’s living marine and aquatic resources throughout jurisdictional river basins in coordination with other state and federal agencies, local governments, Indian tribes, fisheries commissions, commercial and recreational fishers, and conservation organizations. Our authority to manage diadromous fish in these river basins comes from Congress. Specifically, Congress has directed us (NMFS) to manage diadromous species in river basins, including a grant of discretionary authority to order fish passage at dams licensed by the Federal Energy Regulatory Commission. NMFS’ congressionally mandated statutory authorities include the Federal Power Act, the Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act, the Atlantic Coastal Fisheries Cooperative Management Act, the Fish and Wildlife Coordination Act, and the National Environmental Policy Act.

#### 3.1 THE FEDERAL POWER ACT (FPA) (AS AMENDED)( 16 USC §§791A, *ET SEQ.*)

**Section 18 of the FPA** - Section 18 of the FPA expressly grants to the DOC and the Department of the Interior (DOI) unilateral authority to prescribe fishways. Section 18 of the FPA states that FERC must require construction, maintenance, and operation by a licensee at the licensee’s own expense of such fishways, as may be prescribed by the Secretary of Commerce or the Secretary of the Interior. Within the DOC, the authority to prescribe fishways is delegated to the NMFS Regional Administrators.

**Section 10(j) of the FPA** - Under Section 10(j) of the FPA, licenses for hydroelectric projects must include conditions to protect, mitigate damages to, and enhance fish and wildlife resources, including related spawning grounds and habitat. These conditions are to be based on recommendations received from Federal and State fish and wildlife agencies. FERC is required to include such recommendations unless it finds that they are inconsistent with Part I of the FPA or other applicable law, and that alternative conditions must adequately address fish and wildlife issues. Before rejecting an agency recommendation, FERC must attempt to resolve the inconsistency, giving due weight to the agency’s recommendations, expertise, and statutory authority. If FERC does not adopt a Section 10(j) recommendation, in whole or in part, it must publish findings that adoption of the recommendation is inconsistent with the purposes and requirements of Part 1 of the FPA or other applicable provisions of law, and that conditions selected by FERC adequately and equitably protect, mitigate damages to, and enhance fish and wildlife and their habitats.

**Section 10(a)(1) of the FPA** - Resource agencies may also recommend conditions under Section 10(a)(1) of the FPA for the protection, mitigation and enhancement of fish and wildlife (including related spawning grounds and habitat).

### 3.2 ENDANGERED SPECIES ACT (ESA) (AS AMENDED) (16 USC §1531 *ET SEQ.*)

Section 7(a)(2) of the ESA, states that each Federal agency shall, in consultation with the Secretary, insure that any action an agency authorizes, funds, or carries out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Any discretionary federal action that may affect a listed species must undergo Section 7 consultation. Section 7(a)(1) requires Federal agencies to use their authorities to further the conservation of listed species.

### 3.3 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT (MSA) (AS AMENDED) (MSA) (16 USC §§1801, *ET SEQ.*)

The 1996 amendments to the MSA set forth a number of mandates for us, the Fishery Management Councils (Councils), and other Federal agencies to identify and protect important marine and diadromous fish habitats. The councils are required to identify and describe essential fish habitat (EFH) for all managed species in order to protect habitat from fishing impacts and to allow for consultation with federal agencies whose actions may adversely impact essential fish habitat. EFH is defined as “those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity” 16 U.S.C. § 1853(a)(7) and § 1802(10). The MSA requires federal agencies to consult with the Secretary of Commerce, through us, with respect to “any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat identified under this Act” 16 U.S.C. § 1855(b)(2). In the EFH consultation process, the federal action agency initiates consultation by preparing and submitting a completed EFH assessment describing the potential impacts of the action on EFH.

### 3.4 ATLANTIC COASTAL FISHERIES COOPERATIVE MANAGEMENT ACT (ACFCMA) (AS AMENDED) (16 USC §§5101, *ET SEQ.*)

The purpose of the ACFCMA is to provide for more effective fishery resource conservation of coastal fish species that are distributed across the jurisdictional boundaries of the Atlantic States and the Federal Government. These coastal fish species, which include American eel, shad and river herring, are managed by various species boards of the Atlantic States Marine Fisheries Commission (ASMFC), which develop fishery management plans and recommend management action to the states and NMFS.

### 3.5 FISH AND WILDLIFE COORDINATION ACT (FWCA) (AS AMENDED) (16 USC §§661, *ET SEQ.*)

The FWCA provides that fish and wildlife conservation shall receive equal consideration and be coordinated with other features of water resource development programs. A Federal action agency, such as the Federal Energy Regulatory Commission (FERC), shall consult with us with a view to the conservation of fish and wildlife resources by preventing loss of and damage to such resources as well as providing for the development and improvement thereof in connection with

such water resource development. We may provide recommendations to the Federal action agency to which the action agency shall give full consideration.

### 3.6 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) (AS AMENDED) (42 USC §§4321, *ET SEQ.*)

The NEPA of 1969 (42 USC §§4321 *et seq.*) and its implementing regulations require Federal action agencies to analyze the direct and indirect environmental effects and cumulative impacts of project alternatives and connected actions. The NEPA requires the Federal action agency to conduct a comparative evaluation of the environmental benefits, costs, and risks of the proposed action, and alternatives to the proposed action.

### 3.7 POLICY AND COORDINATION

Based on the above listed laws, we have developed policies designed to implement these laws.

#### 3.7.1 NOAA STRATEGIC PLAN

To achieve this mission, NOAA's Next Generation Strategic Plan identifies the Habitat program for the protection and restoration of coastal marine habitats that support NOAA trust resources. An important objective of the Habitat program is to "improve ecosystem health through conservation and restoration of habitat." Our strategic plan further identifies the Protected Resources program to protect and work to recover species at risk of extinction, and the Fisheries Management program to ensure maintenance of fisheries at productive levels for supporting sustainability and the ecosystems to which they contribute. Strategies utilized to achieve this objective include implementing cooperative approaches at the local level in habitat conservation and restoration, including greater involvement in the review of FERC activities; and, by working to increase the survival of anadromous fish passing through hydroelectric facilities.

#### 3.7.2 ATLANTIC STATES MARINE FISHERIES COMMISSION (ASMFC)

The role of the ASMFC is to facilitate cooperative management of inter-jurisdictional fish stocks. ASMFC does this by creating Interstate Fisheries Management Plans for jurisdictional species. These plans set forth the management strategy for the fishery and are based upon the best available information from the scientists, managers, and industry. The plans are created and adopted at the ASMFC Policy Board level and the plans provide recommendations to the states and Federal government that allow all jurisdictions to independently respond to fishery conditions in a unified, coordinated way. The Atlantic Coastal Fisheries Cooperative Management Act requires the Federal government to support the ASMFC's management efforts. The Federal government enacts regulations to complement ASMFC recommendations when appropriate. To the extent the Federal government seeks to regulate an ASMFC managed species, those Federal regulations must be compatible with the ASMFC's plan and consistent with the 10 National Standards set forth in the Magnuson-Stevens Act.

The ASMFC has developed two plans that relate to our trust species. We highlight the plans' goals and recommendations below.

### 3.7.3 ASMFC'S AMENDMENT 3 TO THE INTERSTATE FISHERY MANAGEMENT PLAN FOR SHAD AND RIVER HERRING (2010)

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010 includes the following objective:

1. Maximize the number of juvenile recruits emigrating from freshwater stock complexes

When considering options for restoring alosine habitat, NOAA should include study of impacts and possible alteration of dam-related operations to enhance river habitat.

This document includes the following recommendations:

#### *General Fish Passage*

- 1) States should work in concert with the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) to identify hydropower dams that pose significant impediment to diadromous fish migration, and target them for appropriate recommendations during FERC relicensing.
- 2) States should identify and prioritize barriers in need of fish passage based on clear ecological criteria (e.g., amount and quality of habitat upstream of barrier, size, and status of affected populations). These prioritizations could apply to a single species, but are likely to be more useful when all diadromous species are evaluated together.
- 3) A focused, coordinated, well supported effort among federal, state, and associated interests should be undertaken to address the issue of fish passage development and efficiency. The effort should attempt to develop new technologies and approaches to improve passage efficiency with the premise that existing technology is insufficient to achieve restoration and management goals for several Atlantic coast river systems.
- 4) Where obstruction removal is not feasible, install appropriate passage facilities, including fish lifts, fish locks, fishways, navigation locks, or notches (low-head dams and culverts).
- 5) At sites with passage facilities, evaluate the effectiveness of upstream and downstream passage; when passage is inadequate, facilities should be improved.
- 6) Facilities for monitoring the effectiveness of the fish passage devices should be incorporated into the design where possible.
- 7) When designing and constructing fish passage systems, the behavioral response of each species of interest to appropriate site-specific physical factors should be considered.
- 8) If possible, protection from predation should be provided at the entrance, exit, and throughout the passage.
- 9) The passage facility should be designed to work under all conditions of head and tail water levels that prevail during periods of migration.
- 10) Passages are vulnerable to damage by high flows and waterborne debris. Techniques for preventing damage include robust construction, siting facilities where they are least exposed to adverse conditions, and removing the facilities in the winter.

11) Passage facilities should be designed specifically for passing alosines at optimum efficiency.

#### *Upstream Fish Passage*

- 1) American shad must be able to locate and enter the passage facility with little effort and without stress.
- 2) Where appropriate, improve upstream fish passage effectiveness through operational or structural modifications at impediments to migration.
- 3) Fish that have ascended the passage facility should be guided/routed to an appropriate area so that they can continue upstream migration, and avoid being swept back downstream below the obstruction.

#### *Downstream Fish Passage*

- 1) To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g., turbines, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the best survival rate.

#### *Other Dam Issues*

- 1) Where practicable, remove obstructions to upstream and downstream migration in lieu of fishway construction.
- 2) Locate water intakes where impingement/entrainment rates are likely to be lowest, employ intake screens or deterrent devices to prevent egg and larval mortality, and alter water intake velocities to reduce mortalities.
- 3) To mitigate hydrological changes from dams, consider operational changes such as turbine venting, aerating reservoirs upstream of hydroelectric plants, aerating flows downstream, and adjusting in-stream flows.
- 4) Natural river discharge should be taken into account when instream flow alterations are being made to a river (flow regulation) because river flow plays an important role in the migration of diadromous fish.
- 5) Ensure that decisions on river flow allocation (e.g., irrigation, evaporative loss, out of basin water transport, hydroelectric operations) take into account instream flow needs for American shad migration, spawning, and nursery use, and minimize deviation from natural flow regimes.
- 6) When considering options for restoring alosine habitat, include study of impacts and possible alteration of dam-related operations to enhance river habitat.

The relicensing process for the Lowell project provides an excellent opportunity to incorporate many of the ASMFC recommendations.

#### 3.7.4 ASMFC'S INTERSTATE FISHERIES MANAGEMENT PLAN FOR AMERICAN EEL (2000)

The goals in this plan include the following:

1. Protect and enhance the abundance of American eel in inland and territorial waters of the Atlantic States and jurisdictions and contribute to the viability of the American eel spawning population

2. Protect and enhance American eel abundance in all watersheds where eel now occur
3. Where practical, restore American eel abundance in all watersheds where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers and yellow eel and adequate escapement to the ocean for pre-spawning adult eel.

#### *Recommendations for Federal Energy Regulatory Commission Relicensing*

The ASMFC recognizes that many factors influence the American eel population, including harvest, barriers to migration, habitat loss, and natural climatic variation. The ASMFC's authority, through its member states is limited to controlling commercial and recreational fishing activity; however, to further promotes the rebuilding of the American eel population, the ASMFC strongly encourages member states and jurisdictions, as well as the USFWS, to consider and mitigate, if possible, other factors that limit eel survival. Specifically, the ASMFC requests that member states and jurisdictions request special consideration for American eel, in the FERC relicensing process. This consideration should include, but not be limited to, improving upstream passage and downstream passage, and collecting data on both means of passage.

#### 4 NMFS COMMENTS ON THE PRE-APPLICATION DOCUMENT (PAD)

Based on our review of the PAD submitted by Licensee, we offer the following comments.

##### 4.1 PAD SECTION 4.0 PROJECT LOCATION, FACILITIES, AND OPERATIONS

Figure 4.0-1 shows two approximate upstream Project Boundary locations. One in Tyngsborough, MA and the other in Merrimack/Litchfield, NH. The Licensee should explain the significance of these two points in the project boundary. We recommend the geographic scope under the environmental analysis of fisheries resource be extended to fully evaluate cumulative effects. The geographic scope should extend from the Eastman Falls dam (FERC no. 2457 and Lake Winnepesaukee to the confluence of the Pemigewasset and Winnepesaukee Rivers, downstream to the Atlantic Ocean.

##### 4.2 PAD SECTION 4.5 DESCRIPTION OF PROJECT OPERATIONS

According to information described in the PAD, the Lowell Project operates in a run-of-river (ROR) mode and has no usable storage capacity. The Licensee should describe how they are defining ROR: instantaneous, daily average, or some other time step. In addition, with the pneumatic crest gates now operational, typical headpond fluctuation should also be clarified and described in detail.

###### 4.2.1 PAD SUBSECTION 4.5.1.1 GENERAL OPERATION

The Licensee should describe the tolerance of the automatic pond level control. In the previous description of the E.L. Field Powerhouse turbines, the rated hydraulic capacity of each turbine is 3,300 cfs. We understand that under different headpond and tailwater conditions, the maximum hydraulic capacity can vary, but the description should remain consistent throughout the draft license application to prevent confusion by the reader. Therefore, the maximum hydraulic capacity of the E.L. Field Powerhouse is 6,600 cfs, and river flow that exceeds that value goes through the Pawtucket Canal up to 2,000 cfs with the remainder spilling over the Pawtucket Dam. Minimum flow is 1,990 cfs or inflow, whichever is less, as measured downstream from the

project. The license application should describe the purpose of this flow and why it proposes to continue to operate in this manner. In addition, at flows below 6,600 cfs, the license application should describe the preferential operation of the two turbines and state the minimum hydraulic capacity. Such details are necessary to fully understand project operation and evaluate potential impacts of project operation on fisheries resources.

#### 4.2.2 PAD SUBSECTION 4.5.1.2 CANAL SYSTEM OPERATIONS

The Licensee should provide more detail on canal operations. For example, it is not clear from the PAD when the Pawtucket Canal generation begins once river flow exceeds the E.L. Field Powerhouse hydraulic capacity. During the recent site visit on July 18, 2018, we learned that the Licensee decommissioned the Assets Power Station as part of the City's redevelopment plans. The license application should describe in detail, which generation assets will be operating during the upcoming license and the routing protocol through the Pawtucket Canal system, which turbines are first on and last off, etc. based on hydraulic conditions. In addition, the license application should provide estimates of leakage flow and other latent flow conveyed through the canal when National Park Service tour boats are operating, if measurable.

#### 4.2.3 PAD SUBSECTION 4.5.1.3 PNEUMATIC CREST GATE OPERATIONS

The pneumatic crest gate consists of multiple zones from the Pawtucket Gatehouse to the fish ladder. The Licensee should describe the actuation of these zones during times of spill (e.g., first on, etc.). This information is important to understand project impacts on fisheries resources, as zones that are distal from the fish ladder may result in false attraction away from the fish ladder entrance, which can lead to significant migratory delay.

#### 4.2.4 PAD SUBSECTION 4.5.1.4 FISH PASSAGE OPERATIONS

The license application should append the existing Comprehensive Fish Passage Plan (CFPP). In addition, much of the existing CFPP is outdated and the Licensee should provide updates to the plan based on current and proposed fish passage measures and operations.

### 4.3 PAD SECTION 5.4 FISH AND AQUATIC RESOURCES

#### 4.3.1 PAD SUBSECTION 5.4.5.6 ALOSINE CLUPEIDS

The license application should state that river herring are currently under status review by NMFS for listing under the Endangered Species Act.

#### 4.3.2 PAD SUBSECTION 5.4.6 OTHER SITE-SPECIFIC FISHERIES INFORMATION

This section of the PAD describes past studies at the site, including a 1988 study evaluating fish passage at the Pawtucket Gatehouse (RMC Environmental Services 1988). The Licensee states, "In addition, a 1988 acoustic telemetry study performed by RMC Environmental Services of adult American shad movement through the Northern Canal demonstrated successful passage through the Pawtucket Gatehouse, as well as incidental information regarding downstream passage routes for post-spawning individuals". We do not consider the conclusions drawn from this study to be accurate. In that study, gatehouse passage was extremely limited and the majority of fish that did pass upstream went through the boat lock. All the fish in the study had significant delay. We do not deem this as successful passage through the Pawtucket Gatehouse.



The license application should include information from the recent study entitled, *Analysis of Upstream Fish Passage Facilities and Operation* (Gomez and Sullivan Engineers 2016). As part of that study, one of the recommendation was to remove part of the ledge downstream from the E.L. Field Powerhouse fish lift entrance to improve entrance efficiency. The licensee has previously agreed to remove ledge downstream of the fish lift entrance. Our agency engineer, as well as the U.S. Fish and Wildlife Service (USFWS) worked with the Licensee on the excavation design plans, providing feedback through an August 2017 technical memo, which was filed with FERC on September 28, 2017. The Licensee confirmed plans, in an email dated June 19, 2018, to complete this work during the 2019 construction season. A detailed description of the ledge excavation is important information to include in the license application. We expect some studies evaluating upstream passage at the project may need to be delayed until the ledge excavation is complete.

Table 5.4-3 includes major findings of fish passage studies performed during the last license term. In that table, the Licensee labels the first column ‘Year’; we determined some inconsistencies with the year representing either the year published or the migratory year the study occurred. We have the following comments regarding the conclusions and omissions in the table.

- The 1988 Study (RMC Environmental Services, Inc.) – We disagree that there was ‘little delay’ for the tagged fish that passed to upstream spawning grounds. Tagged fish released at E.L. Field power station reached the Pawtucket Gatehouse in a few hours, but then exhibited delay behaviors going up and down the Northern Canal numerous times. Fish that used the boat lock (after opening) passed usually within a day, but the fish that used the gatehouse wells took up to 3 days to pass. We do not consider this timely fish passage. We do not agree with the statement, ‘The Pawtucket Canal should not entrap emigrating adult shad’. One tagged shad passed the Francis Guard Locks gatehouse. Six other shad initially approached the Francis Guard Locks gatehouse exhibiting delay behavior. Overall project mortality estimated from stationary tags was 61.5%.
- The 1991 Juvenile Study (Normandeau Associates, Inc.) – The corrected bypass efficiency was 7%. Delay was less than 72 hours with 95% passing within 24 hours.
- The 1991 Adult Study (Normandeau Associates, Inc.) – In this study, release of the tagged fish was in the Northern Canal testing the effectiveness the Pawtucket Gatehouse passage. Only 72% of the fish passed the gatehouse to upstream spawning habitat and the boat lock was open throughout the study. Twelve post-spawn adults approached the project with 42% passing through the turbines, 17% passing through the downstream bypass, 17% through the Pawtucket Canal, and 25% passing over the Pawtucket Dam. Of the 23 tagged fish that passed downstream of the project (both post-spawn fish and fish that did not pass the Pawtucket Gatehouse), an estimated 61% died. E.L. Field Powerhouse turbine mortality was 64%.
- The 1994 Study (Normandeau Associates, Inc.) – Though much better than the corrected bypass efficiency of 7% from the 1991 study, we do not consider a downstream bypass efficiency of 32% as ‘very efficient’.

- The 1995 Study (Normandeau Associates, Inc.) – no comments.
- The 1996 Fish Lift Efficiency Study (Normandeau Associates, Inc.) – Publication date was 1997.
- The 1996 Downstream Passage Smolt Study (Normandeau Associates, Inc.) – This study included a mixture of hatchery and wild sources of fish. Of the 49 released fish, 61% passed the project via the powerhouse (77%), the fish bypass (13%), the Pawtucket Canal (7%), and an unknown route (3%). Of the fish that passed the project, hatchery fish took approximately 100 hours to pass and wild fish took about 28 hours.
- From 1999 through 2001, the Licensee performed yearly internal fish lift efficiency studies. Table 5.4-3 in the Pre-Application Document does not clearly describe the chronology, the purpose, and results of these studies. The Licensee should be consistent by only using the publication date to avoid confusion. Each study tested a specific component or modification these tests need more clarification.
- The 2002 USFWS Study – no comments.
- The 2003 Downstream Passage and Smolt Survival Study (Normandeau Associates, Inc.) – The Licensee studied three fish bypass flows (2%, 3.5%, and 4.5% station discharge) with 20 tagged smolts each. Bypass efficiency improved with increased flow, though none of the tests resulted in adequate passage efficiency. Cumulatively, 59% went through the turbines, 32% went through the bypass, and 9% were undetermined. Turbine survival was very high, but predation in the tailrace was also extremely high. We consider tailrace predation a project effect. Turbine passage and other designated downstream passage routes that concentrate the migration into a small area provide predators unfettered access to easy prey. Without the project, dispersal of prey would result in decreased predatory efficiency.
- The 2011 Upstream Three-Dimensional Study (Alden Research Laboratory, Inc. – no comments.
- The 2013 Upstream Three-Dimensional Study Further Analysis (Blue Leaf Environmental) – The study showed that greater than 80% of the detections of tagged shad were between the elevations of 40 and 50 feet suggesting that fishway entrance efficiency would dramatically improve by lowering the invert of the entrance and maintaining the entrance jet velocity.
- The Licensee should include a description of the 1990 Normandeau Associates study entitled, “An assessment of the effectiveness of a fish bypass for passing downstream migrating Atlantic salmon smolts and estimated survival of salmon smolts passed through the 8.6-MW Kaplan Turbines at the E.L. Field Hydroelectric Project, Lowell, Massachusetts”.
- The Licensee should include a description of the 2016 study entitled, “Analysis of Upstream Fish Passage Facilities and Operation”.

## 5 REQUESTED STUDIES

Our study requests intend to facilitate the collection of information necessary to conduct effects analyses; develop reasonable and prudent conservation measures; and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

### 5.1 REQUESTED STUDY #1: AMERICAN EEL PASSAGE DOWNSTREAM STUDY

The Merrimack River is a migratory corridor for American eel. This species must be able to pass the project without undue harm or delay to complete their life cycle. Poor passage at the project limits access to spawning habitats in the Sargasso Sea harming genetic diversity and resilience within the population. The Lowell project includes potential emigration routes over the Pawtucket Dam, through the E.L. Field Powerhouse turbines, over the E.L. Field Powerhouse fish bypass, and through the Pawtucket Canal including multiple dams and powerhouses. The Licensee is installing a pneumatic crest gate at the dam that decreases leakage through the flashboards and provides more control of spill over the dam. We request a study to determine the downstream passage routes at multiple river flows and operating conditions to inform safe, timely, and effective passage measures at the project.

#### GOALS AND OBJECTIVES

The goal of this study is to determine the impact of the Lowell hydroelectric project on the emigration of silver eels in the Merrimack River. Project operations can result in delay, mortality or injury during emigration. We need to understand the extent of delay, the passage routes, and the potential for mortality to determine measures and recommendations to increase survival and improve fish passage at the project.

The objectives of this study are:

- Quantify the movement rates and delay caused by multiple river flows and project operations
- Quantify the relative proportion of eels passing each emigration route at the project during multiple river flows and various project operations.
- Quantify instantaneous and latent mortality of eels passed via each emigration route.

#### RESOURCE MANAGEMENT GOALS

The ASMFC has developed five documents related to the management of American eel including:

- Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
- Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the fishery management plan include:

- (1) protect and enhance American eel abundance in all watersheds where eel now occur; and

- (2) where practical, restore American eel to those waters where they had historical abundance, but may now be absent, by providing access to inland waters for glass eel, elvers, and yellow eel, and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the Federal Energy Regulatory Commission relicensing process.

The American eel population is severely depressed in the Merrimack River watershed. Our goal is to restore American eel to historical habitats and ensure safe migratory pathways to build abundance and resilience in the population.

#### PUBLIC INTEREST

The requestor, NMFS, is a federal resource agency.

#### EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Upstream of the Lowell Hydroelectric Project is the Merrimack Project (FERC No. 1893) which has been conducting ongoing silver eel downstream passage studies. In 2017, the Licensee installed receivers at the Lowell project to continue the monitoring of the tagged eels that passed the Merrimack Project (Normandeau Associates 2018). The study detected fourteen eels near the Lowell Project with eight going through the turbines, five passing over the spillway, and one undetermined route. One of the eels that passed through the E.L. Field Powerhouse died. The study did not monitor the Pawtucket Canal or the downtown project facilities. Throughout the study, the canal system was not operating though there was sufficient river flow to operate. Therefore, the study lacks information regarding project effects in the canal system on silver eel emigration. In addition, the study has an insufficient sample size and does not have a control group or mobile tracking to account for drifting of dead eels.

#### PROJECT NEXUS

The Lowell Hydroelectric Project does not have entrainment prevention at any of the turbine intakes. Adult eels have an average mortality of 10.9% ( $\pm 13.0$  S.D.) passing through Francis turbines and an average mortality of 25.7% ( $\pm 10.6$  S.D.) passing through Kaplan turbines (Pracheil et al. 2016). E.L. Field Powerhouse has two Kaplan turbines and the canal system has 19 Francis turbines (12 still operate). Silver eels emigrate during the mid-summer through late fall (Haro 2003), a time of year when Merrimack River flows equal or exceed the operating capacity of the stations only part of the time. Therefore, we expect the project to spill infrequently during the silver eel emigration forcing eels to pass through the canal system, the E.L. Field Powerhouse, or the fish bypass. We assume entrained eel at the project powerhouses will incur unacceptable levels of mortality. We base this assumption on published mortality statistics, the age and specifications of the turbines, the complexity of canal routing, and the likelihood that emigrating silver eels will have to pass two turbines to reach downstream of the project (upper canal and lower canal). Therefore, as a first step in understanding overall project mortality, we need to understand the routes of emigration and the potential for delay under different river flow conditions and project operations. This study will contribute to the development of an administrative record in support of potential Section 18 fishway prescriptions or 10(j) recommendations.

## PROPOSED METHODOLOGY

This study should be conducted using radio telemetry, with a study design that specifies sample size and tag and receiver configurations. A statistically significant number of telemetered eels are necessary to establish a clear understanding of how project operations affect eel emigration. The Licensee should release groups of eels during spill and non-spill periods. The Licensee should operate the Pawtucket Canal system turbines during the study. The Licensee should record river flow and project operations throughout the study. Release of tagged eels should be a few kilometers (km) upstream of the Pawtucket Dam. The project design should include a smaller sample of dead eel to act as a control group, as fish can drift significant distances downstream after they have died (Havn et al. 2017). Telemetry receivers and antennas should be located above and below the project to assess passage. Receivers should monitor the following potential routes: entrance into Pawtucket Canal via the Guard Lock and Gates Facility, passage over the Pawtucket Dam, entrance into Northern Canal at Pawtucket Gatehouse, entrance into E.L. Field Powerhouse turbines, and entrance into the E.L. Field Powerhouse bypass.

Mobile tracking (i.e., via boat) in river reaches between release sites and several km downstream of E.L. Field Powerhouse should be performed at regular intervals during and after releases to confirm routes and fates of fish.

Movement rates (time between release and passage) of eels passing the projects by various routes should also be quantified using time-to-event analyses (Castro-Santos and Perry 2012).

This study will require two years of field data collection to account for inter-annual variability in river discharge and water temperatures.

## LEVEL OF EFFORT AND COST

The level of cost and effort for the downstream eel passage study is moderate to high. We anticipate the study will require two migratory seasons to acquire enough data. The Licensee will need to purchase silver eels from a distributor with ample supply, as the Merrimack River does not have an adequate population to harvest. To use the acquired eels, the Licensee will need to permit the use of out-of-basin eels in the study. Each group of eels will require tagging and release over the course of each migration season representing seasonal flows and project operations. The Licensee will download the data periodically, analyze it, and report the results. We estimate the cost will be approximately \$150,000 per year for the study. No alternatives are proposed.

## 5.2 REQUESTED STUDY #2: JUVENILE ALOSINE DOWNSTREAM STUDY

The Merrimack River is a migratory corridor for juvenile alosines. These species must be able to pass the project without undue harm or delay to complete their life cycle. Poor passage at the project limits access to marine habitats harming stock recruitment and resilience within the population and ecosystem benefits to other trophic levels. The Lowell project includes potential emigration routes over the Pawtucket Dam, through the E.L. Field Powerhouse turbines, over the E.L. Field Powerhouse fish bypass, and through the Pawtucket Canal including multiple dams and powerhouses. The Licensee is installing a pneumatic crest gate at the dam that decreases leakage through the flashboards and provides more control of spill over the dam. We request a study to determine the downstream passage routes at multiple river flows and operating conditions to inform safe, timely, and effective passage measures at the project.

## GOALS AND OBJECTIVES

The goal of this study is to determine the impact of the Lowell Hydroelectric Project on the emigration of juvenile alosines in the Merrimack River. Project operations can result in delay, mortality or injury during emigration. We need to understand the extent of delay, the passage routes, and the potential for mortality to determine measures and recommendations to increase survival and improve fish passage at the project.

The objectives of this study are:

- Quantify the movement rates and delay caused by project operations
- Quantify the relative proportion of juvenile alosines passing each emigration route at the project during various project operations.
- Quantify instantaneous and latent mortality of juvenile alosines passed via each emigration route.

## RESOURCE MANAGEMENT GOALS

The NMFS is a federal resource agency with a mandate to protect and conserve fishery resources and associated habitat. Regulatory statutes codify our resource management goals and plans. We rely on the best available data to support conservation recommendations and management decisions. Data sought in this study are not available. This study is an appropriate request for the pre-application period.

The ASMFC has developed six documents related to the management of alosines including:

- Interstate Fishery Management Plan for American Shad and River Herring. October 1985. Atlantic States Marine Fisheries Commission.
- Supplement to American Shad and River Herring Fishery Management Plan. October 1988. Atlantic States Marine Fisheries Commission.
- Amendment II to the Interstate Fishery Management Plan for Shad and River Herring (River Herring Management). May 2009. Atlantic States Marine Fisheries Commission.
- Amendment III to the Interstate Fishery Management Plan for shad and river herring (American Shad Management). February 2010. Atlantic States Marine Fisheries Commission.

Relevant objectives in the fishery management plans include:

- (1) Improve habitat accessibility and quality in a manner consistent with appropriate management actions for non-anadromous fisheries.
  - a. Improve or install fish passage facilities at dams and other obstacles preventing fish from reaching potential spawning areas
  - b. Ensure that decisions on river flow allocation (e.g., hydroelectric operations) take into account flow needs for alosine migration, spawning, and nursery usage
  - c. Ensure that water withdrawal effects (e.g., impingement and entrainment)

do not affect alosine stocks to the extent that they result in stock declines

Addendum II and III contains specific management recommendations for improving upstream and downstream passage of alosines, including requesting that member states and jurisdictions seek special consideration for alosines in the Federal Energy Regulatory Commission relicensing process.

The alosine population is severely depressed in the Merrimack River watershed (Technical Committee for Anadromous Fishery Management of the Merrimack River Basin 2010). We have achieved dramatic increases in alewife returns in recent years through a stocking effort lead by fisheries agencies and compliance with fish passage conditions in existing hydroelectric licenses, but American shad and blueback herring populations still have not shown improvement. Our goal is to restore alosines to historical habitats and ensure safe migratory pathways to build abundance and resilience in the population.

#### PUBLIC INTEREST

The requestor, NMFS, is a federal resource agency.

#### EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

The Licensee conducted three separate mark-recapture studies of emigrating juvenile alosines from 1990 to 1995 (Normandeau Associates, Inc., 1991, 1994, 1995). These studies examined only entrainment into E.L. Field Powerhouse turbines and the fish bypass at the powerhouse as potential routes of passage. The early 1990's studies used antiquated technology that did not adequately address the goals and objectives of this study. We have no information regarding usage of the Pawtucket Canal or the spillway as emigration routes for juvenile alosines at the Lowell Hydroelectric Project.

#### PROJECT NEXUS

The Lowell Hydroelectric Project does not have entrainment prevention at the turbine intakes or designated spillway passage routes. The designated fish bypass system at the E.L. Field Powerhouse has a documented poor entrance efficiency and is unable to operate throughout the diurnal cycle. Juvenile alosines emigrate during the fall at the project, a time of year when Merrimack River flows equal or exceed the operating capacity of the power stations only part of the time. Therefore, we expect juvenile alosines have the opportunity to use multiple routes of passage during emigration. We assume entrained juvenile alosines at the Pawtucket Canal powerhouses will incur unacceptable levels of delay, injury and mortality. We base this assumption on published mortality statistics, the age and specifications of the turbines, the complexity of canal routing, and the likelihood that emigrating juvenile alosines will have to pass two turbines to reach downstream of the project (upper canal and lower canal). Conversely, we assume that turbine passage at the E.L. Field Powerhouse and passage over the spillway may be viable routes of downstream passage, but we do not have delay or mortality information supporting those assumptions. Therefore, to determine overall project survival, we need to understand the routes of emigration and the potential for delay under different river flow conditions and project operations. This study will contribute to the development of an administrative record in support of potential Section 18 fishway prescriptions or 10(j) recommendations.

#### PROPOSED METHODOLOGY

This study should be conducted using radio telemetry, with a study design that specifies sample size and tag and receiver configurations. Through the agency-led stocking program in the Merrimack River watershed, large numbers of juvenile alewife emigrate from the upper watershed on a yearly basis. The Licensee should catch these juveniles for the study, as these fish have been used successfully in acoustic telemetry studies for other facilities on the Merrimack River ([Accession No. 20170223-5040](#)). A statistically significant number of telemetered juvenile alewife are necessary to establish a clear understanding of how project operations affect juvenile alewife emigration (juvenile alewife will serve as a proxy for juvenile American shad and blueback herring). The Licensee should release groups of juvenile alewife during spill and non-spill periods. The Licensee should operate the Pawtucket Canal system turbines during the study. The Licensee should record river flows and project operations throughout the study. Release of tagged juvenile alewife should be a few kilometers (km) upstream of the Pawtucket Dam. Telemetry receivers and antennas will be located above and below the project to assess passage. Receivers should monitor the following potential routes: entrance into Pawtucket Canal via the Guard Lock and Gates Facility, passage over the Pawtucket Dam, entrance into Northern Canal at Pawtucket Gatehouse, entrance into E.L. Field Powerhouse turbines, and entrance into the E.L. Field Powerhouse bypass.

Mobile tracking (i.e., via boat) in river reaches between release sites and several km downstream of E.L. Field Powerhouse will be performed at regular intervals during and after releases to confirm routes and fates of fish.

Movement rates (time between release and passage) of juvenile alewife passing the projects by various routes will also be quantified using time-to-event analyses (Castro-Santos and Perry 2012).

This study will require two years of field data collection to account for inter-annual variability in river discharge and water temperatures.

#### LEVEL OF EFFORT AND COST

The level of cost and effort for the downstream juvenile alewife passage study is moderate to high. We anticipate the study will require two migratory seasons to acquire enough data. The Licensee will download the data periodically, analyze it, and report the results. We estimate the cost will be approximately \$125,000 per year for the study. No alternatives are proposed.

### 5.3 REQUESTED STUDY #3: UPSTREAM AND DOWNSTREAM ADULT ALOSINE PASSAGE STUDY

The Merrimack River is a migratory corridor for alosines. These species must be able to pass the project without undue harm or delay to complete their life cycle. Poor passage at the project limits access to freshwater spawning habitats and marine habitats harming resilience within the population and ecosystem benefits to other trophic levels. The Lowell project includes potential immigration routes through the E.L. Field Powerhouse fish lift and the Pawtucket Dam fish ladder. Potential emigration routes include over the Pawtucket Dam, through the E.L. Field Powerhouse turbines, over the E.L. Field Powerhouse fish bypass, and through the Pawtucket Canal including multiple dams and powerhouses. The Licensee is installing a pneumatic crest gate at the dam that decreases leakage through the flashboards and provides more control of spill over the dam. We request a study to determine the effectiveness of the upstream fishways and



downstream passage routes at multiple river flows and operating conditions to inform safe, timely, and effective passage measures at the project.

#### GOALS AND OBJECTIVES

The goal of this study is to determine the impact of the Lowell Hydroelectric Project on the migration of adult alosines in the Merrimack River. Project operations can result in delay, mortality or injury during migration. We need to understand the extent of delay, the passage routes, and the potential for mortality to determine measures and recommendations to increase survival and improve fish passage at the project.

The objectives of this study are:

- Quantify the movement rates and delay caused by project operations at multiple river flows.
- Quantify the relative proportion of alosines passing each migration route at the project during various project operations at multiple river flows.
- Quantify instantaneous and latent mortality of alosines passed via each migration route at multiple river flows.

#### RESOURCE MANAGEMENT GOALS

The NMFS is a federal resource agency with a mandate to protect and conserve fishery resources and associated habitat. Regulatory statutes codify our resource management goals and plans. We rely on the best available information and data to support conservation recommendations and management decisions. Data sought in this study are not available. This study is an appropriate request for the pre-application period.

#### PUBLIC INTEREST

The requestor, NMFS, is a federal resource agency.

#### EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Since the commissioning of the fish passage facilities at the Lowell Hydroelectric Project, passage of alosines has been unable to meet management goals. For example, greater than 50% of the tagged adult American shad that pass the downstream Lawrence Hydroelectric Project reach the Lowell tailrace, yet only a small percentage of those fish use the designated upstream fishways (Sprankle 2005), (Alden Research Laboratory 2011). Therefore, through the course of the original license, the Licensee conducted numerous studies to investigate fish passage at the project (Table 1).

**Table 1.** Adult Alosine Upstream and Downstream Fish Passage Studies.

| Year | Study Title                                                                                 | Author                           | Study Results                                                                                                                                                                                                                                                             |
|------|---------------------------------------------------------------------------------------------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1988 | Passage of Radio-tagged American shad through the Northern Canal Headgate Structure: Lowell | RMC Environmental Services, Inc. | Upstream Results: Of the 25-tagged fish, 24 passed the Northern Canal Gatehouse and one died through turbine passage. Of the 24 passed fish, 19 used the boat lock and 5 used the gate wells. Fish took a few hours to reach the gatehouse from the fish lift. Those that |

|      |                                                                                                                                                 |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | Hydroelectric Project                                                                                                                           |                             | <p>passed the boat lock took less than a day and those that passed through the gate wells took 1 to 3 days to get to the headpond.</p> <p>Downstream Results: Of the 24-tagged fish, 13 approached Lowell after spawning. One of these entered the Pawtucket Canal and died. Eight went through either the Northern Canal and the remainder were undetermined routes. Only 5 fish reached Lawrence suggesting a project mortality of 61.5%. There was delay behavior approaching the gatehouse and Pawtucket Canal.</p> |
| 1991 | Downstream Passage Routes of Radio-tagged Adult American shad at the Lowell Hydroelectric Project on the Merrimack River: Lowell, Massachusetts | Normandeau Associates, Inc. | <p>Upstream Results: 28 of the 45-tagged fish passed the gatehouse.</p> <p>Downstream Results: 12 of the 28 fish approached the project after spawning. 5 went through the turbines, 2 went through the Pawtucket Canal, 2 went through the fish bypass, and 3 went over the dam. Of the 17 fish that did not pass upstream of the gatehouse, 6 died in the Northern Canal, 8 went through the powerhouse, and 3 went through the fish bypass. Project mortality through various downstream passage routes was 61%.</p> |
| 1997 | Lowell Hydroelectric Project Internal Fish Lift Efficiency Monitoring Program, Spring 1996                                                      | Normandeau Associates, Inc. | At 50 cfs attraction flow, the fishway efficiency was 0.5%. At 90 cfs, the fishway efficiency was 2.4%. Both entrances were operating. Entrance #2 was a net loss of 4,175 shad and entrance #1 was a net gain of 113 shad.                                                                                                                                                                                                                                                                                             |
| 1999 | An Assessment of Internal Fish Lift Efficiency at the Lowell Hydroelectric Project, Spring 1998                                                 | Normandeau Associates, Inc. | The fishway internal efficiency increased by 10% from previous years after modifications.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 2000 | An Assessment of Internal Fish Lift Efficiency at the Lowell                                                                                    | Normandeau Associates, Inc. | At 120 cfs attraction flow, the fishway efficiency was 42% ranging from 9% to 98%.                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|      |                                                                                                       |                                 |                                                                                                                                                                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | Hydroelectric Project, Spring 1999                                                                    |                                 |                                                                                                                                                                                                                                                                                                                                                                                                |
| 2001 | An Assessment of Internal Fish Lift Efficiency at the Lowell Hydroelectric Project, Spring 2000       | Normandeau Associates, Inc.     | At 120 cfs attraction flow, the fishway average efficiency was 46.4% ranging from 13% to 92%. Efficiency was best at the 2-foot crowder opening (72%) and worst at the 4-foot opening (29%)                                                                                                                                                                                                    |
| 2002 | Interdam Movements and Passage Attraction of American shad in the Lower Merrimack River Main Stem     | U.S. Fish and Wildlife Service  | Upstream results: Of the tagged fish at Lawrence, 55% entered the Lowell tailrace and 66% reached the project. Passage efficiency was 6% using tagged fish and was 10% using count room data.<br><br>Downstream results: Of the four-tagged fish that passed Lowell, one died upstream, one died using the fish bypass, and the other two reached Lawrence suggesting a 33% project mortality. |
| 2011 | Shad Upstream Passage Assessment at Lowell Hydroelectric Project (FERC 2790)                          | Alden Research Laboratory, Inc. | Of the tagged fish at Lawrence, 57% reach the Lowell project. Shad explored the tailrace in a “U” shaped pattern along the edges. Only three fish entered the fishway.                                                                                                                                                                                                                         |
| 2013 | Additional Analysis of American Shad Three-Dimensional Behavior in the Tailrace of the Lowell Project | Blue Leaf Environmental         | Shad exhibited a random roaming behavior within the previously determined “U” shaped pattern. Greater than 80% of the detections were between the elevations of 40 and 50 feet.                                                                                                                                                                                                                |

Though the Licensee has completed numerous studies over the course of their original license, additional information is necessary to determine appropriate fish passage and protection measures for adult alosines in the upcoming license. Concerning upstream passage, none of the studies simultaneously focused on both the Pawtucket Dam fish ladder and the E.L. Field Powerhouse fish lift. As both facilities are necessary to meet management goals, we need to understand route selection and delay approaching the project with both fish passage facilities operating and monitored. In 2019, the Licensee will excavate part of the Lowell tailrace to improve attraction to the riverside fish lift entrance. Therefore, we need to understand whether this measure will improve entrance efficiency. In addition, none of the previous studies incorporated both Passive Integrated Transponder (PIT) tags and radio tags on the same fish. Dual tagging of the upstream migrating fish will allow us to quantify route selection, delay, and internal fishway efficiency. Concerning downstream passage, none of the previous studies had a

statistically significant number of fish to account for tagging effects, natural post-spawn mortality, or the myriad of route selections during emigration. In addition, the new pneumatic crest gate constitutes a new hydraulic condition that may affect route selection during emigration. Finally, none of the previous studies focused on adult river herring, which exhibit different migratory behaviors than American shad.

