



Revised Study Plan

Lawrence Hydroelectric Project
(FERC No. 2800)

April 10, 2024

Prepared by:



Prepared for:

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A subsidiary of Patriot Hydro, LLC



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Contents

1	Introduction and Background	1
1.1	Study Plan Overview	1
1.2	Essex’s Approach to the Revised Study Plan	5
1.3	Project Description and Location	13
2	Execution of the Study Plan	15
3	Process Plan and Schedule	15
4	Requested Studies Modified or Not Adopted	20
4.1	Fish Assemblage Study.....	22
4.2	Fish Passage Improvement and Feasibility Assessment.....	24
4.3	Sturgeon Distribution and Project Interaction Study	25
4.4	Sturgeon Habitat Mapping and Assessment Study	26
4.5	Climate Related Project Impacts on Shortnose Sturgeon Habitat	28
4.6	Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem.....	30
4.7	Evaluation of Potential Project Impacts on the Merrimack River and Floodplain Habitats throughout the Term of a New License.....	32
4.8	Water Quality Study	34
4.9	State-listed Odonates and Assemblage Study	35
4.10	Invasive Plant Baseline Survey	36
4.11	CSO and Drinking Water Intake Interactions within Project Area	37
4.12	Fish Stranding and Ramping Rate Study.....	38
4.13	Upstream Anadromous Fish Passage Assessment.....	40
5	Study Reports and Progress Reports	41
6	Upstream Anadromous Fish Passage Assessment.....	42
6.1	Study Requests	42
6.2	Goals and Objectives	42
6.3	Study Area.....	43
6.4	Background and Existing Information	43
6.5	Project Nexus	43
6.6	Methodology	43
6.6.1	Sample Size	43
6.6.2	Radio Telemetry Equipment.....	47
6.6.3	Radio Telemetry Monitoring Stations	47
6.6.4	Tagging and Release Procedures.....	52
6.6.5	Data Collection	52
6.6.5.1	Stationary Telemetry Data	52

6.6.5.2	River and Operational Data	53
6.6.6	Analysis and Reporting	53
6.6.6.1	Data Management	53
6.6.6.2	Data Analysis – Approach and Passage Metrics	54
6.6.6.3	Data Analysis – Parameter Estimates for Evaluating Passage Success ...	55
6.7	Schedule, Level of Effort, and Estimated Cost	56
6.8	Discussion of Alternative Approaches.....	57
7	Upstream American Eel Passage Assessment.....	57
7.1	Study Requests	57
7.2	Goals and Objectives	58
7.3	Study Area.....	58
7.4	Background and Existing Information	58
7.5	Project Nexus	59
7.6	Methodology	59
7.6.1	Nighttime Observations – Assessment of Attraction Efficiency	59
7.6.2	Quantitative Evaluation of Internal Efficiency	60
7.6.2.1	Internal Efficiency – South Side Eel Trap.....	60
7.6.2.2	Internal Efficiency – North Side Eel Lift	61
7.6.2.3	Collection Tank Retention Evaluation.....	61
7.6.3	Data Analysis and Reporting.....	61
7.7	Schedule, Level of Effort, and Estimated Cost	62
7.8	Discussion of Alternative Approaches.....	62
8	American Eel Upstream Passage Siting Study	63
8.1	Study Requests	63
8.2	Goals and Objectives	63
8.3	Study Area.....	63
8.4	Background and Existing Information	63
8.5	Project Nexus	64
8.6	Methodology	64
8.6.1	Nighttime Visual Surveys	64
8.6.2	Electrofish Surveys.....	65
8.6.3	Temporary Eel Traps.....	66
8.6.4	Data Analysis and Reporting.....	67
8.7	Schedule, Level of Effort, and Estimated Cost	68
8.8	Discussion of Alternative Approaches.....	68
9	Desktop Entrainment, Impingement, and Turbine Passage Survival Study	68
9.1	Study Requests	68
9.2	Study Requests	69
9.3	Study Area.....	69

9.4	Background and Existing Information	69
9.5	Project Nexus	69
9.6	Methodology	70
9.6.1	Description of the Project Facilities and Operations	70
9.6.2	Turbine Entrainment/Passage Survival Review	70
9.6.3	Project Passage Survival Estimates	71
9.7	Schedule, Level of Effort, and Estimated Cost	71
9.8	Discussion of Alternative Approaches.....	71
10	Sturgeon Distribution and Project Interaction Study	72
10.1	Study Requests	72
10.2	Goals and Objectives	72
10.3	Study Area.....	72
10.4	Background and Existing Information	72
10.5	Project Nexus	73
10.6	Methodology	73
10.6.1	Active Sturgeon Surveys	73
10.6.2	Data Analysis and Reporting.....	74
10.7	Schedule, Level of Effort, and Estimated Cost	74
10.8	Discussion of Alternative Approaches.....	74
11	Diadromous Fish Behavior, Movement, and Project Interaction Study	80
11.1	Study Requests	80
11.2	Goals and Objectives	80
11.3	Study Area.....	81
11.4	Background and Existing Information	81
11.5	Project Nexus	81
11.6	Methodology	81
11.6.1	Phase 1: JSATS Feasibility Evaluation	82
11.6.1.1	Overview of JSATS Technology	82
11.6.1.2	JSATS Evaluation: Proposed Equipment	83
11.6.1.3	JSATS Evaluation: Approach	83
11.6.1.4	JSATS Evaluation: River Herring Tag Retention Assessment	84
11.6.1.5	JSATS Evaluation: Review and Application to the Phase 2 Behavioral Study	85
11.6.2	Phase 2: Behavior, Movement, Interaction Assessment	87
11.6.2.1	Behavior Evaluation: Geographical Scope	87
11.6.2.2	Behavior Evaluation: Acoustic Equipment and Deployment Approach.....	87
11.6.2.3	Behavior Evaluation: Target Fish Species, Sample Size Determination, and Tagging	88
11.6.2.4	Behavior Evaluation: Data Analysis and Reporting	88
11.7	Schedule, Level of Effort, and Estimated Cost	88
11.8	Discussion of Alternative Approaches.....	89

12	Project Operations and Fish Stranding Study	89
12.1	Study Requests	89
12.2	Goals and Objectives	90
12.3	Study Area.....	90
12.4	Background and Existing Information	90
12.5	Project Nexus	90
12.6	Study Methodology.....	90
12.6.1	Phase 1 – Operational Data Review	91
12.6.2	Phase 2 – Project Operations and CFD Modeling	91
12.7	Analysis and Reporting	92
12.8	Schedule, Level of Effort, and Estimated Cost	92
13	Freshwater Mussel Habitat Assessment and Survey	92
13.1	Study Requests	92
13.2	Goals and Objectives	93
13.3	Study Area.....	93
13.4	Background and Existing Information	93
13.5	Project Nexus	94
13.6	Methodology	94
13.6.1	Field Sampling.....	94
13.6.2	Analysis and Reporting	96
13.7	Schedule, Level of Effort, and Estimated Cost	98
13.8	Discussion of Alternative Approaches.....	98
14	Water Quality Study	99
14.1	Study Requests	99
14.2	Goals and Objectives	99
14.3	Study Area.....	100
14.4	Background and Existing Information	100
14.5	Project Nexus	100
14.6	Methodology.....	101
14.6.1	Continuous Water Quality Data Logging.....	104
14.6.2	Vertical Profiles of DO and Water Temperature	105
14.6.3	Secchi Disk Depth	106
14.6.4	Water Sample Collection for Laboratory Analysis of Nutrients and Chlorophyll-a	106
14.6.5	Water Sample Collection for Laboratory Analysis of Turbidity, TSS, and True Color	107
14.6.6	Benthic Macroinvertebrate Sampling	108
14.6.7	Quality Assurance/Quality Control (QA/QC) Protocols	109
14.6.8	Flow and Operations Data	112

14.6.9	Data Analysis and Reporting.....	112
14.7	Schedule, Level of Effort, and Estimated Cost	113
14.8	Discussion of Alternative Approaches.....	113
15	Three-Dimensional Computational Fluid Dynamics (CFD) Modeling	113
15.1	Study Requests	113
15.2	Goals and Objectives	114
15.3	Study Area.....	114
15.4	Background and Existing Information	114
15.5	Project Nexus	115
15.6	Study Methodology.....	115
15.6.1	Bathymetric Survey	115
15.6.2	Model Construction and Calibration	115
15.6.3	Model Simulation Runs	116
15.6.3.1	Essex Powerhouse Forebay and Downstream Bypass Model	116
15.6.3.2	Essex Powerhouse Tailrace Model	116
15.6.3.3	Essex Fishway Model.....	116
15.7	Analysis and Reporting	117
15.8	Schedule, Level of Effort, and Estimated Cost	117
16	Recreation Facilities, Use, and Aesthetics Study.....	118
16.1	Study Requests	118
16.2	Goals and Objectives	119
16.3	Study Area.....	119
16.4	Background and Existing Information	119
16.5	Project Nexus	120
16.6	Methodology	121
16.6.1	Literature Review	121
16.6.2	Identification of Focus Group Participants and Focus Group Meetings.....	122
16.6.3	Field Inventory.....	122
16.6.4	Field Reconnaissance and Visitor-Intercept Surveys	123
16.6.5	Visual Survey for Vegetation and Waterborne Trash.....	124
16.7	Analysis and Reporting	125
16.8	Schedule, Level of Effort, and Estimated Cost	125
17	Historically Significant Waterpower Equipment Study	126
17.1	Study Requests	126
17.2	Goals and Objectives	126
17.3	Study Area.....	126
17.4	Background and Existing Information	127
17.5	Project Nexus	127

17.6	Study Methodology.....	128
17.6.1	Site Visit and Consultation	128
17.6.2	Photography and Documentation.....	128
17.6.2.1	Photography	128
17.6.2.2	Documentation.....	128
17.7	Analysis and Reporting	129
17.8	Schedule, Level of Effort, and Estimated Cost	129
18	Condition Assessment of Historic Properties and Associated Canal System.....	131
18.1	Study Requests	131
18.2	Goals and Objectives	131
18.3	Study Area.....	131
18.4	Background and Existing Information	131
18.5	Project Nexus	132
18.6	Study Methodology.....	132
18.6.1	Document Review of Existing Conditions	132
18.6.2	Assessment of Water Levels, Flows, and Project Effects.....	133
18.7	Analysis and Reporting	133
18.8	Schedule, Level of Effort, and Estimated Cost	134
19	Literature Cited.....	135

Tables

Table 1-1.	Stakeholder Study Requests and Essex’s Proposal with Estimated Cost	9
Table 3-1.	Process Plan and Schedule.....	15
Table 5-1.	Preliminary Schedule for Study Reporting.....	41
Table 6-1.	Upstream Fish Passage Study Requests	42
Table 6-2.	Achieved statistical power to detect differences between the assumed population proportion under the null hypothesis of 20% and the alternative population proportions	46
Table 6-3.	Confidence interval calculations for a sample size of 100 by sample passage rate	46
Table 7-1.	American Eel Study Requests	57
Table 8-1.	American Eel Study Requests	63
Table 9-1.	Aquatic Resource Study Request.....	68
Table 10-1.	Aquatic Resource Study Request.....	72
Table 11-1.	Aquatic Resource Study Request.....	80
Table 12-1.	Aquatic Resource Study Request.....	89
Table 13-1.	Mussel Survey Study Request.....	92

Table 14-1. Water Quality Study Request	99
Table 14-2. Proposed Water Quality Monitoring Locations	101
Table 14-3. Field Meter Calibration Method, Frequency, and Acceptance Criteria.....	110
Table 14-4. Data QC Acceptance Criteria	111
Table 15-1. Aquatic Resource Study Request.....	113
Table 16-1. Recreation Use and Needs Study Requests	118