#### PROJECT NEXUS

The Lowell Hydroelectric Project has two fishways that have not met alosine management goals for the Merrimack River watershed. The project also does not have entrainment prevention at any of the operating turbine intakes. In addition, project operations produce a myriad of migratory routes, both upstream and downstream, that can lead to delay, increased predation, and mortality. Information gained from this study will greatly increase our understanding of project effects. This study will contribute to the development of an administrative record in support of potential Section 18 fishway prescriptions or 10(j) recommendations.

#### PROPOSED METHODOLOGY

We recommend incorporating state-of-the-art telemetry methods for this study including both PIT and radio tag technology. The study design should specify sample size and tag and receiver configurations and include two years of field data collection to attempt to account for inter-annual variability in river discharge and water temperatures. Because ledge excavation in the tailrace will be occurring in 2019, a third year of study may be necessary to account for delay of the upstream passage evaluation.

The first year of study, prior to the completion of the ledge excavation, should focus on downstream passage and upstream passage through the Northern Canal only. The Licensee should tag a statistically significant number of both adult river herring and American shad during the migration run of each species captured at the Lawrence project. Each species should have two release locations, one group at the E.L. Field Powerhouse fish lift exit and the other in the Lowell project impoundment. The E.L. Field Powerhouse group should be dual tagged and the Northern Canal Gatehouse wells should be equipped with PIT tag receivers (if the boat lock is open, then receivers should be installed there as well). Release of radio-tag only groups of American shad and river herring should be a few kilometers (km) upstream of the Pawtucket Dam. A small sample of dead river herring and shad should be included in this release to act as a control group, as fish can drift significant distances downstream after they have died (Havn et al. 2017) Radio telemetry receivers and antennas will be located above and below the project to assess passage. Receivers should monitor the following potential routes: entrance into Pawtucket Canal via the Guard Lock and Gates Facility, passage over the Pawtucket Dam, entrance into Northern Canal at Pawtucket Gatehouse, entrance into E.L. Field Powerhouse turbines, and entrance into the E.L. Field Powerhouse bypass.

During the study seasons following the ledge excavation, the Licensee should tag a statistically significant number of both adult river herring and adult American shad captured at the Lawrence project during their migration run. Half of the test specimens for each species should be dual-tagged. The release location for all test specimens should be the Lawrence impoundment. In addition to the receivers installed during the first year of study, the Licensee should equip the entrance and exit of both fishways with PIT tag receivers (the ladder should have an additional PIT receiver in the turning pool) to evaluate fishway efficiencies. The Licensee should also equip the tailrace entrance, the fish lift entrance, and three equally spaced locations within the bypass

reach (e.g., downstream cross-section, mid-point cross-section, and proximal to the ladder entrance) with radio tag receivers.

The Licensee should release groups of test specimens during spill and non-spill periods. The Licensee should operate the Pawtucket Canal system turbines during the study. The Licensee should record river flows and project operations throughout the study.

Mobile tracking (i.e., via boat) in river reaches between release sites and several km downstream of E.L. Field Powerhouse will be performed at regular intervals during and after releases to confirm routes and fates of fish.

Movement rates (time between release and passage) of juvenile alewife passing the projects by various routes will also be quantified using time-to-event analyses (Castro-Santos and Perry 2012).

#### LEVEL OF EFFORT AND COST

The level of cost and effort for the upstream and downstream alosine passage study is high. The study will require at least two migratory seasons to acquire enough data. Because of the ledge excavation, a third year of study is likely for the comprehensive upstream and downstream telemetry study depending on the environmental and operating conditions of the second year. The Licensee will download the data periodically, analyze it, and report the results. We estimate the cost will be approximately \$150,000 for the first year study and \$300,000 per year for the comprehensive study. No alternatives are proposed.

#### 5.4 REQUESTED STUDY #4: PROJECT SURVIVAL STUDY

The Merrimack River is migratory corridor for a multitude of diadromous fish species including American eel, American shad, river herring, and Atlantic salmon. These species must be able to pass the Lowell Hydroelectric Project without significant mortality. The Lowell project includes 2 identical full Kaplan units at the E.L. Field Powerhouse and 19 Francis units of various specifications through a two-tiered canal system in downtown Lowell (12 units are still operating). Each of these turbine passage routes represent a significant risk of mortality to emigrating fish. In addition, the Licensee installed new pneumatic crest gates on the Pawtucket Dam with improved spill control that may provide a safe emigration route. We request a study to determine project survival by quantifying turbine mortality and injury under multiple operating conditions to inform safe, timely, and effective downstream passage measures at the project.

#### GOALS AND OBJECTIVES

The goal of this study is to quantify project survival for emigrating diadromous species that pass through project turbines. The objectives of the study are to:

- Conduct a field study of turbine survival at the E.L. Field Powerhouse with adult American eels and adult American shad.
- Conduct a desktop survival study for the full suite of diadromous species and life stages through all of the project units.

#### RESOURCE MANAGEMENT GOALS

The NMFS is a federal resource agency with a mandate to protect and conserve fishery resources and associated habitat. Regulatory statutes codify our resource management goals and plans. We

rely on the best available data to support conservation recommendations and management decisions. Data sought in this study are not available. This study is an appropriate request for the pre-application period.

#### PUBLIC INTEREST

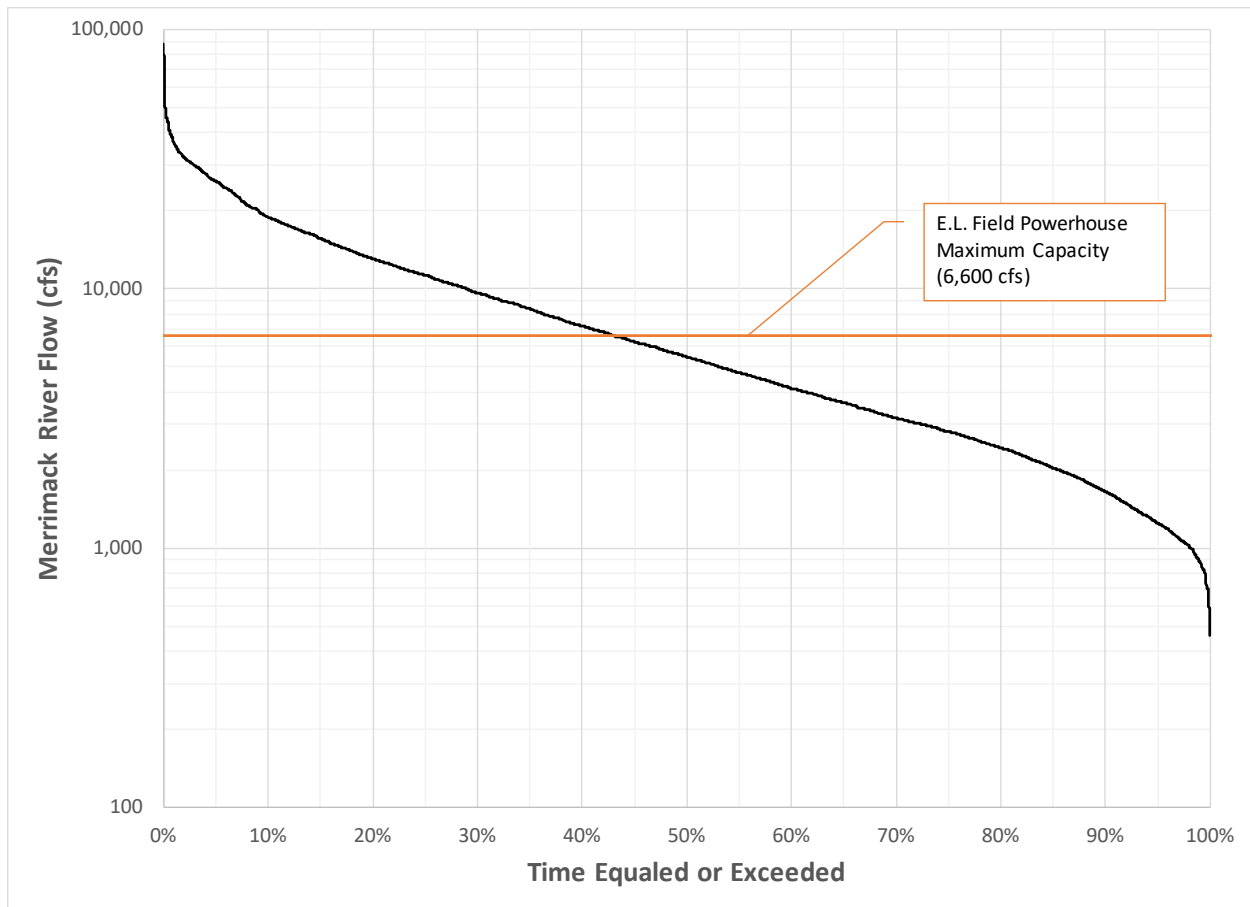
The requestor, NMFS, is a federal resource agency.

#### EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Turbine mortality is a well-documented effect of hydroelectric facility operation on the fisheries resource. In the last half-century, dozens of previous licensing studies quantified the effects of many types of turbines. Industry professionals have compiled much of this information in a database (EPRI 1997). In general, American eels have higher survival passing Francis turbines and alosines have higher survival passing Kaplan turbines (Pracheil et al. 2016). However, the extent of turbine mortality relates to the species, life stage, and the specifications of the turbine, which result in dramatic differences in turbine survival. Fish length, runner rotational speed, and the number of runner blades are key variables determining turbine mortality (Headrick 2001).

In 2003, the Licensee completed a comprehensive study of the Atlantic salmon smolt survival through the E.L. Field Powerhouse (Normandeau Associates Inc. 2003). The results from that study were favorable with the desktop analysis predicting 94% survival and the field test results showing 100% survival. However, the average length of the Atlantic salmon smolts in that study was 202.8 millimeters (mm). Adult American eel and American shad are much longer, approximately 1,000 mm and 450 mm, respectively. Because fish length is a key determinant of turbine survival, we need quantitative field data for larger fish with different swimming forms and abilities to conclude that the E.L. Field Powerhouse turbines are a safe route of emigration for the full suite of diadromous species. In addition, the previous smolt study only looked at one operational scenario for the full Kaplan units. Unlike smolts, both American eel and American shad will emigrate past the facility during times when river flow is well below operational capacity. Finally, American eels are more susceptible to blade strike with Kaplan turbines and the previous telemetry studies of American shad suggested poor turbine survival at the E.L. Field Powerhouse (RMC Environmental Services 1988) (Normandeau Associates Inc. 1991).

None of the previous studies conducted at the Lowell Hydroelectric Facility examined the potential for eel or alosine turbine mortality in the Pawtucket Canal units using estimates from either turbine mortality equations or field studies. Based on our hydrologic analysis, during the downstream fish passage season as defined in the existing Comprehensive Fish Passage Plan, the downtown canal units will be operating approximately 40% of the time (Figure 1). Therefore, the Pawtucket Canal may be an emigration route. We need to understand the risks of mortality for fish that migrate through the Pawtucket Canal.



**Figure 1.** Flow duration curve for the Merrimack River during the downstream fish passage season showing the amount of time river flow equals or exceeds the E.L. Field Powerhouse maximum discharge capacity.

#### PROJECT NEXUS

Operation of the Lowell Hydroelectric Project has a direct effect on the survival of emigrating diadromous fish through turbine passage. None of the 14 operating turbines has entrainment prevention leading to the potential for high turbine mortality at the project. Information gained from this study will greatly increase our understanding of project effects. This study will contribute to the development of an administrative record in support of potential Section 18 fishway prescriptions or 10(j) recommendations.

#### PROPOSED METHODOLOGY

The E.L. Field Powerhouse turbine field study should use the balloon tag-recapture technology. A methodology similar to the one outlined in the previous Atlantic salmon study is acceptable (Normandeau Associates Inc. 2003). A statistically significant number of both adult American eels and American shad are necessary for testing at two turbine settings, a low operational flow (less than 1,200 cfs) and a high operational flow (between 1,800 and 3,300 cfs). The Licensee should evaluate and document the fitness of the test specimens used in the study.

The desktop turbine survival study should use standard methodology appropriate for the type of turbine and empirical information available (Franke et al. 1997). The Licensee should evaluate each of the unique turbines still in operation including:

- the E.L. Field, Fuji Horizontal Full Kaplan,
- the Bridge Street, Hercules Type D Single Runner,
- the Hamilton, Leffel Type Z Single Runner at
  - 120 rpm
  - 133 rpm
  - 150 rpm,
- the John Street, Leffel Single Runner, and
- the John Street, Allis Chalmers Single Runner.

The turbine survival assessment should evaluate American shad, American eel, and river herring. The Licensee should evaluate both adult and juvenile life stages for the alosines. The study should use published average length values for each species and life stage in the calculations. Alewife may be used as a proxy for both river herring species. After determining estimates for each unique turbine, the Licensee will derive overall project survival estimates using typical operating curves and expected flows (i.e., the flow duration curve) during the downstream migration season for each species. The Licensee should use the rule of thumb that fish will emigrate proportionally with flow to estimate overall project survival. Where applicable, the Licensee should use turbine survival based on field collected data instead of calculated estimates.

#### LEVEL OF EFFORT AND COST

The level of cost and effort for the project survival study is moderate. The study will likely take one year. The Licensee will collect the field data during the migratory season, calculate the turbine survival estimates, estimate overall project survival, and report the results. We estimate the cost will be approximately \$120,000 for the study. No alternatives are proposed.

#### 5.5 REQUESTED STUDY #5: THREE-DIMENSIONAL HYDRAULIC MODELING

Complex flow fields occur upstream of the entrance to powerhouse intakes and dedicated fish bypasses, downstream of fishway entrances, and internally within a fishway. With respect to downstream passage, we need to understand the direction and magnitude of flow fields that are upstream of the turbine intakes and fish bypass in order to inform license conditions that may improve downstream passage. Concerning upstream passage, we need to understand the hydraulic conditions proximal to the entrances of both fishways to inform license conditions that may improve fishway attraction. In addition, internal hydraulics (particularly upwelling from floor diffusers) can cause fallback from committed immigrants in a fishway. We request a three-dimensional computational fluid dynamics (CFD) modeling study to understand the hydraulics of integral components of the fish passage facilities at the Lowell Hydroelectric Project.

#### GOALS AND OBJECTIVES

The goal of this study is to determine the flow field conditions that exist in and around the Lowell fish passage facilities. The objectives of the study are to:



- Develop and calibrate a three-dimensional model of the E.L. Field Powerhouse forebay and downstream bypass facility then run simulations of various operational conditions.
- Develop and calibrate a three-dimensional model of the E.L. Field Powerhouse fish lift then run simulations of various operational conditions.
- Develop and calibrate a three-dimensional model of the Pawtucket Dam fish ladder then run simulations of various operational conditions.

#### RESOURCE MANAGEMENT GOALS

The NMFS is a federal resource agency with a mandate to protect and conserve fishery resources and associated habitat. Regulatory statutes codify our resource management goals and plans. We rely on the best available data to support conservation recommendations and management decisions. Data sought in this study are not available. This study is an appropriate request for the pre-application period.

#### PUBLIC INTEREST

The requestor, NMFS, is a federal resource agency.

#### EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

No three-dimensional models exist for the fish passage facilities at the Lowell Hydroelectric Project. Documented issues with the fish passage facilities include poor entrance efficiency at the E.L. Field Powerhouse downstream bypass, poor entrance efficiency at the E.L. Field Powerhouse upstream fish lift, and fallback in both fishways. Detailed hydraulic modeling of the fish passage facilities will elucidate potential license conditions and measures that may improve fish passage at the project.

#### PROJECT NEXUS

With the existing fish passage facilities, the Lowell Hydroelectric Project has not met management goals for anadromous fish in the Merrimack River Watershed. Either new infrastructure, operational changes, or both are necessary to avoid and minimize project effects on fish populations in the Merrimack River and the Atlantic Ocean. The results of this study will inform future measures at the project to improve fish passage.

#### PROPOSED METHODOLOGY

A three-dimensional CFD model has become an increasingly common standard of analysis at hydroelectric projects around the nation. Within the Northeast region, we have used these models to address fish passage issues at the Holyoke (P-2004), Turners Falls (P-1889) Brunswick (P-2284), Shawmut (P-2322), Milford (P-2534) and Orono (P-2710) projects. Many three-dimensional hydraulic software packages are acceptable for this requested study, one of which is open source. We are not recommending one model over another, but the Licensee shall understand and document the limitations of the modeling software used. At a minimum, the modeling output should produce velocity, turbulence, and water depth for each cell in the mesh. The modeling domain shall be of sufficient size and mesh to characterize the hydraulic environment for each fishway evaluated. The domain for the forebay model should include the Northern Canal where the flow is relatively uniform and continue to the trash racks and to the point of free discharge in the fish bypass. The domain for the E.L. Field Powerhouse fish lift model should include upstream of the hopper through the tailrace where the highest density of detections occurred in the three-dimensional telemetry study (Alden Research Laboratory 2011), (Blue Leaf Environmental 2013). This model

should reflect conditions after ledge removal in the tailrace. The domain of the Pawtucket Dam fish ladder model should include the exit flume through the ladder and past the influence of the entrance jet and any auxiliary attraction water supply (e.g., adjacent crest gate and sluice gates). Calibration of each model should include a low and a high design flow to bracket the simulated hydraulic conditions, if possible. In order to understand project effects, multiple simulations of each calibrated model are necessary to evaluate hydraulic issues for the full range of design flows (i.e., up to 5% exceedance values during the migratory period) and typical existing operating conditions. At a minimum, we expect the following simulations:

- Forebay model with downstream bypass set at 5% E.L. Field Powerhouse turbine discharge.
  - Minimum flow, Unit 1
  - Minimum flow, Unit 2
  - 5% exceedance, both units
  - 75% exceedance, typical unit setting
- Fish lift model with auxiliary water supply (AWS) set at recommended settings.
  - Minimum flow, Unit 1
  - Minimum flow, Unit 2
  - 5% exceedance, both units
  - 50% exceedance, both units
- Fish ladder model with AWS set at recommended settings.
  - Minimum flow, AWS from adjacent crest gate
  - Minimum flow, AWS from sluice gate
  - 5% exceedance, typical spill settings

Model output should show potential hydraulic conditions that effect fish passage. For example, eddy formation, zones of rapid acceleration/deceleration, upwelling, high/low velocity, and high turbulence areas.

#### LEVEL OF EFFORT AND COST

The level of cost and effort for the three-dimensional CFD modeling study is moderate. The study will likely take one year. The Licensee will develop the models using existing drawings supplemented with limited survey, collect calibration data, run simulations, and report the results. We estimate the cost will be approximately \$175,000 for the study. No alternatives are proposed.

#### 5.6 REQUESTED STUDY #6: BYPASS ZONE-OF-PASSAGE STUDY

The Merrimack River is migratory corridor for a multitude of diadromous fish species including American eel, American shad, river herring, sea lamprey, and Atlantic salmon. These species must be able to pass the project without undue harm or delay to complete their life cycles. Poor passage at the project limits access to upstream spawning habitats harming genetic diversity and resilience within the population. The Lowell project includes an approximately 0.7-mile-long bypass reach from Pawtucket Dam to the E.L. Field Powerhouse tailrace. The powerhouse houses a fish lift and the dam includes a fish ladder that provide fish passage. The Licensee installed the dam fish ladder as a condition under the original license to provide passage at the dam during periods when river flow was high enough that the Project spilled. Due to increased numbers of diadromous species and fish observed at Lowell over the last decade and the

ineffectiveness of the fish lift, the Merrimack River Anadromous Fish Restoration Technical Committee decided to operate the fish ladder throughout the season, regardless of spill conditions. In addition, the Licensee has subsequently installed a pneumatic crest gate at the dam that decreases leakage through the flashboards and provides more control of spill over the dam. We request a study to determine a zone-of-passage through the bypass reach at multiple flows to ensure safe, timely, and effective passage at the project. A zone-of-passage is defined as the contiguous area of sufficient lateral, longitudinal, and vertical extent in which adequate hydraulic and environmental conditions are maintained to provide a route of passage through a stream reach influenced by a hydroelectric project (USFWS 2017).

#### GOALS AND OBJECTIVES

The goal of this study is to determine the zone-of-passage at multiple flows in the bypass reach that facilitate safe, timely, and effective fish passage through the project. The objectives of the study are to:

- complete a detailed survey of the bypass reach,
- develop a high-resolution, two-dimensional hydraulic model of the bypass reach,
- release multiple flows from the dam to collect calibration data for the model,
- simulate additional flows through the bypass reach with the calibrated model, and
- determine minimum and optimal zone-of-passage in the project bypass reach.

#### RESOURCE MANAGEMENT GOALS

The NMFS is a federal resource agency with a mandate to protect and conserve fishery resources and associated habitat. Regulatory statutes codify our resource management goals and plans. We rely on the best available data to support conservation recommendations and management decisions. Data sought in this study are not available. This study is an appropriate request for the pre-application period.

#### PUBLIC INTEREST

The requestor, NMFS, is a federal resource agency.

#### EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Article 36 of the original license required the Licensee, after consultation with resource agencies, to develop an in-stream flow study plan to determine the relationship between project discharges and downstream aquatic habitat and a fishery study plan to determine project discharges necessary to provide for the migration of anadromous fish (i.e., zone of passage). After completion of the approved studies, the Licensee shall file a report on the results of the studies, and, for Commission approval, recommendations for the flow releases from the project. The Licensee filed the study plan on August 13, 1983 with proof of agency consultation ([Accession No. 19830818-0191](#)). However, we have been unable to obtain the reports required under Article 36. We have no reports on file nor have we found that the Licensee filed the reports in the eLibrary. Therefore, we have no quantitative data supporting the agreement that 300 cubic feet per second (cfs) at night and 500 cfs during the day are adequate for a zone-of-passage in the bypass reach as mentioned in the letter dated August 8, 1983 accompanying the study plan.

In the Comprehensive Fish Passage Plan filed on March 9, 2000 ([Accession No. 20000313-0322](#)), the Licensee states:

*The adequacy of flows for upstream fish passage at the Project was addressed by BHI's construction of six (6) concrete flow control weirs (with adjustable stoplog sections) in the bypass reach, at the request of U.S. Fish and Wildlife Service and in response to Article 36, section (2) of the Project's FERC license.*

Similar to the study plan, we have an agreement with no supporting information that substantiates the conclusion that these are adequate flows for a zone-of-passage in the bypass reach for the full suite of diadromous species.

As part of compliance for Article 34 of the original license, the Licensee filed as-built drawings of the fish passage facilities ([Accession No. 19860902-0215](#)). Within this abbreviated drawing set, drawing number 344D-PC001, 3844D-FC001, and 3844D-FC004 show topographic survey for small portions of the bypass reach. However, the drawings do not document the accuracy and precision of the survey, the drawing quality is illegible, and the drawings do not show the majority of the bypass reach.

This existing, supporting data is sparse, antiquated, and inadequate to determine the zone-of-passage at multiple flows in the bypass reach. Since agreeing upon the current zone-of-passage flows during the original license, we have new technologies in topographic survey methods, a better understanding of the hydraulic requirements of diadromous species, multi-dimensional hydraulic modeling capabilities, and an increased need to pass fish at the spillway ladder.

#### PROJECT NEXUS

Diadromous fish orient their migration based on the environmental conditions of the river: flow, depth, velocity, and temperature (Goodwin et al. 2014). Project operations affect the environmental conditions in the river, including the bypass reach. Two key hydraulic model outputs from the requested study are depth and depth-averaged velocity, which we can use to determine the likelihood of predation, delay, and the cessation of migration. Evaluating the flow fields in the bypass reach under different spill conditions will assist in the consultation process for determining a zone-of-passage in the bypass reach to optimize fish passage at the project. These data will contribute to the development of an administrative record in support of a potential settlement agreement, Section 18 fishway prescriptions, or 10(j) recommendations.

#### PROPOSED METHODOLOGY

We proposed the following methodology to accomplish the five objectives and ultimately the goal of the study, to determine zone-of-passage flows for the bypass reach.

##### 1) Topographic survey

The bypass reach area is large making traditional topographic survey methods laborious and costly. We recommend using Light Detection and Ranging (LiDAR) methods with limited traditional surveying. Outside of the fish passage season and during a river flow when the project is in control of the river, the bypass reach will be mostly dewatered. At this time, a licensed surveyor can fly the area to collect LiDAR data. Once this data is processed, traditional methods will fill in the gaps (e.g., pooled water areas, under bridges). The topographic survey shall be of sufficient resolution and quality to complete the remaining objectives.

2) Two-dimensional hydraulic model

There are many two-dimensional hydraulic models that are acceptable for accomplishing the goal of this requested study, many of which are open source. We are not requiring one model over the other, but the Licensee shall understand and document the limitations of the modeling software used. At a minimum, the modeling output should produce depth-average velocity and water depth for each cell in the mesh. The modeling domain shall be of sufficient size and mesh to delineate a zone-of-passage through the entire length and width of the bypass reach.

3) Calibration flows

The Licensee shall collect calibration data by spilling a minimum of two flows from the Pawtucket Dam. The calibration flows shall bracket the range of simulated flows in the study. We recommend 300 cfs for the low flow as it represents the current lowest operation flow for the fish ladder. For the high calibration flow, we recommend collecting data near the high fish passage design flow (i.e., the 5% exceedance value for the migratory period of record) which is approximately 26,000 cfs in the Merrimack River (bypass flow would be approximately 17,000 cfs with full project generation). The Licensee shall collect calibration data (depth-averaged velocity and depth) with an Acoustic Doppler Current Profiler (ADCP) at a minimum of four cross sections, including the downstream boundary condition. The Licensee shall use the ADCP in locations spread evenly throughout the bypass that have hydraulic conditions that are conducive to accurate readings (i.e., less turbulence).

4) Additional flow simulations

After calibrating the model, the Licensee shall simulate additional bypass flows including 500 cfs, 1,000 cfs, and couple other flows up to the high calibration flow. The additional simulations should represent the full range of hydraulic conditions in the bypass reach from the low to high fish passage design flow.

5) Zone-of-passage determination

The Licensee will use the model output to delineate a zone-of-passage pathway for each of the modeled flows. To determine the zone-of-passage, the Licensee will use the SprintSwim model developed by U.S. Geological Survey researchers (Haro et al. 2004).

#### LEVEL OF EFFORT AND COST

The level of cost and effort for the project survival study is low to moderate. The Licensee should be able to finish the bypass zone-of-passage study in one year depending on seasonal flow conditions. We estimate the cost to be approximately \$80,000. No alternatives are proposed.

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## Scott, Kelsey

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**From:** Quiggle, Robert  
**Sent:** Tuesday, May 7, 2019 2:08 PM  
**To:** celeste\_bernardo@nps.gov; Bob Nasdor (bob@americanwhitewater.org); Kevin.hollenbeck@state.ma.us  
**Cc:** Kevin\_mendik@nps.gov; 'Kevin.Webb@enel.com'; Anderson, Elise (EGP North America); Gibson, Jim; MacVane, Kelly; Scott, Kelsey  
**Subject:** Lowell Hydroelectric Project (FERC No. 2790-072) -- Consultation Regarding the Recreation and Aesthetics Study  
**Attachments:** 20190507 Lowell Hydro Project Recreation Study Consultation.pdf

Ms. Bernardo, Mr. Nasdor, and Mr. Hollenbeck:

On behalf of Boott Hydropower, LLC (Boott), I am distributing the attached consultation request in support of the Federal Energy Regulatory Commission (FERC) relicensing of the Lowell Hydroelectric Project (Project). As described in the attached correspondence, Boott is consulting with the National Park Service, American Whitewater, and the Massachusetts Department of Conservation and Recreation to identify locations in the Project's vicinity to conduct visitor intercept surveys of recreationists for the approved Recreation and Aesthetics Study.

Should you have any questions regarding the attached correspondence, please contact Kevin Webb with Boott at 978-935-6039 or [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank you,

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
1304 Buckley Road, Suite 202  
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**D** 315.414.2216 **M** 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)





**Boott Hydropower, LLC**

A Subsidiary of Enel Green Power North America, Inc.

100 Brickstone Square, Suite 300 – Andover, MA 01810 – USA  
T +1 978 681 1900 – F +1 978 681 7727

**Via Electronic Distribution**

May 7, 2019

Celeste Bernardo  
Superintendent of Lowell National Historical Park  
National Park Service  
67 Kirk Street  
Lowell, MA 01852

Re: Lowell Hydroelectric Project (FERC No. 2790-072);  
Consultation Regarding the Water Level and Flow Effects on Historic Resources Study

Dear Ms. Bernardo,

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc. (Enel), is the Licensee and operator of the 22.4 megawatt (MW) Lowell Hydroelectric Project (Project or Lowell Project). The Lowell Project is located on the Merrimack River in Middlesex County, Massachusetts, and in Hillsborough County, New Hampshire. The existing license for the Project was issued by the Federal Energy Regulatory Commission (FERC or Commission) with an effective date of May 1, 1973. The existing license expires on April 30, 2023. Accordingly, Boott is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

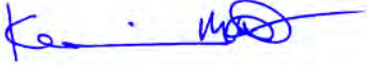
In accordance with the Commission's Study Plan Determination issued on March 13, 2019, Boott is initiating consultation with the National Park Service (NPS) regarding the locations of water level loggers (pressure transducers) to be placed within the Lowell canal system for the Water Level and Flow Effects on Historic Resources Study. As part of the study, Boott will temporarily install level loggers at up to ten locations within the canal system. At each location, Boott will install one primary and one backup level logger, for a total of twenty level loggers. The level loggers will record water elevations in 15-minute increments from May 2019 through May 2020. In addition to these loggers, water levels at the Pawtucket Dam and E.L. Field Powerhouse forebay are logged by the Project's control system

The information collected will be compared to Project operational and flow data for the period of record to assess how Project operations and flows into the canal system effect water levels, which in turn may affect historic resources and NPS operations. Boott will conduct the assessment of the data in the spring and summer of 2020.

As shown in Figure 1 provided as Attachment A, Boott is proposing ten strategic and representative locations to deploy the level loggers within the Lowell canal system. These level logger locations may be slightly revised based on site conditions encountered during deployment. As we are planning on deploying these loggers in the near term, Boott respectfully requests any comments regarding these proposed deployment locations within 15 days of this letter (i.e. by May 22, 2019). If we do not receive a response from your office, Boott will move forward with the temporary installation of the level loggers at the locations shown on the attached map.

On behalf of Boott, I appreciate the opportunity to consult with the NPS regarding this study. Please do not hesitate to contact me at (978) 935-6039 if you have any questions concerning this matter.

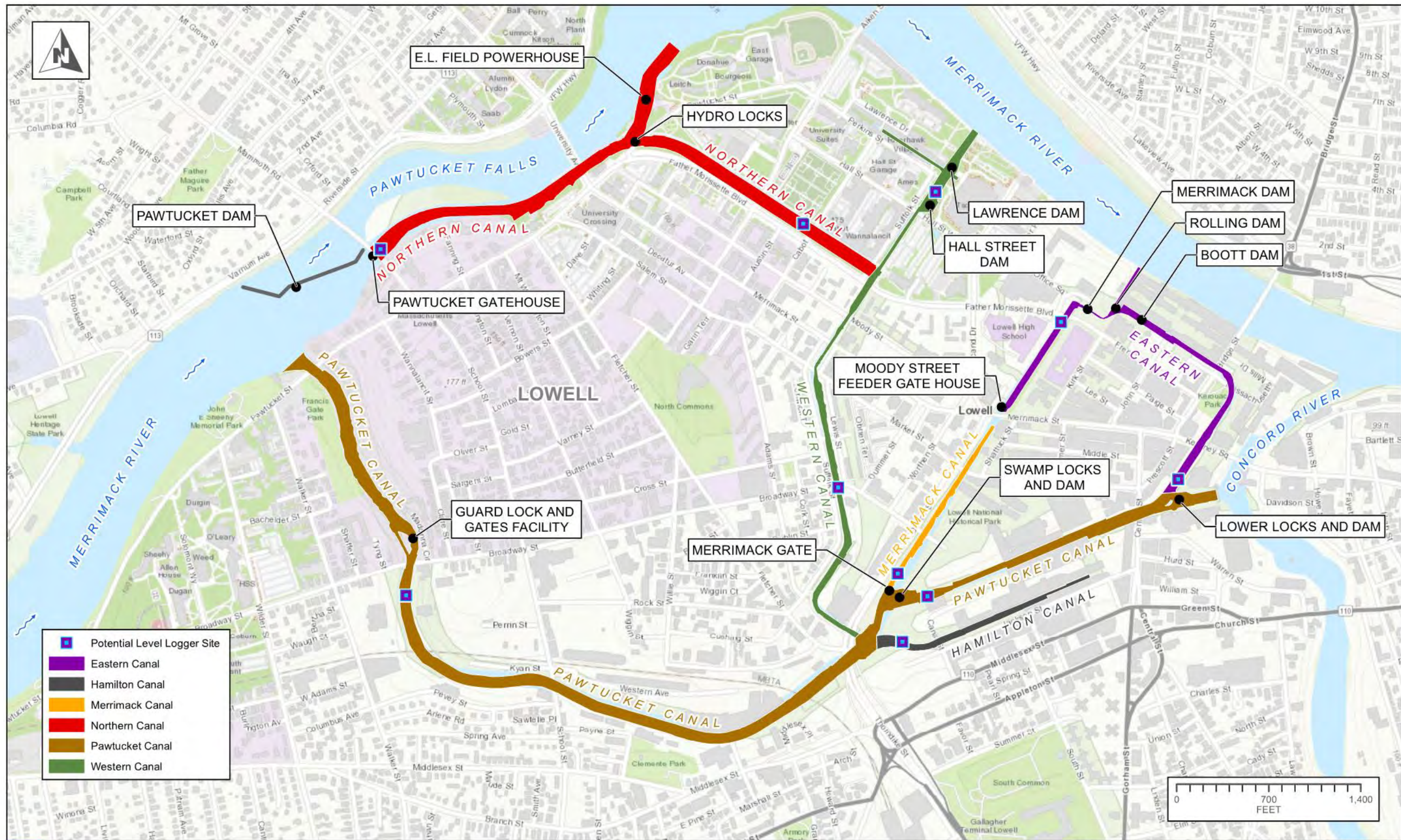
Sincerely,  
**Boott Hydropower, LLC**



Kevin M. Webb  
Hydro Licensing Manager

cc: K. Bose, FERC  
K. Mendik, NPS

Attachment A – Figure 1





**Boott Hydropower, LLC**

A Subsidiary of Enel Green Power North America, Inc.

100 Brickstone Square, Suite 300 – Andover, MA 01810 – USA  
T +1 978 681 1900 – F +1 978 681 7727

**Via Electronic Distribution**

May 7, 2019

Celeste Bernardo  
Superintendent of Lowell National Historical Park  
National Park Service  
67 Kirk Street  
Lowell, MA 01852

Robert Nasdor  
NE Stewardship Director  
American Whitewater  
65 Blueberry Hill Lane  
Sudbury, MA 01776

Kevin Hollenbeck  
Metrowest District Manager  
DCR Great Brook Farm State Park  
984 Lowell Street  
Carlisle, MA 01741

Re: Lowell Hydroelectric Project (FERC No. 2790-072);  
Consultation Regarding the Recreation and Aesthetics Study

Dear Stakeholders:

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc. (Enel), is the Licensee and operator of the 22.4 megawatt (MW) Lowell Hydroelectric Project (Project or Lowell Project). The Lowell Project is located on the Merrimack River in Middlesex County, Massachusetts, and in Hillsborough County, New Hampshire. The existing license for the Project was issued by the Federal Energy Regulatory Commission (FERC or Commission) with an effective date of May 1, 1973. The existing license expires on April 30, 2023. Accordingly, Boott is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with the Commission's Study Plan Determination issued on March 13, 2019, Boott is initiating consultation with the National Park Service (NPS), American Whitewater, and the Massachusetts Department of Conservation and Recreation (MADCR) to identify specific locations for field reconnaissance and visitor-intercept surveys. As part of the Recreation and Aesthetics Study, Boott will conduct field reconnaissance and visitor-intercept interviews at specific recreational facilities during the prime recreational season from May 2019 through October 2019. Boott will interview recreationists visiting these locations to collect data relevant to visitors' recreational experience in the Project area, including but not limited to, data regarding demographics, types of recreational activities participated in or may participate in during their visit, and their reasons for choosing the site or area. As a separate component of the Recreation and Aesthetics Study, Boott is hosting an online version of the visitor-intercept survey to capture additional recreationists that would like to participate (the online version of the visitor survey is available at: [https://hdrinc.co1.qualtrics.com/jfe/form/SV\\_0AnPxTboxMRT8nX](https://hdrinc.co1.qualtrics.com/jfe/form/SV_0AnPxTboxMRT8nX)). Boott will install signage informing recreationists of the online survey at various locations determined in consultation with NPS.

As shown in Figure 1 provided as Attachment A, Boott is proposing the following nine locations to conduct the reconnaissance and visitor-intercept surveys:

- Lowell Heritage State Park
- Merrimack Trail System

- Pawtucket Falls Overlook
- NPS Canal Walkways
- Lowell National Historic Park
- Lowell National Historic Park Visitor Center
- Chelmsford Boat Access
- Rourke Brothers Boat Ramp
- Merrill Park

Boott is also proposing ten locations<sup>1</sup> (as shown in Figure 1) to install the temporary signs informing recreationists of the online survey opportunity. Boott respectfully requests any comments regarding the proposed reconnaissance and visitor-intercept locations or the signage locations within 15 days of this letter (i.e., by May 22, 2019). Following consultation with stakeholders, Boott will develop the final list of reconnaissance and visitor-intercept locations and will file the final list with the Commission and distribute to American Whitewater, NPS, and the MADCR. If we do not receive a response from your office, Boott will move forward with the study to include the visitor-intercept survey locations as shown in the attached figure.

On behalf of Boott, I appreciate the opportunity to consult with your offices regarding this study. Please do not hesitate to contact me at (978) 935-6039 if you have any questions concerning this matter.

Sincerely,

**Boott Hydropower, LLC**



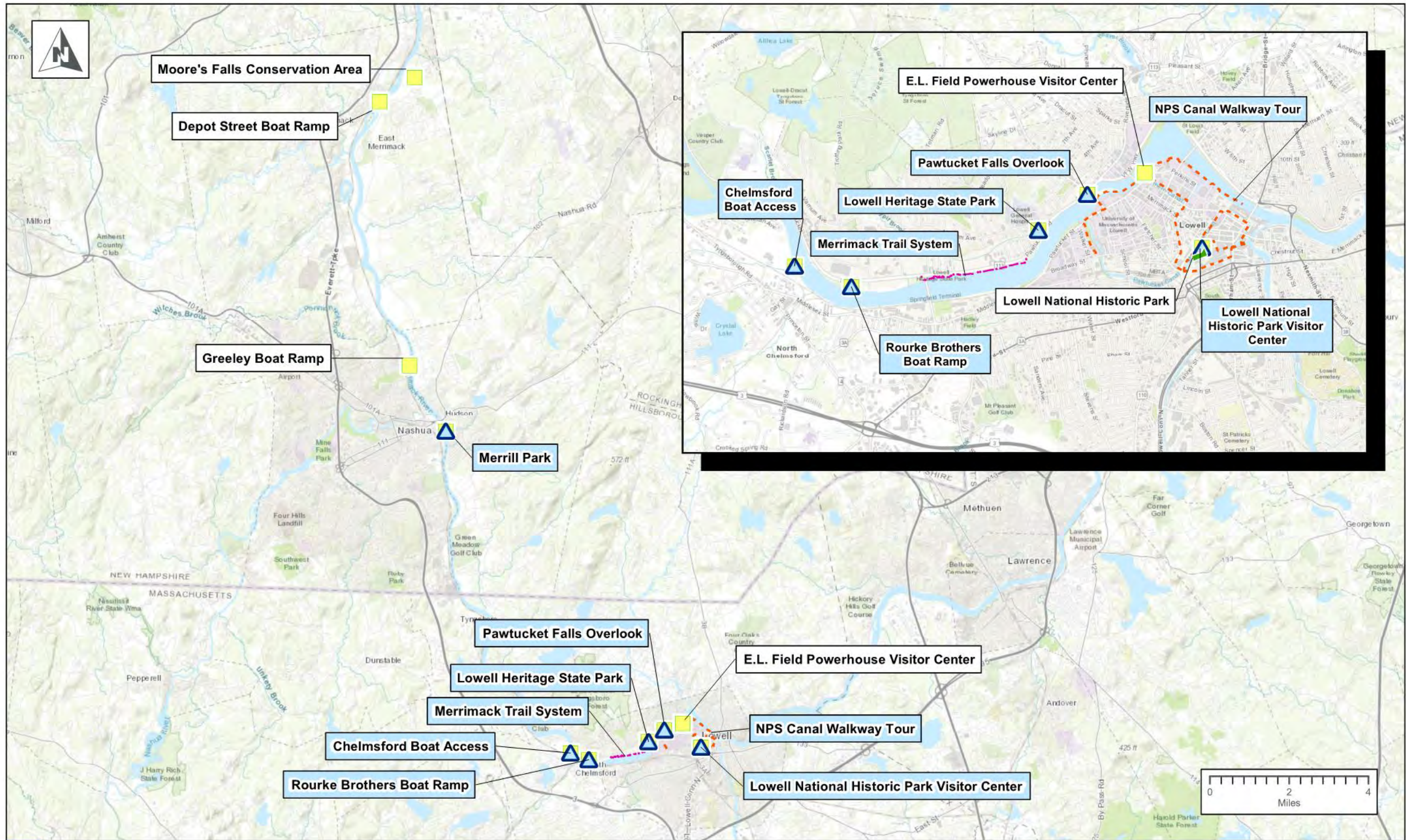
Kevin M. Webb  
Hydro Licensing Manager

cc: K. Bose, FERC  
K. Mendik, NPS

Attachment A – Figure 1

---

<sup>1</sup>Boott will install temporary signs that will be removed at the completion of the study season. Boott will not affix signage to any historic structures or cultural resources without additional prior consultation with NPS and NPS partners.