Figures

Figure 1-1. Lawrence Hydroelectric Project Facilities.....	14
Figure 6-1. Proposed stationary receiver placement for monitoring upstream migration on Merrimack River near Lawrence Project.....	50
Figure 6-2. Proposed stationary receiver placement for monitoring upstream passage effectiveness at the Lawrence Project	51
Figure 10-1. Example ARIS image showing broken hard-substrate bottom habitat.....	75
Figure 10-2. Example ARIS image showing submerged log on smooth bottom habitat.	76
Figure 10-3. Example ARIS image showing sand wave bottom habitat.	77
Figure 10-4. Example ARIS image showing discarded tire.	78
Figure 10-5. Example ARIS image showing midwater fish species (yellow oval) with corresponding bottom shadow (red oval).....	79
Figure 13-1. Proposed freshwater mussel search locations within the Lawrence Project Impoundment	97
Figure 14-1. Site Map with Proposed Monitoring Locations	103

Appendices

Appendix A – Comments on the PSP

Appendix B – Essex Response to Comments on the PSP

Appendix C – Summary of Results from Downstream American Eel Passage Assessment at the Lawrence Hydroelectric Project in 2019, and an Evaluation of Adult Alosine Downstream Passage Effectiveness in 2020

List of Acronyms

2D	Two-dimensional
3D	Three-dimensional
A	area
ADCP	Acoustic Doppler Current Profiler
APE	Area of Potential Effects
ArcGIS	Aeronautical Reconnaissance Coverage Geographic Information System
AWS	Auxiliary Water Supply
CAD	Computer aided drawing
CFD	Computational Fluid Dynamics
CFR	Code of Federal Regulations
cfs	cubic feet-per-second
CJS	Cormack Jolly Seber
CSO	Combined Sewer Overflow
DO	Dissolved Oxygen
EA	Environmental Assessment
Essex	Essex Company, LLC
FERC	Federal Energy Regulatory Commission (or Commission)
ft	feet
GIS	Geographic Information System
GLSD	Greater Lawrence Sanitary District
GPS	Global Positioning System
GWL	Groundwork+ Lawrence
HPMP	Historic Properties Management Plan
ILP	Integrated Licensing Process
ISR	Initial Study Report
LiDAR	Light Detection and Ranging
MADCR	Massachusetts Department of Conservation and Recreation
MADEP	Massachusetts Department of Environmental Protection
MADMF	Massachusetts Division of Marine Fisheries
MassWildlife	Massachusetts Division of Fisheries and Wildlife

mm	millimeters
MRTC	Merrimack River Technical Committee
MRWC	Merrimack River Watershed Council
MW	megawatt
NEPA	National Environmental Policy Act of 1969
NGOs	non-governmental organizations
NGVD	National Geodetic Vertical Datum of 1929
NHFG	New Hampshire Fish and Game Department
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NPS	National Park Service
NRHP	National Register of Historic Places
PAD	Pre-Application Document
PIT	passive-integrated transponder
PM&E	protection, mitigation, and enhancement
Project	Lawrence Hydroelectric Project (or Lawrence Project)
PSP	Proposed Study Plan
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Performance Plan
ROR	run-of-river
RSP	Revised Study Plan
SD1	Scoping Document 1
SHPO	State Historic Preservation Office
SPD	Study Plan Determination
SRHP	State Register of Historic Places
TNC	The Nature Conservancy
USFWS	U.S. Fish and Wildlife Service
USR	Updated Study Report
V	velocity
VIE	Visual Elastomer

1 Introduction and Background

Essex Company, LLC (Essex), a subsidiary of Patriot Hydro, LLC, is the Licensee, owner, and operator of the Lawrence Hydroelectric Project (FERC No. 2800) (Project or Lawrence Project). The Project was licensed by the Federal Energy Regulatory Commission (FERC or Commission) on December 4, 1978 (with an effective date of December 1, 1978), and the license expires on November 30, 2028. The Lawrence Project is located on the Merrimack River in the City of Lawrence in Essex County, Massachusetts.

The Project is currently licensed by the Commission under the authority granted to FERC by Congress through the Federal Power Act (FPA), 16 United States Code (USC) §791(a), et seq., to license and oversee the construction and operation of non-federal hydroelectric projects on jurisdictional waters and/or federal lands. In accordance with FERC's regulations at 18 Code of Federal Regulations (CFR) §16.9(b), Essex must file an application for a new license for the Project on or before November 30, 2026. Accordingly, Essex is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 CFR Part 5 of the Commission's regulations. In accordance with 18 CFR §5.13(a) of the Commission's regulations, Essex is filing this Revised Study Plan (RSP) with the Commission in support of relicensing the Project.

1.1 Study Plan Overview

Essex filed a Pre-Application Document (PAD) and associated Notice of Intent (NOI) with the Commission on June 16, 2023, to initiate the ILP. The PAD provides a description of the Project and summarizes the existing, relevant, and reasonably available information to assist the Commission, resource agencies, Indian tribes, non-governmental organizations (NGOs), and other stakeholders to identify issues, determine information needs, and prepare study requests.

The National Environmental Policy Act of 1969 (NEPA), the Commission's regulations, and other applicable statutes require the Commission to independently evaluate the environmental effects of issuing new licenses for the Project, and to consider reasonable alternatives to relicensing. At this time, the Commission has expressed its intent to prepare an Environmental Assessment (EA) that describes and evaluates the site-specific and cumulative potential effects (if any) of issuing the new license, as well as potential alternatives to relicensing. The EA is being supported by a scoping process to identify issues, concerns, and opportunities for resource enhancement associated with the proposed action. Accordingly, the Commission issued Scoping Document 1 (SD1) for the Project on August 15, 2023. SD1 was intended to advise resource agencies, Indian tribes, NGOs, and other stakeholders as to the proposed scope of the EA and to seek additional information pertinent to the Commission's analysis. As provided in 18 CFR §5.8(a) and §5.18(b), the Commission issued a notice of commencement of the relicensing proceeding concomitant with SD1.

On September 13 and 14, 2023, the Commission held public scoping meetings in Lawrence, Massachusetts. During these meetings, FERC staff presented information regarding the ILP and details regarding the study scoping process and how to request a relicensing study, including the Commission's study criteria. In addition, FERC staff solicited comments regarding the scope of issues and analyses for the EA. Pursuant to 18 CFR §5.8(d), a public site visit of the Project was conducted on September 13, 2023.

Resource agencies, Indian tribes, and other interested parties were afforded a 60-day period to request studies and provide comments on the PAD and SD1. The comment period was initiated with the Commission's August 15, 2023 notice and concluded on October 14, 2023.

During the comment period, a total of nineteen stakeholders filed letters with the Commission providing general comments, comments regarding the PAD, comments regarding SD1, and/or study requests. Thirteen stakeholders filed timely study requests during the comment period including FERC, U.S. Fish and Wildlife Service (USFWS), New Hampshire Fish and Game Department (NHFG), Massachusetts Division of Marine Fisheries (MADMF), National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NMFS), Massachusetts Division of Fisheries and Wildlife (MassWildlife), Groundwork+ Lawrence (GWL), The Nature Conservancy (TNC), National Park Service (NPS), Greater Lawrence Sanitary District (GLSD), Lawrence Community Works (LCW), Massachusetts Department of Environmental Protection (MADEP), and Merrimack River Watershed Council (MRWC).

In addition, the Nashua River Watershed Association (NRWA), OARS (Alison Field-Juma), the Lawrence History Center (Susan Grabski), Massachusetts State Senator Pavel Payano, Lawrence City Council (Marc Laplante), and one individual filed general information, statements, and/or informal study requests related to the Projects and/or relicensing process.

On November 28, 2023, FERC issued Scoping Document 2 (SD2). Essex also filed the Proposed Study Plan (PSP) on November 28, 2023. Essex held in-person PSP meetings, with a virtual option, on January 4-5, 2024 which provided stakeholders the opportunity to review, comment, and ask questions on the PSP. The PSP meeting was attended by representatives from Essex, as well as from the organizations listed below:¹

- FERC
- NMFS
- USFWS
- NPS
- Bureau of Indian Affairs
- MADMF
- MassWildlife
- NHFG

¹ The list is based on attendance information provided by stakeholders during the PSP meetings.

- TNC
- City of Lawrence
- Lawrence Conservation Commission
- City of Methuen
- City of Merrimack
- GWL
- GLSD
- LCW
- PIC
- MRWC
- Eagle Tribune
- North Side Ventures
- University of New Hampshire
- Several private citizens
- HDR Inc

Subsequent to the PSP meeting and pursuant to 18 CFR §5.12, stakeholder comments on the PSP were due by March 11, 2024. Between November 28, 2023 and March 20, 2024, a total of thirteen stakeholders filed written correspondence with FERC providing general comments, comments regarding SD2, and/or study requests. Copies of these letters are provided in Appendix A, and a summary of the primary comments and information requests from these letters and Essex's responses is provided in Appendix B.

FERC's ILP regulations require that stakeholders who provide study requests include specific information in the request in order to allow the Licensee, as well as Commission staff, to determine a requested study's appropriateness and relevancy to the Project and proposed action. As described in 18 CFR §5.9(b) of the Commission's ILP regulations, and as presented by FERC staff during the September 13, 2023 scoping meetings, the required information to be included in a study request is as follows:

(1) Describe the goals and objectives of each study and the information to be obtained (§5.9(b)(1));

This section describes why the study is being requested and what the study is intended to accomplish, including the goals, objectives, and specific information to be obtained. The goals of the study must clearly relate to the need to evaluate the effects of the Project on a particular resource. The objectives are the specific information that needs to be gathered to allow achievement of the study goals.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied (§5.9(b)(2));

This section must clearly establish the connection between the study request and management goals or resource of interest. A statement by an agency connecting its

study request to a legal, regulatory, or policy mandate needs to be included that thoroughly explains how the mandate relates to the study request, as well as the Project's potential impacts.

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study (§5.9(b)(3));

This section is for non-agency or Indian tribes to establish the relationship between the study request and the relevant public or tribal interest considerations.

(4) Describe existing information concerning the subject of the study proposal and the need for additional information (§5.9(b)(4));

This section must discuss any gaps in existing data by reviewing the available information presented in the PAD or information relative to the Project that is known from other sources. This section must explain the need for additional information and why the existing information is inadequate.

(5) Explain any nexus between project operation and effects (direct, indirect, and/or cumulative) on the resource to be studied and how the study results would inform the development of license requirements (§5.9(b)(5));

This section must clearly connect Project operations and Project effects on the applicable resource. This section can also explain how the study results would be used to develop protection, mitigation, and enhancement (PM&E) measures that could be implemented under a new FERC license. The PM&E measures can include those related to any mandatory conditioning authority under Section 401 of the Clean Water Act² or Sections 4(e) and 18 of the Federal Power Act, as applicable.

(6) Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate, considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration (§5.9(b)(6));

This section must provide a detailed explanation of the study methodology. The methodology may be described by outlining specific methods to be implemented or by referencing an approved and established study protocol and methodology.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs (§5.9(b)(7));

² 33 U.S.C. §1251 *et seq.*

This section must describe the expected level of cost and effort to conduct the study. If there are proposed alternative studies, this section can address why the alternatives would not meet the stated information needs.

1.2 Essex's Approach to the Revised Study Plan

Consistent with the Commission's regulations, Essex has evaluated all the study requests submitted by the stakeholders, with a focus on the study requests that addressed the seven criteria set forth in §5.9(b) of the Commission's ILP regulations, as discussed above. For the study requests that did not attempt to address the seven study criteria, where appropriate, Essex considered the study in the context of providing the requested information in conjunction with one of Essex's proposed studies.