## Scott, Kelsey

---

**From:** Quiggle, Robert  
**Sent:** Tuesday, May 7, 2019 1:45 PM  
**To:** celeste\_bernardo@nps.gov  
**Cc:** kevin.mendik@nps.gov; 'Kevin.Webb@enel.com'; Gibson, Jim; MacVane, Kelly; Anderson, Elise (EGP North America); Scott, Kelsey  
**Subject:** Lowell Hydroelectric Project (FERC No. 2790-072) -- Consultation Regarding the Water Level and Flow Effects on Historic Resources Study  
**Attachments:** 20190507 Lowell Hydro Project Flow Effects Study Consultation.pdf

Ms. Bernardo:

On behalf of Boott Hydropower, LLC (Boott), I am distributing the attached consultation request in support of the Federal Energy Regulatory Commission (FERC) relicensing of the Lowell Hydroelectric Project (Project). As described in the attached correspondence, Boott is consulting with the National Park Service to identify locations at the Project where water surface level loggers will be temporarily installed to record data for the approved Water Level and Flow Effects on Historic Resources Study.

Should you have any questions regarding the attached correspondence, please contact Kevin Webb with Boott at 978-935-6039 or [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank you,

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)



Robert A. Nasdor  
Northeast Stewardship & Legal Director  
365 Boston Post Road, Suite 250  
Sudbury, MA 01776  
617-584-4566  
[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)

[www.americanwhitewater.org](http://www.americanwhitewater.org)

---

May 17, 2019

Kevin Webb  
Enel Green Power  
100 Brickstone Square, Suite 300  
Andover, MA 01810

Dear Kevin,

I write in response to your letter of May 7, 2019 regarding the proposed locations for field reconnaissance user intercept surveys for the Lowell Hydroelectric Project Recreation and Aesthetics Study. Thank you for reaching out to us to solicit our feedback in accordance with the requirements of the Study Plan Determination.

While the proposed locations will provide useful information to better understand aspects of current and future recreational use in the project area, these proposed locations will not collect information that will enable the Licensee and FERC to evaluate recreational demand for flows, access, and facilities that would support whitewater boating opportunity in the bypassed reach or in other areas that are impacted by project operations. There is well established history of whitewater boating on the Concord River during the spring freshet, demonstrating that there is strong interest in whitewater boating opportunity in the project area. Given the current lack of flows, access and information that would provide for whitewater boating opportunity in the bypassed reach, we do not believe that the survey locations will adequately collect information that will be useful for determining future whitewater boating use.

We recommend that the Licensee utilize the online survey instrument to collect information from whitewater boaters to evaluate the demand for whitewater boating opportunity at the project. In addition, the Licensee should incorporate into this study the results of the planned whitewater boating study that will evaluate the suitability of the bypassed reach for whitewater boating. We also recommend that the licensee collect user intercept surveys at the whitewater takeout on the Merrimack River below the confluence with the Concord River during weekends during the spring freshet in 2020 in order to include information from whitewater boaters in this study.

Thank you for considering this information in the development of the survey plan.



We look forward to working with you throughout the relicensing process.

Very truly yours,

Bob Nasdor  
Northeast & Legal Stewardship Director  
365 Boston Post Road, Suite 250  
Sudbury, MA 01776  
617-584-4566  
[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)

## Scott, Kelsey

---

**From:** Bernardo, Celeste <celeste\_bernardo@nps.gov>  
**Sent:** Tuesday, May 28, 2019 9:16 AM  
**To:** Jones, Scott  
**Subject:** Re: [EXTERNAL] Lowell Level Logger Deployment

Great. Thank you!  
Celeste

Celeste Bernardo  
Superintendent  
[Lowell National Historical Park](#)  
978 275-1703  
[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)  
Like us on [Facebook](#)

On Tue, May 28, 2019 at 7:56 AM Jones, Scott <[Scott.Jones@hdrinc.com](mailto:Scott.Jones@hdrinc.com)> wrote:

Celeste,

Made it in safely last night. I will meet you at the Boot Mills Museum Conference Room at 10:30 this morning. Thanks,

### **Scott A. Jones, B.S., PWS**

Senior Environmental Scientist/Project Manager

**D** 315.414.2205 **M** 315.317.6680

[scott.jones@hdrinc.com](mailto:scott.jones@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

**From:** Bernardo, Celeste [mailto:[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)]  
**Sent:** Friday, May 24, 2019 2:56 PM  
**To:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Cc:** [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com); Gibson, Jim <[Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com)>; Anderson, Elise (EGP North America) <[elise.anderson@enel.com](mailto:elise.anderson@enel.com)>; Jones, Scott <[Scott.Jones@hdrinc.com](mailto:Scott.Jones@hdrinc.com)>  
**Subject:** Re: [EXTERNAL] Lowell Level Logger Deployment

Great! We will actually be meeting at the Boott Cotton Mills Museum at the Foot of John Street. There is pay parking in the Joseph Downes Garage at 75 John Street. He can walk to the Boott Mills Museum, but rather than going in the entrance, he should continue down the mill courtyard to the business entrance. There he can enter and take the elevator up to the 5th floor where we will be meeting in the conference room (left out of the elevators). My cell phone is 508.415.4715 should he need to reach me.

Celeste

Celeste Bernardo

Superintendent

[Lowell National Historical Park](#)

978 275-1703

[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)

Like us on [Facebook](#)

On Fri, May 24, 2019 at 2:47 PM Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)> wrote:

Celeste:

It was good to talk with you this afternoon. Scott Jones, a Senior Scientist with HDR, will be at the project on Tuesday to install the equipment as we discussed. Scott will be travelling part of the way on Monday evening, and will try to be at your office by 10:30 AM on Tuesday morning. If he is delayed due to traffic he will head over to your office as soon as he gets into town.

I am passing along Scott's contact information so that you or your staff can reach out to him directly while he's in the field:

**Scott A. Jones, B.S., PWS**

*Senior Environmental Scientist/Project Manager*

**HDR**

1304 Buckley Road, Suite 202  
Syracuse, NY 13212  
D 315.414.2205 M 315.317.6680  
[scott.jones@hdrinc.com](mailto:scott.jones@hdrinc.com)

If you could let Scott know the best way to contact you (email, phone, text), he'll contact you on Tuesday morning so that you'll know his schedule.

Thanks again for taking the time to review the maps and material with your team on Tuesday, and we look forward to working with the Park Service on these upcoming studies.

Sincerely,

**Robert Quiggle**, RPA

*Regulatory and Environmental Section Manager*

**HDR**

1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](https://www.hdrinc.com/follow-us)

## Scott, Kelsey

---

**To:** Jones, Scott  
**Subject:** RE: [EXTERNAL] Lowell Project Recreation and Aesthetics Study

**From:** Bruins, Christine [mailto:christine\_bruins@nps.gov]  
**Sent:** Friday, June 14, 2019 10:15 AM  
**To:** Jones, Scott <Scott.Jones@hdrinc.com>  
**Cc:** Quiggle, Robert <Robert.Quiggle@hdrinc.com>; Webb, Kevin (EGP North America) <Kevin.Webb@enel.com>  
**Subject:** Re: [EXTERNAL] Lowell Project Recreation and Aesthetics Study

Scott,

The City of Lowell is carrying out a number of bridge construction project this year and the crew is experiencing issues controlling water. There is a moderate probability the entire canal system will be drained down next week to diagnose and resolve the problem. City is being fined thousands of dollars daily while work cannot not resume and the water control issue cannot be delayed. Is there any chance you could rework your schedule for the following week?

**Christine Bruins | Community Planner**  
Lowell National Historical Park  
978.275.1726 (office) | 978.954.1011 (cell)

On Fri, Jun 14, 2019 at 7:52 AM Jones, Scott <[Scott.Jones@hdrinc.com](mailto:Scott.Jones@hdrinc.com)> wrote:

Christine,

Right now we are scheduled for Tuesday (6/18) as I am also scheduled to be on another project on Wednesday and Thursday of that week. This other work is flow and weather dependent so if anything changes I will certainly let you know. Thanks for the update.

Regards,

**Scott A. Jones, B.S., PWS**

Senior Environmental Scientist/Project Manager

**D** 315.414.2205 **M** 315.317.6680

[scott.jones@hdrinc.com](mailto:scott.jones@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

**From:** Bruins, Christine [mailto:[christine\\_bruins@nps.gov](mailto:christine_bruins@nps.gov)]  
**Sent:** Thursday, June 13, 2019 11:54 AM  
**To:** Jones, Scott <[Scott.Jones@hdrinc.com](mailto:Scott.Jones@hdrinc.com)>  
**Cc:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>; Webb, Kevin (EGP North America) <[Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com)>  
**Subject:** Re: [EXTERNAL] Lowell Project Recreation and Aesthetics Study

Scott,

Now that the Eastern Canal is drained for bridge work, there is a lot of trash visible on the canal bottom. This includes electronics and other hazardous items. Our staff are in a required 2-day occupational hazard training Tuesday and Wednesday next week. Would it at all be possible to meet in the field with you Thursday instead?

**Christine Bruins | Community Planner**

Lowell National Historical Park

978.275.1726 (office) | 978.954.1011 (cell)

On Wed, Jun 12, 2019 at 2:47 PM Bruins, Christine <[christine\\_bruins@nps.gov](mailto:christine_bruins@nps.gov)> wrote:

We can arrange to take you by trolley/boat to efficiently get you to and around most of the canal areas.

**Christine Bruins | Community Planner**

Lowell National Historical Park

978.275.1726 (office) | 978.954.1011 (cell)

On Wed, Jun 12, 2019 at 2:44 PM Jones, Scott <[Scott.Jones@hdrinc.com](mailto:Scott.Jones@hdrinc.com)> wrote:

Christine,

Thank you for following up with us. I received your message but have been tied up this afternoon. I am still solidifying my plans for next week, but we envision either Tuesday or Wednesday and can certainly meet you/staff/partners during one of those afternoons. I should know for sure by the end of this week. Thank you also for the detailed map, it will certainly make our visit more efficient. I will let you know as soon as I confirm my schedule. Thanks again,

**Scott A. Jones, B.S., PWS**

Senior Environmental Scientist/Project Manager

**D** 315.414.2205 **M** 315.317.6680

[scott.jones@hdrinc.com](mailto:scott.jones@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

**From:** Bruins, Christine [mailto:[christine\\_bruins@nps.gov](mailto:christine_bruins@nps.gov)]  
**Sent:** Wednesday, June 12, 2019 2:34 PM  
**To:** Webb, Kevin (EGP North America) <[Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com)>  
**Cc:** Jones, Scott <[Scott.Jones@hdrinc.com](mailto:Scott.Jones@hdrinc.com)>; Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Subject:** Re: [EXTERNAL] Lowell Project Recreation and Aesthetics Study

Scott,

Celeste asked me to coordinate your trash survey next week with our staff and partners. I have gathered information from our staff on the areas where trash collects (see attached map). I am very interested in meeting with you to discuss the issues and problem areas. I'd also be interested in accompanying you and others for part of your field work. I'm collecting the availability of other staff and partners that would like to be involved in the study. Have you narrowed your field work within next week? My availability next week is as follows, will update you when I hear back from a couple of others.

Mon 6/17 - After 2 pm

Tue 6/18 - after 12 pm

Wed 6/19 before 2 pm

Thurs - anytime

Fri - anytime

**Christine Bruins | Community Planner**

Lowell National Historical Park

978.275.1726 (office) | 978.954.1011 (cell)

On Tue, Jun 4, 2019 at 10:35 AM Bernardo, Celeste <[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)> wrote:

Christine, in my absence, are you okay with coordinating with ENEL on this? I am fine with them attending a management team or biweekly meeting, although biweekly would be better since there are more supervisors. Or else you can set up a separate meeting. Can you check with Paul and Kevin and see who on their staffs should participate?

Celeste

Celeste Bernardo

Superintendent

[Lowell National Historical Park](#)

978 275-1703

[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)

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----- Forwarded message -----

From: **Jones, Scott** <[Scott.Jones@hdrinc.com](mailto:Scott.Jones@hdrinc.com)>

Date: Mon, Jun 3, 2019 at 2:50 PM



Subject: [EXTERNAL] Lowell Project Recreation and Aesthetics Study

To: Bernardo, Celeste <[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)>

Cc: [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com) <[Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com)>, Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>

Celeste,

As part of the Lowell Recreation and Aesthetics Study, HDR is planning on visiting the Project the week of June 17-21, 2019 to survey and document waterborne trash as outlined in the study plan approved by the Federal Energy Regulatory Commission. In accordance with the approved plan, HDR is conducting this work in the spring of 2019 when higher flows typically push trash and debris downstream. Based on our meeting last week, HDR understands that NPS staff is very familiar with locations within the canal system where waterborne trash accumulates. In anticipation of our visit, HDR would like to coordinate with your office to identify these areas so that we can accurately document and record these locations.

Accordingly, we are hoping to meet with you or your staff to briefly review project maps prior to the start of fieldwork. If you could let me know a good time during the week of June 17 to meet with you or appropriate NPS staff, it would be greatly appreciated. Please note that NPS staff is also welcome to accompany us as we conduct this fieldwork (we expect the work to take about a day to complete).

Thank you,

**Scott A. Jones, B.S., PWS**

*Senior Environmental Scientist/Project Manager*

**HDR**

1304 Buckley Road, Suite 202  
Syracuse, NY 13212  
D 315.414.2205 M 315.317.6680  
[scott.jones@hdrinc.com](mailto:scott.jones@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

## Scott, Kelsey

---

**From:** Bernardo, Celeste <celeste\_bernardo@nps.gov>  
**Sent:** Wednesday, July 3, 2019 8:25 AM  
**To:** Jones, Scott  
**Cc:** Kevin.Webb@enel.com; Quiggle, Robert  
**Subject:** Re: [EXTERNAL] Lowell Project Recreation and Aesthetics Study

That's great Scott. Thank you for the clarification. Look forward to assisting where we can.

Celeste

Celeste Bernardo  
Superintendent  
[Lowell National Historical Park](#)  
978 275-1703  
[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)  
Like us on [Facebook](#)

On Tue, Jul 2, 2019 at 7:48 PM Jones, Scott <[Scott.Jones@hdrinc.com](mailto:Scott.Jones@hdrinc.com)> wrote:

Celeste,

As the RSP and the FERC SPD indicates we will be surveying for water-borne trash after spring freshet, so with the unusual conditions this year we will be performing this component in 2020. Tomorrow we will be downloading the level loggers and installing recreational survey signs. Call or email me if you or Christine have any questions.

Sent via the Samsung Galaxy S9+, an AT&T 5G Evolution capable smartphone



**Boott Hydropower, LLC**

A Subsidiary of Enel Green Power North America, Inc.

100 Brickstone Square, Suite 300 – Andover, MA 01810 – USA  
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*Via Email and Post*

July 24, 2019

Mr. Robert Nasdor  
NE Stewardship Director  
American Whitewater  
65 Blueberry Hill Lane  
Sudbury, MA 01776  
[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)

Ms. Celeste Bernardo  
Superintendent  
Lowell National Historic Park  
US National Park Service  
67 Kirk Street  
Lowell, MA 01852  
[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)

Mr. Steve Carlin  
Park Supervisor  
Lowell Heritage State Park  
Massachusetts Department of Conservation & Recreation  
160 Pawtucket Blvd.  
Lowell, MA 01854  
[steve.carlin@state.ma.us](mailto:steve.carlin@state.ma.us)

Mr. George Rose  
Deputy Director  
Office of Emergency Management  
The City of Lowell Fire Department  
JFK Civic Center  
99 Moody Street  
Lowell, MA 01852

**Re: Lowell Hydroelectric Project (FERC No. 2790-072);  
Whitewater Boating and Access Study**

Dear Stakeholders:

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc. (Enel), is the Licensee and owner of the 22.4 megawatt Lowell Hydroelectric Project (FERC No. 2790) (Project or Lowell Project). The Lowell Project is located on the Merrimack River in Middlesex County, Massachusetts, and in Hillsborough County, New Hampshire. The existing license for the Project was issued by the Federal Energy Regulatory Commission (FERC or Commission) with an effective date of May 1, 1973. The existing license expires on April 30, 2023. Accordingly, Boott is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations Part 5.

In accordance with the ILP, Boott developed a Pre-Application Document (PAD) and Notice of Intent (NOI) which were filed with the Commission on April 30, 2018 to initiate the formal relicensing process. By letter dated August 8, 2018, American Whitewater (AW) provided comments on the PAD and NOI and requested that Boott undertake a controlled flow release whitewater study in support of Project relicensing. Pursuant

to the requirements of the ILP, Boott developed a Proposed Study Plan (PSP) that was filed with the Commission on September 28, 2018. In the PSP, Boott proposed a Whitewater Boating and Access Study to assess the Project's bypass reach for whitewater boating and boater accessibility. A revised Whitewater Boating and Access Study plan was filed in Boott's January 28, 2019 Revised Study Plan (RSP) for Project relicensing. As described in the RSP, Boott proposed to conduct a Whitewater Boating and Access Study based on the guidance provided in *Flows and Recreation: A Guide to Studies for River Professionals*<sup>1</sup>. FERC issued the Study Plan Determination (SPD) for the Project on March 13, 2019. The Commission's SPD approved the Whitewater Boating and Access Study plan without modifications.

As described in the approved Whitewater Boating and Access Study plan, Boott has proposed to form a Whitewater Boating and Access Study Working Group (Working Group) to assist in study planning and coordination and to identify volunteer boaters to participate in this study. As an initial step in the planning process, Boott is inviting potentially interested stakeholders to participate in a Working Group site visit at the Project to discuss the study schedule and logistics, volunteer participation, general safety, flow releases, and the survey forms included as appendices D, E, and F of the RSP. During this site visit, the Working Group will also conduct a reconnaissance of the Project's bypass reach to identify site-specific safety concerns and access areas.

**Boott invites stakeholders to participate in a Working Group site visit at the Project on August 8, 2019 from 9:00 AM until 12:00 PM.** Please notify the undersigned at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com) if you intend to participate in the Working Group site visit or if you would like to suggest a different date and/or time. Parties interested in participating should meet at the Project's E.L. Field Powerhouse located at 145 Pawtucket Street, Lowell, Massachusetts 01854. Please wear sturdy footwear; no sandals, open-toed shoes, or shorts.

At this time, Boott is not aware of other stakeholders or organizations with an interest in participating in the Working Group. If your office knows of any additional stakeholders or organizations who should be invited to participate, Boott respectfully requests that you notify the undersigned via email at your earliest convenience so that they can be invited to participate in the site visit.

On behalf of Boott, I appreciate the opportunity to consult with you, and we look forward to meeting with you in August to discuss the upcoming Whitewater Boating and Access Study. Please do not hesitate to contact me at (978) 935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com) if you have any questions concerning this study or Project relicensing.

Sincerely,  
**Boott Hydropower, LLC**



Kevin M. Webb  
Hydro Licensing Manager

Cc: E. Anderson (Enel)  
Christine Bruins (NPS)  
R. Quiggle (HDR)

---

<sup>1</sup> Whittaker. (2005). *Flows and Recreation: A Guide to Studies for River Professionals*. Washington, DC: Hydropower Reform Coalition and National Park Service - Hydropower Recreation Assistance.

## Scott, Kelsey

---

**From:** Quiggle, Robert  
**Sent:** Wednesday, July 31, 2019 11:24 AM  
**To:** Bob Nasdor; Webb, Kevin (EGP North America)  
**Cc:** Anderson, Elise (EGP North America); Scott, Kelsey  
**Subject:** RE: Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study

Thanks, Bob. We are continuing to do outreach to the invited participants, and we will let you know when we have a response.

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
Robert.Quiggle@hdrinc.com

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

---

**From:** Bob Nasdor [mailto:[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)]  
**Sent:** Wednesday, July 31, 2019 6:48 AM  
**To:** Webb, Kevin (EGP North America) <[kevin.webb@enel.com](mailto:kevin.webb@enel.com)>; Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Cc:** Anderson, Elise (EGP North America) <[elise.anderson@enel.com](mailto:elise.anderson@enel.com)>  
**Subject:** Re: Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study

We need to firm up whether this is happening on the 8th by Friday or wise postpone the meeting to another week.

Robert Nasdor  
American Whitewater  
Northeast Stewardship & Legal Director  
65 Blueberry Hill Lane  
Sudbury, MA 01776  
617-584-4566  
[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)

---

**From:** Webb, Kevin (EGP North America) <[Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com)>  
**Sent:** Friday, July 26, 2019 9:58:18 AM  
**To:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>; Bob Nasdor <[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)>  
**Cc:** Anderson, Elise (EGP North America) <[elise.anderson@enel.com](mailto:elise.anderson@enel.com)>  
**Subject:** RE: Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study

Thanks Rob. Either of those days would work for me.

---

**From:** Quiggle, Robert [mailto:[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)]  
**Sent:** Friday, July 26, 2019 9:52 AM  
**To:** Bob Nasdor

**Cc:** Webb, Kevin (EGP North America); Anderson, Elise (EGP North America)

**Subject:** RE: Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study

Bob:

I haven't had any additional feedback, but I will let you know when we hear back from the group. Copying Kevin and Elise with Enel here so that they can stay in the loop for planning purposes.

Thanks,

**Robert Quiggle**, RPA

*Regulatory and Environmental Section Manager*

**HDR**

1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

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**From:** Bob Nasdor [<mailto:bob@americanwhitewater.org>]

**Sent:** Thursday, July 25, 2019 7:51 AM

**To:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>

**Subject:** Re: Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study

Any feedback from others on the meeting? My first choice would be on the 9th, second choice on the afternoon of the 8th. Thanks

Bob

Robert Nasdor  
American Whitewater  
Northeast Stewardship & Legal Director  
65 Blueberry Hill Lane  
Sudbury, MA 01776  
617-584-4566  
[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)

---

**From:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>

**Sent:** Wednesday, July 24, 2019 1:03:16 PM

**To:** Bob Nasdor | AW <[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)>

**Subject:** RE: Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study

No problem, Bob. See you next month

**Robert Quiggle**, RPA

*Regulatory and Environmental Section Manager*

**HDR**

1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

**From:** Bob Nasdor | AW [<mailto:bob@americanwhitewater.org>]  
**Sent:** Wednesday, July 24, 2019 12:58 PM  
**To:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Subject:** Re: Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study

Oops. Wrong year. 2020. That should work for me.

Bob Nasdor  
Northeast Stewardship & Legal Director  
American Whitewater  
65 Blueberry Hill Lane  
Sudbury, MA 01776  
[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)  
617-584-4566

Join American Whitewater!

On Wed, Jul 24, 2019 at 12:42 PM Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)> wrote:

Bob:

You may be looking at the wrong month (maybe June?); August 8 is a Thursday.

I think this will be a good opportunity for everyone to really have a look at the reach together and work out some of the logistics. Looking forward to meeting with you at Lowell.

Thanks,

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](https://hdrinc.com/follow-us)

**From:** Bob Nasdor | AW [<mailto:bob@americanwhitewater.org>]  
**Sent:** Wednesday, July 24, 2019 12:37 PM  
**To:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Subject:** Re: Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study

Hi Rob,

Thanks for sending this. Looking forward to the meeting. This is scheduled for Saturday, August 8th? I would have no objections to this taking place on Friday August 7th if that's better for others.

Bob

Bob Nasdor  
Northeast Stewardship & Legal Director  
American Whitewater  
65 Blueberry Hill Lane  
Sudbury, MA 01776  
[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)  
617-584-4566

Join American Whitewater!

On Wed, Jul 24, 2019 at 10:20 AM Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)> wrote:

Dear Stakeholders:

Boott Hydropower, LLC, a subsidiary of Enel Green Power North America, is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the Lowell Hydroelectric Project (FERC No. 2790) (Project) located along the Merrimack River in Middlesex County, Massachusetts, and in Hillsborough County, New Hampshire. In support of Project relicensing, Boott is conducting a Whitewater Boating and Access Study in the Project's bypassed reach located in the City of Lowell. On behalf of Boott, we are inviting your participation in an upcoming Whitewater Boating and Access Study Working Group site visit to the Project on August 8, 2019. The site visit is an important component of the study and will be an opportunity to discuss study logistics, volunteer participation, safety, boater access, boatability, flows in the bypassed reach, and survey instruments. Additional details regarding the August 8, 2019 site visit are presented in the attached letter.

Should you have any questions regarding the upcoming site visit, please contact Mr. Kevin Webb, Enel Hydro Licensing Manager, at 978-935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank you,

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)



## Scott, Kelsey

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**From:** Anderson, Elise (EGP North America) <elise.anderson@enel.com>  
**Sent:** Monday, August 5, 2019 2:38 PM  
**To:** Quiggle, Robert; Bob Nasdor (bob@americanwhitewater.org); celeste\_bernardo@nps.gov; steve.carlin@state.ma.us; jcalvin@lowelllandtrust.org; Christine\_bruins@nps.gov  
**Cc:** Webb, Kevin (EGP North America); Battaglia, Brett; Scott, Kelsey; Gibson, Jim; Jones, Scott; Clark, Jeff (EGP North America)  
**Subject:** RE: Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study

Hi All-

We have invited the Lowell Fire Chief to attend the working group meeting (awaiting confirmation). The City's perspective on emergency responder access to the bypass area will be an important component to consider for the study.

Looking forward to our meeting Thursday.

Thank you,

### Elise Anderson

Sr. Environmental Permitting Specialist  
Business Development



### Enel Green Power North America

100 Brickstone Square– Ste 300 – Andover , MA – 01810- USA  
M +1-978-447-4408  
[elise.anderson@enel.com](mailto:elise.anderson@enel.com)

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This message is intended for the following use only: **PUBLIC** – INTERNAL – CONFIDENTIAL – STRICTLY CONFIDENTIAL

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**From:** Quiggle, Robert [mailto:Robert.Quiggle@hdrinc.com]  
**Sent:** Friday, August 2, 2019 2:11 PM  
**To:** Bob Nasdor (bob@americanwhitewater.org) <bob@americanwhitewater.org>; celeste\_bernardo@nps.gov; steve.carlin@state.ma.us; jcalvin@lowelllandtrust.org; Christine\_bruins@nps.gov  
**Cc:** Anderson, Elise (EGP North America) <elise.anderson@enel.com>; Webb, Kevin (EGP North America) <Kevin.Webb@enel.com>; Battaglia, Brett <Brett.Battaglia@hdrinc.com>; Scott, Kelsey <Kelsey.Scott@hdrinc.com>;

Gibson, Jim <Jim.Gibson@hdrinc.com>; Jones, Scott <Scott.Jones@hdrinc.com>

**Subject:** RE: Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study

Dear Stakeholders:

Based on feedback from American Whitewater and the National Park Service, we are confirming the Whitewater Boating and Access Study Working Group site visit at the Lowell Hydroelectric Project on August 8, 2019. Participants indicated that an afternoon meeting would be best; accordingly, we are inviting interested stakeholders to **meet at 12 PM on Thursday, August 8, 2019 at the E.L. Field Powerhouse** located at 145 Pawtucket Street, Lowell, Massachusetts 01854. We expect the site visit will last about three hours. As a reminder, please wear sturdy footwear; no sandals, open-toed shoes, or shorts. Should you have any questions about the site visit, please contact me at the phone number or email address below, or contact Mr. Kevin Webb, Enel Hydro Licensing Manager, at 978-935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank you,

**Robert Quiggle**, RPA

*Regulatory and Environmental Section Manager*

**HDR**

1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

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**From:** Quiggle, Robert

**Sent:** Wednesday, July 24, 2019 10:21 AM

**To:** Bob Nasdor ([bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)) <[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)>; 'celeste\_bernardo@nps.gov' <[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)>; 'steve.carlin@state.ma.us' <[steve.carlin@state.ma.us](mailto:steve.carlin@state.ma.us)>

**Cc:** 'Christine\_bruins@nps.gov' <[Christine\\_bruins@nps.gov](mailto:Christine_bruins@nps.gov)>; Anderson, Elise (EGP North America) <[elise.anderson@enel.com](mailto:elise.anderson@enel.com)>; 'Kevin.Webb@enel.com' <[Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com)>; MacVane, Kelly <[Kelly.MacVane@hdrinc.com](mailto:Kelly.MacVane@hdrinc.com)>; Scott, Kelsey <[Kelsey.Scott@hdrinc.com](mailto:Kelsey.Scott@hdrinc.com)>; Gibson, James ([Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com)) <[Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com)>

**Subject:** Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study

Dear Stakeholders:

Boott Hydropower, LLC, a subsidiary of Enel Green Power North America, is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the Lowell Hydroelectric Project (FERC No. 2790) (Project) located along the Merrimack River in Middlesex County, Massachusetts, and in Hillsborough County, New Hampshire. In support of Project relicensing, Boott is conducting a Whitewater Boating and Access Study in the Project's bypassed reach located in the City of Lowell. On behalf of Boott, we are inviting your participation in an upcoming Whitewater Boating and Access Study Working Group site visit to the Project on August 8, 2019. The site visit is an important component of the study and will be an opportunity to discuss study logistics, volunteer participation, safety, boater access, boatability, flows in the bypassed reach, and survey instruments. Additional details regarding the August 8, 2019 site visit are presented in the attached letter.

Should you have any questions regarding the upcoming site visit, please contact Mr. Kevin Webb, Enel Hydro Licensing Manager, at 978-935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank you,

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
**D** 315.414.2216 **M** 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

## Scott, Kelsey

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**To:** Scott, Kelsey  
**Subject:** RE: [EXTERNAL] RE: Agenda / Schedule for 2 day FERC Study Plan Work Session

**From:** Quiggle, Robert  
**Sent:** Tuesday, September 17, 2019 3:50 PM  
**To:** Bruins, Christine <[christine\\_bruins@nps.gov](mailto:christine_bruins@nps.gov)>  
**Cc:** 'Kevin.Webb@enel.com' <[Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com)>; Anderson, Elise (EGP North America) <[elise.anderson@enel.com](mailto:elise.anderson@enel.com)>; Scott, Kelsey <[Kelsey.Scott@hdrinc.com](mailto:Kelsey.Scott@hdrinc.com)>; Gibson, Jim <[Jim.Gibson@hdrinc.com](mailto:Jim.Gibson@hdrinc.com)>  
**Subject:** RE: [EXTERNAL] RE: Agenda / Schedule for 2 day FERC Study Plan Work Session

Christine:

Attached is a draft agenda for the proposed two-day workshop in support of the Lowell Hydroelectric Project FERC relicensing. Once you've had a chance to review with your team, we can look to see what dates would make sense. I'd like to try for a mid-October timeframe, as there is a field/site visit component associated with this, and it would probably be better to get that done before things get too snowy/icy.

If you have questions or would like to discuss further, please don't hesitate to call or email me.

Thanks,

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

**From:** Bruins, Christine [[mailto:christine\\_bruins@nps.gov](mailto:christine_bruins@nps.gov)]  
**Sent:** Monday, September 16, 2019 5:05 PM  
**To:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Subject:** Re: [EXTERNAL] RE: Agenda / Schedule for 2 day FERC Study Plan Work Session

Hi Rob,

Have you made progress on a 2-day work session agenda?

**Christine Bruins** | **Community Planner**  
Lowell National Historical Park  
978.275.1726 (office) | 978.954.1011 (cell)

On Mon, Sep 9, 2019 at 10:17 AM Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)> wrote:

Christine:

We are working on finalizing that agenda now, and will provide to you shortly.

Thanks,

**Robert Quiggle**, RPA

*Regulatory and Environmental Section Manager*

**HDR**

1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

**From:** Bruins, Christine [mailto:[christine\\_bruins@nps.gov](mailto:christine_bruins@nps.gov)]  
**Sent:** Monday, September 9, 2019 10:15 AM  
**To:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Subject:** Agenda / Schedule for 2 day FERC Study Plan Work Session

Rob,

Can you please forward the agenda / schedule for the planned 2 day FERC Study work session so that I can get a list of contacts to reach out to regarding scheduling?

**Christine Bruins | Community Planner**

Lowell National Historical Park

978.275.1726 (office) | 978.954.1011 (cell)

## Scott, Kelsey

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**From:** Quiggle, Robert  
**Sent:** Monday, October 28, 2019 3:25 PM  
**To:** Bob Nasdor (bob@americanwhitewater.org); celeste\_bernardo@nps.gov; Bruins, Christine; Cooksey, William (DCR); John Aziz; Hoffmann, Peter (DCR); 'bruce@zoaroutdoor.com'; kevin@zoaroutdoor.com; Rose, George; CMcCall@lowellma.gov  
**Cc:** 'Kevin.Webb@enel.com'; Anderson, Elise (EGP North America); Scott, Kelsey  
**Subject:** Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study  
**Attachments:** 20191028 Lowell Whitewater Flow Documentation Plan.pdf  
**Follow Up Flag:** Follow up  
**Flag Status:** Completed

### Working Group Participants:

Boott Hydropower, LLC (Boott) is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the continued operation of the Lowell Hydroelectric Project (FERC No. 2790)(Project) located along the Merrimack River. In support of Project relicensing, Boott is conducting a Whitewater Boating and Access Study as approved in FERC's March 13, 2019 Study Plan Determination for the Project. Pursuant to the approved study plan, Boott met with the Whitewater Boating and Access Study Working Group (Working Group) at the Project on August 8, 2019 to coordinate study planning, identify potential volunteers to participate in controlled flow releases, and to identify potential put-in and take-out locations.

During the August 8, 2019, meeting and site visit, the Working Group indicated a need to visually document a range of flows in the Project's bypass reach in order to assist the participants in identifying which flows to select for the controlled flow releases. Accordingly, Boott has developed the attached Whitewater Flow Documentation Plan that describes the methods for documenting a range of flow conditions in the bypass reach and consulting with the Working Group to identify the appropriate flows for the controlled flow releases.

In order to facilitate implementation of the Whitewater Flow Documentation Plan, Boott is seeking your written (email) concurrence with the proposed plan by November 11, 2019. If you have questions or need additional information, please contact Kevin Webb, Boott Hydro Licensing Manager, at (978) 935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank you,

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
**D** 315.414.2216 **M** 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)



**Boott Hydropower, LLC**

A Subsidiary of Enel Green Power North America, Inc.

100 Brickstone Square, Suite 300 – Andover, MA 01810 – USA  
T +1 978 681 1900 – F +1 978 681 7727

*Via Email Distribution*

October 28, 2019

**To: Whitewater Boating and Access Working Group**

**Re: Lowell Hydroelectric Project (FERC No. 2790-072);  
Whitewater Boating and Access Study  
Whitewater Flow Documentation Plan**

Dear Whitewater Boating and Access Working Group:

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc., is the Licensee and owner of the 20.2 megawatt Lowell Hydroelectric Project (FERC No. 2790) (Project). The Project is located on the Merrimack River in Middlesex County, Massachusetts, and in Hillsborough County, New Hampshire. The existing license for the Project was issued by the Federal Energy Regulatory Commission (FERC or Commission) with an effective date of May 1, 1973. The existing license expires on April 30, 2023. Accordingly, Boott is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process, as described at 18 Code of Federal Regulations Part 5.

In support of Project relicensing, Boott is conducting a Whitewater Boating and Access Study as approved in the Commission's March 13, 2019 Study Plan Determination for the Project. Pursuant to the approved study plan, Boott met with the Whitewater Boating and Access Study Working Group (Working Group) at the Project on August 8, 2019 to coordinate study planning, identify potential volunteers to participate in controlled flow releases, and to identify potential put-in and take-out locations. During the August 8, 2019, meeting and site visit, the Working Group indicated a need to visually document a range of flows in the Project's bypass reach in order to assist the participants in identifying which flows to select for the controlled flow releases. Since the Working Group participants have had limited experience boating the bypass reach, participants could not make informed choices on which flows would be appropriate for boating. Accordingly, Boott has developed the enclosed Whitewater Flow Documentation Plan that describes the methods for documenting a range of flow conditions in the bypass reach and consulting with the Working Group to identify the appropriate flows for the controlled flow releases.

Boott is proposing to document flows in the bypass reach using cellular-enabled trail cameras and to provide the Working Group with a summary report that presents photographs of the bypass reach under various flow conditions. To capture a wide range of flow conditions, Boott is proposing to deploy cellular-enabled trail cameras from approximately December 1, 2019 through May 15, 2020. The cameras will record photos on an hourly basis during daylight hours, and the photographs will be date- and time-stamped. In the summary report, Boott will present representative photographs at approximately 500 cubic feet-per-second (cfs) intervals (e.g., 500 cfs, 1,000 cfs, 1,500 cfs, etc.) along with the corresponding river flow data.

As described in the enclosed plan, Boott will consult with the Working Group based on the Whitewater Flow Documentation Report to determine the appropriate flows for the controlled flow releases. To facilitate the flow documentation and consultation, Boott anticipates conducting the controlled flow releases once the Working Group has had the opportunity to review the Whitewater Flow Documentation Report and after fish passage operations at the Project end around July 15, 2020. The timing of the controlled flow releases will be dependent on available flows in the Merrimack River.

At this time, Boott is seeking your concurrence regarding the Whitewater Flow Documentation Plan and the general schedule for documenting flows and conducting the controlled flow releases. To facilitate timely deployment of the trail cameras, Boott respectfully requests your written (email) concurrence on or

---

before November 11, 2019. Please send correspondence to the undersigned at the email address provided below.

On behalf of Boott, I look forward to continued discussions and consultation with the Working Group regarding this study. Please do not hesitate to contact me at (978) 935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com) if you have any questions concerning this study or Project relicensing.

Sincerely,  
**Boott Hydropower, LLC**



Kevin M. Webb  
Hydro Licensing Manager

Encls.

Cc: E. Anderson (Boott)  
R. Quiggle (HDR)



**Lowell Hydroelectric Project (FERC No. 2790- 072)  
Whitewater Boating and Access Study Working Group**

**Email Distribution List**

---

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Ms. Christine McCall  
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City of Lowell Dept. of Planning and Development  
[CMcCall@lowellma.gov](mailto:CMcCall@lowellma.gov)



# Whitewater Flow Documentation Plan

Lowell Hydroelectric Project  
(FERC No. 2790)

October 2019

Prepared by:



Prepared for:

Boott Hydropower, LLC  
Andover, Massachusetts



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## List of Acronyms

|               |                                                      |
|---------------|------------------------------------------------------|
| Boott         | Boott Hydropower, LLC                                |
| CFR           | Code of Federal Regulations                          |
| cfs           | cubic feet-per-second                                |
| FERC          | Federal Energy Regulatory Commission (or Commission) |
| ILP           | Integrated Licensing Process                         |
| MW            | megawatt                                             |
| NPS           | National Park Service                                |
| Project       | Lowell Hydroelectric Project (or Lowell Project)     |
| RSP           | Revised Study Plan                                   |
| SPD           | Study Plan Determination                             |
| Study         | Whitewater Boating and Access Study                  |
| USGS          | U.S. Geological Survey                               |
| Working Group | Whitewater Boating and Access Study Working Group    |

# 1 Introduction and Background

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc., is the Licensee and operator of the 20.2 megawatt (MW) Lowell Hydroelectric Project (FERC Project No. 2790) (Project or Lowell Project). The Project is located along the Merrimack River in Middlesex County, Massachusetts and in Hillsborough County, New Hampshire. Boott owns and operates the Project as an independent power producer.

The existing license for the Project was issued by the Federal Energy Regulatory Commission (FERC or Commission) with an effective date of May 1, 1973. The existing license expires on April 30, 2023. Accordingly, Boott is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5. As proposed in Boott's January 28, 2019 Revised Study Plan (RSP) and approved in the Commission's March 13, 2019 Study Plan Determination (SPD), Boott will conduct a Whitewater Boating and Access Study (Study) in support of Project relicensing.

## 1.1 Whitewater Boating and Access Study Overview

The Lowell Project is a run-of-river hydropower plant. When river flows exceed the hydraulic capacity of the two generating units located at the E.L. Field Powerhouse (combined capacity of approximately 8,000 cubic feet per second [cfs]), excess flows (up to approximately 2,000 cfs) are routed through the downtown Lowell canal system and through the canal units. When inflows exceed the 10,000 cfs capacity of the generating units and canals, all excess flows are passed over the Pawtucket Dam spillway into the bypass reach. The Project has the potential to affect whitewater boating opportunities in the bypass reach when flows are less than 10,000 cfs.

As described in the approved Revised Study Plan, the goal of the Study is to assess the Project's bypass reach for whitewater boating and access opportunities. The objectives of the study are as follows:

- Assess a range of flows suitable for whitewater boating opportunities in the Project's bypass reach;
- Assess the frequency, timing, duration, and predictability of paddling flows under current and proposed Project operations;
- Define potential locations for put-in and take-out points for boaters; and,
- Assess the flow information needs for whitewater boating and the current and potential flow information distribution system.

In accordance with the approved study plan, Boott met with the Whitewater Boating and Access Study Working Group (Working Group) at the Project on August 8, 2019 to coordinate study planning, identify potential volunteers to participate in controlled flow releases, and to identify potential put-in and take-out locations.

During the August 8, 2019, meeting and site visit, the Working Group indicated a need to visually document a range of flows in the Project's bypass reach in order to assist the participants in identifying which flows to select for the controlled flow releases. Since the Working Group participants had limited experience boating the bypass reach, participants could not make informed choices on which flows would be appropriate for boating. Accordingly, Boott has developed this Whitewater Flow Documentation Plan that describes the methods for documenting a range of flow conditions in the bypass reach and consulting with the Working Group to identify the appropriate flows for the controlled flow releases.