Based on Essex's review of the requested studies, FERC criteria for study requests under the ILP (e.g., how the study results would inform the development of license requirements), and available information (e.g., associated with ongoing fish passage activities or other study activities within the watershed), Essex is proposing thirteen studies to be performed in support of issuing a new license for the Project. Information regarding each of these studies is provided in Sections 6 through 18 of this RSP. For each of Essex's proposed studies, this RSP describes:

1. The goals and objectives of the study;
2. The defined study area;
3. A summary of background and existing information pertaining to the study;
4. The nexus between Project operations and potential effects on the resources to be studied;
5. The proposed study methodology;
6. Level of effort, cost, and schedules for conducting the study.

Table 1-1 provides a summary of proposed studies relative to the study requests and a brief description of how the study plan has been revised from the PSP filed with the Commission. These revisions to the study proposed study plans are based on the conversations during the two-day PSP meeting, stakeholder comments filed with the Commission, the Commission's SD2, and the subsequent follow up consultation meetings held between Essex and various stakeholders regarding a number of the requested and proposed study plans. Based on the conversations during the PSP meeting, Essex coordinated with a number of stakeholders to continue the consultation regarding the studies to be performed. This consultation resulted in an addition of three studies from the PSP and the modification of multiple studies to incorporate stakeholder comments.

Essex and various stakeholders held five meetings following the PSP Meeting. The Recreation Study Plan, which incorporates components of the vegetation and waterborne trash study requests, was revised based on a meeting held on February 22, 2024 with the City of Lawrence, GWL, LCW, and Lawrence Conservation Commission. Various fish and aquatic resources studies were modified based on meetings with the

Merrimack River Technical Committee (MRTC)³ and MADEP on March 28, 2024 and April 1, 2024. In addition, Essex also held meetings on April 3, 2024 and April 5, 2024 with MassWildlife and the MADEP to discuss the Water Quality Study, and other studies as they pertain to water quality. Essex fully recognizes and appreciates the efforts of the stakeholders to reach agreement on specific study components within the timeframe allowed by the ILP.

Essex's overarching approach to the RSP is to appropriately apply FERC's study criteria with emphasis on matters and issues for which it has direct control (i.e., how do Project operations affect a given resource and how the study results would inform the development of license requirements). This is supported by FERC's March 2012 Guide To Understanding And Applying The Integrated Licensing Process Study Criteria which states, "*Staff would not, however, typically recommend that a licensee conduct studies on effects caused by developmental activities over which the licensee has no control.*" For example, as a run-of-river (ROR) facility with no bypassed reach, Essex has no control over the volume of natural river flows that pass through the Project. With a constant flow of water through the North and South Canals, the flow entering the Project's impoundment is consistent with the flows exiting the Project. As discussed with Project stakeholders, Essex is not proposing to alter downstream flows in the Merrimack River by varying releases for energy generation. The Project is not operating in either peaking or store-and-release mode. In addition, given the configuration of the Project's spillway and powerhouse, the Project has no bypassed reach.

One of the prominent discussion points woven through numerous comments and study requests was regarding Essex's use of the Commission's ILP Study criteria. Stakeholders point to the Final Rule, re Hydroelectric Licensing under the Federal Power Act under RM02-16 (Order 2002)⁴, specifically Paragraphs 98 and 108 of that issuance.

98. CHRC counters that a study might be required to establish the existence of a nexus. Taken to its extreme, CHRC's position would have us approving study proposals that amount to mere speculation. We think a common sense approach to demonstrating a nexus between project operations and resource impacts, informed by the professional judgment of qualified agency, Commission, and tribal staff, should ensure that this criterion is reasonably applied.

Essex agrees that the process of study selection through the ILP is generally a common-sense approach. As noted above, the Commission is part of the common-sense approach, and Essex has considered the Commission's recent rulings on relevant issues in deciding which study requests to adopt. Essex encourages the Commission to consider reasonings outlined in Section 4 of this RSP, and to review the proposed studies provided for in Sections 6 through 18. FERC continues to not recommend studies

³ The Merrimack River Technical Committee (MRTC) consists of representatives from the U.S. Fish & Wildlife Service (USFWS); the National Marine Fisheries Service (NMFS); the New Hampshire Fish and Game Department (NHFG); the Massachusetts Division of Marine Fisheries (MADMF); and the Massachusetts Division of Fisheries and Wildlife (MassWildlife).

⁴ FERC Accession # [20030724-3002](#)

that lack sufficient precision to identify and evaluate issues (P-3777)⁵ or that require accepting an unreasonable level of uncertainty for likely limited information (P-2467; P-2179).⁶

Essex believes this RSP reflects the common-sense approach of the Commission. For instance, as per the conversations during the PSP meetings and subsequent consultation, Essex has incorporated into this RSP the Diadromous Fish Behavior, Movement, and Project Interaction Study, as provided for below in Section 11. Essex previously recognized the importance of this study in the PSP and updated the RSP as appropriate. Similarly, based on additional consultation with the MRTC and comments provided by other stakeholders, Essex has proposed the Sturgeon Distribution and Project Interaction Study, as provided for below in Section 10.

With regard to a “nexus” or searching for a problem (Study Criteria No. 5), Essex’s approach is supported by *City of Centralia vs. FERC* (D.C. Circuit Court of Appeals) where the Court held that an applicant does not have “a *duty to determine if a problem exists*” and that it is not enough to speculate that a problem may exist with “*evidence*” of a problem based on a “*prediction based on opinions*.” Since the *Centralia* decision, and in cases decided after the Final Rule was published, FERC has consistently noted that “*where evidence of a problem has not been shown, the licensee does not have a duty to perform studies to determine whether a problem exists.*” *City of Jackson, Ohio*, 105 F.E.R.C. ¶61,136 n. 9 (2003); see *FPL Energy Maine Hydro, LLC*, 95 F.E.R.C. ¶61,106 n.15 (2001); *Allegheny Energy Supply Company, LLC*, 109 F.E.R.C. ¶61,028, 61,117 (2004).

Of note, in Paragraph 97 of the Commission’s Final Rule, FERC posits that the nexus between Project operations and effects on a resource is a threshold requirement that must be demonstrated in every case... “otherwise the door would be open to study requests having nothing to do with Project impacts”. While the Commission acknowledges the common-sense approach in their Final Rule in Paragraph 98, they repeatedly note throughout the Final Rule that a nexus must be demonstrated. Relatedly in Paragraph 99 of the Final Rule, FERC notes that even if a nexus is demonstrated between Project operations and a resource impacts, not all related study requests must be approved. Essex believes that this would be particularly applicable to a ROR facility with limited impoundment fluctuations and downstream influences.

⁵ See [FERC Accession 20210823-3025](#). FERC states “we cannot predict whether and to what extent climate change could affect species with sufficient precision to identify and evaluate today any operational changes that could protect fish from future climate change effects.”

⁶ See [FERC Accession 20211103-3003](#). FERC states “Given the level of uncertainty that would need to be accepted with NMFS’ requested study, generating downscaled data for the Merced River would not substantially contribute to our understanding of ecological processes related to anadromous fish in project waters. Climate model projections may capture aspects of future climate scenarios, but it is not clear how these models could guide management decisions at the project level and inform license conditions because the level of uncertainty precludes the identification and development of specific requirements that could mitigate potential future effects of various climate patterns.”

Essex recognizes the interest in examining the aspects over which Essex has direct control; however, Essex disagrees with attempts to establish connections between the Project's ROR operations and overall river-wide issues (or, world-wide, in the case of climate change). As described in detail in the PAD, today's operation of the Project is authorized by the original 1978 FERC license, as well as all subsequent FERC Orders and Amendments issued to-date. Key amendments include the June 19, 2007 amendment which approved installation of the crest gates, an addition FERC noted in their approval letter would "(a) allow the licensees to more consistently maintain water levels and thereby enhancing the efficiency and generation capabilities of the project, (b) improve upstream fish passage, (c) eliminate dangers associated with the replacement of wooden flashboards, and (d) enhance the aesthetics."

As noted in Section 4, Essex is not proposing to perform certain studies as requested because it is not clear how the resource in question is affected by the Project's ROR operations, and relatedly, how the Project's ROR operations would be modified under a new license based on the results of the study (i.e., how the study results would inform the development of license requirements) (Study Criteria No. 5). As currently operated, as well as proposed in the Project's new license, the Project passes the natural river flow immediately downstream of the Project's spillway and adjacent powerhouse. Given the constant steady state of water that flows through the North and South Canals, the Project is not diverting the river's natural flows from the river reach downstream of the spillway or powerhouse. Therefore, it is not clear how certain requested studies would inform the Project's influence on aquatic habitat downstream of the Project. If some day additional water were to be diverted to the canals (e.g., for hydropower generation), this action would be the subject of a separate proceeding.

For instance, certain study requests would have Essex surveying/sampling for long distances downstream of the Project. However, FERC consistently recognizes that it is unreasonable to assume effects extend far from a Project, stating in the SD2 for the Skagit River Project:⁷

While we have yet to determine just how far downstream the effects of project operation extend, the analysis of project effects would not likely include the entire length of the Skagit River from the headwaters to the estuary, the estuary and marine environment, and all adjacent tributaries because some of these areas are either too geographically remote or any effects occurring there are the product of a lengthy causal chain making any such analysis meaningless.

In summary, these collective guiding principles are factored into Essex's RSP with each proposed study (or response to study request) providing additional detail as appropriate. Essex believes this RSP is balanced and appropriate to examining those aspects for which Essex has direct control.

⁷ See FERC Accession [20201204-3022](#).

Table 1-1. Stakeholder Study Requests and Essex’s Proposal with Estimated Cost

Study Request	Stakeholder Requesting Study	Essex RSP Proposal	Brief description of changes from PSP to RSP	Estimated Cost of Study in RSP
Water Quality Study	FERC, MassDEP	Adopted with modifications	After discussion with the MADEP and MassWildlife on April 3 and April 5, 2024, Essex updated the study plan to add new logger stations, nutrient testing at certain stations, benthic macroinvertebrate sampling following available USEPA protocols, and turbidity, total suspended solids, and color data collection. See updated Water Quality Study, Section 14.	\$125,000
Sturgeon Distribution and Project Interaction Study	NHFGD, NMFS, MassWildlife, USFWS	Adopted with modifications	Essex is proposing to perform the Sturgeon Distribution and Project Interaction Study, as provided for in Section 10. Essex believes the Sturgeon Distribution and Project Interaction Study as proposed is a balanced level of effort commensurate to the degree to which there is a known problem (Section 4.3).	\$65,000
Desktop Entrainment, Impingement, and Turbine Passage Survival Study	FERC	Adopted	After review of FERC’s comment letter and conversations with the MRTC on March 28 and April 1 2024, Essex is proposing to perform this study. See Desktop Entrainment, Impingement, and Turbine Passage Survival Study, Section 9.	\$30,000
Diadromous Fish Behavior, Movement, and Project Interaction Study	MADMF, NHFGD, NMFS, MassWildlife, USFWS	Adopted with modifications	After discussions with the MRTC on March 28 and April 1, Essex is proposing to perform the Diadromous Fish Behavior, Movement, and Project Interaction Study, as provided for in Section 11. Essex previously recognized the importance of this study in the PSP and provided a study plan for review and comment in this RSP.	\$700,000
Fishway Hydraulic Modeling (CFD) Study	MADMF, NHFGD, NMFS, MassWildlife, USFWS	Adopted with modifications	Essex believes the study plan as provided for in the PSP is sufficient for the Commission’s Environmental Analysis. See Section 15 for the study as proposed.	\$200,000
Downstream American Eel Passage Assessment	FERC	Not adopted	Essex considers the proposed protection, mitigation, and enhancement measures (PM&Es) and the proposed Desktop Entrainment, Impingement, and Turbine Passage Survival Study sufficient to evaluate downstream passage for American eels. See Section 9 for the Desktop Entrainment, Impingement, and Turbine Passage Survival Study. In addition, as noted in Section 4, Normandeau Associates performed a Downstream American Eel Passage Assessment at the Lawrence Hydroelectric Project in 2019. An overview of study results is provided in Appendix C. Essex intends to file the report in its entirety prior to the Commission’s Study Plan Determination.	--
Freshwater Mussel Study	MassWildlife, USFWS	Adopted with modifications	Essex is adopting this study with modifications as provided for in Section 13 of this RSP. Primary revisions include additional survey locations below the dam down to the Lawrence 1-495 Bridge location (1.5 miles downstream). Essex updated the plan in this RSP based on comments from stakeholders and discussions with the MRTC and MADEP on March 28, 2024 and April 1, 2024.	\$70,000
Juvenile Alosine Downstream Passage Assessment	FERC	Not adopted	Essex considers the proposed PM&Es, existing information, and the proposed Desktop Entrainment, Impingement, and Turbine Passage Survival Study sufficient to evaluate downstream passage of juvenile alosines. See Section 4 and Section 9.	--

Study Request	Stakeholder Requesting Study	Essex RSP Proposal	Brief description of changes from PSP to RSP	Estimated Cost of Study in RSP
Upstream and Downstream Adult Alosine Passage Assessment	FERC	Adopted with modifications	<p>Essex is proposing to perform an Upstream Anadromous Fish Passage Assessment to determine the impact of the Lawrence Project on the upstream migration of adult alosines. Following receipt of comments on the PSP and additional consultation with the MRTC, this evaluation was updated to focus on the American shad [(<i>Alosa sapidissima</i>), as well as the analysis of sample size and statistical significance. See Section 6 for the revised Upstream Anadromous Fish Passage Assessment. Essex is also proposing the Diadromous Fish Behavior, Movement, and Project Interaction Study (Section 11), which is intended to provide significant insights into upstream diadromous fish passage.</p> <p>Regarding downstream adult alosine passage, Essex considers the proposed PM&Es and the proposed Desktop Entrainment, Impingement, and Turbine Passage Survival Study sufficient to evaluate downstream passage. See Section 4 and Section 9. In addition, as noted in Section 4, Normandeau Associates performed an Evaluation of Adult Alosine Downstream Passage Effectiveness in 2020. An overview of study results is provided in Appendix C. Essex intends to file the report in its entirety prior to the Commission's Study Plan Determination.</p>	--
Recreation Facilities, Use, and Aesthetics Study	FERC, NPS, GWL	Adopted	Essex is proposing to perform the Recreation Facilities, Use, and Aesthetics Study as provided for in Section 16. Essex updated the study plan in response to comments from stakeholders, as well as consultation meetings, to include recreation surveys and focus group discussions, as well as additional vegetation and waterborne trash surveys.	\$120,000
Condition Assessment of Historic Properties and Associated Canal System	FERC	Adopted	Essex is proposing the study as provided for in Section 18.	\$75,000
Historically Significant Waterpower Equipment Study	FERC	Adopted	Essex is proposing the study as provided for in Section 17.	\$35,000
Water Level and Flow Effects on Historic Resources	NPS	Adopted with modifications	Essex has adopted this study with modifications as part of the Condition Assessment of Historic Properties and Associated Canal System. See Section 18.	--
Vegetation and Aquatic Trash Management Study	NPS	Adopted with modifications	Essex has adopted this study with modifications as part of the Recreation Facilities, Use, and Aesthetics Study and Condition Assessment of Historic Properties and Associated Canal System. See Section 16 and 18, respectively.	--
American Eel Upstream Passage Siting Study	MADMF, NHFGD, MassWildlife, USFWS	Adopted	Essex adopted this study and made modifications to the study plan as appropriate in response to comments on the PSP and meetings with the MRTC on March 28, 2024 and April 1, 2024. See Section 8. Primary revisions include minor clarifications to the methodology, and the inclusion of general fish assemblage data collected during electrofish events.	\$60,000
Upstream Fish Passage Effectiveness for American Eel	MADMF, NHFGD, NMFS, MassWildlife	Adopted	Essex adopted this study and made modifications to the study plan as appropriate in response to comments on the PSP and meetings with the MRTC on March 28, 2024 and April 1, 2024. See Section 7. Primary revisions include the elimination of the PIT-based approach to rely on visible mark-recapture approach to account for eel size.	\$60,000
Upstream Anadromous Fish Passage Assessment	MADMF, NHFGD, NMFS, MassWildlife, USFWS	Adopted with modifications	Essex adopted this study and made modifications to the study plan as appropriate in response to comments on the PSP and meetings with the MRTC on March 28, 2024 and April 1, 2024. See Section 6. Following receipt of comments on the PSP and additional consultation with the MRTC, this evaluation was updated to focus on the American shad [(<i>Alosa sapidissima</i>), analysis of sample size and statistical significance, and the addition of monitoring locations.	\$170,000

Study Request	Stakeholder Requesting Study	Essex RSP Proposal	Brief description of changes from PSP to RSP	Estimated Cost of Study in RSP
Downstream Migratory Species Passage Assessment	MADMF, NHFGD, NMFS, MassWildlife, USFWS	Not adopted	Regarding downstream fish passage, Essex considers the proposed PM&Es and the proposed Desktop Entrainment, Impingement, and Turbine Passage Survival Study sufficient to evaluate downstream passage. See Section 4 and Section 9. In addition, as noted in Section 4, Normandeau Associates performed an Evaluation of Adult Alosine Downstream Passage Effectiveness in 2020 and a Downstream American Eel Passage Assessment at the Lawrence Hydroelectric Project in 2019. An overview of study results is provided in Appendix C. Essex intends to file the reports in their entirety prior to the Commission's Study Plan Determination.	--
Fish Passage Improvement and Feasibility Assessment	MADMF, NHFGD, MassWildlife, USFWS	Not adopted	Essex is not adopting this study. See Section 4.2.	--
Fish Stranding and Ramping Rate Study	MADMF, NHFGD, MassWildlife, USFWS	Adopted with modifications	Essex is adopting this study with modifications. In response to comments on the PSP and consultation meetings with the MRTC, Essex incorporated language into the study plan to use existing aerial imagery, combined with new photographs collected from trail cameras, to capture conditions below the dam to identify potential fish stranding locations. See Section 12 for the study as proposed.	\$50,000
Sturgeon Habitat Mapping and Assessment Study	NMFS, MassWildlife	Not adopted	Essex is not adopting this study. Essex believes the Sturgeon Distribution and Project Interaction Study as proposed in Section 10 is a balanced level of effort commensurate to the degree to which there is a known problem. See Section 4.4.	--
Climate-Related Project Impacts on Shortnose Sturgeon Habitat	NMFS, MassWildlife	Not adopted	Essex is not adopting this study. The Commission continues to acknowledge that it is unclear how hypothetical climate change analyses would inform license conditions. As noted in recent decisions, the Commission cannot require mitigation for conditions that don't exist today. See Section 4.5.	--
Invasive Plant Baseline Survey	MassWildlife, USFWS	Not adopted	Essex is not adopting this study as requested. Essex is proposing to record readily identifiable invasive species during the three vegetation surveys of the canals performed for the Recreation Facilities, Use, and Aesthetics Study. There are many pathways related to propagation of invasive plant species, factors outside of Project operations and Essex's control. See Section 4.10.	--
State-listed Odonates and Assemblage, Baseline Data Collection and Assessment of Operational Impacts	MassWildlife	Not adopted	Essex is not adopting this study. Essex considers the proposed PM&Es as described in Section 4.9 sufficient to mitigate any potential impacts to odonates.	--
Fish Assemblage Assessment	MassWildlife, USFWS	Not adopted	Essex is not adopting this study as requested. Essex updated the American Eel Upstream Passage Siting Study (Section 8) to provide additional data collection on the general fish assemblage downstream of Lawrence Dam. See Section 4.1.	--
Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem	MassWildlife, TNC	Not adopted	Essex is not adopting this study. The Commission continues to acknowledge that it is unclear how such hypothetical climate change analyses would inform license conditions. As noted in recent decisions, the Commission cannot predict whether and to what extent climate change could affect aquatic resources with sufficient precision to identify and evaluate today any operational changes that could mitigate future climate change effects. See Section 4.6.	--
Evaluation of Potential Project Impacts on the Merrimack River and Floodplain Habitats Throughout the Term of a New License	MassWildlife, TNC	Not adopted	Essex is not adopting this study. The Commission continues to acknowledge that it is unclear how such hypothetical climate change analyses would inform license conditions. As noted in recent decisions, the Commission cannot predict whether and to what extent climate change could affect aquatic resources with sufficient precision to identify and evaluate today any operational changes that could mitigate future climate change effects. See Section 4.7.	--

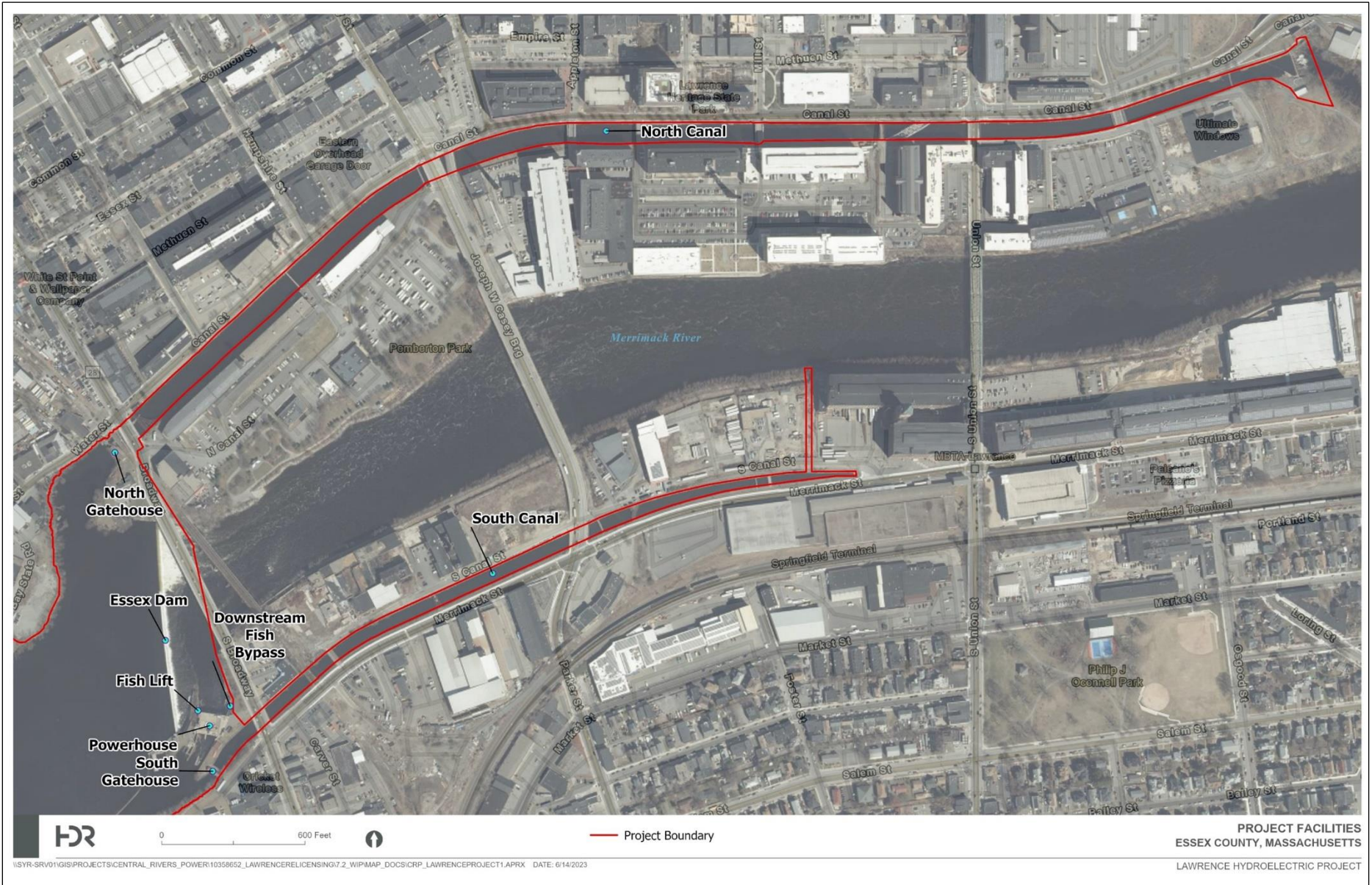
Study Request	Stakeholder Requesting Study	Essex RSP Proposal	Brief description of changes from PSP to RSP	Estimated Cost of Study in RSP
Lawrence Dam Minimum Flow Requirements and Proposed Changes Study	GLSD	Adopted	Essex is proposing a Project Operations and Fish Stranding Study which will summarize the operational conditions of the Project over a five-year period of record, including impoundment elevations, generation records, minimum flows, and maintenance events. See Section 12.	--
Cultural Resources Study	GWL	Adopted	Essex has adopted this study as part of the Historically Significant Waterpower Equipment Study and the Condition Assessment of Historic Properties and Associated Canal System Study. See Sections 17 and 18.	--
Environmental Justice Study	GWL	Adopted	Essex has adopted this study as part of the Historically Significant Waterpower Equipment Study and the Condition Assessment of Historic Properties and Associated Canal System Study. See Sections 17 and 18. Essex will also evaluate environmental justice considerations in the license application as appropriate.	--
Study of the current condition of North and South canal walls, and all historic canal infrastructure	LCW	Adopted with modifications	Essex has adopted this study as part of the Historically Significant Waterpower Equipment Study and the Condition Assessment of Historic Properties and Associated Canal System Study. See Sections 17 and 18.	--
Study to determine the effects of continuous water flow through the canals on the operation of the Project	LCW	Adopted with modifications	Essex has adopted this study as part of the Historically Significant Waterpower Equipment Study and the Condition Assessment of Historic Properties and Associated Canal System Study. See Sections 17 and 18.	--
CSO and Drinking Water Intake Interactions within Project Area	MRWC	Not adopted	Essex is not adopting this study. CSOs and Drinking Water Intakes are not Project features and are outside of Essex's control. See Section 4.11.	--
Anticipated Study Total Cost				\$1,760,000