## 2 Methodology

To document the whitewater conditions in the bypass reach under various flows, Boott proposes to deploy cellular-enabled trail cameras to capture time- and date-stamped images of the bypass reach on an hourly basis during daylight hours.

In general, the average flows at the Project from June through February are within the operating range of the Project's E.L. Field Powerhouse and the units along the downtown canal system; however, seasonal high water events (in excess of 10,000 cfs) do occasionally occur in the late fall. Boott also maintains flows in the canal system to facilitate National Park Service (NPS) boat tours from May 15 through October 15, annually<sup>1</sup>. Therefore, to capture flows in the bypass reach during months where higher flows typically occur (March through May), and to document a broad range of flow conditions, Boott is proposing to deploy cellular-enabled trail cameras from approximately December 1, 2019 through May 15, 2020.

Boott will deploy cellular-enabled trail cameras at four locations along the bypass reach to capture images of different sections of the reach under the various flows conditions. As shown below in Figure 2-1, Boott is proposing to deploy cameras at the following four locations:

- The Fish Ladder at the Pawtucket Dam;
- A location along the bypass reach located upstream from the University Avenue Bridge;
- A location along the bypass reach located downstream from the University Avenue Bridge; and
- The E.L. Field Powerhouse.

To verify the flows represented by the photographs, Boott will use Project operations data in combination with U.S. Geological Survey (USGS) information. There is an

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<sup>1</sup> 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

existing USGS gage installed approximately 2.1 miles downstream from the Pawtucket Dam (USGS No. 01100000, Merrimack River BL Concord River at Lowell, MA). There is also an existing USGS gage installed on the Concord River (USGS No. 01099500, Concord R below R Meadow Brook, at Lowell, MA). Flows from the USGS Gage No. 01099500 will be subtracted from the flows at USGS Gage No. 01100000 to calculate flows at the Project. Flows in the bypass can be estimated by applying the weir formula to the depth of flow over each crest gate zone (plus any flow provided via the fish ladder). Bypass flows can also be estimated by subtracting the sum of flow at the E.L. Field Powerhouse and through the canal system from the inflow calculated from the USGS gages as described above.

### 3 Consultation with Working Group

Boott will prepare a summary Whitewater Flow Documentation Report that provides photographic documentation of a range of flows in the Project's bypass reach. Boott anticipates providing images and verified flows in intervals of approximately 500 cfs (e.g., 500 cfs, 1,000 cfs, 1,500 cfs, etc.). Boott also intends to provide images of verified flows at the lowest and highest flows observed from December 1 through May 15. Once the Working Group has had the opportunity to review the Whitewater Flow Documentation Report, Boott anticipates conducting the controlled flow releases after fish passage operations end around July 15, 2020, to avoid any interference with fish passage studies scheduled for the Spring/Summer 2020 fish passage season.

Based on the information presented in the Whitewater Flow Documentation Report, Boott will consult with the Working Group to select the controlled releases to be provided during the Study in 2020. The timing of the controlled flow releases will be dependent on available flows in the Merrimack River. Each of the controlled releases will be provided for approximately 3 hours. This will afford participants the opportunity to boat the reach and make multiple passes at each flow so that participants are able to evaluate different lines through various portions of the study reach. Pre, post, and comparative surveys will be provided to controlled flow release participants for their completion during this portion of the study (draft pre, post, and comparative surveys can be found in Appendices D through F of the RSP).



Lowell Hydroelectric Project  
Whitewater Flow Documentation Plan

Figure 2-1. Locations of Cellular-Enabled Cameras



## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Friday, November 1, 2019 2:24 PM  
**To:** celeste\_bernardo@nps.gov; christine\_bruins@nps.gov; Paul\_Fontaine@nps.gov; kevin\_coffee@nps.gov; laurel\_racine@nps.gov; peter\_reitchel@nps.gov; kevin\_mendik@nps.gov; duncan\_hay@nps.gov; Emily.Byrne@mail.house.gov; darryl.forgione@mass.gov; patrice.kish@mass.gov; thomas.m.walsh@mass.gov; william.cooksey@mass.gov; peter.hoffmann@mass.gov; dtradd@lowellma.gov; KKeefeMullin@lowellma.gov; cthomas@lowellma.gov; cclancy@lowellma.gov; jwinward@lowellma.gov; CRicker@lowellma.gov; chayes@lowellma.gov; CMcCall@lowellma.gov; scerand@hotmail.com; greenesh@comcast.net; jcalvin@lowelllandtrust.org; ffaust@edgegroupinc.com  
**Cc:** Quiggle, Robert; Webb, Kevin (EGP North America); elise.anderson@enel.com  
**Subject:** Lowell Hydroelectric Project (FERC No. 2790) Study Workshop  
**Attachments:** November 2019\_Lowell Hydro Project Workshop Agenda.pdf

Dear Stakeholders:

Boott Hydropower, LLC (Boott) is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the continued operation of the Lowell Hydroelectric Project (FERC No. 2790)(Project) located along the Merrimack River. In support of Project relicensing, Boott is conducting a Recreation and Aesthetics Study, a Historically Significant Waterpower Equipment Study, and a Water Level and Flow Effects on Historic Resources Study, as approved in FERC's March 13, 2019 Study Plan Determination for the Project. Boott intends to hold a two-day Lowell Hydroelectric Project Study Workshop (Workshop) with interested stakeholders to address data needs and conduct a Project site visit related to the above studies.

The Workshop will be held in Lowell, MA over two days in November 2019. The first day will focus on stakeholder consultation, information gathering, and data needs for the three studies mentioned above. Boott anticipates this first day will take place from 9am-4pm in Lowell, MA. Additional details regarding the meeting space to follow. The second day will consist of a site visit to target specific Project facilities associated with the studies.

Boott is proposing the following dates for the two-day Workshop:

November 12-13, 2019  
November 13-14, 2019  
November 14-15, 2019  
November 19-20, 2019

Please notify Boott of the dates you can attend the Workshop by completing the poll here: <https://www.surveymonkey.com/r/YQFX7LD> . Boott has developed the attached Lowell Hydroelectric Project Study Workshop Agenda. In order to facilitate the scheduling of the Workshop, Boott is asking that all interested stakeholders complete the poll by November 6, 2019. If you have questions or need additional information, please contact Kevin Webb, Boott Hydro Licensing Manager, at (978) 935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank You –

**Kelsey Scott, MS**  
*Assistant Regulatory Specialist*

**HDR**

1304 Buckley Road, Suite 202  
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[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)  
[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

## Scott, Kelsey

---

**To:** Racine, Laurel  
**Subject:** RE: [EXTERNAL] Lowell Hydroelectric Project (FERC No. 2790) Study Workshop

**From:** Racine, Laurel [mailto:laurel\_racine@nps.gov]  
**Sent:** Monday, November 4, 2019 8:09 AM  
**To:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>  
**Subject:** Re: [EXTERNAL] Lowell Hydroelectric Project (FERC No. 2790) Study Workshop

Kelsey,  
I'm writing because the NPS blocked my access to your poll. My participation would be most useful for the first day, not the site visits. Days I'm available for the day 1 workshop are November 12 or November 13, so either of the first two options are good for me. Thanks.  
Laurel

---

Laurel A. Racine, Chief of Cultural Resources  
Lowell National Historical Park  
67 Kirk Street  
Lowell, MA 01852

Desk: 978-970-5055  
Cell: (978) 423-3081



On Fri, Nov 1, 2019 at 2:24 PM Scott, Kelsey <[Kelsey.Scott@hdrinc.com](mailto:Kelsey.Scott@hdrinc.com)> wrote:

Dear Stakeholders:

Boott Hydropower, LLC (Boott) is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the continued operation of the Lowell Hydroelectric Project (FERC No. 2790)(Project) located along the Merrimack River. In support of Project relicensing, Boott is conducting a Recreation and Aesthetics Study, a Historically Significant Waterpower Equipment Study, and a Water Level and Flow Effects on Historic Resources Study, as approved in FERC's March 13, 2019 Study Plan Determination for the Project. Boott intends to hold a two-day Lowell Hydroelectric Project Study Workshop (Workshop) with interested stakeholders to address data needs and conduct a Project site visit related to the above studies.

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Thank You –

**Kelsey Scott, MS**

*Assistant Regulatory Specialist*

**HDR**

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# Agenda

Project: Lowell Hydroelectric Project (FERC No. 2790)

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Date/Time: TBD

---

Location: Lowell National Historic Park, Lowell MA

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## **Subject: Lowell Hydroelectric Project Study Workshop**

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc., is the Licensee and owner of the 20.2 megawatt Lowell Hydroelectric Project (FERC No. 2790) (Project). The Project is located on the Merrimack River in Middlesex County, Massachusetts, and in Hillsborough County, New Hampshire. The existing license for the Project was issued by the Federal Energy Regulatory Commission (FERC or Commission) with an effective date of May 1, 1973. The existing license expires on April 30, 2023. Accordingly, Boott is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process, as described at 18 Code of Federal Regulations Part 5.

In support of Project relicensing, Boott is proposing to hold a two-day study workshop in Lowell, MA to consult with the National Park Service (NPS), Massachusetts Department of Conservation and Recreation (MADCR), City of Lowell (City), and other partners regarding certain studies approved in the Commission's March 13, 2019 Study Plan Determination for the Project. As described in the approved study plan, Boott is seeking information from the NPS, MADCR, and other partners regarding the Recreation and Aesthetics Study, the Historically Significant Waterpower Equipment Study, and the Water Level and Flow Effects on Historical Resources Study. The proposed two-day workshop will be an opportunity for consulting parties to share information and to identify the specific focus for field activities.

### **Day One: Data Needs and Information Gathering**

The first day of the proposed workshop is intended to allow Boott, the NPS, MADCR, City, and other participating parties to discuss data needs and review available documentation. A proposed agenda for this day one of the workshop is presented below.

#### **1. Introduction**

- Welcome and introduction
- Overview and status of FERC relicensing process

#### **2. Recreation and Aesthetics Study**

##### *Study-specific Data Needs and Information Gathering*

- Recreation opportunities and access along the canal system;
- Future use or planning documents that address anticipated or desired changes to the Lowell National Historic Park and Lowell Heritage State Park (e.g., The Foundation Report, or 5-year and 10-year plans);
- Documentation of any reoccurring public safety issues or incidents within the parks associated with the canal infrastructure related to public recreation;
- Annual maintenance schedules for the canal system;
- Management or operations plans for the parks; and
- Annual use records.

### **3. Historically Significant Waterpower Equipment Study**

#### *Study-specific Data Needs and Information Gathering*

- Historically significant waterpower equipment owned and operated by Boott Hydropower of interest to the NPS for potential future interpretation, exhibition, or as scrap equipment to maintain and operate other historic machinery;
- Engineering reports, drawings, and/or photographs related to historically significant waterpower equipment owned and operated by Boott Hydropower of interest to the NPS; and
- Components of historically significant waterpower equipment owned and operated by Boott Hydropower that will require photography and documentation.

### **4. Water Level and Flow Effects on Historic Resources Study**

#### *Study-specific Data Needs and Information Gathering*

- Engineering reports or evaluations of historic canal structures, including documentation of previous maintenance and/or repairs related to canal water levels;
- Descriptions and/or photographs of properties that have been previously affected by canal operations; and
- Engineering and architectural drawings, maintenance records, and structural modifications of the Great River Wall.

### **5. Action Items and Next Steps**

#### **Day Two: Site Visit**

Day two of the proposed workshop is focused on a site visit at the Project. The purpose of the site visit is to view locations identified during day one of the workshop, including:

- Areas of potential recreation enhancements and potential recreational access areas;
- Historically significant waterpower equipment selected by the NPS for documentation, including specific equipment to be photographed;
- Canal features that have been previously impacted by flows and water levels; and
- Areas along the canal system where waterborne trash collects.

## Scott, Kelsey

---

**From:** Hayes, Christopher <chayes@lowellma.gov>  
**Sent:** Monday, November 4, 2019 9:59 AM  
**To:** Scott, Kelsey  
**Cc:** Ricker, Claire V.; McCall, Christine  
**Subject:** RE: Lowell Hydroelectric Project (FERC No. 2790) Study Workshop

**Follow Up Flag:** Follow up  
**Flag Status:** Flagged

Hi, Kelsey,

Should I forward this to other potential interested stakeholders, or is the invitation limited to this list?

Thanks so much,  
-Chris

### Christopher Glenn Hayes | *Neighborhood Planner*

The City of Lowell | Department of Planning and Development

50 Arcand Drive | Lowell, MA 01852

t: 978.674.1405 | f: 978.970.4262

<http://www.lowellma.gov>

**LOWELL** *Alive. Unique. Inspiring.*

---

**From:** Scott, Kelsey [mailto:Kelsey.Scott@hdrinc.com]

**Sent:** Friday, November 01, 2019 2:24 PM

**To:** celeste\_bernardo@nps.gov; christine\_bruins@nps.gov; Paul\_Fontaine@nps.gov; kevin\_coffee@nps.gov; laurel\_racine@nps.gov; peter\_reitchel@nps.gov; kevin\_mendik@nps.gov; duncan\_hay@nps.gov; Emily.Byrne@mail.house.gov; darryl.forgione@mass.gov; patrice.kish@mass.gov; thomas.m.walsh@mass.gov; william.cooksey@mass.gov; peter.hoffmann@mass.gov; Tradd, Diane; Keefe Mullin, Kara; Thomas, Craig; Clancy, Christine; jwinward@lowellma.gov; Ricker, Claire V.; Hayes, Christopher; McCall, Christine; scerand@hotmail.com; greenesh@comcast.net; jcalvin@lowelllandtrust.org; ffaust@edgegroupinc.com

**Cc:** Quiggle, Robert; Webb, Kevin (EGP North America); elise.anderson@enel.com

**Subject:** Lowell Hydroelectric Project (FERC No. 2790) Study Workshop

Dear Stakeholders:

Boott Hydropower, LLC (Boott) is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the continued operation of the Lowell Hydroelectric Project (FERC No. 2790)(Project) located along the Merrimack River. In support of Project relicensing, Boott is conducting a Recreation and Aesthetics Study, a Historically Significant Waterpower Equipment Study, and a Water Level and Flow Effects on Historic Resources Study, as approved in FERC's March 13, 2019 Study Plan Determination for the Project. Boott intends to hold a two-day Lowell Hydroelectric Project Study Workshop (Workshop) with interested stakeholders to address data needs and conduct a Project site visit related to the above studies.



The Workshop will be held in Lowell, MA over two days in November 2019. The first day will focus on stakeholder consultation, information gathering, and data needs for the three studies mentioned above. Boott anticipates this first day will take place from 9am-4pm in Lowell, MA. Additional details regarding the meeting space to follow. The second day will consist of a site visit to target specific Project facilities associated with the studies.

Boott is proposing the following dates for the two-day Workshop:

November 12-13, 2019

November 13-14, 2019

November 14-15, 2019

November 19-20, 2019

Please notify Boott of the dates you can attend the Workshop by completing the poll here:

<https://www.surveymonkey.com/r/YQFX7LD> . Boott has developed the attached Lowell Hydroelectric Project Study Workshop Agenda. In order to facilitate the scheduling of the Workshop, Boott is asking that all interested stakeholders complete the poll by November 6, 2019. If you have questions or need additional information, please contact Kevin Webb, Boott Hydro Licensing Manager, at (978) 935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank You –

**Kelsey Scott, MS**

*Assistant Regulatory Specialist*

**HDR**

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## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Friday, November 8, 2019 11:17 AM  
**To:** 'celeste\_bernardo@nps.gov'; 'christine\_bruins@nps.gov'; 'Paul\_Fontaine@nps.gov'; 'kevin\_coffee@nps.gov'; 'laurel\_racine@nps.gov'; 'peter\_reitchel@nps.gov'; 'kevin\_mendik@nps.gov'; 'duncan\_hay@nps.gov'; 'Emily.Byrne@mail.house.gov'; 'darryl.forgione@mass.gov'; 'patrice.kish@mass.gov'; 'thomas.m.walsh@mass.gov'; 'william.cooksey@mass.gov'; 'peter.hoffmann@mass.gov'; 'dtradd@lowellma.gov'; 'KKeefeMullin@lowellma.gov'; 'cthomas@lowellma.gov'; 'cclancy@lowellma.gov'; 'jwinward@lowellma.gov'; 'CRicker@lowellma.gov'; 'chayes@lowellma.gov'; 'CMcCall@lowellma.gov'; 'scerand@hotmail.com'; 'greenesh@comcast.net'; 'jcalvin@lowelllandtrust.org'; 'ffaust@edgegroupinc.com'  
**Cc:** 'Anderson, Elise (EGP North America)'; Webb, Kevin (EGP North America); Quiggle, Robert  
**Subject:** Update - Lowell Hydroelectric Project (FERC No. 2790) Study Workshop  
**Attachments:** December 2019\_Lowell Hydro Project Workshop Agenda.pdf

Dear Stakeholders –

Due to scheduling conflicts, Boott is resurveying this group for available dates to hold the two-day Lowell Hydroelectric Project Study Workshop (Workshop) with interested stakeholders. The first day of the Workshop will focus on stakeholder consultation, information gathering, and data needs. Boott anticipates this first day will take place from 9am-4:30pm in Lowell, MA. Additional details regarding the meeting space to follow. The second day will consist of a site visit to target specific Project facilities.

Boott is proposing the following dates for the two-day Workshop:

December 4-5, 2019  
December 5-6, 2019  
December 9-10, 2019  
December 10-11, 2019  
December 11-12, 2019  
December 17-18, 2019  
December 18-19, 2019

Please notify Boott of the dates you can attend the Workshop by completing the Doodle Poll here:

<https://doodle.com/poll/dp2qb9232aq66awg>

In order to facilitate the scheduling of the Workshop, Boott is asking that all interested stakeholders complete the poll by November 13, 2019. If you have questions or need additional information, please contact Kevin Webb, Boott Hydro Licensing Manager, at (978) 935-6039 or via email at Kevin.Webb@enel.com.

Thank You –

**Kelsey Scott, MS**  
*Assistant Regulatory Specialist*

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[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

# Agenda

Project: Lowell Hydroelectric Project (FERC No. 2790)

---

Date/Time: TBD

---

Location: Lowell National Historic Park, Lowell MA

---

## **Subject: Lowell Hydroelectric Project Study Workshop**

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc., is the Licensee and owner of the 20.2 megawatt Lowell Hydroelectric Project (FERC No. 2790) (Project). The Project is located on the Merrimack River in Middlesex County, Massachusetts, and in Hillsborough County, New Hampshire. The existing license for the Project was issued by the Federal Energy Regulatory Commission (FERC or Commission) with an effective date of May 1, 1973. The existing license expires on April 30, 2023. Accordingly, Boott is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process, as described at 18 Code of Federal Regulations Part 5.

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#### **1. Introduction**

- Welcome and introduction
- Overview and status of FERC relicensing process

#### **2. Recreation and Aesthetics Study**

##### *Study-specific Data Needs and Information Gathering*

- Recreation opportunities and access along the canal system;
- Future use or planning documents that address anticipated or desired changes to the Lowell National Historic Park and Lowell Heritage State Park (e.g., The Foundation Report, or 5-year and 10-year plans);
- Documentation of any reoccurring public safety issues or incidents within the parks associated with the canal infrastructure related to public recreation;
- Annual maintenance schedules for the canal system;
- Management or operations plans for the parks; and
- Annual use records.

### **3. Historically Significant Waterpower Equipment Study**

#### *Study-specific Data Needs and Information Gathering*

- Historically significant waterpower equipment owned and operated by Boott Hydropower of interest to the NPS for potential future interpretation, exhibition, or as scrap equipment to maintain and operate other historic machinery;
- Engineering reports, drawings, and/or photographs related to historically significant waterpower equipment owned and operated by Boott Hydropower of interest to the NPS; and
- Components of historically significant waterpower equipment owned and operated by Boott Hydropower that will require photography and documentation.

### **4. Water Level and Flow Effects on Historic Resources Study**

#### *Study-specific Data Needs and Information Gathering*

- Engineering reports or evaluations of historic canal structures, including documentation of previous maintenance and/or repairs related to canal water levels;
- Descriptions and/or photographs of properties that have been previously affected by canal operations; and
- Engineering and architectural drawings, maintenance records, and structural modifications of the Great River Wall.

### **5. Action Items and Next Steps**

#### **Day Two: Site Visit**

Day two of the proposed workshop is focused on a site visit at the Project. The purpose of the site visit is to view locations identified during day one of the workshop, including:

- Areas of potential recreation enhancements and potential recreational access areas;
- Historically significant waterpower equipment selected by the NPS for documentation, including specific equipment to be photographed;
- Canal features that have been previously impacted by flows and water levels; and
- Areas along the canal system where waterborne trash collects.



IN REPLY REFER TO:

## United States Department of the Interior

NATIONAL PARK SERVICE  
Lowell National Historical Park  
67 Kirk Street  
Lowell, Massachusetts 01852-1029

Kevin Webb, Hydro Licensing Manager  
Enel Green Power North America, Inc.  
100 Brickstone Square, Suite 300  
Andover, MA 01810

November 15, 2010  
E filed at FERC – Non-ER

**RE: NPS Response to Whitewater Boating and Access Study  
Whitewater Flow Documentation Plan  
Boott Hydropower, LLC  
Lowell Hydroelectric Project, FERC No. 2790-072  
Merrimack River, Middlesex County, MA, and Hillsborough County, NH**

Thank you for providing an opportunity to comment on the Whitewater Flow Documentation Plan. Upon review, Lowell National Historical Park staff do not have comments for the proposed methodology to identify target flows. We do have questions and comments relating to data collected during the controlled flow releases in the study period.

### **NPS Boat Tours and Northern Canal Walkway**

Page 2: We greatly appreciate that you have noted the arrangement between Boott Hydropower, LLC and the National Park Service (NPS) in regard to NPS boat tours and have planned study parameters with this operation in mind. Please also note that public access to the Northern Canal Walkway is dependent on flow conditions in the Merrimack River being under 3500 cubic feet per second (CFS). The normal operating season for the Northern Canal Walkway is also May 15-Oct 15. There is strong public support for increasing walkway access through longer daily hours and/or lengthening the operating season.

### **Controlled Flow Releases for Whitewater Rafting**

Page 3: In regard to the controlled flow releases to be performed around July 2020 for the study:

1. How far up and downstream will flows in the Merrimack River and Canal System be affected by controlled flow releases at the dam? How will the Whitewater Boating and Access Study monitor flow impacts outside of the bypass reach? Please note:
  - a. Merrimack River flow rate must be under 18,500 CFS for NPS to operate education programs on a river boat along the Merrimack River. NPS offers river boat education programs annually May 1 through October 15.
  - b. Merrimack River flow must be under 12,500 CFS for NPS canal boats to enter Merrimack River from Pawtucket Canal. The NPS canal boat operating season occurs annually May 15 through October 15.
  - c. Merrimack River flow rate must be under 3500 CFS to open the NPS Northern Canal Walkway. The operating season for the Northern Canal Walkway is May 15 through October 15. There is strong public support to increase the operating season for this walkway.
  - d. With the Pawtucket Dam measured at 0'0", if water level readings at Francis Gate go below 1'0" canal boats cannot navigate through lock chamber at Francis Gate as boat engines will run into ground on granite ledge upstream of Francis Gate. If water level readings are above 6'0", boats cannot fit under Pawtucket Street Bridge. The NPS canal boat operating season occurs annually May 15 through October 15.
2. Would controlled flow releases impact water flow and/or fish access to the fish ladder? How will this be monitored in the study period?
3. Could controlled flow releases cause scour conditions or other negative impacts to historic properties, particularly along the foundation wall of the Northern Canal/Pawtucket Gatehouse and the Great Wall separating the Northern Canal from the Merrimack River? How will this be monitored in the study period?

We appreciate the opportunity to assist Enel in the development, conduct and evaluation of the Whitewater Boating and Access Study.

Sincerely,



Celeste Bernardo,

Superintendent, Lowell National Historical Park

## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Thursday, November 21, 2019 5:04 PM  
**To:** Quiggle, Robert  
**Subject:** FW: [EXTERNAL] RE: Update - Lowell Hydroelectric Project (FERC No. 2790) Study Workshop

FYI an item to discuss tomorrow.

**From:** Bruins, Christine [mailto:christine\_bruins@nps.gov]  
**Sent:** Thursday, November 21, 2019 5:00 PM  
**To:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>; Webb, Kevin (EGP North America) <Kevin.Webb@enel.com>  
**Subject:** Re: [EXTERNAL] RE: Update - Lowell Hydroelectric Project (FERC No. 2790) Study Workshop

Kelsey and Kevin,

I don't see the "Resources, Ownership, Boundaries, and Land Rights Study" on the agenda. City, DCR, NPS are very invested in the success of that study. We're hoping it can serve as the basis for a new MOU among parties for maintenance and canal stewardship. Could you add it to the agenda as item 2 or 3? We can host this size of group in our Visitor Center (246 Market Street). Meeting attendees can park for free in our visitor center parking lot.

**Christine Bruins | Community Planner**  
Lowell National Historical Park  
978.275.1726 (office) | 978.954.1011 (cell)

On Thu, Nov 21, 2019 at 4:43 PM Scott, Kelsey <[Kelsey.Scott@hdrinc.com](mailto:Kelsey.Scott@hdrinc.com)> wrote:

Dear Stakeholders:

Based on the results of recent scheduling polls, we are confirming that the Lowell Hydroelectric Project Study Workshop (Workshop) with interested stakeholders will occur over two days from December 18—19, 2019. The first day will focus on stakeholder consultation, information gathering, and data needs for the three studies listed in the attached agenda. Boott anticipates this first day will take place from 9am-4:30pm in Lowell, MA at the National Park Service Headquarters for the Lowell National Historical Park. The second day will consist of a site visit to target specific Project facilities associated with the studies. Boott anticipates this second day site visit to occur from 9am-12pm.

Additional information will follow this email in the weeks ahead of the Workshop meeting. Should you have any questions about the Workshop, please contact me at the phone number or email address below, or contact Mr. Kevin Webb, Enel Hydro Licensing Manager, at 978-935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).



Thank You –

## Kelsey Scott, MS

Assistant Regulatory Specialist

### HDR

1304 Buckley Road, Suite 202  
Syracuse, NY 13212

D 315.414.2206  
[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

---

**From:** Scott, Kelsey

**Sent:** Friday, November 8, 2019 11:17 AM

**To:** '[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)' <[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)>; '[christine\\_bruins@nps.gov](mailto:christine_bruins@nps.gov)' <[christine\\_bruins@nps.gov](mailto:christine_bruins@nps.gov)>; '[Paul\\_Fontaine@nps.gov](mailto:Paul_Fontaine@nps.gov)' <[Paul\\_Fontaine@nps.gov](mailto:Paul_Fontaine@nps.gov)>; '[kevin\\_coffee@nps.gov](mailto:kevin_coffee@nps.gov)' <[kevin\\_coffee@nps.gov](mailto:kevin_coffee@nps.gov)>; '[laurel\\_racine@nps.gov](mailto:laurel_racine@nps.gov)' <[laurel\\_racine@nps.gov](mailto:laurel_racine@nps.gov)>; '[peter\\_reitchel@nps.gov](mailto:peter_reitchel@nps.gov)' <[peter\\_reitchel@nps.gov](mailto:peter_reitchel@nps.gov)>; '[kevin\\_mendik@nps.gov](mailto:kevin_mendik@nps.gov)' <[kevin\\_mendik@nps.gov](mailto:kevin_mendik@nps.gov)>; '[duncan\\_hay@nps.gov](mailto:duncan_hay@nps.gov)' <[duncan\\_hay@nps.gov](mailto:duncan_hay@nps.gov)>; '[Emily.Byrne@mail.house.gov](mailto:Emily.Byrne@mail.house.gov)' <[Emily.Byrne@mail.house.gov](mailto:Emily.Byrne@mail.house.gov)>; '[darryl.forgione@mass.gov](mailto:darryl.forgione@mass.gov)' <[darryl.forgione@mass.gov](mailto:darryl.forgione@mass.gov)>; '[patrice.kish@mass.gov](mailto:patrice.kish@mass.gov)' <[patrice.kish@mass.gov](mailto:patrice.kish@mass.gov)>; '[thomas.m.walsh@mass.gov](mailto:thomas.m.walsh@mass.gov)' <[thomas.m.walsh@mass.gov](mailto:thomas.m.walsh@mass.gov)>; '[william.cooksey@mass.gov](mailto:william.cooksey@mass.gov)' <[william.cooksey@mass.gov](mailto:william.cooksey@mass.gov)>; '[peter.hoffmann@mass.gov](mailto:peter.hoffmann@mass.gov)' <[peter.hoffmann@mass.gov](mailto:peter.hoffmann@mass.gov)>; '[dtradd@lowellma.gov](mailto:dtradd@lowellma.gov)' <[dtradd@lowellma.gov](mailto:dtradd@lowellma.gov)>; '[KKeefeMullin@lowellma.gov](mailto:KKeefeMullin@lowellma.gov)' <[KKeefeMullin@lowellma.gov](mailto:KKeefeMullin@lowellma.gov)>; '[cthomas@lowellma.gov](mailto:cthomas@lowellma.gov)' <[cthomas@lowellma.gov](mailto:cthomas@lowellma.gov)>; '[cclancy@lowellma.gov](mailto:cclancy@lowellma.gov)' <[cclancy@lowellma.gov](mailto:cclancy@lowellma.gov)>; '[jwinward@lowellma.gov](mailto:jwinward@lowellma.gov)' <[jwinward@lowellma.gov](mailto:jwinward@lowellma.gov)>; '[CRicker@lowellma.gov](mailto:CRicker@lowellma.gov)' <[CRicker@lowellma.gov](mailto:CRicker@lowellma.gov)>; '[chayes@lowellma.gov](mailto:chayes@lowellma.gov)' <[chayes@lowellma.gov](mailto:chayes@lowellma.gov)>; '[CMcCall@lowellma.gov](mailto:CMcCall@lowellma.gov)' <[CMcCall@lowellma.gov](mailto:CMcCall@lowellma.gov)>; '[scerand@hotmail.com](mailto:scerand@hotmail.com)' <[scerand@hotmail.com](mailto:scerand@hotmail.com)>; '[greenesh@comcast.net](mailto:greenesh@comcast.net)' <[greenesh@comcast.net](mailto:greenesh@comcast.net)>; '[jcalvin@lowelllandtrust.org](mailto:jcalvin@lowelllandtrust.org)' <[jcalvin@lowelllandtrust.org](mailto:jcalvin@lowelllandtrust.org)>; '[ffaust@edgegroupinc.com](mailto:ffaust@edgegroupinc.com)' <[ffaust@edgegroupinc.com](mailto:ffaust@edgegroupinc.com)>

**Cc:** 'Anderson, Elise (EGP North America)' <[elise.anderson@enel.com](mailto:elise.anderson@enel.com)>; Webb, Kevin (EGP North America) <[Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com)>; Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>

**Subject:** Update - Lowell Hydroelectric Project (FERC No. 2790) Study Workshop

Dear Stakeholders –

Due to scheduling conflicts, Boott is resurveying this group for available dates to hold the two-day Lowell Hydroelectric Project Study Workshop (Workshop) with interested stakeholders. The first day of the Workshop will focus on stakeholder consultation, information gathering, and data needs. Boott anticipates this first day will take place from 9am-4:30pm in Lowell, MA. Additional details regarding the meeting space to follow. The second day will consist of a site visit to target specific Project facilities.

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December 4-5, 2019

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December 9-10, 2019

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December 17-18, 2019

December 18-19, 2019

Please notify Boott of the dates you can attend the Workshop by completing the Doodle Poll here:  
<https://doodle.com/poll/dp2qb9232aq66awg>

In order to facilitate the scheduling of the Workshop, Boott is asking that all interested stakeholders complete the poll by November 13, 2019. If you have questions or need additional information, please contact Kevin Webb, Boott Hydro Licensing Manager, at (978) 935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank You –

**Kelsey Scott, MS**

*Assistant Regulatory Specialist*

**HDR**

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**D** 315.414.2206 **M** 315.706.5176  
[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

## Scott, Kelsey

---

**To:** Scott, Kelsey  
**Subject:** RE: Update - Lowell Hydroelectric Project (FERC No. 2790) Study Workshop

---

**From:** Scott, Kelsey

**Sent:** Thursday, November 21, 2019 4:42 PM

**To:** 'celeste\_bernardo@nps.gov' <celeste\_bernardo@nps.gov>; 'christine\_bruins@nps.gov' <christine\_bruins@nps.gov>; 'Paul\_Fontaine@nps.gov' <Paul\_Fontaine@nps.gov>; 'kevin\_coffee@nps.gov' <kevin\_coffee@nps.gov>; 'laurel\_racine@nps.gov' <laurel\_racine@nps.gov>; 'peter\_reitchel@nps.gov' <peter\_reitchel@nps.gov>; 'kevin\_mendik@nps.gov' <kevin\_mendik@nps.gov>; 'duncan\_hay@nps.gov' <duncan\_hay@nps.gov>; 'Emily.Byrne@mail.house.gov' <Emily.Byrne@mail.house.gov>; 'darryl.forgione@mass.gov' <darryl.forgione@mass.gov>; 'patrice.kish@mass.gov' <patrice.kish@mass.gov>; 'thomas.m.walsh@mass.gov' <thomas.m.walsh@mass.gov>; 'william.cooksey@mass.gov' <william.cooksey@mass.gov>; 'peter.hoffmann@mass.gov' <peter.hoffmann@mass.gov>; 'dtradd@lowellma.gov' <dtradd@lowellma.gov>; 'KKeefeMullin@lowellma.gov' <KKeefeMullin@lowellma.gov>; 'cthomas@lowellma.gov' <cthomas@lowellma.gov>; 'cclancy@lowellma.gov' <cclancy@lowellma.gov>; 'jwinward@lowellma.gov' <jwinward@lowellma.gov>; 'CRicker@lowellma.gov' <CRicker@lowellma.gov>; 'chayes@lowellma.gov' <chayes@lowellma.gov>; 'CMcCall@lowellma.gov' <CMcCall@lowellma.gov>; 'scerand@hotmail.com' <scerand@hotmail.com>; 'greenesh@comcast.net' <greenesh@comcast.net>; 'jcalvin@lowelllandtrust.org' <jcalvin@lowelllandtrust.org>; 'ffaust@edgegroupinc.com' <ffaust@edgegroupinc.com>; 'Euris Gonzalez (DCR) (Euris.Gonzalez@mass.gov)' <Euris.Gonzalez@mass.gov>  
**Cc:** 'Anderson, Elise (EGP North America)' <elise.anderson@enel.com>; 'Webb, Kevin (EGP North America)' <Kevin.Webb@enel.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>  
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*Assistant Regulatory Specialist*

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**Cc:** 'Anderson, Elise (EGP North America)' <[elise.anderson@enel.com](mailto:elise.anderson@enel.com)>; Webb, Kevin (EGP North America) <[Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com)>; Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>

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Thank You –

**Kelsey Scott, MS**  
*Assistant Regulatory Specialist*

**HDR**  
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Syracuse, NY 13212

D 315.414.2206 M 315.706.5176  
[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Monday, December 9, 2019 3:55 PM  
**To:** 'celeste\_bernardo@nps.gov'; 'christine\_bruins@nps.gov'; 'Paul\_Fontaine@nps.gov'; 'kevin\_coffee@nps.gov'; 'laurel\_racine@nps.gov'; 'peter\_reitchel@nps.gov'; 'kevin\_mendik@nps.gov'; 'duncan\_hay@nps.gov'; 'Emily.Byrne@mail.house.gov'; 'darryl.forgione@mass.gov'; 'patrice.kish@mass.gov'; 'thomas.m.walsh@mass.gov'; 'william.cooksey@mass.gov'; 'peter.hoffmann@mass.gov'; 'dtradd@lowellma.gov'; 'KKeefeMullin@lowellma.gov'; 'cthomas@lowellma.gov'; 'cclancy@lowellma.gov'; 'jwinward@lowellma.gov'; 'CRicker@lowellma.gov'; 'chayes@lowellma.gov'; 'CMcCall@lowellma.gov'; 'scerand@hotmail.com'; 'greenesh@comcast.net'; 'jcalvin@lowelllandtrust.org'; 'ffaust@edgegroupinc.com'; 'Euris Gonzalez (DCR) (Euris.Gonzalez@mass.gov)'  
**Cc:** 'Anderson, Elise (EGP North America)'; 'Webb, Kevin (EGP North America)'; Quiggle, Robert  
**Subject:** RE: Update - Lowell Hydroelectric Project (FERC No. 2790) Study Workshop  
**Attachments:** December 2019 Lowell Study Workshop Agenda.pdf

Dear Stakeholders:

The agenda is attached for the upcoming December 18 – 19, 2019 Study Workshop & Site Visit for the Lowell Hydroelectric Project. Boott appreciates the opportunity to consult with stakeholders and we look forward to seeing you next week.

Should you have any questions about the Study Workshop, please contact me at the phone number or email address below, or contact Mr. Kevin Webb, Enel Hydro Licensing Manager, at 978-935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank You –

### **Kelsey Scott, MS**

*Assistant Regulatory Specialist*

#### **HDR**

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D 315.414.2206

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**Sent:** Thursday, November 21, 2019 4:42 PM  
**To:** 'celeste\_bernardo@nps.gov' <celeste\_bernardo@nps.gov>; 'christine\_bruins@nps.gov' <christine\_bruins@nps.gov>; 'Paul\_Fontaine@nps.gov' <Paul\_Fontaine@nps.gov>; 'kevin\_coffee@nps.gov' <kevin\_coffee@nps.gov>; 'laurel\_racine@nps.gov' <laurel\_racine@nps.gov>; 'peter\_reitchel@nps.gov' <peter\_reitchel@nps.gov>; 'kevin\_mendik@nps.gov' <kevin\_mendik@nps.gov>; 'duncan\_hay@nps.gov' <duncan\_hay@nps.gov>; 'Emily.Byrne@mail.house.gov' <Emily.Byrne@mail.house.gov>; 'darryl.forgione@mass.gov' <darryl.forgione@mass.gov>; 'patrice.kish@mass.gov' <patrice.kish@mass.gov>; 'thomas.m.walsh@mass.gov' <thomas.m.walsh@mass.gov>; 'william.cooksey@mass.gov' <william.cooksey@mass.gov>; 'peter.hoffmann@mass.gov' <peter.hoffmann@mass.gov>; 'dtradd@lowellma.gov' <dtradd@lowellma.gov>; 'KKeefeMullin@lowellma.gov' <KKeefeMullin@lowellma.gov>; 'cthomas@lowellma.gov' <cthomas@lowellma.gov>; 'cclancy@lowellma.gov'

<cclancy@lowellma.gov>; 'jwinward@lowellma.gov' <jwinward@lowellma.gov>; 'CRicker@lowellma.gov' <CRicker@lowellma.gov>; 'chayes@lowellma.gov' <chayes@lowellma.gov>; 'CMcCall@lowellma.gov' <CMcCall@lowellma.gov>; 'scerand@hotmail.com' <scerand@hotmail.com>; 'greenesh@comcast.net' <greenesh@comcast.net>; 'jcalvin@lowelllandtrust.org' <jcalvin@lowelllandtrust.org>; 'ffaust@edgegroupinc.com' <ffaust@edgegroupinc.com>; 'Euris Gonzalez (DCR) (Euris.Gonzalez@mass.gov)' <Euris.Gonzalez@mass.gov>  
**Cc:** 'Anderson, Elise (EGP North America)' <elise.anderson@enel.com>; 'Webb, Kevin (EGP North America)' <Kevin.Webb@enel.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>  
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*Assistant Regulatory Specialist*

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**Sent:** Friday, November 8, 2019 11:17 AM

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**Cc:** 'Anderson, Elise (EGP North America)' <[elise.anderson@enel.com](mailto:elise.anderson@enel.com)>; Webb, Kevin (EGP North America) <[Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com)>; Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>

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December 4-5, 2019  
December 5-6, 2019  
December 9-10, 2019  
December 10-11, 2019  
December 11-12, 2019  
December 17-18, 2019  
December 18-19, 2019

Please notify Boott of the dates you can attend the Workshop by completing the Doodle Poll here:

<https://doodle.com/poll/dp2qb9232aq66awg>

In order to facilitate the scheduling of the Workshop, Boott is asking that all interested stakeholders complete the poll by November 13, 2019. If you have questions or need additional information, please contact Kevin Webb, Boott Hydro Licensing Manager, at (978) 935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank You –

**Kelsey Scott, MS**

*Assistant Regulatory Specialist*

**HDR**

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[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)



# Agenda

Project: Lowell Hydroelectric Project (FERC No. 2790)

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Subject: Lowell Project Study Workshop & Site Visit

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Date: December 18 – 19, 2019

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Location: Lowell National Historical Park Visitor Center (246 Market Street), Lowell, MA.

Pursuant to the Federal Energy Regulatory Commission’s (FERC or Commission) Study Plan Determination (SPD) for the relicensing of the Lowell Hydroelectric Project (FERC No. 2790) (Project), Boott Hydropower, LLC (Boott) will conduct a Recreation and Aesthetics Study, a Water Level and Flow Effects on Historic Resources Study, and a Historically Significant Waterpower Equipment Study (collectively Studies). This Study Workshop to consult with stakeholders regarding these Studies will be held from 9:00 AM until 4:00 PM at the Lowell National Historical Park Visitor Center (246 Market Street) in Lowell, MA. The adjacent parking at 304 Dutton Street is free. On the following day after the Study Workshop, stakeholders are invited to participate in a site visit of the Project to consult on the field portion of the Studies, which is expected to end at noon. The proposed agenda for the Study Workshop is as follows:

|                                                                     |                     |
|---------------------------------------------------------------------|---------------------|
| Welcome and Introductions.....                                      | 9:00 AM – 9:30 AM   |
| Discussion of FERC Relicensing and ILP Study Process.....           | 9:30 AM – 10:00 AM  |
| <i>Break</i> .....                                                  | 10:00 AM – 10:15 AM |
| Recreation and Aesthetics Study Needs .....                         | 10:15 AM – 11:15 AM |
| Water Level and Flow Effects on Historic Resources Study Needs..... | 11:15 AM – 12:00 PM |
| <i>Lunch Break</i> .....                                            | 12:00 PM – 1:00 PM  |
| Historically Significant Waterpower Equipment Study Needs .....     | 1:00 PM – 2:00 PM   |
| <i>Open discussion/Break</i> .....                                  | 2:00 PM – 3:00 PM   |
| Upcoming ILP Schedule (2020-2021) .....                             | 3:00 PM – 3:30 PM   |
| Action Items and Next Steps.....                                    | 3:30 PM – 4:00 PM   |

## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Tuesday, December 10, 2019 2:28 PM  
**To:** celeste\_bernardo@nps.gov; christine\_bruins@nps.gov; Paul\_Fontaine@nps.gov; kevin\_coffee@nps.gov; laurel\_racine@nps.gov; peter\_reitchel@nps.gov; kevin\_mendik@nps.gov; duncan\_hay@nps.gov; Emily.Byrne@mail.house.gov; darryl.forgione@mass.gov; patrice.kish@mass.gov; thomas.m.walsh@mass.gov; william.cooksey@mass.gov; peter.hoffmann@mass.gov; dtradd@lowellma.gov; KKeefeMullin@lowellma.gov; cthomas@lowellma.gov; cclancy@lowellma.gov; jwinward@lowellma.gov; CRicker@lowellma.gov; chayes@lowellma.gov; CMcCall@lowellma.gov; scerand@hotmail.com; greenesh@comcast.net; jcalvin@lowelllandtrust.org; ffaust@edgegroupinc.com; Euris Gonzalez (DCR) (Euris.Gonzalez@mass.gov)  
**Cc:** Anderson, Elise (EGP North America); Webb, Kevin (EGP North America); Quiggle, Robert  
**Subject:** RE: Update - Lowell Hydroelectric Project (FERC No. 2790) Study Workshop  
**Attachments:** December 2019 Lowell Study Workshop Agenda.pdf

### Stakeholders –

There is strong interest in discussing the Resources, Ownership, Boundaries, and Land Rights Study that is being performed as part of the relicensing of the Lowell Hydroelectric Project. Boott added the study to the agenda for the upcoming Study Workshop on December 18, 2019. Please see the attached updated agenda (the most recent version) and we look forward to seeing you next week.

Should you have any questions about the Study Workshop, please contact me at the phone number or email address below, or contact Mr. Kevin Webb, Enel Hydro Licensing Manager, at 978-935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

Thank You –

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#### **HDR**

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**From:** Scott, Kelsey  
**Sent:** Monday, December 9, 2019 3:55 PM  
**To:** 'celeste\_bernardo@nps.gov' ; 'christine\_bruins@nps.gov' ; 'Paul\_Fontaine@nps.gov' ; 'kevin\_coffee@nps.gov' ; 'laurel\_racine@nps.gov' ; 'peter\_reitchel@nps.gov' ; 'kevin\_mendik@nps.gov' ; 'duncan\_hay@nps.gov' ; 'Emily.Byrne@mail.house.gov' ; 'darryl.forgione@mass.gov' ; 'patrice.kish@mass.gov' ; 'thomas.m.walsh@mass.gov' ; 'william.cooksey@mass.gov' ; 'peter.hoffmann@mass.gov' ; 'dtradd@lowellma.gov' ; 'KKeefeMullin@lowellma.gov' ; 'cthomas@lowellma.gov' ; 'cclancy@lowellma.gov' ; 'jwinward@lowellma.gov' ; 'CRicker@lowellma.gov' ; 'chayes@lowellma.gov' ; 'CMcCall@lowellma.gov' ; 'scerand@hotmail.com' ; 'greenesh@comcast.net' ; 'jcalvin@lowelllandtrust.org' ; 'ffaust@edgegroupinc.com' ; 'Euris Gonzalez (DCR) (Euris.Gonzalez@mass.gov)'

**Cc:** 'Anderson, Elise (EGP North America)'; 'Webb, Kevin (EGP North America)'; Quiggle, Robert

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Dear Stakeholders:

The agenda is attached for the upcoming December 18 – 19, 2019 Study Workshop & Site Visit for the Lowell Hydroelectric Project. Boott appreciates the opportunity to consult with stakeholders and we look forward to seeing you next week.

Should you have any questions about the Study Workshop, please contact me at the phone number or email address below, or contact Mr. Kevin Webb, Enel Hydro Licensing Manager, at 978-935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

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**Sent:** Thursday, November 21, 2019 4:42 PM

**To:** 'celeste\_bernardo@nps.gov' <[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)>; 'christine\_bruins@nps.gov' <[christine\\_bruins@nps.gov](mailto:christine_bruins@nps.gov)>; 'Paul\_Fontaine@nps.gov' <[Paul\\_Fontaine@nps.gov](mailto:Paul_Fontaine@nps.gov)>; 'kevin\_coffee@nps.gov' <[kevin\\_coffee@nps.gov](mailto:kevin_coffee@nps.gov)>; 'laurel\_racine@nps.gov' <[laurel\\_racine@nps.gov](mailto:laurel_racine@nps.gov)>; 'peter\_reitchel@nps.gov' <[peter\\_reitchel@nps.gov](mailto:peter_reitchel@nps.gov)>; 'kevin\_mendik@nps.gov' <[kevin\\_mendik@nps.gov](mailto:kevin_mendik@nps.gov)>; 'duncan\_hay@nps.gov' <[duncan\\_hay@nps.gov](mailto:duncan_hay@nps.gov)>; 'Emily.Byrne@mail.house.gov' <[Emily.Byrne@mail.house.gov](mailto:Emily.Byrne@mail.house.gov)>; 'darryl.forgione@mass.gov' <[darryl.forgione@mass.gov](mailto:darryl.forgione@mass.gov)>; 'patrice.kish@mass.gov' <[patrice.kish@mass.gov](mailto:patrice.kish@mass.gov)>; 'thomas.m.walsh@mass.gov' <[thomas.m.walsh@mass.gov](mailto:thomas.m.walsh@mass.gov)>; 'william.cooksey@mass.gov' <[william.cooksey@mass.gov](mailto:william.cooksey@mass.gov)>; 'peter.hoffmann@mass.gov' <[peter.hoffmann@mass.gov](mailto:peter.hoffmann@mass.gov)>; 'dtradd@lowellma.gov' <[dtradd@lowellma.gov](mailto:dtradd@lowellma.gov)>; 'KKeefeMullin@lowellma.gov' <[KKeefeMullin@lowellma.gov](mailto:KKeefeMullin@lowellma.gov)>; 'cthomas@lowellma.gov' <[cthomas@lowellma.gov](mailto:cthomas@lowellma.gov)>; 'cclancy@lowellma.gov' <[cclancy@lowellma.gov](mailto:cclancy@lowellma.gov)>; 'jwinward@lowellma.gov' <[jwinward@lowellma.gov](mailto:jwinward@lowellma.gov)>; 'CRicker@lowellma.gov' <[CRicker@lowellma.gov](mailto:CRicker@lowellma.gov)>; 'chayes@lowellma.gov' <[chayes@lowellma.gov](mailto:chayes@lowellma.gov)>; 'CMcCall@lowellma.gov' <[CMcCall@lowellma.gov](mailto:CMcCall@lowellma.gov)>; 'scerand@hotmail.com' <[scerand@hotmail.com](mailto:scerand@hotmail.com)>; 'greenesh@comcast.net' <[greenesh@comcast.net](mailto:greenesh@comcast.net)>; 'jcalvin@lowelllandtrust.org' <[jcalvin@lowelllandtrust.org](mailto:jcalvin@lowelllandtrust.org)>; 'ffaust@edgegroupinc.com' <[ffaust@edgegroupinc.com](mailto:ffaust@edgegroupinc.com)>; 'Euris Gonzalez (DCR)' ([Euris.Gonzalez@mass.gov](mailto:Euris.Gonzalez@mass.gov)) <[Euris.Gonzalez@mass.gov](mailto:Euris.Gonzalez@mass.gov)>

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*Assistant Regulatory Specialist*

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[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

# Agenda

Project: Lowell Hydroelectric Project (FERC No. 2790)

---

Subject: Lowell Project Study Workshop & Site Visit

---

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---

Location: Lowell National Historical Park Visitor Center (246 Market Street), Lowell, MA.

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|                                                                      |                     |
|----------------------------------------------------------------------|---------------------|
| Welcome and Introductions.....                                       | 9:00 AM – 9:30 AM   |
| Discussion of FERC Relicensing and ILP Study Process.....            | 9:30 AM – 10:00 AM  |
| <i>Break</i> .....                                                   | 10:00 AM – 10:15 AM |
| Recreation and Aesthetics Study Needs .....                          | 10:15 AM – 11:15 AM |
| Resources, Ownership, Boundaries, and Land Rights Study Needs .....  | 11:15 AM – 12:00 PM |
| <i>Lunch Break</i> .....                                             | 12:00 PM – 1:00 PM  |
| Historically Significant Waterpower Equipment Study Needs .....      | 1:00 PM – 2:00 PM   |
| Water Level and Flow Effects on Historic Resources Study Needs ..... | 2:00 PM – 3:00 PM   |
| Upcoming ILP Schedule (2020-2021) .....                              | 3:00 PM – 3:30 PM   |
| Action Items and Next Steps .....                                    | 3:30 PM – 4:00 PM   |

## Scott, Kelsey

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**From:** Bruins, Christine <christine\_bruins@nps.gov>  
**Sent:** Thursday, December 19, 2019 9:22 AM  
**To:** Webb, Kevin (EGP North America); Scott, Kelsey; Quiggle, Robert  
**Cc:** Mendik, Kevin; Duncan Hay  
**Subject:** Lowell NHP Exotic Species Treatment Schedule - Vegetation Mgmt  
**Attachments:** 2018.9.11 EXOTIC SPECIES TREATMENT LOWELL.docx

Hi folks,

Thank you so much for hosting a meeting with the canal stewardship partners. I'm attaching a document from our maintenance department which outlines the exotic species that exist along the canals and treatment schedules.

**Christine Bruins | Community Planner**  
Lowell National Historical Park  
978.275.1726 (office) | 978.954.1011 (cell)

# EXOTIC SPECIES TREATMENT CALENDAR FOR LOWELL NATIONAL HISTORICAL PARK

Prepared by Lars Boyd, Sept 11, 2018.

## OUTLINE

- I. Purpose of document
- II. Target species for 2019
- III. Tentative Treatment Calendar
- IV. Best Management Practices
- V. Brief description of each species with photos and treatment strategies

## I. PURPOSE

This document provides a series of tables and exotic plant management information to aid in organizing of a 2019 treatment schedule for Lowell NHP.

This document will present an appropriate species to be focused on in a park for the given, and a potential control method. Often other species may be treated at the same time as the target species if the appropriate treatment method is able to be performed concurrently. For foliar spraying, a generic herbicide mixture can be used to treat a broad spectrum of species within the same day. A generic herbicide mixture can be applied to multiple species for basal bark and cut stem/stump treatments as well. Refer to the individual species treatment guides (Table 6-13) to determine if the application method is appropriate within the given time window before treating other species in the area with herbicide.



## II. TARGET SPECIES FOR 2019 LOWELL NHP

Table 1: Reported Target Species W/ Locations for FY 2019

| Species                                               | NCW | BSS | FG | SW/JS | DSC&T | KP | VCC | TT | KSH | WCW |
|-------------------------------------------------------|-----|-----|----|-------|-------|----|-----|----|-----|-----|
| <i>Ailanthus altissima</i><br>(Tree of Heaven)        | X   |     | X  |       | X     |    |     |    |     | X   |
| <i>Alliaria petiolata</i><br>(Garlic mustard)         |     | X   | X  | X     |       | X  |     |    | X   |     |
| <i>Celastrus orbiculatus</i><br>(Asiatic Bittersweet) | X   |     | X  |       | X     | X  |     |    |     | X   |
| <i>Convolvulus arvensis</i><br>(Bind Weed)            |     |     |    |       |       |    |     |    |     | X   |
| <i>Cynanchum louiseae</i><br>(Black Swallow-wort)     | X   |     |    | X     | X     | X  | X   | X  |     | X   |
| <i>Fallopia japonica</i><br>(Japanese Knotweed)       |     | X   |    | X     | X     |    |     |    |     |     |
| <i>Lythrum salicaria</i><br>(Purple Loosestrife)      | X   |     |    | X     |       |    |     |    |     | X   |
| <i>Rosa multiflora</i><br>(Multiflora Rose)           |     |     |    |       |       |    |     |    |     | X   |

NCW- Northern Canal Walkway  
 BSS- Black Smith Shop  
 FG- Francis Gate  
 SW/JS- Swamp Locks/Jackson St  
 DSC&T- Dutton St Canal & Tracks  
 KP- Kerouac Park  
 VCC- Visitor Center Courtyard  
 TT- Tremont St Tracks  
 KSH- Kirk St Headquarters  
 WCW- Western Canal Walkway

### III. TENTATIVE CALENDAR FOR LOWELL NHP EXOTIC PLANT REMOVAL

**Table 2: Foliar Spray Treatment Sequencing**

| Species                                            | M<br>A<br>R | A<br>P<br>R | M<br>A<br>Y | J<br>U<br>N | J<br>U<br>L | A<br>U<br>G | S<br>E<br>P | O<br>C<br>T | N<br>O<br>V |
|----------------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <i>Rosa multiflora</i> (Multiflora Rose)           |             |             | X           | X           |             |             |             |             |             |
| <i>Ailanthus altissima</i> (Tree of Heaven)        |             |             |             | X           | X           | X           |             |             |             |
| <i>Cynanchum louiseae</i> (Black Swallow-wort)     |             |             |             | X           | X           |             |             |             |             |
| <i>Convolvulus arvensis</i> (Bindweed)             |             |             |             |             | X           | X           | X           |             |             |
| <i>Fallopia japonica</i> (Japanese Knotweed)       |             |             |             |             |             | X           | X           |             |             |
| <i>Lythrum salicaria</i> (Purple Loosestrife)      |             |             |             |             |             | X           |             |             |             |
| <i>Alliaria petiolata</i> (Garlic mustard)         |             |             |             |             |             |             | X           | X           |             |
| <i>Celastrus orbiculatus</i> (Asiatic Bittersweet) |             |             |             |             |             |             |             | X           | X           |

### IV. BEST MANAGEMENT PRACTICES (ADOPTED FROM THE EXOTIC SPECIES TREATMENT CALENDAR FOR BOSTON METROPOLITAN PARKS by Lyndon Langthorne)

#### Non-chemical Treatment

Non-chemical treatment, when appropriate for the target species, should be attempted before chemical treatment. In most situations, chemical treatment can be made more effective when applied in conjunction with non-chemical management strategies. Non-chemical management strategies are generally labor intensive, but can be performed in most areas, including areas where chemical treatment would not be advisable.

**Table 3. Non-chemical Treatment Methods**

|              |                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hand pulling | Manual removal of top growth of plant, and as much of the root system as possible. Extensive, deep, and large root systems are not removable by hand. Hand pulling will prevent the formation of seed pods if consistently implemented throughout the growing season. This method is often not effective in managing regenerative species. Rhizomatous species are not generally manageable through this strategy alone. |
| Digging      | Manual or mechanical removal of root system when hand pulling alone is not sufficient in removing the root system. Species that re-                                                                                                                                                                                                                                                                                      |

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                          | <p>sprout from roots must have the root system removed. Digging is labor intensive. This method is not viable when managing regenerative plants with extensive, deep, or large roots. Digging disturbs the soil, encouraging colonization by other exotic species.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Cutting                                  | <p>Manual removal of the entire top growth of the plant by cutting the stem close to the ground. Plant matter removed by cutting may, depending on the species and desired conditions, be allowed to compost (either where it is cut or moved to another location), or destroyed to prevent reshooting of roots. Cutting can be effective on annuals or biennials if done before seeding, but in most perennial species, cutting alone is not capable of achieving control. Stump grinding of larger, woody stumps can prevent reshooting (e.g. <i>F. alnus</i>, <i>R. cathartica</i>, <i>A. altissima</i>). Herbicide can be applied to the cut surface to destroy the roots and prevent reshooting.</p>                                                                                                                                                                                                                                          |
| Flower clipping /<br>Seed-heading        | <p>Manual removal of flowers or seed heads to prevent seeding or seed spread, but not removal of the plant top growth; seeds collected are destroyed. This method will limit the ability of the plant to spread through seeding, but will not prevent vegetative spread by the root system.</p> <p>Some plants do not rely on seeds as the primary vector of spread (e.g. <i>F. japonica</i>).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Mulching /<br>Mats /<br>"Buckthorn Bags" | <p>Covering of a disturbed or treated area to limit the ability of exotic species to grow and recolonize an area. Mulch can be layered over soil, and possible supplemented with a permeable material, like cloth or paper, to limit the ability of exotics to reshoot while also providing an area that can be used for planting. Reshooting may still occur with mulch, and monitoring is advisable.</p> <p>Mats of rubber or black plastic can be layered on the soil as an impervious surface. This surface cannot be used for planting, but is more likely to prevent any regrowth. If the mats are in an area of direct or partial sunlight, the heat collected will kill covered roots.</p> <p>"Buckthorn bags" can be placed over stumps of <i>F. alnus</i> and <i>R. cathartica</i> that are over two inches in diameter. Left in place for two years, these bags will prevent regeneration and destroy the root system of the plant.</p> |
| Mowing                                   | <p>Mechanical removal of top growth of plants. Able to be applied quickly to large areas. Mowing is less precise than most manual methods, and is most viable on land that is already managed land. Will not destroy the root system of most plants, but often stresses the plant and prevents seed production if done consistently. Herbicide applied after mowing will often be more effective, either applying immediately after mowing as cut stem/stump treatment, or upon regrowth as a foliar spray.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                    |

|                |                                                                                |
|----------------|--------------------------------------------------------------------------------|
| Stump grinding | Perennial shrubs and trees can have their stumps ground to prevent reshooting. |
|----------------|--------------------------------------------------------------------------------|

Seeds forming on exotic plants should always be removed when observed. Removal of seeds can be a valuable management strategy in areas of lower priority, or where other management strategies are inadvisable. Seed removal will not disrupt existing plants, but will limit growth and spread of these populations. Seed removal also prevents exotics from further contributing to the soil seed bank, all the viable seeds existing within the soil of an area. Seeds of exotics should be burned or bagged and disposed of in a landfill to prevent further contamination.

Bare patches of soil, particularly those remaining after soil is disturbed by digging or hand pulling, is vulnerable to colonization by new exotic species. To mitigate this threat, new plants and grasses should be added to bare areas whenever possible. If a bare patch was the site of chemical treatment that will be repeated the following year, seed of an inexpensive annual ryegrass can be planted to limit the cost of further chemical treatments.

### Chemical Treatment

Use pesticides at rates recommended by the label, and never exceed labeled rates. Mitigate damage to other plants and ecosystems by taking care for herbicide drift. Only apply herbicides on calm, dry days, and never any closer to standing water than is specified on the label. Herbicide applicators should always be properly fitted with Personal Protective Equipment (PPE) required by label, which represents the **minimum** PPE required for use. When applying chemicals, it is advisable to add a dye to the mix, unless otherwise stipulated, to better mark which plants have been treated. Dyes also allow contaminated gear to be easily identified for safety reasons.

**Table 4. Chemical Treatment Method Overview**

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Foliar Spray</b> | <p>Broadcast or spot application of herbicide with a sprayer targeting foliage of species, wetting the leaves with herbicide to be absorbed into the root system. Apply to intact, green leaves. This is often the most efficient herbicide application method. Lower concentrations are used with foliar spray than other application methods. Foliar spray has the greatest potential to unintentionally damage surrounding plants, and may not be preferred for this reason. Foliar application is best for treating large, dense stands of invasive plants where risk of damaging surrounding plants can be minimized. When spraying, herbicide should wet leaves without dripping, as excessive spraying can harm non-target species.</p> <p>The extent of the application depends on the size of the area being treated. Spot spraying is application of herbicide in one location,</p> |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                            | <p>generally to one plant. This type of application minimizes damage to surrounding plants. Broadcast application is more extensive than spot spraying for heavier infestations.</p> <p>Foliar spraying should not be performed on wet weather days as any herbicide may not be absorbed into plants, instead being washed away as runoff. Foliar spraying should not be performed on days when wind speeds are greater than 5 mph to prevent pesticide drift. Foliar spraying should also not be performed in areas where damage to non-target species is a concern. Large trees should not be treated by foliar spray.</p> |
| <b>Cut Stem/Stump</b>                      | <p>Application of herbicide either by brush or spray bottle to a cut surface to be absorbed into the root system. After cut, herbicide should be applied to the cut surface immediately for best effect, and not more than 15 minutes later; this time limit is particularly important for the best absorption of water-based herbicides, and oil based herbicides can be applied longer after cutting.</p> <p>Cut stump applications are more effective than basal bark on woody stems greater than 5" diameter, and thick barked species.</p>                                                                              |
| <b>Basal Bark</b>                          | <p>Application of herbicide to the bark with a sprayer, from surface to 12-18 inches above the root collar, to be absorbed into root system. Useful in precisely controlling woody species. Treatment can be performed while herbaceous species are dormant. Uses oil-based herbicides that penetrate bark, mixed with a carrier (basal oil). The entire surface area of the trunk should be coated within the 12-18 inch range, and rough bark requires more spray. Application should be stopped short of runoff.</p>                                                                                                      |
| <b>Stem Injection</b>                      | <p>Application of herbicide into the stems of hollow plants via specialized injection equipment. This method ensures absorption of the herbicide into the roots of the plant, and limits exposure to and contamination by pesticides.</p>                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hand Wicking<br/>("Glove of death")</b> | <p>Application of herbicide to the leaf surface with an absorbent cotton glove coated in herbicide layered over a chemical resistant glove. Small spray bottles are used to wet the fingertips and palm of the glove, which is then wiped directly on the plant, coating the leaves. This method is precise, faster than cut stem/stump treatment, and limits exposure of herbicide to other plants.</p> <p>Cuff the ends of the glove to prevent dripping. Gloves used for this method will become saturated with herbicide and should not be stored with other equipment.</p>                                              |

## Herbicides

Use with caution.

Be aware of local regulations before use.

Always read the label thoroughly before use, and follow all requirements (including PPE, site location, concentration, etc.).

Chemicals should be chosen based on a variety of factors, including: effectiveness on target species, environmental impact (toxicity to animals, persistence in soil, activity in water), and safety. The correct herbicide should be chosen for the site, and herbicide labelling will list use sites.

**Table 5. General Overview of Commonly Used Herbicides**

|                               |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Glyphosate</b></p>      | <p><i>(Rodeo®)</i></p>     | <p>Glyphosate is a non-selective systemic post-emergent herbicide, damaging to most plants, including broadleaf plants and grasses. Pure glyphosate is generally environmentally safe, essentially non-toxic to mammals and fish, and mildly toxic to birds. Glyphosate is quickly absorbed into soil, and has negligible lasting environmental effects, and leaching to other areas is not expected to occur. Glyphosate has a short half-life in soil and water. Glyphosate may or may not be metabolized by plants, and potentially persists in plants where it was applied, including in the roots. Be aware that not all glyphosate herbicides are registered for aquatic use, and some formulations contain adjuvants that make them highly toxic to aquatic life. If using in an aquatic area, be sure to use a product that omits these toxic ingredients (eg. <i>Rodeo®</i>).</p> <p>Pure glyphosate has low human toxicity, but is often made more hazardous to humans with adjuvants that disseminate the chemical into plants. Causes significant eye irritation.</p> |
| <p><b>Triclopyr amine</b></p> | <p><i>(Garlon® 3A)</i></p> | <p>Triclopyr is a selective systemic post-emergent herbicide. It is relatively non-toxic to humans and terrestrial mammals, and some formulations are registered for aquatic use.</p> <p>Triclopyr should generally be used in areas where it is desired to protect surrounding grasses and sedges. Triclopyr amine is preferred for foliar applications over triclopyr ester.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

|                               |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Triclopyr ester</b></p> | <p><i>(Garlon® 4 Ultra)</i></p>    | <p>Triclopyr is a selective systemic post-emergent herbicide. It is relatively non-toxic to humans and terrestrial mammals. It is not registered for aquatic use.</p> <p>Triclopyr ester is only recommended as a foliar spray prior to full leaf-out of the target plant. After leaf out, other herbicides would be preferred.</p> <p>Good for basal barking when mixed with a basal oil. Cannot be used within 35 ft. of wetland.</p> |
| <p><b>Imazapyr</b></p>        | <p><i>(Plateau®, Habitat®)</i></p> | <p>Imazapyr is a non-selective, systemic, pre- and post-emergent herbicide. Imazapyr formulations can be registered for aquatic use.</p> <p>Imazapyr has a low human toxicity in skin contact or if ingested. Harmful if inhaled and may cause irreversible eye damage.</p>                                                                                                                                                             |

A good strategy for foliar application efficiency is to mix a general formulation of triclopyr amine and glyphosate. This mixture can be applied on a wide spectrum of species, and allow more treatment to occur during a single application session.

## **V. BRIEF DESCRIPTION OF EACH TARGET SPECIES (ADOPTED FROM THE EXOTIC SPECIES TREATMENT CALENDAR FOR BOSTON METROPOLITAN PARKS by Lyndon Langthorne)**

### ***Ailanthus altissima* (Tree of Heaven)**

#### **Description**

*A. altissima* is a large non-native short-lived deciduous perennial tree. The trunk grows up to eighty feet tall, and is straight and gray, with smooth to bumpy bark that fissures with age. Leaves are silvery-green and pinnately compound, with alternate leaflets on one to four foot leaf veins. Leaves produce a foul smell if crushed. Five-petaled flowers are small, yellow-green, and grow in dense clusters. Reddish-brown seed pods are produced in late summer, and are twisted like helicopters, each containing one seed



[https://www.extension.iastate.edu/forestry/iowa\\_trees/trees/tree\\_of\\_heaven.html](https://www.extension.iastate.edu/forestry/iowa_trees/trees/tree_of_heaven.html)

The tree is resilient, and will grow in a wide range of environments, including urban where the root system can disrupt hardscaping and cause damage to structures. *A. altissima* crowds out native trees quickly with its ability to spread quickly to new areas. The roots are toxic and may limit growth potential for native plants.

#### **Non-chemical Treatment**

Seedlings and root suckers should be dug consistently to control spread. Any remaining stumps and roots will continue to generate new shoots. Cutting and mowing alone are not an effective form of management, and may increase density and spread potential. Mechanical measures that remove top growth are most effective when followed up by chemical treatment.

#### **Chemical Treatment**

Foliar spraying is the most common form of treatment for *A. altissima*<sup>1</sup> Foliar treatment best applied between full canopy and fall color. Foliar application cannot be applied to larger trees, and is most effective in treating dense stands of saplings.

Cut stump treatment is a more labor intensive method, but may be necessary in treating larger trees. After cutting tree, immediately apply herbicide to cut surface. Cutting alone will lead to increased suckering, and should be mitigated with herbicide application



Basal bark used for follow up treatments or small infestations. Root injury is maximized when used after full canopy to fall color. Following basal bark treatment, the tree is left in place to be cut at a later time. *A. altissima* may require multiple applications.

To maximize root damage, any chemical treatment should be performed within the time window where the tree has developed its full canopy and before the leaves have turned to fall colors.

**Table 6: *A. altissima* Treatment Guide**

| Application Method             | Herbicide       | Brand                                       | Selectivity   | Concentration       | Time                   | Notes                  |
|--------------------------------|-----------------|---------------------------------------------|---------------|---------------------|------------------------|------------------------|
| <b>Non-chemical Treatment</b>  |                 |                                             |               |                     |                        |                        |
| Hand pulling                   |                 |                                             |               |                     | Apr - Jun              | Seedlings and saplings |
| <b>Chemical Treatment</b>      |                 |                                             |               |                     |                        |                        |
| Foliar                         | Glyphosate      | <i>Rodeo</i> ®                              | Non-selective | 2%                  | Late Jun - Aug         | Surfactant             |
|                                | Triclopyr       | <i>Garlon</i> ® 3A                          | Selective     | 2%                  |                        |                        |
|                                |                 | <i>Garlon</i> ® 4 Ultra                     |               | 1.5%                |                        |                        |
|                                | Imazapyr        | <i>Habitat</i> ®                            | Non-selective | 1%                  |                        |                        |
| Cut stem/stump                 | Triclopyr       | <i>Garlon</i> ® 3A, <i>Garlon</i> ® 4 Ultra | Selective     | 50%                 | Late Jun - Aug         |                        |
| Basal bark                     | Triclopyr ester | <i>Garlon</i> ® 4 Ultra                     | Selective     | 20-25% <sup>1</sup> | Mar - Oct <sup>1</sup> | Basal oil              |
| Notes:<br>1. Contributed by BM |                 |                                             |               |                     |                        |                        |

***Alliaria petiolata* (Garlic Mustard)**

## Description

*A. petiolata* is a non-native biennial herb. First year plants are immature and resemble many native plants, such as *Viola*. In its first year leaves stay green all year long. *A. petiolata* is much easier to identify in the second year after bolting. In the second year, the leaves take on a garlicky odor and the stem forms up to three feet in height.



[https://www.michigan.gov/invasives/0,5664,7-324-68002\\_71240\\_73853-379483--,00.html](https://www.michigan.gov/invasives/0,5664,7-324-68002_71240_73853-379483--,00.html)

Leaves are alternate, sharply toothed, and triangular. Flowers bloom early in the season and are white with four petals. Seed pods develop atop the stem and burst to project seeds up to five feet from the plants, leading to rapid expansion of patches. *A. petiolata* produces more seeds in wet environments.

*A. petiolata* populations can grow rapidly when unchecked. Roots of *A. petiolata* have an allelopathic effect on native plants, limiting growth potential in areas of infestation. The plant provides no benefits as a food source for native animal species.

## Non-chemical Treatment

Stems are attached to a single root, and plants can be removed entirely by pulling, particularly in moist and loose soil. Plants can also be dug. These methods can be an effective for control, but disturbs soil and leaves bare patches, which can be recolonized. Roots must be removed completely to prevent resprouting and are easily broken.

Mowing or cutting of *A. petiolata* in its second year after bolting can also be an effective management strategy, destroying plants, especially those already under stress, and preventing seed development.

Clipping and removing of flowers will prevent the formation of new seeds, and will reduce population growth rates.

These methods must be repeated over many years until seed bank is depleted. Size of the seed bank depends on the age of the population. When utilizing these methods, it is important to clean any equipment used or worn in order to prevent seed spread.

## Chemical Treatment

Foliar spray is the recommended method for chemical treatment of *A. petiolata*, if chemical treatment is deemed necessary. Leaves should be cleaned of debris prior to application to ensure absorption into the plant. Glyphosate and triclopyr amine application to rosettes is most effective in late fall, and is best used only on dense stands where non-chemical treatment would be prohibitively laborious. Triclopyr amine can be used to avoid damaging surrounding grasses.

**Table 7. *A. petiolata* Treatment Guide**

| Method                         | Herbicide       | Brand             | Selectivity   | Concentration       | Time      | Notes                                                             |
|--------------------------------|-----------------|-------------------|---------------|---------------------|-----------|-------------------------------------------------------------------|
| <b>Non-chemical Treatment</b>  |                 |                   |               |                     |           |                                                                   |
| Hand pulling                   |                 |                   |               |                     | Apr - Oct |                                                                   |
| Mowing                         |                 |                   |               |                     | Aug - Oct | Most effective if plants are already under stress (drought, etc.) |
| Flower clipping                |                 |                   |               |                     | Apr - Jun |                                                                   |
| <b>Chemical Treatment</b>      |                 |                   |               |                     |           |                                                                   |
| Foliar spray                   | Glyphosate      | <i>Rodeo®</i>     | Non-selective | 0.5-1% <sup>1</sup> | Sep - Oct |                                                                   |
|                                | Triclopyr amine | <i>Garlon® 3A</i> | Selective     | 0.5-1% <sup>1</sup> |           |                                                                   |
| Notes:<br>1. Contributed by BM |                 |                   |               |                     |           |                                                                   |

## ***Celastrus orbiculatus* (Asiatic Bittersweet)**

### Description

*C. orbiculatus* is a non-native deciduous woody perennial that grows as either a vine or a shrub. Stem is woody with smooth brown bark. Leaves are alternate, glossy, and round with a pointed tip and shallow toothed margins. The leaves grow from two to five inches in length. Small greenish-yellow flowers with five petals form at leaf axils in clusters. Fruits are distinctive, in round orange capsules that split open in fall revealing fleshy red fruits with one or two seeds each.



<https://orleansconservationtrust.org/asiatic-bittersweet-celastrus-orbiculatus/>

The fruits persist throughout winter, and are highly attractive to birds and other animals, and to humans who often use vines and fruits in decorative manners. *C. orbiculatus* can spread far as seed, and is also capable of root suckering.

*C. orbiculatus* looks very similar to *C. scandens* (American Bittersweet), particularly when young. As the plant matures, it distinguishes itself with the placement of the fruit: *C. scandens* develops fruit on the tips of its branches, whereas *C. orbiculatus* develops fruits on the leaf axils. *C. scandens* leaves are also less round. Hybridization makes identification difficult. *C. orbiculatus* may be sold as *C. scandens* due to the difficulty in identification.

*C. orbiculatus* displaces native species through competition, and also displaces *C. scandens* through hybridization, potentially threatening *C. scandens* genetic identity. *C. orbiculatus* grows rapidly and can quickly dominate areas it is introduced into. *C. orbiculatus* also twines around native trees, increasing the load on limbs and contributing to failure.

### **Non-chemical Treatment**

Smaller plants can be hand pulled or dug out. The entire root should be removed to prevent resprouting.

Vines climbing into trees can be cut at a comfortable height to kill any of the vine in the canopy and relieve trees. The base of the vine will continue to grow, and will require continued treatment to manage. When cutting vines from trees, take care to limit damage done to the bark of the tree as much as possible, for the sake of continued tree health.

### **Chemical Treatment**

Foliar spraying of triclopyr is recommended for large, dense patches. Foliar spray is best applied in autumn or early winter, after most other species are dormant. If the vine is fully leafed out at the time of spraying, it is recommended to use triclopyr amine over the ester form. Foliar spray should only be applied on calm days when ambient air temperature is above the required sixty-five degrees Fahrenheit.

Vines of the plant that grow up into the canopy cannot viably be treated with a foliar application. The cut stump method is preferable for *C. orbiculatus* vines that climb trees, as well as for vines that are in close proximity to desired plants. When cutting, cut the vine six inches above the ground, in case more cut stump applications are required. Immediately apply the herbicide with a brush or spray bottle. Cut stump treatment can be used at any time in the year as long as the ambient air temperature is above the necessary temperatures: forty degrees Fahrenheit for glyphosate application, and sixty-five degrees Fahrenheit for triclopyr application. The ground should not be frozen at the time of application.

Basal bark treatment with triclopyr ester can also be applied at any time in the year, if the ambient air temperature has been above the required sixty-five degrees Fahrenheit for several days. Basal bark treatment should also not be done if there is snow on the ground, or if any part of the application area is wet from rain or flooding. Before applying, cut any stems sprouting from the vine within the twelve to eighteen inch application range to reveal the bark, and apply the treatment to cover the entire of that area.

Systemic herbicides should destroy an entire *C. orbiculatus* plant in a week.

**Table 8. *C. orbiculatus* Treatment Guide**

| Method | Herbicide | Brand | Selectivity | Concentration | Time | Notes |
|--------|-----------|-------|-------------|---------------|------|-------|
|--------|-----------|-------|-------------|---------------|------|-------|

| Non-chemical Treatment |                 |                                              |               |     |            |                                                                                                            |
|------------------------|-----------------|----------------------------------------------|---------------|-----|------------|------------------------------------------------------------------------------------------------------------|
| Hand pulling           |                 |                                              |               |     | Mar - Nov  | Small plants                                                                                               |
| Cutting                |                 |                                              |               |     | Mar - Nov  | Will kill any climbing vines in canopy to relieve tree, will not destroy roots                             |
| Chemical Treatment     |                 |                                              |               |     |            |                                                                                                            |
| Foliar spray           | Triclopyr       | <i>Garlon® 3A,</i><br><i>Garlon® 4 Ultra</i> | Selective     | 2%  | Oct - Nov  | Use late season so most native species are dormant; ambient temperature should still be above 65 degrees F |
| Cut stem/stump         | Glyphosate      | <i>Rodeo®</i>                                | Non-selective | 25% | Year round | Ambient air temperature above 40°F                                                                         |
|                        | Triclopyr       | <i>Garlon® 3A,</i><br><i>Garlon® 4 Ultra</i> | Selective     |     |            | Ambient air temperature above 65°F, no frozen ground                                                       |
| Basal bark             | Triclopyr ester | <i>Garlon® 4 Ultra</i>                       | Selective     | 20% | Year round | Should only be performed when ambient air temperature has been above 65°F for several days                 |

***Cynanchum louiseae* (Black Swallow-wort)**

## Description

*C. louiseae* is a non-native rhizomatous perennial milkweed. Stems are yellowish-green, long and thin, vine-like and twining. The stems tend to climb and twist around other plant stems or themselves. Leaves are opposite, smooth, shiny, dark green, and elliptic or heart shaped with sharp tips. Flowers are small and dark purple, with five petals. *C. louiseae* has milkweed-like seed pods, with many small brown seeds attached to fluffy white hairs.



[https://www.maine.gov/dacf/mnap/features/invasive\\_plants/cynanchum.htm](https://www.maine.gov/dacf/mnap/features/invasive_plants/cynanchum.htm)

*C. louiseae* is spread long distances by its seeds, which float in wind, and many seeds will drop into already infested areas, increasing the density of *C. louiseae* in patches.

*C. louiseae* outcompetes native species and forms sprawling and dense mats of plant matter that completely cover areas, limiting the growth potential for native species. It will also twine around native species, stressing those plants and limiting ability to grow.

## Non-chemical Treatment

Non-chemical treatment of *C. louiseae* has limited effects for control. Hand pulling or mowing the part of the plant above soil prevents the development of seed pods, limiting the ability of the plant to spread; this is not an effective method of long-term control.

Digging the roots of the plant is labor intensive, and any control established is limited as the plant will resprout from any remaining rhizomatous matter. The entire crown and root system must be removed in order to control by digging.

Any seed pods that do form should be pulled by hand and bagged or burned to prevent propagation.

## Chemical Treatment

*C. louiseae* is a pervasive species and will require multiple years of treatment to achieve control. It is very important to not apply herbicide too early in the season when treating *C. louiseae*. While the shoots emerge in the early spring, herbicide should only be applied after the plants have begun to flower in June or July, and must be applied before

the formation of seed pods. Foliar spraying before the formation of seed pods will greatly reduce seed viability in affected plants.

Foliar spray is optimal when treating large monotypic stands of *C. louiseae*. If the exotic plants are surrounded by desired grasses, then triclopyr can be used minimize damage to grasses. Plants will appear sick one to two weeks after herbicide treatment, exhibiting yellowed leaves, and dead spots. Do not reapply herbicide to plants that are sick, as sick plants cannot effectively absorb herbicides into roots.

For particularly sensitive areas, cut stem treatment of *C. louiseae* is a viable control method. Stems should be cut to about two inches from the ground, and non-selective herbicide should be applied immediately.

**Table 9. *C. louiseae* Treatment Guide**

| Method                        | Herbicide  | Brand                                                  | Selectivity   | Concentration | Time        | Notes                                                      |
|-------------------------------|------------|--------------------------------------------------------|---------------|---------------|-------------|------------------------------------------------------------|
| <b>Non-chemical Treatment</b> |            |                                                        |               |               |             |                                                            |
| Hand-pulling                  |            |                                                        |               |               | Aug - Nov   | Target seedpods                                            |
| <b>Chemical Treatment</b>     |            |                                                        |               |               |             |                                                            |
| Foliar spray                  | Glyphosate | <i>Rodeo®</i>                                          | Non-selective | 3-5%          | June - July | Spray as plants begin to flower                            |
|                               | Triclopyr  | <i>Garlon® 3A,</i><br><i>Garlon® 4</i><br><i>Ultra</i> | Selective     | 1%            |             |                                                            |
|                               | Imazapyr   | <i>Habitat®</i>                                        |               |               |             |                                                            |
| Cut stem/stump                | Glyphosate | <i>Rodeo®</i>                                          | Non-selective | 50-100%       | June - July | Cut stems to two inches from the ground before application |



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## ***Fallopia japonica* (Japanese Knotweed)**

### **Description**

*F. japonica* is a non-native rhizomatous perennial that is a particularly difficult exotic species to manage. The stems emerge in early spring and grow tall, up to ten feet. The stems are reddish-brown and hollow, resembling bamboo. Heart-shaped leaves are large, growing four to seven inches in length. Clusters of small, greenish-yellow to white flowers are formed in July. Fruits mature in August or September, and are winged to increase seed dispersal.



<https://www.hortweek.com/network-rail-loses-japanese-knotweed-court-ruling/landscape/article/1486930>

The seeds rarely germinate, and North American knotweed is presumed to be a sterile male clone. It is still possible to produce viable seeds, usually through hybridization. *F. japonica* mainly spreads vegetatively, extending its massive woody rhizome system and sending up new shoots. Any piece of rhizome material moved to a new area can lead to new infestation. As such, it is generally contained in defined patches, and will not cross impervious surfaces like roads easily.

*F. japonica* offers no ecological benefits to native species other than dense cover. It can colonize a variety of ecosystems, swiftly converting them to monocultures, and degrading habitat value.

### **Non-chemical Treatment**

Digging is an ineffective method of management, as *F. japonica* grows from a thick rhizome, forming large crowns that are extremely difficult to fully remove.

Mowing of *F. japonica* alone is not an effective means of control, and must be coupled with chemical treatment.

Small stands of *F. japonica* can be managed by mowing the area and covering it with impervious mats, thick enough that *F. japonica* is unable to grow through. Leaving the mats in place for several years will prevent the root system from sending up new shoots in the covered area, preventing photosynthesis. If in an area of full or partial sun, the heat will also damage the root system.

*F. japonica* is limited in its ability to spread across impervious surfaces, and will be more easily contained closer to roads.

### **Chemical Treatment**

The most effective method of chemical treatment is first to mow *F. japonica* at the beginning of July, and follow with herbicide application. At least six weeks should pass between mowing and herbicide application, and when herbicide is applied the height of *F. japonica* is limited to its regrowth: three to four feet tall instead of six to ten feet tall.