1.3 Project Description and Location

The Lawrence Project works consist of: (1) the 35-foot-high by 900-foot-long gravity Essex Dam of stone masonry construction (also known as the Great Stone Dam), with a five-foot-high pneumatic crest gate system mounted on the spillway crest; (2) a 9.8-mile-long impoundment having a surface area of 655 acres at a normal water elevation of 44.17 feet National Geodetic Vertical Datum of 1929 (NGVD) at the top of the crest gates, and gross storage capacity of approximately 19,900 acre-feet; (3) a powerhouse located at the end of a small forebay adjacent to the south abutment of the Essex Dam, containing two 8.4 megawatt (MW) generating units, and a tailrace channel extending into the Merrimack River channel; (4) fish passage facilities integral with the powerhouse, including a fish elevator and downstream fish bypass, and an eel ladder at the right abutment of the dam; (5) the North Canal, approximately 5,300 feet long by 95 feet wide by 15 feet deep, originating at the north abutment of the dam and paralleling the Merrimack River downstream of the Essex Dam; (6) the South Canal, approximately 2,750 feet long by 35 feet wide by 10 feet deep, originating the south abutment of the Essex Dam and generally paralleling the Merrimack River downstream of the Essex Dam; (7) a single-circuit, underground/underwater 23.0-kilovolt (kV) transmission line to the Massachusetts Electric Company's Lawrence No. 1 substation; and (8) appurtenant facilities.

The Project is located on the Merrimack River in the City of Lawrence, Massachusetts (Figure 1-1).

Figure 1-1. Lawrence Hydroelectric Project Facilities



2 Execution of the Study Plan

As required by Section 5.15 of FERC’s ILP regulations, Essex will prepare progress reports on a quarterly basis, file an Initial Study Report (ISR), hold a meeting with stakeholders and FERC staff to discuss the initial study results (ISR Meeting), and prepare and file an Updated Study Report (USR) and convene an associated USR Meeting, as appropriate. Essex will submit all study documents that must be filed with the Commission via FERC’s eFiling system.

3 Process Plan and Schedule

The Process Plan and Schedule is presented in Table 3-1. 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. The Process Plan and Schedule below is based on the revised schedule issued by the Commission on November 28, 2023 in SD2.

Pursuant to 18 CFR §5.13(b), comments on this RSP must be filed with FERC within 15 days following the filing of this RSP, by April 25, 2024. Pursuant to 18 CFR §5.13(c), within 30 days following the filing of the RSP, FERC will issue the Commission’s Study Plan Determination.

Table 3-1. Process Plan and Schedule

Milestone	Responsible Party	Time Frame	Estimated Date
File PAD and NOI PAD (18 CFR §5.5(d))	Essex	As early as five and one half years but no later than five years prior to license expiration	June 16, 2023
Initial Tribal Consultation Meeting (18 CFR §5.7)	FERC	No later than 30 days of filing PAD/NOI	TBD
Issue Notice of PAD/NOI and SD1 (18 CFR §5.8(a))	FERC	Within 60 days of filing PAD/NOI	August 15, 2023
Conduct Scoping Meetings and Site Visit (18 CFR §5.8(b) (viii))	FERC	Within 30 days of PAD/NOI notice and SD1 issuance	September 13 and 14, 2023
Comments on PAD, SD1, and Study Requests (18 CFR §5.9(a))	Stakeholders	Within 60 days of PAD/NOI notice and issuance of SD1	October 16, 2023
Issuance of Scoping Document 2 (SD2) (18 CFR §5.10) (if necessary)	FERC	Within 45 days of deadline for filing comments on SD1	November 28, 2023

Milestone	Responsible Party	Time Frame	Estimated Date
File Proposed Study Plan (PSP) (18 CFR §5.11)	Essex	Within 45 days of deadline for filing comments on PAD	November 28, 2023
Study Plan Meeting(s) (18 CFR §5.11(e))	Essex	Meeting to be held within 30 days of filing PSP	January 11, 2024
Comments on PSP (18 CFR §5.12)	Stakeholders	Within 90 days of filing PSP	March 11, 2024
File Revised Study Plan (RSP) (18 CFR §5.13(a))	Essex	Within 30 days of deadline for comments on PSP	April 10, 2024
Comments on RSP (18 CFR §5.13(b))	Stakeholders	Within 15 days following RSP	April 25, 2024
Issuance of Study Plan Determination (SPD) (18 CFR §5.13(c))	FERC Director	Within 30 days of RSP	May 10, 2024
Formal Study Dispute Resolution Process (18 CFR §5.14(a)) (if necessary)	Agencies and Tribes with mandatory conditioning authority	Within 20 days of study plan determination	May 30, 2024
Third Panel Member Selection Due (18 CFR §5.14(d)(3)) (if necessary)	Dispute Resolution Panel	Within 15 days of when Dispute Resolution Panel convenes	June 14, 2024
Dispute Resolution Panel Convenes (18 CFR §5.14(d)) (if necessary)	Dispute Resolution Panel	Within 20 days of a notice of study dispute	June 19, 2024
Comments on Study Plan Disputes (18 CFR §5.14(i)) (if necessary)	Essex	Within 25 days of notice of study dispute	June 24, 2024
Dispute Resolution Panel Technical Conference (18 CFR §5.14(j)) (if necessary)	Dispute Resolution Panel, Essex, Stakeholders	-	June 29, 2024
Dispute Resolution Panel Findings and Recommendations (18 CFR §5.14(k)) (if necessary)	Dispute Resolution Panel	No later than 50 days after notice of dispute	July 19, 2024
Study Dispute Determination (18 CFR §5.14(1)) (if necessary)	FERC Director	No later than 70 days after notice of dispute	August 8, 2024

Milestone	Responsible Party	Time Frame	Estimated Date
Conduct First Season of Studies (18 CFR §5.15)	Essex	-	Spring 2024
Study Progress Report (18 CFR §5.15(b))	Essex	Essex will provide summary updates every three months	Quarterly, beginning in Quarter 3 of 2024 through filing of the USR
Initial Study Report (18 CFR §5.15(c))	Essex	Pursuant to the Commission-approved study plan or no later than 1 year after Commission approval of the study plan, whichever comes first	April 26, 2025
Initial Study Report Meeting (18 CFR §5.15(c)(2))	Essex and Stakeholders	Within 15 days of filing the initial study report	May 11, 2025
File Initial Study Report Meeting Summary (18 CFR §5.15(c)(3))	Essex	Within 15 days of initial study report meeting	May 26, 2025
File Disputes/Requests to Amend Study Plan (18 CFR §5.15(c)(4))	Stakeholders	Within 30 days of study results meeting summary	June 25, 2025
File Responses to Meeting Summary Disagreements (18 CFR §5.15(c)(5))	Essex	Within 30 days of filing meeting summary disagreements	July 25, 2025
Resolution of Disagreements (18 CFR §5.15(c)(6)) (if necessary)	FERC Director	Within 30 days of filing responses to disagreements	August 24, 2025
Conduct Second Season of Studies (if necessary)	Essex	-	Spring/Summer/Fall 2025
File Preliminary Licensing Proposal or Draft License Application (18 CFR §5.16(a))	Essex	No later than 150 days prior to the deadline for filing the Final License Application	July 3, 2026
File Updated Study Report (18 CFR §5.15(f)) (if necessary)	Essex	Pursuant to the approved study plan or no later than two years after Commission approval, whichever comes first	April 26, 2026
Comments on Preliminary Licensing Proposal or Draft License Application Due (18 CFR §5.16(e))	Stakeholders	Within 90 days of filing Preliminary Licensing Proposal or Draft License Application	October 1, 2026
Updated Study Report Meeting (18 CFR §5.15(f)) (if necessary)	Essex and Stakeholders	Within 15 days of updated study report	May 11, 2026

Milestone	Responsible Party	Time Frame	Estimated Date
File Updated Study Report Meeting Summary (18 CFR §5.15(f)) (if necessary)	Essex	Within 15 days of study report meeting	May 26, 2026
File Disputes/Requests to Amend Study Plan (18 CFR §5.15(f))	Stakeholders	Within 30 days of study results meeting summary	June 25, 2026
File Responses to Meeting Summary Disagreements (18 CFR §(f))	Essex	Within 30 days of filing meeting summary disagreements	July 25, 2026
Resolution of Disagreements (18 CFR §5.15(f)) (if necessary)	FERC Director	Within 30 days of filing responses to disagreements	August 24, 2026
File License Application (18 CFR §5.17)	Essex	By November 30, 2026— No later than 24 months before the existing license expires	November 30, 2026

4 Requested Studies Modified or Not Adopted

As previously stated, a total of nineteen stakeholders filed comments on the PAD and thirteen of those stakeholders filed formal study requests. Essex has developed study plans to address many of the stakeholders' study requests. In some instances, Essex has consolidated study requests or elements/objectives of study requests into one study to increase efficiencies in how data is collected and analyzed. For example, FERC, NPS, and GWL requested variations of a study assessing recreation uses and needs at the Project. Where appropriate, these studies requests have been combined into a single study, as described in their individual study plans.

Essex and various stakeholders held five meetings following the PSP Meeting. The Recreation Study Plan, which incorporates components of the vegetation and waterborne trash study requests, was revised based on a meeting held on February 22, 2024 with the City of Lawrence, GWL, LCW, and Lawrence Conservation Commission. Various fish and aquatic resources studies were modified based on meetings with the MRTC and MADEP on March 28, 2024 and April 1, 2024. In addition, Essex also held meetings on April 3, 2024 and April 5, 2024 with MassWildlife and the MADEP to discuss the Water Quality Study, and other studies as they pertain to water quality. Essex fully recognizes and appreciates the efforts of the stakeholders to reach agreement on specific study components within the timeframe allowed by the ILP.