Glyphosate can be applied as a foliar spray. Glyphosate is a non-selective herbicide, and patches with *F. japonica* are generally monocultures. Glyphosate should be applied twice in the first year of treatment, first in early August, and following up in September before the first frost. Grass can be seeded in the area if it is necessary for erosion control. As knotweed requires multiple years of treatment, an inexpensive annual rye grass would be optimal.

*F. japonica* can also be treated by stem injection, where herbicide is injected at the nodes, the location where the leaves meet the stem. Stem injection directs as much chemical as possible to the root system, but is labor intensive and requires specialized injection equipment.

*F. japonica* thrives in a range of soils, from sandy roadsides to moist wetlands. In wetland areas, use mechanical methods to the greatest extent feasible (such as thick mats). Work from the upstream seed source to downstream populations. If chemical treatment is used, care should be taken to use an herbicide that will not injure amphibian food sources and rare species such as Blanding's turtle. The table below provides guidance on using *Rodeo*®.

Application should not exceed the regulated rate per acre, of particular concern when filling hollow stems or injecting herbicide.

Herbicide should not be applied after the first frost, as *F. japonica* is frost sensitive and will die back, leaving any herbicides applied after frost unabsorbed.



**Table 10. *F. japonica* Treatment Guide**

| Method                         | Herbicide  | Brand          | Selectivity   | Concentration     | Time                 | Notes                                                                                                                                                            |
|--------------------------------|------------|----------------|---------------|-------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Non-chemical Treatment</b>  |            |                |               |                   |                      |                                                                                                                                                                  |
| Mowing                         |            |                |               |                   | Aug; Sep             |                                                                                                                                                                  |
| <b>Chemical Treatment</b>      |            |                |               |                   |                      |                                                                                                                                                                  |
| Foliar spray                   | Glyphosate | <i>Rodeo</i> ® | Non-selective | 2-4% <sup>1</sup> | Early Aug - Late Sep | Surfactant; first application: Add surfactant, must wait 6 weeks after early July mowing, second application: add surfactant, must be applied before first frost |
| Stem injection                 | Glyphosate | <i>Rodeo</i> ® | Non-selective | 100%              | August               | Injected at the stem nodes                                                                                                                                       |
| Notes:<br>1. Contributed by BM |            |                |               |                   |                      |                                                                                                                                                                  |

## ***Convolvulus arvensis* (Bindweed)**

### **Description**

“Deep rooted perennial vine that grows along the ground until it comes in contact with other plants or structures; then climbs aggressively. Smooth, arrowhead-shaped leaves. Slender, twining stems that can grow to 6 feet long. Trumpet-shaped flowers, light pink to white. Two small leaf bracts about one inch below the flower. Fleshy pale roots that travel deeply and widely”

<https://www.nwcb.wa.gov>

“Reproduces vegetatively from roots, rhizomes, stem fragments and by seeds that can lie dormant in the soil for up to 20 or more years. Roots spread widely underground, both vertically and horizontally, forming dense mats. Flowering is indeterminate, so flowers continue to develop along stems until the first frost”

<https://www.nwcb.wa.gov>



<https://www.swcoloradowildflowers.com/White%20Enlarged%20Photo%20Pages/convolvulus%20arvensis.htm>

### **Non-chemical Treatment**

“Avoid digging or tilling the soil around mature field bindweed roots; roots or rhizome fragments left behind may resprout. Repeated hand pulling works eventually, but is highly labor intensive. It is best to limit hand pulling and tilling to seedlings; do in early spring when the ground is wet. Smothering plants with mulch, black plastic or plastic-fiber mats (geotextiles) is another option, but the covering must be kept in place for several years. Success may be somewhat limited as field bindweed can persist without light, sending its underground roots beyond the edge of the covering to start a new infestation. If using coverings, check often for cracks or openings; pull or spot spray any new growth coming up through the covering. Cutting alone will not control this plant and is not recommended.”

<https://www.nwcb.wa.gov>

### **Chemical Treatment**

“Herbicides can be painted or brushed on leaves to avoid drift onto desirable plants. Products containing glyphosate are effective when applied in the summer and fall before

the leaves die back. However, glyphosate is “non-selective” and will injure any foliage that it comes in contact with including grass. Selective broadleaf herbicides with the active ingredients triclopyr and 2,4-D work well for lawn areas as they won’t harm most grasses. Repeat on regrowth as needed. All these herbicides are absorbed by foliage and moved throughout the plant to kill the roots and shoots. If retreating with glyphosate in the same season, allow plants to grow and produce flowers before each application.”  
<https://www.nwcb.wa.gov>

**Table 11. *C. arvensis* Herbicide Treatment Guide**

| Method                        | Herbicide  | Brand                 | Selectivity   | Concentration | Time        | Notes |
|-------------------------------|------------|-----------------------|---------------|---------------|-------------|-------|
| <b>Non-chemical Treatment</b> |            |                       |               |               |             |       |
| Hand-pulling                  |            |                       |               |               | Mar - Sept  |       |
| Digging                       |            |                       |               |               | Mar - Sept  |       |
| Mowing                        |            |                       |               |               | Mar - Sept  |       |
| <b>Chemical Treatment</b>     |            |                       |               |               |             |       |
| Foliar spray                  | Glyphosate | <i>Rodeo</i> ®        | Non-selective | 2%            | July - Sept |       |
|                               | Triclopyr  | <i>Garlon</i> ®<br>3A | Selective     | 3-5%          |             |       |
|                               | Imazapyr   | <i>Habitat</i> ®      | Non-selective | 2%            |             |       |

***Lythrum salicaria* (Purple Loosestrife)**

**Description**

*L. salicaria* is a non-native herbaceous perennial forb that is an aggressive invader of wetlands. Several four-sided square erect stems grow from a single plant, two to six feet in height. Leaves are opposite on the stem or in whorls around the base, and are smooth, elongated, and heart-shaped. Flower spikes are showy and magenta, made up of many small, five-petaled individual flowers, blooming late in the growing season. The fruit is a capsule developed in autumn containing small seeds.

*L. salicaria* is spread by seed, which are viable for many years, and remain dormant in the soil until conditions are right for growth.

*L. salicaria* can dominate areas where it is introduced, displacing native species and reduces biodiversity. *L. salicaria* also degrades wetlands, catching sediment that fills in wetlands, leading to reduced water flow, and decreased flood retention.



<https://www.minnesotawildflowers.info/flower/purple-loosestrife>

### **Non-chemical Treatment**

*L. salicaria* populations can be partially managed by pulling and digging as long as the entire taproot is removed. This is time consuming and labor intensive, and should only be implemented on small pioneer populations that can be removed efficiently.

Biological control is the best method for long term large scale. Insect species can be introduced to feed on the plants, preventing *L. salicaria* from seeding and weakening, eventually destroying the plant.

### **Chemical Treatment**

*L. salicaria* most commonly is found in sensitive wetland areas. The two most effective herbicides are glyphosate and triclopyr. Glyphosate and triclopyr amine, both registered for aquatic use, are commonly applied when managing *L. salicaria*. Treatment should occur prior to seed set to prevent future spread of the species.

Glyphosate can damage surrounding grasses and sedges, leaving new opportunities for colonization by *L. salicaria*. Pesticide should be selected based on density of the stands being treated, and whether or not surrounding plants are desirable. If surrounding plants are desirable grasses and sedges, triclopyr amine should be selected. If there are many exotic plants, glyphosate should be used, or a mixture of glyphosate and triclopyr. Follow up treatments will be required for years until the seedbank is depleted.

**Table 12. *L. salicaria* Herbicide Treatment Guide**

| Application Method            | Herbicide       | Brand             | Selectivity   | Concentration | Time      | Notes                                                                        |
|-------------------------------|-----------------|-------------------|---------------|---------------|-----------|------------------------------------------------------------------------------|
| <b>Non-chemical Treatment</b> |                 |                   |               |               |           |                                                                              |
| Hand pulling                  |                 |                   |               |               | Apr - Sep |                                                                              |
| Digging                       |                 |                   |               |               | Apr - Sep |                                                                              |
| Cutting                       |                 |                   |               |               | Apr - Sep |                                                                              |
| Biological                    |                 |                   |               |               | Apr - Jun | Introduced insect species to feed on plant                                   |
| <b>Chemical Treatment</b>     |                 |                   |               |               |           |                                                                              |
| Foliar spray                  | Glyphosate      | <i>Rodeo®</i>     | Non-selective | 1-2%          | Late Aug  | Apply after peak bloom; cut and dispose of flower heads prior to application |
|                               | Triclopyr amine | <i>Garlon® 3A</i> | Selective     | 1%            |           |                                                                              |
| Hand wicking                  |                 |                   |               |               | Late Aug  |                                                                              |

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***Rosa multiflora* (Multiflora Rose)**

**Description**



*R. multiflora* is a thorny non-native perennial shrub. The plant is tolerant of many conditions and can grow ten feet tall and ten feet wide. Stems are long, green to brown, with hooked thorns that make hand removal hazardous. Leaves are opposite with five to eleven leaflets, and leaflets are one to two inches in length.



<https://production.wordpress.uconn.edu/cipwg/wp-content/uploads/sites/244/2014/04/RobRoutledgeSaultCollegeBugwood.jpg>

White to pinkish five petal flowers form in clusters in the summer. The plant produces bright red fleshy fruits (hips).

*R. multiflora* can generate new stems to spread, but it is predominantly spread by seed.

*R. multiflora* is easily distinguished from native *Rosa* species. In *R. multiflora* the base of leaf where it is attached to the thorny stem is fringed, and the plant's white to pinkish five petalled flowers occur in branched structures.

Benefits of the plant include the food and cover it provides to native animals. However, the overall effect this shrub has on habitat value is negative. *R. multiflora* crowds out native species and creates dense, impenetrable stands. *R. multiflora* can also act almost as a vine, and choke out native trees.

### **Non-chemical Treatment**

Controlling small populations is much easier than attempting control dense stands. Hand pulling can be effective if the entire root of the plant is removed.

Cutting or mowing alone will not control *R. multiflora*, but are useful in preparation for herbicide treatment. Cut stem application would be impossible on dense stands, so mowing leads to better control.

### **Chemical Treatment**

Foliar applications are made in summer when *R. multiflora* is flowering, with peak bloom being in early June. Spray should thoroughly cover the foliage of the plant, wetting as many leaves as possible without dripping. Glyphosate is less effective on multiflora rose than other herbicides but may be desirable if soil activity is a concern, or to avoid damaging surrounding grasses. Triclopyr can be applied as a foliar spray, and will eliminate top growth; future applications may be necessary to destroy the root system.

Triclopyr can also be applied to cut stems or as basal bark, and is most effective when applied in the dormant season. Cut stem use when mowing or cutting is practical; remove the top growth of the shrub and wet the stubble. This method can be applied year round. Basal bark is only feasible when the base of the plant can be accessed. It is best applied from January to autumn color. Wet the lower twelve inches of plant stem without causing runoff.

**Table 13. *R. multiflora* Treatment Guide**

| Method                        | Herbicide  | Brand                                        | Selectivity   | Concentration | Time       | Notes                                                     |
|-------------------------------|------------|----------------------------------------------|---------------|---------------|------------|-----------------------------------------------------------|
| <b>Non-chemical Treatment</b> |            |                                              |               |               |            |                                                           |
| Hand pulling                  |            |                                              |               |               | Mar - Nov  | Remove entire root                                        |
| Cutting/Mowing                |            |                                              |               |               | Mar - Nov  | Effective when followed immediately by chemical treatment |
| <b>Chemical Treatment</b>     |            |                                              |               |               |            |                                                           |
| Foliar spray                  | Glyphosate | <i>Rodeo®</i>                                | Non-selective | 2%            | May - Jun  |                                                           |
|                               | Triclopyr  | <i>Garlon® 3A,</i><br><i>Garlon® 4 Ultra</i> | Selective     | 1%            |            |                                                           |
| Cut stump/stem                | Triclopyr  | <i>Garlon® 3A,</i><br><i>Garlon® 4 Ultra</i> | Selective     | 50%           | Year round |                                                           |

|            |                 |                        |           |        |           |           |
|------------|-----------------|------------------------|-----------|--------|-----------|-----------|
| Basal bark | Triclopyr ester | <i>Garlon® 4 Ultra</i> | Selective | 20-25% | Jan - Aug | Basal oil |
|------------|-----------------|------------------------|-----------|--------|-----------|-----------|

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**Important Note:** Mention of specific products in this document does not constitute endorsement. Specific product names are mentioned in the resources used to create this document. This document is meant to serve as a guideline for exotic plant management, and is not a legal authority. By law, pesticides must be applied according to their labeling.

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26. *Invasive Plants in Pennsylvania: Glossy Buckthorn (Frangula alnus)*, Pennsylvania Department of Conservation & Natural Resources “[http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr\\_010272.pdf](http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_010272.pdf)”
27. *INVASIVE PLANT MANAGEMENT REPORT: SENEY NATIONAL WILDLIFE REFUGE (2017)* Corace, G., United States Fish & Wildlife Service “[https://www.fws.gov/uploadedFiles/Invasive\\_Plant\\_Mgmt\\_Report\\_SeneyNWR.pdf](https://www.fws.gov/uploadedFiles/Invasive_Plant_Mgmt_Report_SeneyNWR.pdf)”
28. *Imazapyr Chemical Fact Sheet*, Wisconsin Department of Natural Resources, Wisconsin Department of Natural Resources “<https://dnr.wi.gov/lakes/plants/factsheets/ImazapyrFactsheet.pdf>”
29. *Imazapyr: Review for Use in Lakes & Ponds in Massachusetts*, Massachusetts Department of Environmental Protection; Massachusetts Department of Agricultural Resources “<https://www.mass.gov/files/documents/2016/08/ox/imazapyr.pdf>”
30. KING COUNTY NOXIOUS WEED CONTROL PROGRAM WEED ALERT: Field Bindweed (aka Morning Glory) “[https://www.nwcb.wa.gov/pdfs/Bindweed\\_factsheet\\_King.pdf](https://www.nwcb.wa.gov/pdfs/Bindweed_factsheet_King.pdf)”

## Scott, Kelsey

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**To:** Quiggle, Robert  
**Subject:** RE: Lowell Heritage State Park information

**From:** Quiggle, Robert  
**Sent:** Friday, December 20, 2019 3:28 PM  
**To:** Harris, Jeffrey (DCR) <jeffrey.harris@state.ma.us>  
**Cc:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>  
**Subject:** RE: Lowell Heritage State Park information

Jeffrey:

It was good to meet you this week, and thanks for providing this information so quickly. We'll look through this and let you know if we have additional questions, etc.

Have a great holiday,

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
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**From:** Harris, Jeffrey (DCR) [<mailto:jeffrey.harris@state.ma.us>]  
**Sent:** Friday, December 20, 2019 12:33 PM  
**To:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Subject:** Lowell Heritage State Park information

Rob-

Thank you for your presentation on the Boott Hydro relicensing project on Wednesday. As a follow-up, I wanted to provide you with some additional information that may be helpful in the various studies that are planned.

The first is a 2014 Resource Management Plan for the broader complex that includes Lowell Heritage State Park. This addresses DCR ownership, recreation, and other issues within the park. The document is available here:  
<https://www.mass.gov/service-details/lowell-great-brook-planning-unit>

Secondly, our GIS team undertook a major effort a number of years ago to clarify DCR ownership of parcels within the City of Lowell. This data is currently available through Mass GIS:  
<https://docs.digital.mass.gov/dataset/massgis-data-protected-and-recreational-openspace>

Let me know if you have any questions!

Jeffrey

Jeffrey Harris, Preservation Planner

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DCR's Office of Cultural Resources

*Protecting the legacy and experience of history in Massachusetts state parks.*



## Scott, Kelsey

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**From:** Scott, Kelsey  
**Sent:** Wednesday, January 15, 2020 3:21 PM  
**To:** Bob Nasdor (bob@americanwhitewater.org); celeste\_bernardo@nps.gov; Bruins, Christine; Cooksey, William (DCR); John Aziz; Hoffmann, Peter (DCR); 'bruce@zoaroutdoor.com'; kevin@zoaroutdoor.com; Rose, George; CMcCall@lowellma.gov  
**Cc:** Quiggle, Robert; 'Kevin.Webb@enel.com'; Anderson, Elise (EGP North America)  
**Subject:** Lowell Hydroelectric Project (FERC No. 2790-072) -- Whitewater Boating and Access Study  
**Attachments:** 20200115 Lowell Whitewater Flow Documentation Plan Cover Letter.pdf

### Working Group Participants:

Boott Hydropower, LLC (Boott) is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the continued operation of the Lowell Hydroelectric Project (FERC No. 2790)(Project) located along the Merrimack River. In support of Project relicensing, Boott is conducting a Whitewater Boating and Access Study as approved in FERC's March 13, 2019 Study Plan Determination for the Project. Pursuant to the approved study plan, Boott met with the Whitewater Boating and Access Study Working Group (Working Group) at the Project on August 8, 2019. Boott provided the Whitewater Flow Documentation Plan (WFDP) to the Working Group on October 28, 2019 for review and comment.

Boott appreciates the comments on the WFDP provided by the Working Group. Please find the response to comments attached. If you have questions or need additional information, please contact Kevin Webb, Boott Hydro Licensing Manager, at (978) 935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com).

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*Via Email Distribution*

January 15, 2020

**To: Whitewater Boating and Access Working Group**

**Re: Response to Comments on the Lowell Hydroelectric Project (FERC No. 2790-072);  
Whitewater Boating and Access Study  
Whitewater Flow Documentation Plan**

Dear Whitewater Boating and Access Working Group:

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc., is the Licensee and owner of the 20.16 megawatt Lowell Hydroelectric Project (FERC No. 2790) (Project). The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC or Commission) that expires on April 30, 2023. The existing license for the Project was issued by the Commission with an effective date of May 1, 1973, and the license expires on April 30, 2023. Accordingly, Boott is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process, as described at 18 Code of Federal Regulations Part 5.

In support of Project relicensing, Boott is conducting a Whitewater Boating and Access Study (WBAS) as approved in the Commission's March 13, 2019 Study Plan Determination for the Project. In accordance with the approved study plan, Boott met with the WBAS Working Group (Working Group) at the Project on August 8, 2019 to coordinate study planning, identify potential volunteers to participate in controlled flow releases, and to identify potential put-in and take-out locations.

Consultation with the Working Group during the August 8, 2019 site visit indicated that there was a need to visually document a range of flows in the Project's bypass reach in order to assist the participants in identifying which flows to select for the controlled flow releases. Since the Working Group participants had limited experience boating the bypass reach, participants could not make informed choices on which flows would be appropriate for boating. Accordingly, Boott developed a Whitewater Flow Documentation Plan (WFDP) that describes the methods for documenting a range of flow conditions in the bypass reach, and methods for selecting study flows in consultation with the Working Group. The WFDP was submitted to the Working Group on October 28, 2019. In the WFDP, Boott proposed to document flows in the bypass reach using cellular-enabled trail cameras and Project operational data.

Boott appreciates the comments provided by American Whitewater (AW) on November 8, 2019. Based on AW's comments regarding the proposed locations of the cameras, Boott has attached a revised figure showing the updated locations for camera placement. These modified locations will capture more of the area of interest to AW, while also keeping the cameras at locations appropriate to reduce the risk of theft or vandalism. To the extent practicable, field technicians installing the cameras will adjust the locations based on field conditions with the intent of maximizing the visual documentation of whitewater features.

Boott also appreciates comments by the National Park Service (NPS) provided on November 11, 2019, and information provided regarding their operating parameters for various recreational experiences. The purpose of the WFDP is to consult with the Working Group on the methods for documenting a range of flow conditions in the bypass reach. The selection of appropriate flows for the WBAS will take place after May 15, 2020, and will occur in consultation with NPS and other members of the Working Group. Since the selection of proposed flows has not occurred, Boott believes it is premature at this time to attempt to define

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the effects of WBAS flows (if any), on flows in the Merrimack River or throughout the canal system. Generally, the Working Group will likely focus on flows ranging from 500 cubic feet per second (cfs) to 2,000 cfs, which are average bypass flows the Project normally experiences. Additional consultation on the WBAS will occur in late spring of 2020.

Boott appreciates the comments by AW and NPS regarding potential impacts of the study on fishway structures and fish passage. Boott is required to operate the upstream and downstream fish bypass facilities from April 1 through July 15 and from September 1 through November 15. As a result, Boott anticipates conducting the controlled flow releases after July 15, 2020 and before September 1, 2020, therefore the controlled flow releases will not interfere with fish passage or fishway structures.

On behalf of Boott, I look forward to continued discussions and consultation with the Working Group regarding this study. Please do not hesitate to contact me at (978) 935-6039 or via email at [Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com) if you have any questions concerning this study or Project relicensing.

Sincerely,

**Boott Hydropower, LLC**



Kevin M. Webb  
Hydro Licensing Manager

Encls.

Cc: R. Quiggle (HDR)  
K. Scott (HDR)  
E. Anderson (Boott)

**Lowell Hydroelectric Project (FERC No. 2790- 072)  
Whitewater Boating and Access Study Working Group**

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Figure 1. Locations of Cellular-Enabled Cameras



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**HR** BOOTT HYDRO, LLC.

● Proposed Location of Cellular-Enabled Trail Cameras and Approximate Field of View

▭ Project Boundary

WHITEWATER FLOW DOCUMENTATION  
LOWELL HYDROELECTRIC PROJECT  
FERC NO. 2790

NOVEMBER 2019

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## Scott, Kelsey

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**From:** Scott, Kelsey  
**Sent:** Thursday, January 16, 2020 10:36 AM  
**To:** Andrew Maylor - Town of North Andover, MA; Andrew Sheehan - Town of Middleton; Andrew Titler - USDOL; Arthur Johnson - MADES; Ben Gahagan - MADMF; Bill McDavitt - NOAA; Bjorn Lake - NMFS; bob@americanwhitewater.org; Bryan Sojkowski - USFWS (bryan\_sojkowski@fws.gov); Bub Durand - MAOEAA; Caleb Slater, Ph.D.; Celeste Bernardo - Lowell NHP; Charlene Dwin Vaughn; dam.safety@state.ma.us; Daniel Rivera - City of Lawrence, MA; David Meeker - Hull Street Energy LLC; David Turin - USEPA; Dinell Clark - Lowell Flood Owners Group and Williamsburg Condominium I; Duncan Hay - NPS; Ed Reiner - USEPA; Elizabeth Muzzey - NHDHR; Fred Jennings - TU; Gene Porter - LMRLAC; Harold Peterson; jack.buckley@state.ma.us; Jim Donchess - City of Nashua, NH; John Fowler - ACHP; John Nappi - Lowell Flood Owners Group; Jon Kurland - Town of Chelmsford, MA; Julianne Rosset - USFWS; Keith Nislow - USFS; Kevin Hollenbeck - DCR Great Brook Farm State Park; Kevin Mendik - NPS; Kim Galipeau - Town of Hollis, NH; Mark Andrews - Town of Pepperell, MA; Mark Prout - USFS; Matt Carpenter - NHFGD; Michael Bailey - USFWS; michael.judge@state.ma.us; Misty Anne Marold; Norman Sims - AMC 2; Owen David - NHDES; Rachel Freed - MADEP; Richard Reault - Town of Tyngsborough; Robert Bersak - Eversource Energy; Rusty Russell; Scott Galvin - City of Woburn, MA; Sean McDermott - NOAA; Steve Carlin - MADCR; Sue Tuxbury - NMFS; Timothy Higgins - Town of Lincoln, MA; Tom Chapman - USFWS; Tom Dolan - NMFS; Troy Brown - USFWS; Bruins, Christine  
**Cc:** Quiggle, Robert; 'Kevin.Webb@enel.com'; Anderson, Elise (EGP North America)  
**Subject:** Lowell Hydroelectric Project (FERC No. 2790) -- Study Progress Report for Quarter 4 of 2019  
**Attachments:** P-2790 2019 Quarterly Progress Report .pdf

Dear Stakeholders:

Boott Hydropower, LLC (Boott) is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the Lowell Hydroelectric Project. Boott is currently conducting studies approved by FERC in support of Project relicensing. On January 16, 2020, Boott filed the attached Study Progress Report for Quarter 4 (Q4) of 2019 with FERC in accordance with the approved study plan. The progress report describes the activities performed through the Q4 study period, as well as relicensing study activities generally expected to be conducted within the next quarter.

Should you have any questions regarding the attached progress report, please contact Kevin Webb, Hydro Relicensing Manager with Boott, at (978) 935-6039 or [kevin.webb@enel.com](mailto:kevin.webb@enel.com).

**Kelsey Scott, MS**  
*Assistant Regulatory Specialist*

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**January 16, 2020**

**Via eFiling**

Kimberly D. Bose, Secretary  
Federal Energy Regulatory Commission  
888 First Street, N.E.  
Washington, D.C. 20426

Re: Lowell Hydroelectric Project (FERC No. 2790-072)  
Fourth Quarterly Study Progress Report

Dear Secretary Bose:

Boott Hydropower, LLC (Boott), a subsidiary of Enel Green Power North America, Inc. (Enel), is the Licensee and owner of the 20.2 megawatt Lowell Hydroelectric Project (Project or Lowell Project). The existing license for the Project was issued by the Federal Energy Regulatory Commission (FERC or Commission) in 1973 and expires on April 30, 2023. Accordingly, Boott is pursuing a new license from the Commission for the continued operation and maintenance of the Project. Boott has elected to utilize the Commission's Integrated Licensing Process (ILP) for the relicensing of the Lowell Project.

As proposed in Boott's January 28, 2019 Revised Study Plan (RSP) and approved in the Commission's March 13, 2019 Study Plan Determination (SPD), Boott is hereby filing the Study Progress Report for the fourth quarter of 2019 (Q4 2019). This progress report describes the activities performed through the Q4 2019 study period, as well as ILP activities generally expected to be conducted within the next quarter (Q1 2020). Unless otherwise described, all relicensing studies are being conducted in conformance with the approved RSP and the Commission's SPD.

1. Downstream American Eel Passage Assessment

- Boott obtained silver eels for radio-tagging from a commercial vendor in Maine during early October.
- Boott tagged and released a total of 100 adult silver eels upstream of the Project's impoundment during October.
- Boott monitored the downstream progress of radio-tagged eels during October and November using a series of stationary receivers which were checked regularly during the passage season.
- During Q1 2020, Boott will be analyzing downstream passage data collected during October and November on fish movement, river conditions, and station operations.

2. Juvenile Alosine Downstream Passage Assessment

- Boott collected juvenile alosines from Turtle Pond in Concord, NH during October.
- Boott tagged and released a total of 150 juvenile alosines upstream of the

Pawtucket Dam during October.

- Boott monitored the downstream progress of radio-tagged juvenile alosines during October and November using a series of stationary receivers which were checked regularly during the passage season.
- During Q1 2020, Boott will be analyzing downstream passage data collected during October and November on fish movement, river conditions, and station operations.

3. Upstream and Downstream Adult Alosine Passage Assessment

- Boott is currently in the planning stages of this study.
- Planning for this study will continue during Q1 2020.

4. Fish Passage Survival Study

- Boott will initiate preparation of the draft fish passage survival study during Q1 2020.
- Efforts will include compilation of all required Project and turbine parameters as well as a review of results from the American eel and juvenile alosine telemetry studies.

5. Three-Dimensional Computational Fluid Dynamics Modeling

- Boott is currently planning and scheduling the initial 3D-Computational Fluid Dynamics (CFD) Model working group meeting for this study. This CFD Model working group will serve as a platform for discussion and refinement of the eight scenarios to be modeled among the three locations as outlined in the RSP.
- Activities to occur during Q4 2019 include continued study planning and field data collection.

6. Instream Flow Habitat Assessment and Zone of Passage Study in the Bypassed Reach

- Boott conducted a drone-based LiDAR survey of the bypassed reach during November.
- Boott conducted foot-based substrate mapping and bathymetric data collected for permanently wetted sections of the bypassed reach during November.
- Boott collected the water surface elevation and discharge measurements associated with the “low” calibration flow.
- During Q1 2020 Boott will assemble the elevation mesh for the 2D model to identify any areas which may require additional surveying during Q2 2020.
- Boott anticipates field data collection for the mid- and high-calibration flows will occur during Q2 2020.

7. Fish Assemblage Study

- During Q4 2019, Boott conducted the fall sampling for the fish assemblage



study using electrofishing, gill netting, and minnow traps in the impoundment and utilizing portable electrofishing gear in the bypassed reach. This completed the sampling effort for this study.

- Boott anticipates that data analysis and report preparation will continue during Q1 2020.

#### 8. Recreation and Aesthetics Study

- In accordance with the SPD, Boott has initiated the desktop research and literature review to identify and describe the existing recreational uses in the Project area.
- Boott consulted with the National Park Service (NPS), American Whitewater and other stakeholders to develop a list of reconnaissance and visitor intercept survey locations.
- Boott conducted field reconnaissance and visitor intercept surveys on random weekdays and weekend days through the months of May, June, July, August, September, and October. The online recreation survey is still available at the Project's relicensing website (<http://www.lowellprojectrelicensing.com/>).
- Boott conducted the field inventory to document existing formal and informal recreation facilities within the Project Boundary. Boott will continue to analyze this data in Q1 2020.
- Boott held a Study Workshop meeting with NPS and other stakeholders on December 18, 2019, to discuss recreation trends, utilization, facilities, and vegetation and waterborne trash in the canal system.
- Boott conducted a vegetation growth survey throughout the Project's canal system. This included a visual survey, identification of dominant vegetation types, and global positioning system (GPS) mapping of vegetative growth locations. Boott will continue to analyze this data in Q1 2020.

#### 9. Historically Significant Waterpower Equipment Study

- In accordance with the SPD, Boott is conducting background research and consulting with the NPS and other parties to develop a list of historically significant waterpower equipment at the Project.
- Boott held a Study Workshop with the NPS and other stakeholders to collect information regarding this study in Q4 2019.
- During Q1 2020, Boott intends to work closely with an architectural historian to review significant historical equipment owned and operated by Boott within the Project Boundary.

#### 10. Resources, Ownership, Boundaries, and Land Rights Study

- Boott has initiated an internal search for rights-of-way, land lease agreements, surveys, easements, and maintenance agreements related to the Lowell Project.
- Boott has obtained and initiated a review of the three main documents that establish the framework of this study: The Great Deed, the Order of Taking of

the Commonwealth of Massachusetts, and the lease from the Commonwealth of Massachusetts to the Lowell National Historical Park.

- On December 18, 2019, Boott held a consultation meeting with stakeholders, including the NPS and the City of Lowell, to collect information regarding this study.
- During Q1 2020, Boott anticipates a continued review of documents regarding property rights, roles, and responsibilities in coordination with the NPS, Massachusetts Department of Conservation and Recreation (MADCR), the City of Lowell, and private land owners (as applicable).

#### 11. Water Level and Flow Effects on Historic Resources Study

- Boott consulted with the NPS to determine the locations of pressure transducers (level loggers) to monitor flow levels in the canal system.
- Boott deployed water level loggers in June 2019. This is a minor variance in the study plan which called for deployment and data collection to begin on May 1, 2019. Boott plans on collecting continuous data for one full calendar year from the initial date of data collection.
- Monthly water level downloads occurred during Q4 2019. Data download is expected to continue through Q1 2020.
- On December 18, 2019, Boott held a consultation meeting with stakeholders, including the NPS and the City of Lowell, to collect information regarding this study in Q1 2020. During this meeting, stakeholders clarified that their interest is related to the effects of the new crest gate system and potential effects on historic resources at higher water levels. Boott explained that any effects would be limited to structures along the Northern Canal and the Upper Pawtucket Canal. Stakeholders agreed that the historic resources along the Northern Canal and Upper Pawtucket Canal should be the focus of this study. Stakeholders and Boott agreed that Boott should move level loggers to those locations (Upper Pawtucket Canal and Northern Canal), and remove the remaining level loggers from the downtown canal system.

#### 12. Whitewater Boating and Access Study

- Boott initiated consultation with the stakeholders to establish a Whitewater Boating and Access Study Working Group (Working Group). The Working Group conducted a site visit at the Project in August 2019 (Q3 2019) and identified action items necessary to facilitate the study, including flow documentation and a plan for accessing the bypass reach.
- During Q4 2019, Boott developed a Whitewater Flow Documentation Plan (WWFD Plan) and submitted it to stakeholders for review and comment. The WWFD Plan documents the methodologies proposed by Boott to capture the bypass reach under various flow conditions to determine the optimal flows to include during the controlled flow releases in the summer of 2020.
- Boott anticipates continued consultation with the Working Group through Q1 2020, with the intent of conducting controlled flow releases in Q3 2020 when flow

conditions and operational restraints permit.

13. Operation Analysis of the Lowell Canal Study

- Boott is continuing to review and prepare documentation on Project operations, including the operation of the Project's canal system.
- In Q1 2020, Boott anticipates continued review of Project operations and initial development of a study report documenting the findings of the operation analysis.

Please do not hesitate to contact me at (978) 935-6039 or [kevin.webb@enel.com](mailto:kevin.webb@enel.com) if you have any questions concerning this matter.

Sincerely,

**Boott Hydropower, LLC**



Kevin M. Webb  
Hydro Licensing Manager

cc: C. St. Pierre, Boott  
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Bill McDavitt  
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55 Great Republic Drive  
Gloucester, MA 01930

Sean McDermott  
Marine Habitat Resource Specialist,  
Hydropower Coordinator  
NOAA Fisheries Service  
55 Great Republic Drive  
Gloucester, MA 01930

George Rose  
Deputy Director  
Office of Emergency Management  
The City of Lowell Fire Department  
JFK Civic Center, 99 Moody Street  
Lowell, MA 01852

Harold Peterson  
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## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

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Northeast)  
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US National Park Service  
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Duncan Hay  
Northeast Region  
US National Park Service  
15 State Street  
Boston, MA 02109

Kevin Mendik  
Hydro Program Manager  
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Boston, MA 02109

### Indian Tribes

Cedric Cromwell  
Chairman  
Mashpee Wampanoag Tribe  
483 Great Neck Road South  
Mashpee, MA 02649

Ramona Peters  
Mashpee Wampanoag Tribe  
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Mashpee, MA 02649

John Brown  
Narragansett Indian Tribal Historic  
Preservation Office  
Narragansett Indian Tribe  
P.O. Box 268  
Charlestown, RI 02813

Bonney Hartley  
Tribal Historic Preservation Officer  
Stockbridge Munsee Community, Wisconsin  
65 1st Street  
Troy, NY 12180

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Shannon Holsey  
Tribal President  
Stockbridge Munsee Community, Wisconsin  
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Cheryl Andrew-Maltais  
Chairwoman  
Wampanoag Tribe of Gay Head  
20 Black Brook Road  
Aquinnah, MA 02535

Bettina Washington  
Tribal Historic Preservation Officer  
Wampanoag Tribe of Gay Head  
20 Black Brook Road  
Aquinnah, MA 02535

### **Municipalities**

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

Daniel Rivera  
Mayor  
City of Lawrence, MA  
200 Common Street  
3rd Floor Room 309  
Lawrence, MA 01840

Christine Clancy  
City of Lowell Engineer  
City of Lowell, MA  
375 Merrimack Street  
3rd Floor, Room 61  
Lowell, MA 01852

Edward Kennedy  
Mayor  
City of Lowell, MA  
375 Merrimack Street  
2nd Floor, Room 50  
Lowell, MA 01852

Christine O'Connor  
City Solicitor  
City of Lowell, MA  
375 Merrimack Street  
3rd Floor, Room 64  
Lowell, MA 01852

Joyce Craig  
Mayor  
City of Manchester, NH  
One City Hall Plaza  
Manchester, NH 03101

James Jajuga  
Mayor  
City of Methuen, MA  
41 Pleasant Street  
Methuen, MA 01844

Jim Donchess  
City of Nashua, NH  
229 Main Street  
Nashua, NH 03060

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

Paul Bergeron  
District #2  
Hillsborough County, NH  
329 Mast Road  
Suite 120  
Goffstown, NH 03045

Toni Pappas  
District #1  
Hillsborough County, NH  
329 Mast Road  
Suite 120  
Goffstown, NH 03045

Robert Rowe  
District #3  
Hillsborough County, NH  
329 Mast Road  
Suite 120  
Goffstown, NH 03045

Steven Ledoux  
Town Manager  
Town of Acton, MA  
472 Main Street  
Acton, MA 01720

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Andrew Flanagan  
Town Manager  
Town of Andover, MA  
36 Bartlet Street  
Andover, MA 01810

Jason Grosky  
Chairman  
Town of Atkinson, NH  
21 Academy Avenue  
Atkinson, NH 03811

Robert Pontbriand  
Town Administrator  
Town of Ayer, MA  
1 Main Street  
Ayer, MA 01432

Richard Reed  
Town Manager  
Town of Bedford, MA  
10 Mudge Way  
Bedford, MA 01730

John Curran  
Town Manager  
Town of Billerica, MA  
365 Boston Road  
Billerica, MA 01821

Alan Benson  
Town Administrator  
Town of Boxford, MA  
7A Spofford Road  
Boxford, MA 01921

Amy Warfield  
Town Clerk  
Town of Burlington, MA  
29 Center Street  
Burlington, MA 01803

Jon Kurland  
Town Moderator  
Town of Chelmsford, MA  
50 Billerica Road  
Chelmsford, MA 01824

Jane Hotchkiss  
Chair, Select Board  
Town of Concord, MA  
P.O. Box 535  
Concord, MA 01742

James Morgan  
Councilor  
Town of Derry, NH  
14 Manning Street  
Derry, NH 03038

Alison Hughes  
Chairman  
Town of Dracut, MA  
62 Arlington Street  
Dracut, MA 01826

Town Manager  
Town of Groton, MA  
173 Main Street  
Groton, MA 01450

Timothy Bragan  
Town Administrator  
Town of Harvard, MA  
13 Ayer Road  
Harvard, MA 01451

Kim Galipeau  
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Thaddeus Luszey  
Chairman  
Town of Hudson, NH  
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Suzanne Barry  
Chairman  
Town of Lexington, MA  
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Town of Lincoln, MA  
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Troy Brown  
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Litchfield, NH 03052



## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

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Tom Dolan  
Chairman  
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Londonderry, NH 03053

Robert Dolan  
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Town of Lynnfield, MA  
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Eileen Cabanel  
Town Manager  
Town of Merrimack, NH  
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Andrew Sheehan  
Town Administrator  
Town of Middleton, MA  
48 South Main Street  
Middleton, MA 01949

Andrew Maylor  
Town Manager  
Town of North Andover, MA  
120 Main Street  
North Andover, MA 01845

John Murphy  
Town Moderator  
Town of North Reading, MA  
235 North Street  
North Reading, MA 01864

Douglas Viger  
Chairman  
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6 Village Green  
Pelham, NH 03076

Mark Andrews  
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Town of Pepperell, MA  
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John Arena  
Chair, Board of Selectmen  
Town of Reading, MA  
16 Lowell Street  
Reading, MA 01867

Michael Lyons  
Chairman  
Town of Salem, NH  
33 Geremonty Drive  
Salem, NH 03079

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

George Seibold  
Chairman  
Town of Stoneham, MA  
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2nd Floor  
Stoneham, MA 02180

Richard Montuori  
Town Manager  
Town of Tewksbury, MA  
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Richard Reault  
Chair, Board of Selectmen  
Town of Tyngsborough, MA  
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Board of Selectmen  
Town of Westford, MA  
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Room 11  
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Ross Mcleod  
Chairman  
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## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

### Additional Parties

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Lynda Ignacio  
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Steve Masse  
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186 Humphrey Street  
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Lower Merrimack River Local Advisory  
77 Concord Street  
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Thomas Golden, Jr.  
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24 Beacon Street  
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Rady Mom  
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David Nangle  
Massachusetts House of Representatives  
24 Beacon Street  
Room 479  
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Edward Kennedy  
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24 Beacon Street  
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## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

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President, Nor'East Chapter  
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Michele Tremblay  
Upper Merrimack River Local Advisory  
Committee  
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Seth Moulton  
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Carol Shea-Porter  
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1530 Longworth House Office Building  
1st District  
Washington, DC 20515

Lori Trahan  
3rd District  
US House of Representatives  
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Suite 12  
Lowell, MA 01852

Margaret Hassan  
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Washington, DC 20510

Edward Markey  
US Senate  
218 Russell Senate Office Building  
Washington, DC 20510

Jeanne Shaheen  
US Senate  
506 Hart Senate Office Building  
Washington, DC 20510

Elizabeth Warren  
US Senate  
317 Hart Senate Office Building  
Washington, DC 20510

Dinell Clark  
President  
Williamsburg Condominium I  
197 Wellman Avenue  
North Chelmsford, MA 01863

Richard Howe  
Register of Deeds - Middlesex County North  
360 Gorham Street  
Lowell, MA 01852

## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Monday, January 20, 2020 10:00 AM  
**To:** Quiggle, Robert  
**Subject:** FW: Lowell Hydroelectric Project (FERC No. 2790) -- Study Progress Report for Quarter 4 of 2019

Just FYI

**From:** gene porter [mailto:gporter77@gmail.com]  
**Sent:** Monday, January 20, 2020 9:58 AM  
**To:** Scott, Kelsey  
**Cc:** kevin.webb@enel.com; ChisholmD@nashuanh.gov; becanamin@hotmail.com  
**Subject:** Re: Lowell Hydroelectric Project (FERC No. 2790) -- Study Progress Report for Quarter 4 of 2019

Thanks for this report. I regret that I was unable to represent the NH LMRLAC at the December Stakeholders Meetings. I trust that the City of Nashua, a major abutter of the Impoundment, is a Stakeholder and was represented.

Questions for Kevin Webb:

1. The Crestgate installation has important but unknown implications for the Impoundment shoreline in New Hampshire below Cromwells Falls. To what extent do the depth logging and analysis activities include the area at or above the NH-MA border?

2. To what extent did your outreach to recreational users include the NH Paddlers ([www.nhamcpaddlers.org](http://www.nhamcpaddlers.org)) or other NH recreational communities?

Thanks  
Gene Porter  
Chair NH LMRLAC

On Thu, Jan 16, 2020 at 10:35 AM Scott, Kelsey <[Kelsey.Scott@hdrinc.com](mailto:Kelsey.Scott@hdrinc.com)> wrote:

Dear Stakeholders:

Boott Hydropower, LLC (Boott) is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the Lowell Hydroelectric Project. Boott is currently conducting studies approved by FERC in support of Project relicensing. On January 16, 2020, Boott filed the attached Study Progress Report for Quarter 4 (Q4) of 2019 with FERC in accordance with the approved study plan. The progress report describes the activities performed through the Q4 study period, as well as relicensing study activities generally expected to be conducted within the next quarter.

Should you have any questions regarding the attached progress report, please contact Kevin Webb, Hydro Relicensing Manager with Boott, at (978) 935-6039 or [kevin.webb@enel.com](mailto:kevin.webb@enel.com).

**Kelsey Scott, MS**

*Assistant Regulatory Specialist*

**HDR**

1304 Buckley Road, Suite 202  
Syracuse, NY 13212

**D** 315.414.2206 **M** 315.706.5176  
[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Friday, February 21, 2020 12:41 PM  
**To:** Bruins, Christine  
**Cc:** Celeste Bernardo - Lowell NHP; Quiggle, Robert; kwebb@centralriverspower.com  
**Subject:** Lowell Initial Study Report Meeting - March 11, 2020

Hi Christine –

Boott Hydropower is filing the Lowell Hydroelectric Project Initial Study Report (ISR) on February 25, 2020 and planning a subsequent ISR meeting with NPS and partners on March 11, 2020. The conference room in the LNHP Visitor Center worked out well for our last meeting. The ISR meeting will be long with a similar sized group.

If possible, we would like to hold the upcoming March 11 ISR meeting in the LNHP Visitor Center conference room again. Can you let us know if this will work for your team? Let us know if you have any questions.

Thank You -

**Kelsey Scott, MS**  
*Assistant Regulatory Specialist*

**HDR**  
1304 Buckley Road, Suite 202  
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## Scott, Kelsey

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Thank You -

**Kelsey Scott, MS**  
*Assistant Regulatory Specialist*

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## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Monday, February 24, 2020 4:59 PM  
**To:** Kevin Webb; Bruins, Christine A  
**Cc:** Bernardo, Celeste; Quiggle, Robert  
**Subject:** RE: Lowell Initial Study Report Meeting - March 11, 2020

Hi Christine –

To follow up on this as well, these types of meetings can last all day but usually do not. Does it work with your team to hold the meeting in the conference room on March 11?

### **Kelsey Scott, MS**

*Assistant Regulatory Specialist*

#### **HDR**

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[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)  
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---

**From:** Kevin Webb [mailto:kwebb@centralriverspower.com]  
**Sent:** Friday, February 21, 2020 4:17 PM  
**To:** Bruins, Christine A ; Scott, Kelsey  
**Cc:** Bernardo, Celeste ; Quiggle, Robert  
**Subject:** RE: Lowell Initial Study Report Meeting - March 11, 2020

**CAUTION: [EXTERNAL]** This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Christine:

As for timing of the meeting, FERC requires us to hold the ISR meeting within 15 days of filing the ISR report, so the 11<sup>th</sup> is our last day to hold the meeting. I know that the 10<sup>th</sup> wouldn't work for us, the 9<sup>th</sup> is a maybe at best. The previous week we are meeting with the fish agencies, prior to getting together with FERC for the ISR meeting. BTW, we expect that Amy Chang, the new FERC project leader and possibly other FERC staff will plan to attend.

Regarding attendance by CRP, I expect that Jason will attend. Hopefully I can get Matt Stanley, our General Manager, and Curt Mooney, our Regulatory Affairs Manager, to attend at least part of the day. Agree 100% that face-to-face time is very important.

Have a great weekend!

Kevin

---

**From:** Bruins, Christine A  
**Sent:** Friday, February 21, 2020 3:46 PM  
**To:** Scott, Kelsey



**Cc:** Bernardo, Celeste ; Quiggle, Robert ; Kevin Webb  
**Subject:** Re: Lowell Initial Study Report Meeting - March 11, 2020

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe. =====

Kevin, I had been exchanging emails with Jason Bush about his plans to visit Lowell the week of March 10. Will he or any other new points of contact from Central Rivers Power be attending the stakeholder meeting? NPS is very interested in meeting face-to-face with new folks we will be working with.

Kelsey, would the stakeholder meeting be the whole day, a couple of hours? Does the meeting have to happen on Tuesday or could we look at Wednesday or Thursday?

**Christine Bruins | Community Planner**

Lowell National Historical Park  
978.275.1726 (office) | 978.954.1011 (cell)

---

**From:** Scott, Kelsey <[Kelsey.Scott@hdrinc.com](mailto:Kelsey.Scott@hdrinc.com)>  
**Sent:** Friday, February 21, 2020 12:41 PM  
**To:** Bruins, Christine A <[Christine\\_Bruins@nps.gov](mailto:Christine_Bruins@nps.gov)>  
**Cc:** Bernardo, Celeste <[Celeste\\_Bernardo@nps.gov](mailto:Celeste_Bernardo@nps.gov)>; Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>; [kwebb@centralriverspower.com](mailto:kwebb@centralriverspower.com) <[kwebb@centralriverspower.com](mailto:kwebb@centralriverspower.com)>  
**Subject:** [EXTERNAL] Lowell Initial Study Report Meeting - March 11, 2020

Hi Christine –

Boott Hydropower is filing the Lowell Hydroelectric Project Initial Study Report (ISR) on February 25, 2020 and planning a subsequent ISR meeting with NPS and partners on March 11, 2020. The conference room in the LNHP Visitor Center worked out well for our last meeting. The ISR meeting will be long with a similar sized group.

If possible, we would like to hold the upcoming March 11 ISR meeting in the LNHP Visitor Center conference room again. Can you let us know if this will work for your team? Let us know if you have any questions.

Thank You -

**Kelsey Scott, MS**  
*Assistant Regulatory Specialist*

**HDR**  
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Syracuse, NY 13212

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[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

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## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Friday, March 6, 2020 4:38 PM  
**To:** Andrew MacLean - Town of Pepperell; Andrew Maylor - Town of North Andover, MA; Andrew Sheehan - Town of Middleton; Tittler, Andrew; Arthur Johnson - MADES; Ben Gahagan - MADMF; Benjamin Wilson - NHDHR; Bill McDavitt - NOAA; Bjorn Lake - NMFS; bob@americanwhitewater.org; Sojkowski, Bryan; Bub Durand - MAOEEA; Caleb Slater, Ph.D.; Bernardo, Celeste; dam.safety@state.ma.us; dam.safety@state.ma.us; Daniel Rivera - City of Lawrence, MA; David Meeker - Hull Street Energy LLC; David Turin - USEPA; Dinell Clark - Lowell Flood Owners Group and Williamsburg Condominium I; Hay, Duncan E; Ed Reiner - USEPA; Fred Jennings - TU; Gene Porter - LMRLAC; Peterson, Harold S; jack.buckley@state.ma.us; Jim Donchess - City of Nashua, NH; John Eddins - ACHP; John Nappi - Lowell Flood Owners Group; Jon Kurland - Town of Chelmsford, MA; Rosset, Julianne; Keith Nislow - USFS; Kevin Hollenbeck - DCR Great Brook Farm State Park; Mendik, Kevin R; Kevin Webb - CRP; Kim Galipeau - Town of Hollis, NH; Mark Prout - USFS; Matt Carpenter - NHFGD; Bailey, Michael; michael.judge@state.ma.us; Misty Anne Marold; Norman Sims - AMC 2; Owen David - NHDES; Rachel Freed - MADEP; Richard Reault - Town of Tyngsborough; Robert Bersak - Eversource Energy; Rusty Russell; Scott Galvin - City of Woburn, MA; Sean McDermott - NOAA; Steve Carlin - MADCR; Sue Tuxbury - NMFS; Timothy Higgins - Town of Lincoln, MA; Chapman, Tom; Tom Dolan - NMFS; Troy Brown - USFWS; jmacone@merrimack.org; Amy.Chang@ferc.gov; Stephen.Kartalia@ferc.gov; peter.severance@rivermerrimack.org  
**Subject:** Lowell Hydroelectric Project Initial Study Report Meeting March 11, 2020

Dear Stakeholders -

The Initial Study Report meeting for the Lowell Hydroelectric Project will be held on March 11, 2020 at 246 Market Street, Lowell, MA 01852.

If you cannot attend the meeting in person, please use the following conference call information:

**Dial-in number: (866) 583-7984**

**Conference Code: 989-014-9046#**

Should you have any questions regarding the upcoming meeting, please contact Kevin Webb at [kwebb@centralriverspower.com](mailto:kwebb@centralriverspower.com).

### **Kelsey Scott, MS**

#### **HDR**

1304 Buckley Road, Suite 202

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## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Friday, March 6, 2020 4:38 PM  
**To:** Andrew MacLean - Town of Pepperell; Andrew Maylor - Town of North Andover, MA; Andrew Sheehan - Town of Middleton; Tittler, Andrew; Arthur Johnson - MADES; Ben Gahagan - MADMF; Benjamin Wilson - NHDHR; Bill McDavitt - NOAA; Bjorn Lake - NMFS; bob@americanwhitewater.org; Sojkowski, Bryan; Bub Durand - MAOEEA; Caleb Slater, Ph.D.; Bernardo, Celeste; dam.safety@state.ma.us; dam.safety@state.ma.us; Daniel Rivera - City of Lawrence, MA; David Meeker - Hull Street Energy LLC; David Turin - USEPA; Dinell Clark - Lowell Flood Owners Group and Williamsburg Condominium I; Hay, Duncan E; Ed Reiner - USEPA; Fred Jennings - TU; Gene Porter - LMRLAC; Peterson, Harold S; jack.buckley@state.ma.us; Jim Donchess - City of Nashua, NH; John Eddins - ACHP; John Nappi - Lowell Flood Owners Group; Jon Kurland - Town of Chelmsford, MA; Rosset, Julianne; Keith Nislow - USFS; Kevin Hollenbeck - DCR Great Brook Farm State Park; Mendik, Kevin R; Kevin Webb - CRP; Kim Galipeau - Town of Hollis, NH; Mark Prout - USFS; Matt Carpenter - NHFGD; Bailey, Michael; michael.judge@state.ma.us; Misty Anne Marold; Norman Sims - AMC 2; Owen David - NHDES; Rachel Freed - MADEP; Richard Reault - Town of Tyngsborough; Robert Bersak - Eversource Energy; Rusty Russell; Scott Galvin - City of Woburn, MA; Sean McDermott - NOAA; Steve Carlin - MADCR; Sue Tuxbury - NMFS; Timothy Higgins - Town of Lincoln, MA; Chapman, Tom; Tom Dolan - NMFS; Troy Brown - USFWS; jmacone@merrimack.org; Amy.Chang@ferc.gov; Stephen.Kartalia@ferc.gov; peter.severance@rivermerrimack.org  
**Subject:** Lowell Hydroelectric Project Initial Study Report Meeting March 11, 2020

Dear Stakeholders -

The Initial Study Report meeting for the Lowell Hydroelectric Project will be held on March 11, 2020 at 246 Market Street, Lowell, MA 01852.

If you cannot attend the meeting in person, please use the following conference call information:

**Dial-in number: (866) 583-7984**

**Conference Code: 989-014-9046#**

Should you have any questions regarding the upcoming meeting, please contact Kevin Webb at [kwebb@centralriverspower.com](mailto:kwebb@centralriverspower.com).

### **Kelsey Scott, MS**

#### **HDR**

1304 Buckley Road, Suite 202

Syracuse, NY 13212

**D** 315.414.2206 **M** 315.706.5176

[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Wednesday, March 11, 2020 9:04 AM  
**To:** Andrew MacLean - Town of Pepperell; Andrew Maylor - Town of North Andover, MA; Andrew Sheehan - Town of Middleton; Tittler, Andrew; Arthur Johnson - MADES; Ben Gahagan - MADMF; Benjamin Wilson - NHDHR; Bill McDavitt - NOAA; Bjorn Lake - NMFS; bob@americanwhitewater.org; Sojkowski, Bryan; Bub Durand - MAOEEA; Caleb Slater, Ph.D.; Bernardo, Celeste; dam.safety@state.ma.us; dam.safety@state.ma.us; Daniel Rivera - City of Lawrence, MA; David Meeker - Hull Street Energy LLC; David Turin - USEPA; Dinell Clark - Lowell Flood Owners Group and Williamsburg Condominium I; Hay, Duncan E; Ed Reiner - USEPA; Fred Jennings - TU; Gene Porter - LMRLAC; Peterson, Harold S; jack.buckley@state.ma.us; Jim Donchess - City of Nashua, NH; John Eddins - ACHP; John Nappi - Lowell Flood Owners Group; Jon Kurland - Town of Chelmsford, MA; Rosset, Julianne; Keith Nislow - USFS; Kevin Hollenbeck - DCR Great Brook Farm State Park; Mendik, Kevin R; Kevin Webb - CRP; Kim Galipeau - Town of Hollis, NH; Mark Prout - USFS; Matt Carpenter - NHFGD; Bailey, Michael; michael.judge@state.ma.us; Misty Anne Marold; Norman Sims - AMC 2; Owen David - NHDES; Rachel Freed - MADEP; Richard Reault - Town of Tyngsborough; Robert Bersak - Eversource Energy; Rusty Russell; Scott Galvin - City of Woburn, MA; Sean McDermott - NOAA; Steve Carlin - MADCR; Sue Tuxbury - NMFS; Timothy Higgins - Town of Lincoln, MA; Chapman, Tom; Tom Dolan - NMFS; Troy Brown - USFWS; jmacone@merrimack.org; Amy.Chang@ferc.gov; Stephen.Kartalia@ferc.gov; peter.severance@rivermerrimack.org  
**Subject:** Lowell ISR Meeting

Hello –

For stakeholders dialing in, we are currently setting up in the conference room. We will be dialing into the number in a few minutes.

**Dial-in number: (866) 583-7984**

**Conference Code: 989-014-9046#**

Thank You -

**Kelsey Scott, MS**

*Assistant Regulatory Specialist*

**HDR**

1304 Buckley Road, Suite 202

Syracuse, NY 13212

**D** 315.414.2206 **M** 315.706.5176

[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

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## Scott, Kelsey

---

**From:** Bruins, Christine A <Christine\_Bruins@nps.gov>  
**Sent:** Friday, March 13, 2020 2:13 PM  
**To:** Quiggle, Robert  
**Cc:** Scott, Kelsey; Jones, Scott  
**Subject:** Re: [EXTERNAL] Lowell Hydro Relicensing Waterborne Trash Mapping

**CAUTION:** [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

The COVID 19 situation is evolving rapidly. I don't think we can realistically schedule something this month. Let's set a tentative date 30+ days out? Week of 4/20? Monday, Thursday, Friday are free.

**Christine Bruins | Community Planner**  
Lowell National Historical Park  
978.275.1726 (office) | 978.954.1011 (cell)

---

**From:** Quiggle, Robert  
**Sent:** Friday, March 13, 2020 12:03 PM  
**To:** Bruins, Christine A  
**Cc:** Scott, Kelsey ; Jones, Scott

**Subject:** [EXTERNAL] Lowell Hydro Relicensing Waterborne Trash Mapping

Christine: We are looking to schedule our waterborne trash survey and mapping, and I wanted to check in with you to see if there were any specific dates that we should target or avoid. We'd like to get the fieldwork completed before mid-April, and we'd like to meet briefly with NPS staff that may have relevant information on waterborne trash issues while we're at the project.

We can be pretty flexible in terms of scheduling the fieldwork, but just let us know what makes sense on your end.

Thanks,

Robert Quiggle, RPA

*Regulatory and Environmental Section Manager*

HDR  
1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

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## Scott, Kelsey

---

**To:** Scott, Kelsey  
**Subject:** RE: [EXTERNAL] Lowell Hydro Relicensing Waterborne Trash Mapping

**From:** Quiggle, Robert  
**Sent:** Friday, March 13, 2020 4:25 PM  
**To:** Bruins, Christine A <Christine\_Bruins@nps.gov>  
**Cc:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>; Jones, Scott <Scott.Jones@hdrinc.com>  
**Subject:** RE: [EXTERNAL] Lowell Hydro Relicensing Waterborne Trash Mapping

Thanks, Christine. We will look to target the week of April 20, and I'll follow up with you on the specific dates.

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

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---

**From:** Bruins, Christine A [mailto:Christine\_Bruins@nps.gov]  
**Sent:** Friday, March 13, 2020 2:13 PM  
**To:** Quiggle, Robert <Robert.Quiggle@hdrinc.com>  
**Cc:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>; Jones, Scott <Scott.Jones@hdrinc.com>  
**Subject:** Re: [EXTERNAL] Lowell Hydro Relicensing Waterborne Trash Mapping

**CAUTION:** [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

The COVID 19 situation is evolving rapidly. I don't think we can realistically schedule something this month. Let's set a tentative date 30+ days out? Week of 4/20? Monday, Thursday, Friday are free.

**Christine Bruins | Community Planner**  
Lowell National Historical Park  
978.275.1726 (office) | 978.954.1011 (cell)

---

**From:** Quiggle, Robert <Robert.Quiggle@hdrinc.com>  
**Sent:** Friday, March 13, 2020 12:03 PM  
**To:** Bruins, Christine A <Christine\_Bruins@nps.gov>  
**Cc:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>; Jones, Scott <Scott.Jones@hdrinc.com>  
**Subject:** [EXTERNAL] Lowell Hydro Relicensing Waterborne Trash Mapping

Christine: We are looking to schedule our waterborne trash survey and mapping, and I wanted to check in with you to see if there were any specific dates that we should target or avoid. We'd like to get the fieldwork completed before mid-April, and we'd like to meet briefly with NPS staff that may have relevant information on waterborne trash issues while we're at the project.

We can be pretty flexible in terms of scheduling the fieldwork, but just let us know what makes sense on your end.

Thanks,

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

*Via Email Distribution*

March 18, 2020

**Re: Lowell Hydroelectric Project (FERC No. 2790)  
ILP Process Plan and Schedule**

Dear Stakeholders,

Boott Hydropower, LLC (Boott) is the Licensee, owner, and operator of the 20 megawatt Lowell Hydroelectric Project (Project) (FERC No. 2790). Boott operates the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on April 30, 2023. Boott is pursuing a new license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 C.F.R. Part 5.

Pursuant to the ILP, Boott filed the Initial Study Report (ISR) with the Commission on February 25, 2020, and conducted the ISR Meeting on March 11, 2020. As noted during the ISR Meeting, the ILP Process Plan and Schedule presented in the ISR was inaccurate. The correct Process Plan and Schedule can be found in FERC's September 27, 2018 Scoping Document 2 (SD2). A copy of the Process Plan and Schedule presented in SD2 is attached for your reference. Upcoming milestones related to the ISR are presented in Table 1, below.

**Table 1. Upcoming ILP Pre-filing Milestones Related to the ISR.**

| <b>Responsible Party</b> | <b>Pre-filing Milestone</b>                     | <b>Date</b> | <b>FERC Regulations</b> |
|--------------------------|-------------------------------------------------|-------------|-------------------------|
| Boott                    | Initial Study Report                            | 2/25/2020   | 5.15(c)(1)              |
| All stakeholders         | Initial Study Report Meeting                    | 3/11/2020   | 5.15(c)(2)              |
| Boott                    | Initial Study Report Meeting Summary            | 3/26/2020   | 5.15(c)(3)              |
| All stakeholders         | Any Disputes/Requests to Amend Study Plan Due   | 4/25/2020   | 5.15(c)(4)              |
| All stakeholders         | Responses to Disputes/Amendment Requests Due    | 5/25/2020   | 5.15(c)(5)              |
| FERC                     | Director's Determination on Disputes/Amendments | 6/24/2020   | 5.15(c)(6)              |

Please also note that the contact information for Boott's Licensing Manager is:

Mr. Kevin Webb  
Licensing Manager  
Boott Hydropower, LLC  
607 N. Commercial Street, Suite 204  
Manchester, NH 03102



Should you have any additional questions, please do not hesitate to contact me at (978) 935-6039 or [kwebb@centralriverspower.com](mailto:kwebb@centralriverspower.com).

Sincerely,  
**Boott Hydropower, LLC**



Kevin M. Webb  
Licensing Manager

Attachment

Cc: Distribution List

# Lowell Hydroelectric Project (FERC No. 2790) Distribution List

## Federal and State Agencies

John Eddins, PhD  
Archaeologist/Program Analyst  
Advisory Council on Historic Preservation  
401 F Street NW  
Suite 308  
Washington, DC 20001-2637

Kimberly Bose  
Secretary  
Federal Energy Regulatory Commission  
888 1st Street NE  
Washington, DC 20426

Office of Dam Safety  
Massachusetts Department of Conservation  
and Recreation  
John Augustas Hall  
180 Beaman Street  
West Boylston, MA 01583-1109

Steve Carlin  
Park Supervisor  
Massachusetts Department of Conservation  
and Recreation  
Lowell Heritage State Park  
160 Pawtucket Blvd  
Lowell, MA 01854

Michael Judge  
Renewable Energy Division Director  
Massachusetts Department of Energy  
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100 Cambridge Street  
Suite 1020  
Boston, MA 02114-2533

Rachel Freed  
Northeast Region Section Chief  
Massachusetts Department of Environmental  
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205 Lowell Street  
Wilmington, MA 01887

Arthur Johnson  
DWM Environmental Monitoring Program  
Massachusetts Department of Environmental  
Protection  
8 Bond Street  
Worcester, MA 01606

Massachusetts Department of Fish and Game  
251 Causeway Street  
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Boston, MA 02114

Massachusetts Department of Public Utilities  
One South Station  
Boston, MA 02110

Matthew Ayer  
Massachusetts Division of Fisheries & Wildlife  
1 Rabbit Hill Road  
Westborough, MA 01581

Joseph Larson  
Chairman  
Massachusetts Division of Fisheries & Wildlife  
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Westborough, MA 01581

Caleb Slater  
Anadromous Fish Project Leader  
Massachusetts Division of Fisheries & Wildlife  
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Ben Gahagan  
Diadromous Fisheries Biologist  
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Bob Durand  
Massachusetts Executive Office of Energy &  
Environmental Affairs  
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Jonathan Patton  
Preservation Planner  
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Brona Simon  
State Historic Preservation Officer  
Massachusetts Historical Commission  
220 Morrissey Boulevard  
Boston, MA 02125-3314

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Secretary of the Commonwealth  
Massachusetts Historical Commission  
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National Marine Fisheries Service  
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Misty Anne Marold  
Senior Review Biologist  
Natural Heritage Endangered Species  
Program  
Massachusetts Division of Fisheries & Wildlife  
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Westborough, MA 01581

Owen David  
Water Quality Certification Program  
New Hampshire Department of Environmental  
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29 Hazen Drive  
P.O. Box 95  
Concord, NH 03302

Jim Gallagher  
Dam Bureau Administrator  
New Hampshire Department of Environmental  
Services  
29 Hazen Drive  
P.O. Box 95  
Concord, NH 03302

Brad Simpkins  
Director  
New Hampshire Division of Forests and Lands  
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Concord, NH 03301

Benjamin Wilson  
SHPO & Director  
New Hampshire Division of Historical  
Resources  
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2nd Floor  
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Matt Carpenter  
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New Hampshire Fish and Game Department  
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Bill McDavitt  
Environmental Specialist  
NOAA Fisheries Service  
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Sean McDermott  
Marine Habitat Resource Specialist,  
Hydropower Coordinator  
NOAA Fisheries Service  
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Gloucester, MA 01930

George Rose  
Deputy Director  
Office of Emergency Management  
The City of Lowell Fire Department  
JFK Civic Center, 99 Moody Street  
Lowell, MA 01852

Harold Peterson  
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US Department of the Interior  
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David Turin  
Region 1 - New England  
US Environmental Protection Agency  
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## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Michael Bailey  
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Julianne Rosset  
Fish and Wildlife Biologist  
US Fish and Wildlife Service  
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Bryan Sojkowski  
Civil Engineer  
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Keith Nislow  
Northern Research Station  
US Forest Service  
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Mark Prout  
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Northeast)  
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Milwaukee, WI 53202

Celeste Bernardo  
Lowell National Historic Park  
US National Park Service  
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Lowell, MA 01852

Duncan Hay  
Northeast Region  
US National Park Service  
15 State Street  
Boston, MA 02109

Kevin Mendik  
Hydro Program Manager  
US National Park Service  
15 State Street  
Boston, MA 02109

### Indian Tribes

Cedric Cromwell  
Chairman  
Mashpee Wampanoag Tribe  
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Mashpee, MA 02649

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

John Brown  
Narragansett Indian Tribal Historic  
Preservation Office  
Narragansett Indian Tribe  
P.O. Box 268  
Charlestown, RI 02813

Bonney Hartley  
Tribal Historic Preservation Officer  
Stockbridge Munsee Community, Wisconsin  
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Troy, NY 12180

Shannon Holsey  
Tribal President  
Stockbridge Munsee Community, Wisconsin  
N8476 MoHeConNuck Road  
Bowler, WI 54416

Cheryl Andrew-Maltais  
Chairwoman  
Wampanoag Tribe of Gay Head  
20 Black Brook Road  
Aquinnah, MA 02535

Bettina Washington  
Tribal Historic Preservation Officer  
Wampanoag Tribe of Gay Head  
20 Black Brook Road  
Aquinnah, MA 02535

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

### Municipalities

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

Daniel Rivera  
Mayor  
City of Lawrence, MA  
200 Common Street  
3rd Floor Room 309  
Lawrence, MA 01840

Christine Clancy  
City of Lowell Engineer  
City of Lowell, MA  
375 Merrimack Street  
3rd Floor, Room 61  
Lowell, MA 01852

Edward Kennedy  
Mayor  
City of Lowell, MA  
375 Merrimack Street  
2nd Floor, Room 50  
Lowell, MA 01852

Christine O'Connor  
City Solicitor  
City of Lowell, MA  
375 Merrimack Street  
3rd Floor, Room 64  
Lowell, MA 01852

Joyce Craig  
Mayor  
City of Manchester, NH  
One City Hall Plaza  
Manchester, NH 03101

James Jajuga  
Mayor  
City of Methuen, MA  
41 Pleasant Street  
Methuen, MA 01844

Jim Donchess  
City of Nashua, NH  
229 Main Street  
Nashua, NH 03060

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

Paul Bergeron  
District #2  
Hillsborough County, NH  
329 Mast Road  
Suite 120  
Goffstown, NH 03045

Toni Pappas  
District #1  
Hillsborough County, NH  
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Suite 120  
Goffstown, NH 03045

Robert Rowe  
District #3  
Hillsborough County, NH  
329 Mast Road  
Suite 120  
Goffstown, NH 03045

Steven Ledoux  
Town Manager  
Town of Acton, MA  
472 Main Street  
Acton, MA 01720

Andrew Flanagan  
Town Manager  
Town of Andover, MA  
36 Bartlet Street  
Andover, MA 01810

Jason Grosky  
Chairman  
Town of Atkinson, NH  
21 Academy Avenue  
Atkinson, NH 03811

Robert Pontbriand  
Town Administrator  
Town of Ayer, MA  
1 Main Street  
Ayer, MA 01432

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Richard Reed  
Town Manager  
Town of Bedford, MA  
10 Mudge Way  
Bedford, MA 01730

John Curran  
Town Manager  
Town of Billerica, MA  
365 Boston Road  
Billerica, MA 01821

Alan Benson  
Town Administrator  
Town of Boxford, MA  
7A Spofford Road  
Boxford, MA 01921

Amy Warfield  
Town Clerk  
Town of Burlington, MA  
29 Center Street  
Burlington, MA 01803

Jon Kurland  
Town Moderator  
Town of Chelmsford, MA  
50 Billerica Road  
Chelmsford, MA 01824

Jane Hotchkiss  
Chair, Select Board  
Town of Concord, MA  
P.O. Box 535  
Concord, MA 01742

James Morgan  
Councilor  
Town of Derry, NH  
14 Manning Street  
Derry, NH 03038

Alison Hughes  
Chairman  
Town of Dracut, MA  
62 Arlington Street  
Dracut, MA 01826

Town Manager  
Town of Groton, MA  
173 Main Street  
Groton, MA 01450

Timothy Bragan  
Town Administrator  
Town of Harvard, MA  
13 Ayer Road  
Harvard, MA 01451

Kim Galipeau  
Town Administrator  
Town of Hollis, NH  
7 Monument Square  
Hollis, NH 03049

Thaddeus Luszey  
Chairman  
Town of Hudson, NH  
12 School Street  
Hudson, NH 03051

Suzanne Barry  
Chairman  
Town of Lexington, MA  
1625 Massachusetts Avenue  
2nd Floor, Town Office Building  
Lexington, MA 02420

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

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

Keith Bergman  
Town Administrator  
Town of Littleton, MA  
37 Shattuck Street  
3rd Floor, Room 306  
Littleton, MA 01460

Tom Dolan  
Chairman  
Town of Londonderry, NH  
268B Mammoth Road  
Londonderry, NH 03053

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

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

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

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

Andrew Maylor  
Town Manager  
Town of North Andover, MA  
120 Main Street  
North Andover, MA 01845

John Murphy  
Town Moderator  
Town of North Reading, MA  
235 North Street  
North Reading, MA 01864

Douglas Viger  
Chairman  
Town of Pelham, NH  
6 Village Green  
Pelham, NH 03076

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

John Arena  
Chair, Board of Selectmen  
Town of Reading, MA  
16 Lowell Street  
Reading, MA 01867

Michael Lyons  
Chairman  
Town of Salem, NH  
33 Geremonty Drive  
Salem, NH 03079

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

George Seibold  
Chairman  
Town of Stoneham, MA  
35 Central Street  
2nd Floor  
Stoneham, MA 02180

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

Richard Reault  
Chair, Board of Selectmen  
Town of Tyngsborough, MA  
25 Bryants Lane  
Tyngsborough, MA 01879

Board of Selectmen  
Town of Westford, MA  
55 Main Street  
Westford, MA 01886

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

Ross Mcleod  
Chairman  
Town of Windham, NH  
3 North Lowell Street  
Windham, NH 03087

### **Additional Parties**

Robert Nasdor  
NE Stewardship Director  
American Whitewater  
65 Blueberry Hill Lane  
Sudbury, MA 01776

Norman Sims  
Appalachian Mountain Club  
77 Back Ashuelot Road  
Winchester, NH 03470

## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Kevin Hollenbeck  
Metrowest District Manager  
DCR Great Brook Farm State Park  
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Kevin Webb  
Licensing Manager  
Central Rivers Power  
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Manchester, NH 03102

Robert Bersak  
780 North Commercial Street  
Eversource Energy  
P.O. Box 330  
Manchester, NH 03015

Jay Mason  
President  
Friends of Tyler Park  
77 Tyler Park  
Lowell, MA 01851

David Meeker  
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4920 Elm Street  
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Jeffrey J. Winward  
Fire Chief  
Lowell Fire Department  
99 Moody Street  
Lowell, MA 01852

Dinell Clark  
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197 Wellman Avenue  
North Chelmsford, MA 01863

Bob Gagnon  
Lowell Flood Owner's Group  
136 Townsend Avenue  
Lowell, MA 01854

Lynda Ignacio  
Lowell Flood Owner's Group  
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186 Humphrey Street  
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John Nappi  
Lowell Flood Owner's Group  
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Nashua, NH 03064

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Rady Mom  
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Edward Kennedy  
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Suite 211-E  
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Rusty Russell  
Executive Director  
Merrimack River Watershed Council  
60 Island Street  
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## Lowell Hydroelectric Project (FERC No. 2790) Distribution List

Chris Countie  
Water Supply Manager  
Pennichuck Water Works  
P.O. Box 1947  
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Merrimack, NH 03054

Peter Severance  
Research/Program Director  
River Merrimack

Fred Jennings  
President, Nor'East Chapter  
Trout Unlimited  
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Ipswich, MA 01938

Arthur Faneros  
Universal Apartment Rental  
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Michele Tremblay  
Upper Merrimack River Local Advisory  
Committee  
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Seth Moulton  
6th District  
US House of Representatives  
21 Front Street  
Salem, MA 01970

Chris Pappas  
US House of Representatives  
889 Elm Street  
Manchester, NH 03101

Lori Trahan  
3rd District  
US House of Representatives  
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Margaret Hassan  
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Edward Markey  
US Senate  
218 Russell Senate Office Building  
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Jeanne Shaheen  
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Elizabeth Warren  
US Senate  
317 Hart Senate Office Building  
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Dinell Clark  
President  
Williamsburg Condominium I  
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Richard Howe  
Register of Deeds - Middlesex County North  
360 Gorham Street  
Lowell, MA 01852

**APPENDIX A**  
**LOWELL HYDROELECTRIC PROJECT PROCESS PLAN AND SCHEDULE**

Shaded milestones are unnecessary if there are no study disputes. If the due date falls on a weekend or holiday, the due date is the following business day. Early filings or issuances will not result in changes to these deadlines. As appropriate, the process plan and schedule may be revised in the future.

| <b>Responsible Party</b> | <b>Pre-Filing Milestone</b>                                          | <b>Date</b>     | <b>FERC Regulation</b> |
|--------------------------|----------------------------------------------------------------------|-----------------|------------------------|
| Boott Hydropower, LLC    | File NOI/PAD with FERC                                               | 4/30/18         | 5.5, 5.6               |
| FERC                     | Tribal Consultation                                                  | 5/30/18         | 5.7                    |
| FERC                     | Issue Notice of Commencement of Proceeding; Issue Scoping Document 1 | 6/15/18         | 5.8                    |
| FERC                     | Scoping Meetings and Project Site Visit                              | 7/17/18-7/18/18 | 5.8(b)(3)(viii)        |
| All stakeholders         | PAD/SD1 Comments and Study Requests Due                              | 8/14/18         | 5.9                    |
| FERC                     | Issue Scoping Document 2                                             | 9/27/18         | 5.10                   |
| Boott Hydropower, LLC    | File Proposed Study Plan (PSP)                                       | 9/28/18         | 5.11(a)                |
| All stakeholders         | Proposed Study Plan Meeting                                          | 10/28/18        | 5.11(e)                |
| All stakeholders         | Proposed Study Plan Comments Due                                     | 12/27/18        | 5.12                   |
| Boott Hydropower, LLC    | File Revised Study Plan                                              | 1/26/19         | 5.13(a)                |
| All stakeholders         | Revised Study Plan Comments Due                                      | 2/10/19         | 5.13(b)                |
| FERC                     | Director's Study Plan Determination                                  | 2/25/19         | 5.13(c)                |
| Mandatory Conditioning   | Any Study Disputes Due                                               | 3/17/19         | 5.14(a)                |

| <b>Responsible Party</b> | <b>Pre-Filing Milestone</b>                     | <b>Date</b> | <b>FERC Regulation</b> |
|--------------------------|-------------------------------------------------|-------------|------------------------|
| Agencies                 |                                                 |             |                        |
| Dispute Panel            | Third Dispute Panel Member Selected             | 4/1/19      | 5.14(d)(3)             |
| Dispute Panel            | Dispute Resolution Panel Convenes               | 4/6/19      | 5.14(d)                |
| Boott Hydropower, LLC    | Applicant Comments on Study Disputes Due        | 4/11/19     | 5.14(i)                |
| Dispute Panel            | Dispute Resolution Panel Technical Conference   | 4/16/19     | 5.14(j)                |
| Dispute Panel            | Dispute Resolution Panel Findings Issued        | 5/6/19      | 5.14(k)                |
| FERC                     | Director's Study Dispute Determination          | 5/26/19     | 5.14(l)                |
| Boott Hydropower, LLC    | First Study Season                              | 2019        | 5.15(a)                |
| Boott Hydropower, LLC    | Initial Study Report                            | 2/25/20     | 5.15(c)(1)             |
| All stakeholders         | Initial Study Report Meeting                    | 3/11/20     | 5.15(c)(2)             |
| Boott Hydropower, LLC    | Initial Study Report Meeting Summary            | 3/26/20     | 5.15(c)(3)             |
| All stakeholders         | Any Disputes/Requests to Amend Study Plan Due   | 4/25/20     | 5.15(c)(4)             |
| All stakeholders         | Responses to Disputes/Amendment Requests Due    | 5/25/20     | 5.15(c)(5)             |
| FERC                     | Director's Determination on Disputes/Amendments | 6/24/20     | 5.15(c)(6)             |
| Boott Hydropower, LLC    | Second Study Season                             | 2020        | 5.15(a)                |
| Boott Hydropower, LLC    | Updated Study Report due                        | 2/25/21     | 5.15(f)                |
| All                      | Updated Study Report Meeting                    | 3/11/21     | 5.15(f)                |

| <b>Responsible Party</b> | <b>Pre-Filing Milestone</b>                       | <b>Date</b>           | <b>FERC Regulation</b> |
|--------------------------|---------------------------------------------------|-----------------------|------------------------|
| stakeholders             |                                                   |                       |                        |
| Boott Hydropower, LLC    | Updated Study Report Meeting Summary              | 3/26/21               | 5.15(f)                |
| All stakeholders         | Any Disputes/Requests to Amend Study Plan Due     | 4/25/21               | 5.15(f)                |
| All stakeholders         | Responses to Disputes/Amendment Requests Due      | 5/25/21               | 5.15(f)                |
| FERC                     | Director's Determination on Disputes/Amendments   | 6/24/21               | 5.15(f)                |
| Boott Hydropower, LLC    | File Preliminary Licensing Proposal               | 12/1/20               | 5.16(a)                |
| All stakeholders         | Preliminary Licensing Proposal Comments Due       | 3/1/21                | 5.16(e)                |
| Boott Hydropower, LLC    | File Final License Application                    | 4/30/21 <sup>11</sup> | 5.17                   |
| Boott Hydropower, LLC    | Issue Public Notice of License Application Filing | 5/14/21               | 5.17(d)(2)             |

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<sup>11</sup> Pursuant to section 15 of the Federal Power Act and 18 C.F.R § 5.17, any application for a license for this project must be filed with the Commission at least 24 months prior to the expiration of the existing license. Because the current license expires on April 30, 2023, all applications for license for this project must be filed by April 30, 2021.

## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Wednesday, March 18, 2020 5:15 PM  
**To:** Andrew MacLean - Town of Pepperell; Andrew Sheehan - Town of Middleton; Tittler, Andrew; Arthur Johnson - MADES; Ben Gahagan - MADMF; Benjamin Wilson - NHDHR; Bjorn Lake - NMFS; bob@americanwhitewater.org; Kim Galipeau - Town of Hollis, NH; Sojkowski, Bryan; Caleb Slater, Ph.D.; Bernardo, Celeste; dam.safety@state.ma.us; Bruins, Christine A; Dinell Clark - Lowell Flood Owners Group and Williamsburg Condominium I; David Meeker - Hull Street Energy LLC; Hay, Duncan E; Fred Jennings - TU; Bub Durand - MAOEAA; Gene Porter - LMRLAC; Peterson, Harold S; Timothy Higgins - Town of Lincoln, MA; jack.buckley@state.ma.us; John Eddins - ACHP; Jon Kurland - Town of Chelmsford, MA; Rosset, Julianne; Kevin Hollenbeck - DCR Great Brook Farm State Park; Mendik, Kevin R; Keith Nislow - USFS; Kevin Webb - CRP; Matt Carpenter - NHFGD; Daniel Rivera - City of Lawrence, MA; michael.judge@state.ma.us; Bailey, Michael; Misty Anne Marold; Andrew Maylor - Town of North Andover, MA; Mark Prout - USFS; John Nappi - Lowell Flood Owners Group; Jim Donchess - City of Nashua, NH; Norman Sims - AMC 2; Owen David - NHDES; peter.severance@rivermerrimack.org; Rachel Freed - MADEP; Ed Reiner - USEPA; Robert Bersak - Eversource Energy; Richard Reault - Town of Tyngsborough; Sean McDermott - NOAA; Scott Galvin - City of Woburn, MA; Rusty Russell; Steve Carlin - MADCR; Tom Dolan - NMFS; Chapman, Tom; Troy Brown - USFWS; David Turin - USEPA; Bill McDavitt - NOAA  
**Cc:** Quiggle, Robert  
**Subject:** Lowell Hydroelectric Project ILP Process Plan and Schedule  
**Attachments:** Lowell Project ILP Process Plan and Schedule.pdf

Dear Stakeholders –

Boott Hydropower, LLC held the Initial Study Report (ISR) Meeting on March 11, 2020. Thank you to all those attended or called in.

As noted during the ISR Meeting, the Integrated Licensing Process (ILP) Process Plan and Schedule presented in the ISR was inaccurate. The correct Process Plan and Schedule can be found in FERC's September 27, 2018 Scoping Document 2 (SD2), which is posted on the Lowell Relicensing website here: <http://www.lowellprojectrelicensing.com/>

Please see attached for additional information on the upcoming ILP Pre-filing milestones. Should you have any questions, please contact Kevin Webb at [kwebb@centralriverspower.com](mailto:kwebb@centralriverspower.com).

**Kelsey Scott, MS**  
*Assistant Regulatory Specialist*

**HDR**  
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## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Thursday, March 26, 2020 9:10 AM  
**To:** Peter Severance (RM)  
**Subject:** RE: Lowell Initial Study Report Meeting Summary

Thanks Peter –

After review of the ISR Meeting Summary, stakeholders may file disagreements with the meeting summary. Disagreements with the ISR Meeting Summary must be filed with the Commission no later than April 25, 2020.

### **Kelsey Scott, MS**

*Assistant Regulatory Specialist*

#### **HDR**

1304 Buckley Road, Suite 202  
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[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

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**From:** Peter Severance (RM) [mailto:[peter.severance@rivermerrimack.org](mailto:peter.severance@rivermerrimack.org)]  
**Sent:** Thursday, March 26, 2020 8:52 AM  
**To:** Scott, Kelsey  
**Subject:** Re: Lowell Initial Study Report Meeting Summary

**CAUTION:** [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Thanks, Kelsey.

I have one correction - on page 12:

*River Merrimack asked if there were plans to look at water quality, especially given combined sewer overflow (CSO) events in Manchester, NH.*

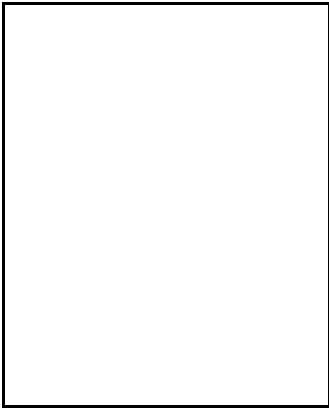
This was not River Merrimack - it was the Merrimack River Watershed Council.