In review of existing information and study requests, Essex anticipates providing proposed protection, mitigation, and enhancement measures (PM&Es) to limit or prevent fish entrainment through the Project's turbines. In particular, Essex is proposing to develop, in consultation with the MRTC, a narrow-spaced trashrack design to replace the existing trashrack system. Essex believes this proposal for a PM&E measure to screen the Project's intake would greatly inform the new Project proposal and would likely result in reduced study costs. Essex understands that while fish entrainment during downstream passage may be mitigated by this PM&E, the existing downstream fish bypass survival for emigrating diadromous species (i.e., adult and juvenile alosines and adult American eel) will need evaluation at a later date. As noted by the Commission in their October 13, 2023 letter, Essex will consult with the MRTC regarding this PM&E and provide details of PM&E proposals within the Draft License Application (DLA).

Given that Essex is proposing PM&E measures related to fish entrainment and passage, Essex is not proposing to perform the Downstream Fish Passage Assessment⁸ for diadromous species recommended by NMFS, USFWS, MADMF, MassWildlife, and NHFG. Alternatively, Essex is proposing to perform the Desktop Entrainment, Impingement, and Turbine Passage Survival Study (See Section 9). Essex also believes

⁸ The Commission also requested this study but requested as the following three separate studies: Downstream American Eel Passage Assessment, Juvenile Alosine Downstream Passage Assessment, and Downstream Adult Alosine Passage Assessment.

that existing information is sufficient for evaluation of fish survival, delay and route selection for emigrating diadromous species. Normandeau Associates, on behalf of Essex, performed a Downstream American Eel Passage Assessment at the Lawrence Hydroelectric Project in 2019, and an Evaluation of Adult Alosine Downstream Passage Effectiveness in 2020. An overview of the results of these studies is provided in Appendix C. Essex intends to make these two reports available in their entirety with the Commission prior to the issuance of the SPD. These studies were performed proactively in conjunction with other studies and are “new” studies to the Commission and relicensing participants. Essex believes that existing information used along with the proposed Desktop Entrainment, Impingement, and Turbine Passage Survival Study, and the proposed PM&E measures, are sufficient for the Commission’s Environmental Analysis.

In addition to the study requests for which Essex has developed study plans (or anticipates developing proposed PM&Es in lieu of study), there were study requests that were deemed wholly or partially inconsistent with the Commission’s study criteria and, therefore, are not being fully incorporated into a study plan for one or more of the following reasons:

1. **There is no evidence of a problem and/or the study request is an attempt to search for a problem or “nexus” (Study Criteria No. 5):** Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question. This “nexus” between the Project’s operation and a resource impact must be supported by some evidence of a specific resource impact, not just a belief that an impact might be occurring. Additionally, the study request should not be a request to search for an impact in the absence of any evidence that one is occurring. If the study request is an attempt to search for a Project effect, or a nexus, then it does not meet the criteria for a study request. Essex’s approach is supported by *City of Centralia vs. FERC* (D.C. Circuit Court of Appeals) where the Court held that an applicant does not have “*a duty to determine if a problem exists*” and that it is not enough to speculate that a problem may exist with “*evidence*” of a problem based on a “*prediction based on opinions*.” That is, study requests on matters outside of Essex’s direct control or are based on speculation are deemed not appropriate for study.
2. **Study request constitutes basic research and/or is not likely to inform the development of license conditions (Study Criteria No. 5):** Study requests should demonstrate the need for additional, site-specific information for purposes other than general research.
3. **Study request is not necessary because existing information is sufficient to answer the questions posed (Study Criteria No. 4):** FERC policy and regulations indicate that if existing information is sufficient to understand the Project effects on the subject resource, then additional study is not needed. Requestors should also describe why existing information is insufficient to inform the development of license requirements.

- 4. Alternative methods or approaches are sufficient to meet the requestor's stated information needs (Study Criteria No. 7):** Where alternative study methods are sufficient to meet information needs, FERC's study criteria require consideration of the level effort and cost of requested studies.

The following requested studies were deemed by Essex as not appropriate for study for the reasons explained below.

4.1 Fish Assemblage Study

USFWS and MassWildlife requested a Fish Assemblage Study, with the stated goal to determine the assemblage of fish species present in the areas affected by the Lawrence Hydroelectric Project. As identified in Table 1-1 above, Essex updated the American Eel Upstream Passage Siting Study (Section 8) to provide additional data collection on the general fish assemblage downstream of Lawrence Dam. During that study, all non-anguillid fish species will also be netted during eel electrofish events. Fish will be identified to species, counted, and total length to the nearest mm will be recorded. Essex considers this collection of fish assemblage data downstream of the Lawrence dam commensurate to which there is a known issue or problem.

Essex is not adopting the Fish Assemblage Study as requested by stakeholders. Recommended methodology by USFWS and MassWildlife generally consists of a robust sampling design across multiple seasons (spring, summer, and fall) for an approximately 41-mile reach of the Merrimack River. Although Essex is proposing more targeted studies for this well-studied, ROR project that has existing upstream and downstream passage, Essex is not adopting this study as requested as it does not meet the following FERC study criteria:

- Study request is not necessary because existing information is sufficient to answer the questions posed and the study request constitutes basic research (Study Criteria Nos. 4 and 5):** Study requests should demonstrate the need for additional, site-specific information for purposes other than general research. Requestors should also describe why existing information is insufficient to inform the development of license requirements and/or contribute to the development of PM&E measures.

Unlike various smaller rivers throughout the Northeast that have not been exhaustively studied or managed over the past few decades, the Merrimack River, as indicated by the establishment of the MRTC and the recently issued Merrimack River Watershed Comprehensive Plan for Diadromous Fishes, is one of the most understood and managed rivers in the Northeast. As such, the existing fishery resources are exhaustively summarized in Section 5.4 of the PAD, and USFWS and MassWildlife do not explain how this existing information cannot meet the goals of the study to describe fish assemblage structure, distribution and abundance, or to compare historical records of fish species occurrence in the Project area. USFWS and MassWildlife do not mention the recent and robust Fish Assemblage Study that was performed upstream at the Lowell Project in 2020 (Normandeau 2021). USFWS and MassWildlife do mention 2009 surveys

at the Lawrence Project, the results of which are consistent with the Lowell Fish Assemblage Study and the information provided in the Project PAD. There is no evidence of a change in species composition over time—consistent across studies, freshwater game species such as smallmouth and largemouth bass, spottail shiner, redbreast sunfish, and pumpkinseed were the most prevalent species collected. In addition, as indicated by the conversations during FERC Scoping Meetings and the site visit, agency representatives with jurisdiction over the Merrimack River fisheries and the Lawrence upstream and downstream fish passage structures have a comprehensive understanding of the fish communities associated with the Project. For example, on an annual basis, representatives of the MRTC regularly visit the Project's upstream fish lift and have firsthand knowledge of the fish species that enter the lift. Furthermore, various study requests (e.g., the Fish Stranding and Predation Studies) indicate that representatives of the MRTC have a thorough understanding of the Merrimack River fishery related to the Project.

As requested by USFWS and MassWildlife, the Fish Assemblage Study is a generic request for general basic research not directly related to the Project and is not likely to inform the development of license requirements. Essex believes that available information is adequate to characterize existing fish resources, therefore, an expensive, year-long fish assemblage study over a 41-mile river reach is not necessary in support of the relicensing proceeding.

USFWS and MassWildlife generally state that hydroelectric projects have the potential to impact fish populations but only provide observations of two specific stranding events to support that claim relative to this ROR project. As such, potential Project effects are unlikely to have any measurable, causal relationship with general fish species composition. Yet, the study area defined by MassWildlife and USFWS is “delineated as habitats between the Lowell dam and the Highway 95 bridge at Salisbury Point.” This constitutes a nearly 41-mile stretch of river, most of which is outside the Project boundary, and the river reach from Haverhill downstream is tidally influenced.⁹ This extensive downstream reach has little or no nexus to Project operations. The reach below the Lowell (Pawtucket) Dam to the upstream limit of the Lawrence impoundment is entirely outside the Project boundary and is associated with the Lowell Hydroelectric Project (P-2790). The reach is completely unaffected by Lawrence Project operations.

In lieu of a generic fish assemblage study that is better suited for a river that is less understood or managed, Essex is proposing to opportunistically collect data on non-target species while collecting fish for other studies. These include an upstream anadromous fish passage assessment, an upstream American eel study, a Sturgeon Distribution and Project Interactions Study, a Diadromous Fish Behavior, Movement, and Project Interactions Study, and a Project Operations and Fish Stranding Study (See Section 6-12 below). Complementing these studies, Essex is proposing a rigorous three-

⁹ e.g., see USGS gage 01100693, Merrimack R 0.3 Miles U.S. Rt 125 at Haverhill, MA, <https://waterdata.usgs.gov/monitoring-location/01100693/#parameterCode=00065&period=P7D&showMedian=false>

dimensional CFD Modeling Study (Section 15). Combined with existing information, Essex believes these studies will be sufficient to inform FERC's Environmental Analysis, and to meaningfully inform the development of license requirements.

4.2 Fish Passage Improvement and Feasibility Assessment

USFWS, MADMF, NHFG, and MassWildlife requested a Fish Passage Improvement and Feasibility Assessment. The stated goal of this study is to utilize information acquired through the implementation of other relevant relicensing studies to assess the need and feasibility for upstream and downstream fish passage improvements at the Project. Given that the study is focused on the development of protection, mitigation, and enhancement (PM&E) measures prior to the completion of the proposed studies to determine if there is a problem, Essex is not proposing this study at this time. In addition, Essex is not proposing this study as it does not meet the following FERC study criteria:

- **Alternative methods or approaches are sufficient to meet the requestor's stated information needs (Study Criteria No. 7):** Where alternative study methods are sufficient to meet information needs, FERC's study criteria require consideration of the level effort and cost of requested studies.
- **Study request is not necessary because existing information is sufficient to answer the questions posed (Study Criteria No. 4):** Requestors should also describe why existing information is insufficient to inform the development of license requirements and/or contribute to the development of PM&E measures.

As stated by the requestors, the study as proposed largely utilizes existing information or information expected to be obtained from other relicensing studies to perform an additional assessment. The requested Fish Passage Improvement and Feasibility Study would require the results of the fish passage studies that Essex is proposing, as well as results of the CFD model, to evaluate PM&E measures and alternatives. Essex is not proposing this study at this time given that the request is to evaluate PM&E measures prior to determining which measures, if any, are warranted.

The fish passage studies Essex is proposing will evaluate the effectiveness of the existing Project passage facilities and operations. If facility enhancements for passage are needed at the Project, a review of passage alternatives may be prudent at that point. At the conclusion of the fish passage studies, Essex will summarize recommended next steps in its study report and/or in the DLA. Essex will include any proposed PM&E measures in the DLA. Such an approach is prudent, consistent with FERC precedent at other Projects, will result in targeted useful information, and will not result in delay in the overall licensing process. Additionally, stakeholders will have the opportunity to comment on any proposed PM&E measures in the DLA.

4.3 Sturgeon Distribution and Project Interaction Study

NMFS, NHFG, MassWildlife, and USFWS requested a Sturgeon Distribution and Project Interaction Study. The goal of this study is to determine if Atlantic and shortnose sturgeon are interacting with the Lawrence dam tailwater, tailrace, or project works (e.g., draft tubes) and identify potential take during Project operations. Essex is proposing the Sturgeon Distribution and Project Interaction Study, as provided for in Section 10, which includes the use of side-scan sonar over five survey events. Essex is not fully adopting this study as requested by stakeholders as it does not meet the following FERC study criteria:

- **There is no evidence of a problem or how the study would be used to inform license requirements, as well as the study request is an attempt to search for a problem (Study Criteria No. 5):** Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question and how the results of the study would be used to inform license requirements.
- **Study request is not necessary because existing information is sufficient to answer the questions posed (Study Criteria No. 4):** FERC policy and regulations state that if existing information is sufficient to understand the Project effects on the subject resource, then additional study is not needed. Requestors should also describe why existing information is insufficient to inform the development of license requirements. Study requests should demonstrate the need for additional, site-specific information for purposes other than general research.