Thanks,

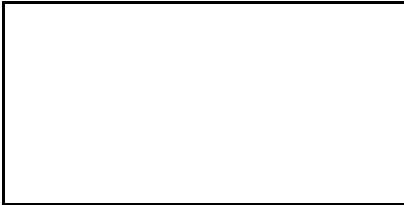
Peter

**Peter Severance**

*Research/Program Director*



[peter.severance@rivermerrimack.org](mailto:peter.severance@rivermerrimack.org)  
978-727-2252



On Wed, Mar 25, 2020 at 4:18 PM Scott, Kelsey <[Kelsey.Scott@hdrinc.com](mailto:Kelsey.Scott@hdrinc.com)> wrote:

Dear Stakeholders:

Boott Hydropower, LLC (Boott) is pursuing a new license from the Federal Energy Regulatory Commission for the Lowell Hydroelectric Project. Boott held the

Initial Study Report (ISR) Meeting on March 11, 2020 at the Lowell National Historical Park in Lowell, MA. The Commission's regulations require Boott file this summary of the ISR Meeting within 15 days of the ISR Meeting.

Should you have any questions regarding the attached ISR Meeting Summary, please contact Kevin Webb, Licensing Manager with Boott, at (978) 935-6039 or [kwebb@centralriverspower.com](mailto:kwebb@centralriverspower.com).

**Kelsey Scott, MS**

**HDR**

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## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Tuesday, April 21, 2020 12:52 PM  
**To:** 'Jean\_Robinson@uml.edu'  
**Cc:** Quiggle, Robert  
**Subject:** UMass Lowell GIS files  
**Attachments:** 20191218 Lowell Study Workshop Meeting Minutes.pdf

Hi Jean,

We are working with Boott Hydropower, LLC to conduct studies for relicensing of the Lowell Hydroelectric Project (FERC No. 2790). During the Study Workshop with stakeholders on December 18, 2019, you kindly offered to provide additional information and GIS shapefiles regarding UMass Lowell facilities throughout the Lowell Downtown and Canal System. Are you able to provide these at this time?

I've attached the Study Workshop meeting minutes as a reminder of the discussions. Thank you for any updates and information you can provide.

Best regards,

**Kelsey Scott, MS**

**HDR**

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## Meeting Minutes

Project: Lowell Hydroelectric Project (P-2790-72)

Subject: Lowell Hydroelectric Project Study Workshop

Date: Wednesday, December 18, 2019

Location: Lowell National Historical Park Visitor Center - Lowell, MA

Attendees: Chris Hayes – City of Lowell  
Christine Bruins – National Park Service  
Celeste Bernardo – National Park Service  
Paul Fontaine – National Park Service  
Kevin Coffee – National Park Service  
Becky Warren – National Park Service  
John Aziz – MADCR  
Peter Hoffman – MADCR  
Jeffery Harris – MADCR  
Fred Faust – Lowell Heritage Partnership  
Robert Quiggle – HDR  
Stephen Greene – Lowell Canal Cleaners  
Euris Gonzalez – Massachusetts DCR  
Christine Clancy – City of Lowell  
Kevin Mendik – National Park Service  
Emily Byrne – Congresswomen Trahen’s Office  
Michael Fernandes – National Park Service  
Jean Robinson – UMass Lowell  
Steve Cerand – Lowell Canal Cleaners  
Duncan Hay – National Park Service  
Kevin Webb – Boott Hydropower  
Patrick Donahue – Boott Hydropower  
Kelsey Scott - HDR

Boott Hydropower, LLC (Boott) is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the continued operation of the Lowell Hydroelectric Project (FERC No. 2790) (Project) located along the Merrimack River. In support of Project relicensing, Boott is conducting a Recreation and Aesthetics Study; Water Level and Flow Effects on Historic Resources Study; Historically Significant Waterpower Equipment Study; and the Resources, Ownership, Boundaries, and Land Rights Study (Resources Study). Boott requested a Lowell Hydroelectric Project Study Workshop (Workshop) with interested stakeholders to address data needs regarding the four studies of interest. Boott appreciates the participation of stakeholders and the thoughtful discussions during the Workshop. At the request of Workshop participants, Boott has developed this general summary of Workshop topics and discussion.

### Introduction

- The Workshop began with a general overview of the Project, the FERC relicensing process, and a discussion of the study schedule. A copy of the PowerPoint presentation is included as Attachment A to this meeting summary.

## Resources Study

- Stakeholders and Boott agreed that identifying resource ownership, boundaries, and land rights is a foundational study task that will inform a number of other studies, and eventually any management measures included Boott's license application documents.
- Stakeholders recommended that the Resources Study evaluate which parties have the authority to address issues, and which have the obligation to do so, based on a review of easements, deeds, and land rights documentation. Stakeholders and Boott agreed that the end result of the Resources Study should be a document that clearly identifies who has responsibilities and obligations with respect to the canal system, so that when future issues related to maintenance, repair, or public safety arise, the party or parties responsible for resolving these issues can respond quickly and effectively.
- These rights and responsibilities need to be detailed in a GIS database as well as a written report.
  - The responsibility of maintaining the GIS database and documentation will be evaluated through future conversations.
- To inform the Resources Study, Boott is proposing to review the Great Deed, Letter of Taking, and the lease from the Commonwealth of Massachusetts to the NPS.
  - Stakeholders indicated that the City of Lowell (City) may also have relevant property records.
  - The City also previously undertook limited research into ownership and responsibilities for the walkways adjacent to the Canal. Boott requested any records from the City that may be helpful in determining ownership and responsibilities for Project features.
  - The NPS indicated that they had developed a preliminary matrix of ownership and responsibilities based on a limited review of documents. Boott requested the existing matrix from the NPS, recognizing that the matrix is preliminary and would require additional review/documentation.
- The University of Massachusetts at Lowell (UMass Lowell) indicated concerns regarding infrastructure in the canal system, including submerged cables and pipelines. UMass Lowell has infrastructure in the canal system, and agreed to share relevant records with Boott.
- Boott suggested that a Resources Study Working Group may be appropriate to coordinate a review of relevant documents. Boott expects that a review of the existing documentation would take place in quarter one of 2020.

## Recreation

- On-water recreation and access is the primary public request received by National Park Service (NPS) and Massachusetts Department of Conservation and Recreation (MADCR). Stakeholders are not necessarily interested in a study which looks at every aspect of recreation; rather, parties are looking for specific practical opportunities for community on-water recreation which provide paths of least resistance. Stakeholders want to know the recreational opportunities they can maximize, and which opportunities are not feasible or are too risky

based on public safety, public interest, and hydropower operational constraints. Boott's primary concern is public safety issues associated with providing recreational access to the Project's canal system.

- Stakeholders noted that parties looking for specific recreational opportunities can focus on expanding current recreational opportunities, such as expanding boat tours on the Pawtucket Canal, and providing more access for the Annual Point of Life Festival on the Western Canal. The parties can also look at specific future opportunities of interest, like providing safe seasonal access at Swamp Locks or kayaking in the Western Canal for organized events.
- Boott indicated that the results of visitor-intercept surveys and the online recreation survey could provide information regarding public interest in on-water recreation.
- Boott expects to assess the potential for safe recreational access to the canal system as a component of the Recreation and Aesthetics study and looks forward to continued conversations with stakeholders regarding this issue.

### **Vegetation Growth along the Canal System**

- Vegetation growth along the canal system is a significant issue for the NPS and other stakeholders. Vegetation growth is not only an aesthetic issue, but has the potential to cause structural damage to the canal system walls and other structures. The NPS requested that Boott consider vegetation growth not just from an aesthetic standpoint but also as it relates to potential structural damages. Boott recognizes this concern and believes that the ongoing vegetation mapping along the canal system will inform both the aesthetics concerns and the potential structural integrity of the canal system.
- The NPS currently undertakes vegetation management along the canal system, but funding for these programs is limited and competitive. The current procedures implemented by the NPS are not intended to be long-term solutions, but rather to keep the problems at bay. Under the NPS's current vegetation management program, it takes approximately five years for the NPS to treat/manage the vegetation along the entire canal system.
- The NPS does not have the capability to address the removal of larger trees that may cause damage to canal structures.
- The NPS also treats exotic/invasive plant species along the canal system. The NPS agreed to share the Exotic Species Treatment Calendar with Boott.
- Stakeholders recognize that it may be appropriate to identify priority areas for vegetation management (e.g., areas where vegetation along the canal system has the highest potential to adversely affect structures), with the goal of addressing these areas first. Vegetation treatment measures should eventually be undertaken for the entirety of the canal system, with the goal of implementing routine management measures to stop new vegetation growth.
- The NPS's current management of vegetation along the canal system is limited in part because the ownership of and responsibility for canal structures is not clear. Understanding the ownership and responsibility for maintenance of the canal structures is an important component in determining how any vegetation management issues can be implemented.

### **Trash in the Canal System**

- Waterborne trash accumulation in the canals is the main complaint reported to the City. The waterborne trash floats down the Merrimack River and builds up behind the gatehouses, or is thrown/blown into the downtown canals.
- Trash at the bottom of canals is a concern to stakeholders due to the hazardous nature (e.g., electronics) but also the aesthetics when the canals are drawn down. Both Boott and stakeholders acknowledged that there are significant safety and liability concerns with managing trash at the bottom of the canals.
- All parties acknowledged the liability concerns of collecting and disposing of any hazardous materials.
- The current methods of flushing the trash out are not meeting the visual and structural safety goals of stakeholders.
- The Studies conducted as part of the relicensing should examine the feasibility of different options for removing waterborne trash from the canals, and also how the other stakeholders can participate. Boott is interested in targeting the source of the trash problem. Examples of the contributions of stakeholders include community education regarding trash and placement of trash bins in strategic areas. A trash management plan for the canal system could incorporate how all stakeholders can contribute to best manage the problem. Boott and stakeholders acknowledged that trash management is not the sole responsibility of the licensee, but would require input and assistance from the City, NPS, and other stakeholders.

### **Historically Significant Waterpower Equipment**

- The NPS would like to determine what equipment owned/operated by Boott is historically significant on a national level. This study does not need to go down the path of documenting every single component, but rather determining what equipment owned/operated by Boott is nationally significant, original, and within the Project boundary. This will tie into the Resources Study, since the ownership and responsibilities of the equipment will need to be determined.
- Boott noted that FERC is very likely to require the development of a Historic Properties Management Plan (HPMP) as a result of the relicensing process. The HPMP would describe how Boott would manage historic waterpower equipment within the Project boundary during the term of the new license; and the HPMP could incorporate provisions for consultation with the NPS regarding historic waterpower equipment. For example, the HPMP could establish provisions such as the right of refusal by NPS when historic waterpower equipment is being replaced or decommissioned. FERC would require the HPMP to be developed in consultation with the NPS and the State Historic Preservation Officer pursuant to a Programmatic Agreement.
- Boott noted that this study had been initiated, and that Boott's cultural resources management consultant, Gray & Pape, Inc., was in the process of reviewing historical documentation. Boott expects that a field visit will occur in quarter one of 2020.

### **Water Level and Flow Effects on Historic Resources**

- Boott has been collecting water level data in the canal system since the spring of 2019. During the Workshop, the NPS clarified that their interest is related to the effects of the new crest gate system and potential effects on historic resources at higher water levels. Boott explained that any effects would be limited to structures along the Northern Canal and the Upper Pawtucket Canal (upstream from the Francis Gate and Guard Locks), as the water levels in the remainder of the canal system are not affected by the crest gate. Given the lack of higher water levels elsewhere through the canal, stakeholders agreed that the historic resources along the Northern Canal and Upper Pawtucket Canal should be the focus of this study. Therefore, stakeholders and Boott agreed that Boott should move level loggers to those locations (Upper Pawtucket Canal and Northern Canal), and remove the remaining level loggers from the downtown canal system.
- The NPS noted that certain recreation activities are prohibited based on water levels and flows. Recreational activities on the Northern Canal and the Upper Pawtucket Canal can be impacted by higher flows (the boat tours and canal walkway).
- There is interest in knowing what impacts (if any) low water levels (i.e., drawdowns) can have on historic resources and canal infrastructure. If possible, stakeholders would like to develop recommendations regarding maintenance drawdowns (e.g., timing and duration) to limit impacts to historic structures.

### **Other Considerations**

- The City and other stakeholders are concerned about potential impacts to water quality in the canal system as a result of stormwater discharges and combined sewage overflows (CSO). Boott noted that the Massachusetts Department of Environmental Protection (MADEP) will issue a Water Quality Certificate (WQC) for the Project under Section 401 of the Clean Water Act. Stakeholders did not request a water quality study during the FERC study scoping process, and FERC did not require Boott to conduct a water quality study. Since any impacts to water quality that may occur as a result of stormwater discharges and CSOs are not Project-related and there is no nexus to Project operations, it is unlikely that FERC would require Boott to study this issue during relicensing.
- The City has an MS4 Permit executed through the wastewater team. This permit may provide information regarding discharges into the canal system. It is unknown what these outfalls are for, who they belong to, and what the discharge is (weep holes, etc.). Documenting outfalls would be an extensive undertaking and would not necessarily absolve stormwater concerns.

Thank you again for your participation in the Workshop. Should you have any additional comments on or clarifications to this meeting summary, please notify Kevin Webb of Boott Hydropower at [kwebb@centralriverspower.com](mailto:kwebb@centralriverspower.com).

## Scott, Kelsey

---

**From:** Bruins, Christine A <Christine\_Bruins@nps.gov>  
**Sent:** Monday, June 15, 2020 3:05 PM  
**To:** Scott, Kelsey; Bernardo, Celeste  
**Cc:** Quiggle, Robert; Kevin Webb; Richard Malloy; Lonsway, Peter; Racine, Laurel A; Lieb, David M  
**Subject:** Re: [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

**CAUTION:** [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Kelsey,

Thanks for giving me a call. To summarize, NPS units are directed to follow state and local guidance for COVID. To stay consistent with MA guidelines, the Gray & Pape site visit should be limited to a gathering of <10 people, face coverings should be worn by all, social distancing should be practiced wherever possible, and folks should take separate vehicles between sites.

cc'd: Laurel Racine, Cultural Resources Chief and David Lieb, Historical Architect should attend and Peter Lonsway, Deputy Superintendent would like to attend. To make the most of the field visit, could you please share draft documents from Gray & Pape's research in advance of the visit?

July 9th is the NPS preferred field visit date; July 16th alternate. Please let us know if you'd like more date options. Thanks!

**Christine Bruins | Community Planner**  
Lowell National Historical Park  
978.275.1726 (office) | 978.954.1011 (cell)

---

**From:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>  
**Sent:** Wednesday, June 10, 2020 10:19 AM  
**To:** Bruins, Christine A <Christine\_Bruins@nps.gov>; Bernardo, Celeste <Celeste\_Bernardo@nps.gov>  
**Cc:** Quiggle, Robert <Robert.Quiggle@hdrinc.com>; Kevin Webb <kwebb@centralriverspower.com>; Richard Malloy <RMalloy@centralriverspower.com>  
**Subject:** [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

Hi Christine and Celeste,

We would like to re-engage with you regarding the ongoing studies as part of the Lowell Relicensing. As per your request at the Initial Study Report meeting, we can schedule with you the onsite visit with the architectural historian (Gray & Pape) for the Historically Significant Waterpower Equipment Study. Regarding this field visit, as well as the other ongoing studies, a conference call with this group would be helpful to understand how LNHP is currently approaching operations, hours, safety measures, etc during COVID-19.

Feel free to propose times that work for you in the coming weeks, and we'll set up a conference call. Thank you -

**Kelsey Scott, MS**

**HDR**

1304 Buckley Road, Suite 202  
Syracuse, NY 13212

**D** 315.414.2206 **M** 315.706.5176

[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)



## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Monday, June 22, 2020 11:38 AM  
**To:** Bruins, Christine A  
**Cc:** Quiggle, Robert  
**Subject:** RE: [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

Hi Christine –

We've let Gray & Pape know the preferred dates for the site visit and I hope to have an update for you in the coming days. Currently, the COVID-19 safety requirements for HDR, Gary & Pape, and LNHP are similar enough that it is not expected to be an issue (in terms of planning the site visit).

Thank you –

### **Kelsey Scott, MS**

D 315.414.2206 M 315.706.5176

[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

[hdrinc.com/follow-us](https://hdrinc.com/follow-us)

---

**From:** Bruins, Christine A [mailto:Christine\_Bruins@nps.gov]  
**Sent:** Monday, June 15, 2020 3:05 PM  
**To:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>; Bernardo, Celeste <Celeste\_Bernardo@nps.gov>  
**Cc:** Quiggle, Robert <Robert.Quiggle@hdrinc.com>; Kevin Webb <kwebb@centralriverspower.com>; Richard Malloy <RMalloy@centralriverspower.com>; Lonsway, Peter <Peter\_Lonsway@nps.gov>; Racine, Laurel A <Laurel\_Racine@nps.gov>; Lieb, David M <David\_Lieb@nps.gov>  
**Subject:** Re: [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

**CAUTION:** [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Kelsey,

Thanks for giving me a call. To summarize, NPS units are directed to follow state and local guidance for COVID. To stay consistent with MA guidelines, the Gray & Pape site visit should be limited to a gathering of <10 people, face coverings should be worn by all, social distancing should be practiced wherever possible, and folks should take separate vehicles between sites.

cc'd: Laurel Racine, Cultural Resources Chief and David Lieb, Historical Architect should attend and Peter Lonsway, Deputy Superintendent would like to attend. To make the most of the field visit, could you please share draft documents from Gray & Pape's research in advance of the visit?

July 9th is the NPS preferred field visit date; July 16th alternate. Please let us know if you'd like more date options. Thanks!

**Christine Bruins | Community Planner**

Lowell National Historical Park

978.275.1726 (office) | 978.954.1011 (cell)

---

**From:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>

**Sent:** Wednesday, June 10, 2020 10:19 AM

**To:** Bruins, Christine A <Christine\_Bruins@nps.gov>; Bernardo, Celeste <Celeste\_Bernardo@nps.gov>

**Cc:** Quiggle, Robert <Robert.Quiggle@hdrinc.com>; Kevin Webb <kwebb@centralriverspower.com>; Richard Malloy <RMalloy@centralriverspower.com>

**Subject:** [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

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**Kelsey Scott, MS**

**HDR**

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**D** 315.414.2206 **M** 315.706.5176

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## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Monday, June 29, 2020 10:43 AM  
**To:** 'Bruins, Christine A'  
**Cc:** Quiggle, Robert; Kevin Webb; Richard Malloy; Lonsway, Peter; Racine, Laurel A; Lieb, David M; 'Celeste Bernardo - Lowell NHP'  
**Subject:** RE: [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

Hi Christine –

The best date that works is the option of July 16, 2020 to conduct the site visit associated with the Historically Significant Waterpower Equipment Study. On our end, the likely participants are Robert Quiggle from HDR, Patrick O'Bannon from Gray & Pape, and Andrew and Kevin from Boott Hydropower.

Thank you –

### Kelsey Scott, MS

#### HDR

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**Subject:** Re: [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

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**Christine Bruins | Community Planner**

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**To:** Bruins, Christine A <Christine\_Bruins@nps.gov>; Bernardo, Celeste <Celeste\_Bernardo@nps.gov>  
**Cc:** Quiggle, Robert <Robert.Quiggle@hdrinc.com>; Kevin Webb <kwebb@centralriverspower.com>; Richard Malloy <RMalloy@centralriverspower.com>  
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[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

## Scott, Kelsey

---

**To:** Scott, Kelsey  
**Subject:** FW: Boott Hydro Equipment Background

Rob & Kelsey,

As per your request, I've conducted background research to determine the extent of the available documentation on the Lowell Hydroelectric Project (FERC No. 2790). Documentation of the hydroelectric components of the larger Lowell Canal System is scant.

The 2018 Pre-Application Document (PAD) for the Lowell Hydroelectric Project notes the Project's major civil works, which include:

- The 1,093-foot-long, stone-masonry gravity Pawtucket Dam (1847 & 1875), topped by a 5-foot high pneumatic crest gate system;
- The 5.5-mile Pawtucket & Downtown canal system that provides flow to four small hydroelectric stations (Hamilton, Assets, Bridge Street, & John Street) located in historic mill buildings;
- The Pawtucket Canal with its Guard Lock & Gates Facility that controls flow into the canal system;
- The main powerhouse containing two 8.6 MW horizontal Kaplan turbine-generator units;
- A fish-lift system at the powerhouse, and;
- A fish ladder adjacent to the Pawtucket Dam

Many of these civil works date from the nineteenth century and are associated with the use of the Merrimack River waterpower as a mechanical power source for the city's textile mills. The use of the river's waterpower to generate electricity came slowly. Patrick Malone's *Waterpower in Lowell: Engineering and Industry in Nineteenth Century America* (2009) notes that while all Lowell's mill complexes had either installed new hydroelectric units or linked generators to some of their existing turbines by 1918, the Lawrence Manufacturing Company continued to rely solely upon mechanical drive as late as 1927 (p. 223). The Historic American Engineering Record (HAER) documentation of the Lowell Canal System (1983) describes the civil and mechanical works in considerable detail, but closes its narrative in the 1880s, prior to the introduction of hydroelectric power. Similarly, other major sources on the history of Lowell, including Laurence Gross' *The Course of Industrial Decline: The Boott Cotton Mills of Lowell, Massachusetts, 1835-1955* (2000) and Theodore Steinberg's *Nature Incorporated: Industrialization and the Waters of New England* (2004) do not provide any detail on the hydroelectric facilities at Lowell.

It seems clear that historians' interest in Lowell and its waterpower system is largely limited to the period of mechanical power transmission between about 1825 and 1880. The introduction of hydroelectric facilities in the Lowell mills has yet to be explored.

Patrick W. O'Bannon, Ph.D.  
Northeast Regional Manager



60 Valley Street, Suite 103  
Providence, RI 02909  
Ph. 401-273-9900  
Mobile 513-300-1511  
[pobannon@graypape.com](mailto:pobannon@graypape.com)

| Structure           | Historic American Engineering Record Number | Massachusetts Cultural Resource Information System Inventory Number(s) | Included in National Register of Historic Places Inventory Nomination Form | Included Lowell National Historical Park 1980 Cultural Resources Inventory |
|---------------------|---------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Pawtucket Canal     | HAER MASS,9-LOW,9-; HAER MASS, 9-LOW,8-     | LOW.929; LOW9.019                                                      | X                                                                          | X                                                                          |
| Guard Locks         | HAER MASS,9-LOW,9A-; HAER MASS, 9-LOW,8-    | LOW.9028                                                               | X                                                                          | X                                                                          |
| Swamp Locks         | HAER MASS,9-LOW,9B-; HAER MASS, 9-LOW,8-    | LOW.932                                                                | X                                                                          | X                                                                          |
| Lower Locks         | HAER MASS,9-LOW,9C-; HAER MASS, 9-LOW,8-    | LOW.931                                                                | X                                                                          | X                                                                          |
| Merrimack Canal     | HAER MASS,9-LOW,10-; HAER MASS, 9-LOW,8-    | LOW.933                                                                | X                                                                          | X                                                                          |
| Merrimack Dam       | HAER MASS,9-LOW,10A-; HAER MASS, 9-LOW,8-   | LOW.984                                                                | X                                                                          |                                                                            |
| Rolling Dam         | HAER MASS,9-LOW,10A-; HAER MASS, 9-LOW,8-   | LOW.983                                                                | X                                                                          |                                                                            |
| Moody Street Feeder | HAER MASS,9-LOW,16A-; HAER MASS, 9-LOW,8-   | LOW.934                                                                | X                                                                          | X                                                                          |
| Lawrence Dam        | HAER MASS,-LOW,13A-; HAER MASS, 9-LOW,8-    | LOW.979                                                                | X                                                                          |                                                                            |

|                                           |                                           |          |   |   |
|-------------------------------------------|-------------------------------------------|----------|---|---|
| Eastern Canal                             | HAER MASS,9-LOW,14-; HAER MASS, 9-LOW,8-  | LOW.923  | X | X |
| Boott Dam                                 | HAER MASS,-LOW,14A-; HAER MASS, 9-LOW,8-  | LOW.961  | X |   |
| Pawtucket Dam                             | HAER MASS,-9-LOW,8A-; HAER MASS, 9-LOW,8- | LOW.937  | X | X |
| Northern Canal & Waste Gates              | HAER MASS,9-LOW,15C-; HAER MASS, 9-LOW,8- | LOW.9018 | X | X |
| Hamilton Canal                            | HAER MASS,9-LOW,11-; HAER MASS, 9-LOW,8-  | LOW.930  | X | X |
| Pawtucket Gatehouse and Hydraulic Turbine | HAER MASS,9-LOW,15A-; HAER MASS, 9-LOW,8- | LOW.73   | X | X |
| Western Canal                             | HAER MASS,9-LOW,12-; HAER MASS, 9-LOW,8-  | LOW.939  | X | X |

## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Thursday, July 9, 2020 11:04 AM  
**To:** 'Bruins, Christine A'; 'Celeste Bernardo - Lowell NHP'  
**Cc:** Quiggle, Robert; Lonsway, Peter; Racine, Laurel A; Lieb, David M; Richard Malloy; 'Kevin Webb - CRP'  
**Subject:** RE: [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study  
**Attachments:** Boott Hydro Document Review Summary.pdf

Hello –

Please find attached further information regarding the records review conducted for the Historically Significant Waterpower Equipment Study.

Currently, the headcount for the site visit on July 16<sup>th</sup> is eight. Participants are Patrick O'Bannon (Gray & Pape), Laurel Racine, Peter Lonsway, David Lieb, Robert Quiggle (HDR), and Kevin, Richard, and Andrew from Boott Hydropower.

Any questions or comments, let us know. Thank You –

### **Kelsey Scott, MS**

#### **HDR**

1304 Buckley Road, Suite 202  
Syracuse, NY 13212  
D 315.414.2206 M 315.706.5176  
[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)  
[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

---

**From:** Bruins, Christine A [mailto:Christine\_Bruins@nps.gov]  
**Sent:** Monday, June 29, 2020 5:04 PM  
**To:** Richard Malloy <RMalloy@centralriverspower.com>; Kevin Webb <kwebb@centralriverspower.com>; Scott, Kelsey <Kelsey.Scott@hdrinc.com>  
**Cc:** Quiggle, Robert <Robert.Quiggle@hdrinc.com>; Lonsway, Peter <Peter\_Lonsway@nps.gov>; Racine, Laurel A <Laurel\_Racine@nps.gov>; Lieb, David M <David\_Lieb@nps.gov>; Bernardo, Celeste <Celeste\_Bernardo@nps.gov>  
**Subject:** Re: [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

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Please count in from NPS, Laurel Racine, Cultural Resources Chief and David Lieb, Historical Architect. If there is space for one additional body keeping the group under 10, Lowell NHP Deputy Superintendent, Peter Lonsway is interested in attending.

Are there any documents from the consultant NPS can review in advance of July 16 to make the most of this field visit?

### **Christine Bruins | Community Planner**

Lowell National Historical Park



978.275.1726 (office) | 978.954.1011 (cell)

---

**From:** Richard Malloy <RMalloy@centralriverspower.com>  
**Sent:** Monday, June 29, 2020 11:35 AM  
**To:** Kevin Webb <kwebb@centralriverspower.com>; Scott, Kelsey <Kelsey.Scott@hdrinc.com>; Bruins, Christine A <Christine\_Bruins@nps.gov>  
**Cc:** Quiggle, Robert <Robert.Quiggle@hdrinc.com>; Lonsway, Peter <Peter\_Lonsway@nps.gov>; Racine, Laurel A <Laurel\_Racine@nps.gov>; Lieb, David M <David\_Lieb@nps.gov>; Bernardo, Celeste <Celeste\_Bernardo@nps.gov>  
**Subject:** RE: [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

Thanks Kevin.

Yes, please count me in for the 16<sup>th</sup> if it is at all possible. Thanks!

---

**From:** Kevin Webb <kwebb@centralriverspower.com>  
**Sent:** Monday, June 29, 2020 11:31 AM  
**To:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>; Bruins, Christine A <Christine\_Bruins@nps.gov>  
**Cc:** Quiggle, Robert <Robert.Quiggle@hdrinc.com>; Richard Malloy <RMalloy@centralriverspower.com>; Lonsway, Peter <Peter\_Lonsway@nps.gov>; Racine, Laurel A <Laurel\_Racine@nps.gov>; Lieb, David M <David\_Lieb@nps.gov>; Celeste Bernardo - Lowell NHP <celeste\_bernardo@nps.gov>  
**Subject:** RE: [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

I think that Richard would like to attend as well. Let's make sure that we get a total headcount so that we stay within the 10 person limit.

Kevin

---

**From:** Scott, Kelsey <[Kelsey.Scott@hdrinc.com](mailto:Kelsey.Scott@hdrinc.com)>  
**Sent:** Monday, June 29, 2020 10:43 AM  
**To:** Bruins, Christine A <[Christine\\_Bruins@nps.gov](mailto:Christine_Bruins@nps.gov)>  
**Cc:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>; Kevin Webb <[kwebb@centralriverspower.com](mailto:kwebb@centralriverspower.com)>; Richard Malloy <[RMalloy@centralriverspower.com](mailto:RMalloy@centralriverspower.com)>; Lonsway, Peter <[Peter\\_Lonsway@nps.gov](mailto:Peter_Lonsway@nps.gov)>; Racine, Laurel A <[Laurel\\_Racine@nps.gov](mailto:Laurel_Racine@nps.gov)>; Lieb, David M <[David\\_Lieb@nps.gov](mailto:David_Lieb@nps.gov)>; Celeste Bernardo - Lowell NHP <[celeste\\_bernardo@nps.gov](mailto:celeste_bernardo@nps.gov)>  
**Subject:** RE: [EXTERNAL] Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

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Thank you –

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**HDR**  
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**HDR**

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[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

## Scott, Kelsey

---

**From:** Scott, Kelsey  
**Sent:** Tuesday, July 14, 2020 2:27 PM  
**To:** Lonsway, Peter; Racine, Laurel A; Lieb, David M  
**Cc:** 'Patrick O'Bannon'; 'Kevin Webb'; Richard Malloy; Quiggle, Robert; 'Bruins, Christine A'; 'Celeste Bernardo - Lowell NHP'  
**Subject:** Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study  
**Attachments:** 20200716 Lowell Site Visit Agenda.pdf

Hello –

An agenda is attached to provide more logistical information regarding the upcoming site visit this week for the Historically Significant Waterpower Equipment Study. Please plan to meet at the Visitor's Center parking lot (304 Dutton Street) at 9am on Thursday, July 16. Thank you.

### **Kelsey Scott, MS**

#### **HDR**

1304 Buckley Road, Suite 202  
Syracuse, NY 13212  
D 315.414.2206 M 315.706.5176  
[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)  
[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

# Agenda

**Project:** Lowell Hydroelectric Project (FERC No. 2790)

**Subject:** Historically Significant Waterpower Equipment Study

**Date:** Thursday, July 16, 2020

**Location:** Lowell, MA

Boot Hydropower, LLC (Boott) is pursuing a new license from the Federal Energy Regulatory Commission (FERC or Commission) for the Lowell Hydroelectric Project (FERC No. 2790) (Project) located along the Merrimack River. In support of Project relicensing, Boott is conducting a Historically Significant Waterpower Equipment Study. In consultation with the National Park Service (NPS) Boott clarified the goals of this study during the December 18, 2019 Study Workshop held at the Lowell National Historical Park Visitor Center. Boott understands that NPS's goals for this study are to determine what original hydroelectric equipment owned/operated by Boott within the Project boundary is historically significant on a national level.

As a component of this study, Boott is conducting a site visit of certain Project facilities on July 16, 2020. The purpose of this site visit is to conduct an initial assessment of the historic significance of Project hydroelectric equipment and collect additional documentation. Boott notes that many of the Project's civil and mechanical components have been well documented in the Historic American Engineering Record (HAER), but those facilities pre-date the introduction of hydroelectric power at Lowell. As a result, the significance of hydroelectric components have not been assessed. Boott's July 16, 2020 site visit will focus on identifying historic hydroelectric equipment, and will include the following facilities:

- Pawtucket Gatehouse
- Hamilton Power Station
- John Street Power Station
- Assets Power Station

Site visit participants are invited to meet at the NPS Visitor Center parking lot at 9:00 a.m. on July 16, 2020 (GPS address 304 Dutton Street, Lowell, MA 01852).

If you require additional information, please contact Kevin Webb with Central Rivers Power at 978-935-6039 or [Kwebb@centralriverspower.com](mailto:Kwebb@centralriverspower.com) or Rob Quiggle with HDR at 724-989-1579 or [Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com).

## Scott, Kelsey

---

**From:** Kevin Webb <kwebb@centralriverspower.com>  
**Sent:** Friday, July 31, 2020 12:19 PM  
**To:** Scott, Kelsey; Lonsway, Peter; Racine, Laurel A; Lieb, David M  
**Cc:** Patrick O'Bannon; Richard Malloy; Quiggle, Robert; Bruins, Christine A; 'Celeste Bernardo - Lowell NHP'  
**Subject:** RE: Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study  
**Attachments:** Proprietors canal system magic book of facts.pdf

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All:

Following up on our on-site meeting on the 16<sup>th</sup>, attached is a copy of Mel Lezberg's "Magic Book" of facts and figures – at least I think that's what he called it. I do not know where the original is. My guess is that it is early 1950's vintage as the latest date recorded in the tables is 1949. Note that all elevations are PL&C datum which is 5.2 feet higher than "mean sea level" or NGVD29 datum. Interesting table on page 4 compares the numerous datum planes in MA.

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Let me know if you have any questions.

Kevin

Kevin Webb  
Licensing Manager



**Central Rivers Power**

670 N Commercial Street, Suite 204 | Manchester, NH 03101

C: 978.935.6039

[kwebb@centralriverspower.com](mailto:kwebb@centralriverspower.com)

---

**From:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>

**Sent:** Tuesday, July 14, 2020 2:27 PM

**To:** Lonsway, Peter <Peter\_Lonsway@nps.gov>; Racine, Laurel A <Laurel\_Racine@nps.gov>; Lieb, David M <David\_Lieb@nps.gov>

**Cc:** Patrick O'Bannon <pobannon@graypape.com>; Kevin Webb <kwebb@centralriverspower.com>; Richard Malloy <RMalloy@centralriverspower.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; Bruins, Christine A <Christine\_Bruins@nps.gov>; 'Celeste Bernardo - Lowell NHP' <celeste\_bernardo@nps.gov>

**Subject:** Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study

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Hello –

An agenda is attached to provide more logistical information regarding the upcoming site visit this week for the Historically Significant Waterpower Equipment Study. Please plan to meet at the Visitor's Center parking lot (304 Dutton Street) at 9am on Thursday, July 16. Thank you.

**Kelsey Scott, MS**

**HDR**

1304 Buckley Road, Suite 202

Syracuse, NY 13212

**D** 315.414.2206 **M** 315.706.5176

[kelsey.scott@hdrinc.com](mailto:kelsey.scott@hdrinc.com)

[hdrinc.com/follow-us](https://hdrinc.com/follow-us)

## Scott, Kelsey

---

**From:** Quiggle, Robert  
**Sent:** Tuesday, August 4, 2020 12:35 PM  
**To:** Kevin Webb; Bob Nasdor | AW  
**Cc:** Richard Malloy; Scott, Kelsey  
**Subject:** RE: Lowell/Merrimack Whitewtater Study

Would a call tomorrow afternoon at 1 or 2 PM work? I am in meetings all day on Thursday and Friday, but I'd like to touch base this week before Kevin goes on vacation.

If that schedule works for folks, I will send a WebEx invite.

Thanks,

**Robert Quiggle**, RPA  
*Regulatory and Environmental Section Manager*

**HDR**  
1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

---

**From:** Kevin Webb [mailto:kwebb@centralriverspower.com]  
**Sent:** Tuesday, August 4, 2020 11:46 AM  
**To:** Bob Nasdor | AW <bob@americanwhitewater.org>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>  
**Cc:** Richard Malloy <RMalloy@centralriverspower.com>; Scott, Kelsey <Kelsey.Scott@hdrinc.com>  
**Subject:** RE: Lowell/Merrimack Whitewtater Study

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My schedule fairly open the rest of this week, Thursday is wide open. Next week I'm on vacation.

Kevin

---

**From:** Bob Nasdor | AW <bob@americanwhitewater.org>  
**Sent:** Tuesday, August 4, 2020 10:15 AM  
**To:** Quiggle, Robert <Robert.Quiggle@hdrinc.com>  
**Cc:** Kevin Webb <kwebb@centralriverspower.com>; Richard Malloy <RMalloy@centralriverspower.com>; Scott, Kelsey <Kelsey.Scott@hdrinc.com>  
**Subject:** Re: Lowell/Merrimack Whitewtater Study

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Thanks Rob. Can we set up a time to talk this week? My schedule is flexible. Bob

Bob Nasdor  
Northeast Stewardship & Legal Director



American Whitewater  
65 Blueberry Hill Lane  
Sudbury, MA 01776  
[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)  
617-584-4566

Join American Whitewater!

On Fri, Jul 31, 2020 at 9:29 AM Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)> wrote:

Bob: Good to hear from you. Let me know what would work for your schedule, and I'll try to set up a call to catch up on study plans next week. FYI, we are going through the photos from the flow documentation study now (more than 3,500) and will be putting together a report to send to you soon.

Thanks,

**Robert Quiggle**, RPA

*Regulatory and Environmental Section Manager*

**HDR**

1304 Buckley Road, Suite 202  
Syracuse, New York 13212-4311  
D 315.414.2216 M 724.989.1579  
[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)

[hdrinc.com/follow-us](http://hdrinc.com/follow-us)

---

**From:** Bob Nasdor | AW [mailto:[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)]  
**Sent:** Wednesday, July 29, 2020 11:46 AM  
**To:** Quiggle, Robert <[Robert.Quiggle@hdrinc.com](mailto:Robert.Quiggle@hdrinc.com)>  
**Subject:** Lowell/Merrimack Whitewtater Study

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Hi Rob,

We should schedule a call to set a date and discuss logistics for the whitewater boating study. Also, I would like to get the images of the different flow levels that you all collected so we can identify a flow range for the study. Thanks.

Bob

Bob Nasdor  
Northeast Stewardship & Legal Director



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65 Blueberry Hill Lane  
Sudbury, MA 01776  
[bob@americanwhitewater.org](mailto:bob@americanwhitewater.org)  
617-584-4566

Join American Whitewater!

## Scott, Kelsey

---

**From:** Bruins, Christine A <Christine\_Bruins@nps.gov>  
**Sent:** Tuesday, August 4, 2020 8:18 AM  
**To:** Kevin Webb; Scott, Kelsey; Lonsway, Peter; Racine, Laurel A; Lieb, David M  
**Cc:** Patrick O'Bannon; Richard Malloy; Quiggle, Robert; Bernardo, Celeste  
**Subject:** Re: [EXTERNAL] RE: Lowell Hydroelectric Project - Historically Significant Waterpower Equipment Study  
**Attachments:** 1\_LOWE-ARCHIV-FindingAid-0908-PL-CI.pdf; 2\_LOWE-ARCHIV-FindingAid-0908-PL-CII.pdf; 3\_PL&C Finding Aid Transcript\_Draft.pdf; 4\_PL&C Drawings Inventory.xlsx; 5\_LHPC-FindingAid-2012-UPDATED.pdf; 6\_Lowell NHP Planning Document Library List.pdf

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Thanks, Kevin! I for one am pretty excited to have access to "a magic book of canal facts." Our notes on next steps from the Historical Water Power Equipment Study site meeting are:

1. Central Rivers Power / HDR / Gray & Pape to have an internal call about the study scope and following would reach out to NPS to confirm scope.
2. NPS to provide HSRs and other archives from the park's PLC collection by request.

Attached are 6 documents for you to look through and develop your request for additional information as needed per the agreed upon study scope. Please let me know if there are questions or anything that I can clarify. Happy researching- we look forward to touching base on the scope when you're ready.

1. **Finding Aid Part I for Proprietor's of Locks and Canals** - LOWE-ARCHIV-FindingAid-0908-PL-CI  
This is searchable and has more current (1980s). Look for whatever terms you think are relevant and make a list of Boxes/Folders you would like to see.
2. **Finding Aid Part II for Proprietor's of Locks and Canals** - LOWE-ARCHIV-FindingAid-0908-PL-CII  
This is primarily not searchable, but it does explain how the collection was broken up. It may help you find out who has drawings that don't belong to the park. Since this isn't searchable the next two documents have transcriptions of the relevant sections of the finding aid.
3. **PL&C Finding Aid Transcript\_Draft**  
This is a transcription of most of the photos in the collection. A list of photo numbers and titles that you want to see is fine for this.
4. **PL&C Drawings Inventory**  
This is a spreadsheet of most of the drawings in the park's PL&C collection. A list of Plan Nos. and Titles that you want to see works for the drawings. As a general rule if there are no dimensions listed we do not have the drawing. It may be at Center For Lowell History. Their findings can be searched online at <https://libguides.uml.edu/archives>
5. **LHPC-FindingAid-2012-UPDATED**

This is the finding aid for the Lowell Historic Preservation Commission Records. As with the PL&C info you can make a list of Boxes/Folders you would like to see.

## 6. Lowell National Historical Park Planning Document Library

This is our list of digitized HSRs and related studies available upon request.

### Christine Bruins | Community Planner

Lowell National Historical Park

978.275.1726 (office) | 978.954.1011 (cell)

---

**From:** Kevin Webb <kwebb@centralriverspower.com>

**Sent:** Friday, July 31, 2020 12:18 PM

**To:** Scott, Kelsey <Kelsey.Scott@hdrinc.com>; Lonsway, Peter <Peter\_Lonsway@nps.gov>; Racine, Laurel A <Laurel\_Racine@nps.gov>; Lieb, David M <David\_Lieb@nps.gov>

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