Essex is not proposing to perform this study as requested because studies should be performed commensurate to the degree to which there is a known problem. As stated by the requestors, the lower Merrimack River has one of the smallest resident populations of sturgeon in the United States. As summarized in the PAD, Kieffer and Kynard (1993) found that spawning of shortnose sturgeon occurred from April to May at RM 19-22 (Haverhill area) and overwintering at RM 12-16 (the Amesbury area); Essex Dam is at RM 29. During those three years of tracking, Atlantic sturgeon also used the same general area. As acknowledged by the requestors, sturgeon movement in the lower Merrimack has been documented up to the I-495 Bridge in Lawrence. Additionally, despite the fish lift passing anadromous fish upriver of Essex Dam since 1983, no sturgeon have been reported entering the lift. The movements of sturgeon from their wintering to spawning and postspawning areas do not encompass the Merrimack River within the Project boundary.

NMFS, NHFG, MassWildlife, and USFWS recommend sidescan sonar surveys conducted periodically through a two-year study period from the I-495 bridge in Lawrence up to the tailrace. By their own admission they request a two-year study period “to account for the low density of sturgeon at the Project,” involving a significant amount of labor and incurring a large study cost for likely minimal information about sturgeon at the Project.

Additionally it is not clear how the Project's ROR operations would be modified under a new license based on the results of the study. As currently operated, as well as proposed in the Project's new license, the Project passes the natural river flow immediately downstream of the Project's spillway and adjacent powerhouse. Given the constant steady state of water that flows through the North and South Canals, the Project is not diverting the river's natural flows from the river reach downstream of the spillway or powerhouse. Therefore, it is not clear as to how the requested study would inform the Project's influence on any potential habitat or fish species downstream of the Project.

Essex believes their proposal in Section 10 represents a balanced effort that is appropriate for the nature and scope of potential Project effects, and to the degree to which there is a known problem.

4.4 Sturgeon Habitat Mapping and Assessment Study

NMFS and MassWildlife requested a Sturgeon Habitat Mapping and Assessment Study. The goal of this study is to map and assess sturgeon habitat affected by the Project within the Lawrence Project boundary, including the Project impoundment, and downstream reach of the Merrimack River. Requestors state that the sidescan sonar survey should cover the Merrimack River from the end of the Lowell Project Area, through the Lawrence impoundment and dam, and then the downstream reach to the upstream extent of previously mapped habitat, approximately 10.1 miles downstream. Given that sturgeon studies have already been completed in the downstream reach, as well as the Project's ROR operations, Essex is not proposing this study. Essex is proposing the Sturgeon Distribution and Project Interaction Study in Section 10, which Essex considers an appropriate level of effort commensurate with known information and the limited scope of potential Project effects. Essex is not proposing this study as it does not meet the following FERC study criteria:

- **There is no evidence of a problem/understanding of how the study would be used to inform license requirements, as well as the study request is an attempt to search for a problem or “nexus” (Study Criteria No. 5):** Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question and how the results of the study would be used to inform license requirement.
- **Study request is not necessary because existing information is sufficient to answer the questions posed (Study Criteria No. 4):** Requestors should also describe why existing information is insufficient to inform the development of license requirements. Study requests should demonstrate the need for additional, site-specific information for purposes other than general research.

Essex is not proposing to perform this study because it is an attempt to search for a problem or nexus and it is not clear how the Project's ROR operations would be modified under a new license based on the results of the study. As currently operated, as well as proposed in the Project's new license, the Project passes the natural river flow

immediately downstream of the Project's spillway and adjacent powerhouse. Given the constant steady state of water that flows through the North and South Canals, the Project is not diverting the river's natural flows from the river reach downstream of the spillway or powerhouse. Therefore, it is not clear as to how the requested study would inform the Project's influence on any potential habitat or fish species downstream of the Project.

In addition, as summarized in the PAD, Kieffer and Kynard (1993) found that spawning of shortnose sturgeon occurred from April to May at RM 19-22 (Haverhill area) and overwintering at RM 12-16 (the Amesbury area); Essex Dam is at RM 29. During those three years of tracking, Atlantic sturgeon also used the same general area. As noted by the requestors, sturgeon movement in the lower Merrimack has been documented up to the I-495 Bridge in Lawrence. Additionally, despite the fish lift passing anadromous fish upriver of Essex Dam since 1983, no sturgeon have been reported entering the lift. NMFS and MassWildlife acknowledge this point but pose, without evidence, that sturgeon could be found in other Project structures like draft tubes. The movements of sturgeon from their wintering to spawning and postspawning areas do not encompass the Project boundary—there is no nexus to the Project.

As stated by NMFS and MassWildlife, the lower Merrimack River has one of the smallest resident populations of shortnose sturgeon in the United States and the spawning population of Atlantic sturgeon has likely been extirpated from the Merrimack River. Reported detections at the I-495 Bridge are minimal; Stantec (2023) performed an acoustic tagging study with a release of 50 shortnose sturgeon below the SR 125 Bridge in Haverhill; only one individual was detected at the I-495 bridge in Lawrence in 2020, and three individuals were detected at the I-495 bridge in Lawrence in 2021. Essex is not aware of any other reported detections at the I-495 bridge. According to the MRTC's 2021 *Merrimack River Watershed Comprehensive Plan for Diadromous Fishes* (MRTC 2021), the Merrimack River is also not an immediate priority for the restoration of sturgeon, stating "*these fish have not passed the lift at Essex Dam, and as such, the goals for their restoration do not include habitat above the Essex Dam.*"

NMFS and MassWildlife justify a sturgeon habitat mapping analysis encompassing the Project boundary, and ten miles downstream of the Project dam, based on speculation that an upstream shift of overwintering habitat is occurring. NMFS and MassWildlife compared the results of Stantec 2023 and Kieffer and Kynard 1993 and highlight the difference of a few kilometers of mapped overwintering habitat between the two studies. Essex reviewed both studies and notes that Stantec did not definitively confirm sturgeon overwintering habitat upriver to river kilometer 28 (RM 17), which is cited in the report as the professional opinion of Micah Kieffer, however no studies supporting that opinion are cited. The results of the Stantec report indicated fewer sturgeon near the western (upstream) portion of Hale's Island in Haverhill, with most sturgeon aggregations around the central and eastern portions of Hale's Island, which is over ten miles downriver from the Project dam and within the tidal portion of the Merrimack River. As stated above, it is not enough to speculate that a problem may exist or that the "evidence" of a problem is simply based on a "*prediction based on opinions.*" Applicable to this study request is the *Centralia* decision (*City of Centralia v FERC*, 213 F.3d 742, 749 (D.C Cir., 2000)) where the Court of Appeals held that while "*FERC is certainly empowered to require an*

applicant to conduct a study when there is some evidence of a problem and a study is necessary to determine the extent of the harm,” an applicant does not have “a duty to determine if a problem exists.”

4.5 Climate Related Project Impacts on Shortnose Sturgeon Habitat

NMFS requested a Climate Related Project Impacts on Shortnose Sturgeon Habitat Study and MassWildlife requested a Project Impacts on Sturgeon Spawning and Rearing Habitat from Future Conditions Study. The stated goal of this study is to determine the risks of increased Project effects (e.g., habitat degradation and contraction) during the course of the new license on shortnose sturgeon overwintering, spawning, and rearing habitat downstream of the Project due to saltwater intrusion, altered temperature regime, and changing hydrology in the Merrimack River. Essex is not proposing this study as it does not meet the following FERC study criteria:

- **Study request constitutes basic research/there is no evidence of a problem or how the study would be used to inform license requirements (Study Criteria No. 5):** Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question. This “nexus” between the Project’s operation and a resource impact must be supported by some evidence of a specific resource impact, not just a belief that an impact might be occurring. That is, study requests on matters outside of Essex’s direct control or are based on speculation are deemed not appropriate for study.

In addition to Essex’s responses to the Sturgeon Habitat Mapping and Assessment Study and the Sturgeon Distribution and Project Interaction Study, Essex is not proposing an evaluation of the potential impact of climate change on sturgeon at the Project. While Essex acknowledges the importance of climate change, it is unclear how such a hypothetical analysis would inform license conditions for this ROR Project. Potential climate and hydrologic changes that may occur over the course of a 30- to 50-year license are far too speculative to allow for a quantitative evaluation as requested. The state of the science is such that climate change forecasts do not exist that could reliably predict how precipitation, saltwater intrusion, snowmelt, evapotranspiration, ice out, and annual runoff patterns may change 30 to 50 years from now. As indicated in a recent (November 3, 2021) determination¹⁰ issued in response to a requested study, FERC determined that given the level of uncertainty that would need to be accepted with the requested study, it would not substantially contribute to an understanding of ecological processes related to anadromous fish in Project waters.

Therefore, analyzing information from general climate research and modeling is not being proposed. Essex is not aware of any available climate change model or assessment that would support, with any degree of accuracy and reliability, prediction of

¹⁰ Merced River Hydroelectric Project (FERC No. 2179) and the Merced Falls Hydroelectric Project (FERC No. 2467). See [FERC Accession 20211103-3003](#).

saltwater intrusion, altered temperature regime, or changing hydrology at the individual project level. Requestors point to use of a Merrimack River model to analyze tidally-varying circulation, stratification, and salt flux mechanisms of the shallow salt wedge in the Merrimack River estuary, located at RM 10 to 12. For context, the Essex Dam is at RM 29, nearly 17 upstream from the location of the salt wedge. There is no evidence that the salt wedge would migrate inland 17 miles; in fact, a report by Alexander Kirshen et al., (2023) indicates the Plymouth, Massachusetts coastal aquifer is only predicted to migrate 0.3 miles inland (100 to 500 meters) under a high sea-level scenario. As discussed in the PSP, climate change forecasts are unreliable for studying evolving climate processes on a regional or local scale. Current climate change models display inconsistencies between observed regional variations and modeled trends (Jain S., et al, 2023). Regardless of how the interval is described, as either “remote in time” or “within the temporal scope”, regional climate variability is largely uncertain and outside of the range of current projections and therefore, incapable of accurately predicting future conditions on a local scale.

Additionally, as FERC notes in a 2023¹¹ issuance, assessing future potential regional conditions outside of the area impacted by the Project would be unrelated to Project effects, speculative, and beyond the scope of the environmental analysis. Further, while climate model projections may capture aspects of future climate scenarios, it is not clear how these models could guide management decisions at the Project level and inform license conditions because the level of uncertainty precludes the identification and development of specific requirements that could mitigate potential future effects of various climate patterns.

FERC indicated that the current guidance from the Council on Environmental Quality (2016) states that, *“in accordance with NEPA’s rule of reason and standards for obtaining information regarding reasonably foreseeable effects on the human environment, agencies need not undertake new research or analysis of potential climate change impacts in the proposed action area but may instead summarize and incorporate by reference the relevant scientific literature.”*

The NEPA defines “effects” as changes to the human environment from the proposed action that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action. Effects should generally not be considered if they are remote in time (such as this request), geographically remote, or the product of a lengthy causal chain. FERC precedent uniformly maintains that climate change studies are not needed in hydropower licensing proceedings. FERC has acknowledged that climate change is a complex issue, but under NEPA and Council on Environmental Quality regulations, it is afforded discretion based on its expertise and experience to determine the scope of an environmental analysis based on available information. FERC has determined that climate change studies are not likely to yield reliable data that can be used to develop

¹¹ See [FERC Accession 20231120-3040](#).

license requirements. In a recent (August 2021) EA¹², in response to a request for impacts on American shad and river herring due to climate change, FERC indicated that *“we cannot predict whether and to what extent climate change could affect species with sufficient precision to identify and evaluate today any operational changes that could protect fish from future climate change effects.”*

Additionally, FERC typically includes standard license articles in licenses which provide the means for the license to be modified in the future. However, to the extent that the upstream and downstream migrations periods change for eels or anadromous fish, Interior’s preliminary prescription allows Interior to change the prescribed fish passage operating periods based on new information, evaluation of new literature, and agency consultation.

4.6 Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem

MassWildlife and TNC requested an Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem. The stated goal of this study is to identify and evaluate alternatives, including modifications to the current project, to minimize project impacts and benefit the resilience of the local community and Merrimack River ecosystem. Essex is not proposing this study as it does not meet the following FERC study criteria:

- **Study request provides no evidence of a problem or how the study would be used to inform license requirements, as well as the study request is an attempt to search for a problem or “nexus” (Study Criteria No. 5):** Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question. This “nexus” between the Project’s operation and a resource impact must be supported by some evidence of a specific resource impact, not just a belief that an impact might be occurring. That is, study requests regarding matters outside of Essex’s direct control or which are based on speculation are deemed not appropriate for study.
- **Study request does not propose a specific methodology, proposes a methodology that is untried or uncertain, or proposed a methodology that will not meet the stated objective or yield the intended results (Study Criteria No 6):** The study request does not provide a methodology. The Commission cannot require a study that lacks definition and methodology to perform the study.

As proposed by MassWildlife and TNC, this study would evaluate Project alternatives such as in-stream turbines, canal turbines, integrated solar, flood risk analysis, and economic benefits to the community and ecosystem. The methodology includes a Phase

¹² See [FERC Accession 20210823-3025](#).

1 qualitative analysis of factors such as alternatives, brown-outs, energy costs, community benefits, nutrient cycling and estimated generation and revenue. Phase 2 would be a quantitative analysis of such factors. As noted above, it is unclear how such a hypothetical analysis would inform license conditions. Potential climate changes that may occur over the course of a 30- to 50-year license are far too speculative to allow for a qualitative or quantitative evaluation as requested. The methodology proposed is not rigorous or well-defined, and it is not clear how certain factors like nutrient cycling, brown-outs, and energy market predictions have any nexus to the Project or Project operations. The study request would require Essex to conduct studies on effects caused by other factors over which the licensee has no control (e.g. brown-outs) and is, therefore, contrary to FERC's guidance (FERC 2012).

Additionally, as FERC notes in a 2023¹³ issuance, assessing future potential regional conditions outside of the area impacted by the Project would be unrelated to Project effects, speculative, and beyond the scope of the environmental analysis. Further, while climate model projections may capture aspects of future climate scenarios, it is not clear how these models could guide management decisions at the project level and inform license conditions because the level of uncertainty precludes the identification and development of specific requirements that could mitigate potential future effects of various climate patterns. As discussed in the PSP, climate change forecasts are unreliable for studying quickly evolving climate processes on a regional or local scale. Current climate change models display inconsistencies between observed regional variations and modeled trends (Jain S., et al, 2023). Regardless of how the interval is described, as either "remote in time" or "within the temporal scope", regional climate variability is largely uncertain and outside of the range of current projections and therefore, incapable of accurately predicting future conditions on a local scale.

Regarding requestors attempt to link this study to the structural integrity of Project infrastructure, as noted in the Commission's SD2, the Project is subject to Part 12 of the Commission's regulations (Safety of Water Power Projects and Project Works) under the current license. Part 12 requires, among other things, periodic operational inspections by Commission staff focusing on the continued safety of the structures. Projects that are subject to Part 12 must also be inspected and evaluated every 5 years by an independent consultant and a consultant's safety report must be submitted for Commission review.

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

¹³ See [FERC Accession 20231120-3040](#).

Furthermore, it appears that the intent of the study request is to replace the existing Project with various alternative sources of electricity, either through Project modifications, the deployment of “innovative” technologies, or through additional hydropower development via competing for Project waters. Essex questions how such a study is applicable to the Commission’s relicensing process. Essex believes that if there are parties interested in such future development, FERC’s preliminary permit and/or Declaration of Intent processes would be the applicable forum to pursue such Projects. Essex is not proposing to add capacity within the North or South Canals, deploy in-stream turbines, or install additional renewable energy resources within the Project boundary at this time.

The fight against climate change amplifies the importance of ensuring that this relicensing proceeding does not result in a reduction of the Project’s ability to produce clean, renewable energy. Every bit of renewable energy matters, and Essex’s interests align with the fact that the clean, renewable energy afforded by the Project is indeed significant. Hydropower remains a highly beneficial clean and renewable energy source. This is borne out in the 2016 U.S. Department of Energy Hydropower Vision Report, which states “*Hydropower has provided clean, affordable, reliable and renewable electricity in the United States for more than a century.*”

4.7 Evaluation of Potential Project Impacts on the Merrimack River and Floodplain Habitats throughout the Term of a New License

MassWildlife and TNC requested an Evaluation of Potential Project Impacts on the Merrimack River and Floodplain Habitats throughout the Term of a New License. The goal of this study is to assess Project effects on hydrology, hydraulics and associated ecosystem components and functions, evaluate potential impacts of project infrastructure and operations on floodplain connectivity, as well as related effects on the local community. As a goal of this study, all the components would be evaluated both under current conditions and future climate change projections. Essex is not proposing this study as it does not meet the following FERC study criteria:

- **Study request constitutes basic research/there is no evidence of a problem or how the study would be used to inform license requirements (Study Criteria No. 5):** Study request constitutes basic research and/or is not likely to inform the development of license conditions. Study requests should demonstrate the need for additional, site-specific information for purposes other than general research.
- **Study request does not propose a specific methodology, proposes a methodology that is untried or uncertain, or proposed a methodology that will not meet the stated objective or yield the intended results (Study Criteria No 6):** The study request does not provide a methodology. The Commission cannot require a study that lacks definition and methodology to perform the study.

The study as proposed generally incorporates sediment sampling and transport analysis, water quality analysis (temperature and NH₃, NH₄⁺, NO₃⁻, PO₄⁻³), an instream flow study, and a flood risk analysis and mapping. The study requests that these evaluations be performed under both current conditions and future climate change projections. Consistent with the responses provided in 4.5 and 4.6 Essex is not proposing to conduct this study. In addition, Essex is not proposing to perform this study because it is not clear how the Project's ROR operations would be modified under a new license based on the results of the study. As currently operated, as well as proposed in the Project's new license, the Project passes the natural river flow immediately downstream of the Project's spillway and adjacent powerhouse. Given the constant steady state of water that flows through the North and South Canals, the Project is not diverting the river's natural flows from the river reach downstream of the spillway or powerhouse. Furthermore, given the Project's crest gate system and ROR operations, the Project's impoundment is held at a constant elevation on an annual basis. Therefore, it is not clear as to how the requested study would inform the Project's influence on any Merrimack River or floodplain habitats. FERC has consistently determined that they cannot mitigate for Project effects that do not exist today, and are only speculated to exist in the future.

While Essex acknowledges the importance of climate change, it is unclear how such a hypothetical analysis would inform license conditions for this ROR Project. Potential climate and hydrologic changes that may occur over the course of a 30- to 50-year license are far too speculative to allow for a quantitative evaluation as requested. The state of the science is such that climate change forecasts do not exist that could reliably predict how precipitation, snowmelt, evapotranspiration, ice out, and annual runoff patterns may change 30 to 50 years from now. As already noted, the NEPA defines "effects" as changes to the human environment from the proposed action that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action. Effects should generally not be considered if they are remote in time (such as this request), geographically remote, or the product of a lengthy causal chain. FERC precedent uniformly maintains that climate change studies are not needed in hydropower licensing proceedings. FERC has acknowledged that climate change is a complex issue, but under NEPA and Council on Environmental Quality regulations, it is afforded discretion based on its expertise and experience to determine the scope of an environmental analysis based on available information. FERC has determined that climate change studies are not likely to yield reliable data that can be used to develop license requirements.

Additionally, as FERC notes in a 2023¹⁴ issuance, assessing future potential regional conditions outside of the area impacted by the Project would be unrelated to Project effects, speculative, and beyond the scope of the environmental analysis. Further, while climate model projections may capture aspects of future climate scenarios, it is not clear how these models could guide management decisions at the project level and inform license conditions because the level of uncertainty precludes the identification and development of specific requirements that could mitigate potential future effects of

¹⁴ See [FERC Accession 20231120-3040](#).

various climate patterns. As discussed in the PSP, climate change forecasts are unreliable for studying quickly evolving climate processes on a regional or local scale. Current climate change models display inconsistencies between observed regional variations and modeled trends (Jain S., et al, 2023). Regardless of how the interval is described, as either “remote in time” or “within the temporal scope”, regional climate variability is largely uncertain and outside of the range of current projections and therefore, incapable of accurately predicting future conditions on a local scale.

Regarding requestors attempt to link this study to the structural integrity of Project infrastructure, as noted in the Commission’s SD2, the Project is subject to Part 12 of the Commission’s regulations (Safety of Water Power Projects and Project Works) under the current license. Part 12 requires, among other things, periodic operational inspections by Commission staff focusing on the continued safety of the structures. Projects that are subject to Part 12 must also be inspected and evaluated every 5 years by an independent consultant and a consultant’s safety report must be submitted for Commission review.

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

4.8 Water Quality Study

MADEP and FERC requested a water quality study with the goal to understand current water quality conditions and assess any effects of Project operations. As noted in Section 14, Essex is proposing the water quality recommended by FERC. Although Essex is not proposing the full water quality study as proposed by MADEP, certain elements from the MADEP request have been incorporated into the proposed water quality plan based on meetings between MADEP staff and the Licensee on April 3 and 5, 2024. Essex believes that the proposed study is directly applicable to the Project’s operations and will provide the necessary information to inform the issuance of the Project’s new license and associated 401 Water Quality Certificate. Essex is not proposing MADEP’s full proposed study because it does not meet the following FERC criteria:

- **Study request is not necessary because the study request constitutes basic research (Study Criteria Nos. 4 and 5):** Study requests should demonstrate the need for additional, site-specific information for purposes other than general research. Requestors should also describe why existing information is insufficient to inform the development of license requirements and/or contribute to the development of PM&E measures.

MADEP requests that a Quality Assurance & Performance Plan (QAPP) be submitted to the MADEP incorporating various parameters including phytoplankton samples, algae, sediment sampling, and toxicants. MADEP does not provide any evidence or present a problem with any of these parameters within or downstream of the Project boundary, and thus, the study request appears to be a request for basic research. The Project is operated as ROR with no bypassed reach, meaning inflows to the Lawrence Project match outflows below the Project. In addition, given the seasonal and annual flows of the Merrimack River, the residence time of water flowing through the Project and its impoundment is limited.

As such, potential Project effects are unlikely to have any measurable, causal relationship with parameters such as phytoplankton, attached algae (periphyton), and *Escherichia coli* (*E. coli*). The Project is not responsible for the presence of any polychlorinated biphenyls (PCBs), heavy metals, polycyclic aromatic hydrocarbons (PAHs), cyanotoxins, or pesticides in the impounded area or in fish tissue. Essex does not have a duty to study a problem based on speculation. As such, there is no nexus to Project operations and this type of study would not “inform the development of license requirements,” as required by FERC’s ILP regulations. As FERC has recognized in other contexts, since Essex is not responsible for the presence of these substances and has no ability to mitigate effects of these substances, this type of study would not inform this relicensing proceeding.

Although the Project is operated on a ROR basis with a limited residence time for water passing through the project, Essex is proposing a water quality study with a focus on dissolved oxygen, water temperature, and pH under various river flows, river temperatures, and Project operating conditions to determine the spatial and temporal effects of project operations on water quality. Essex’s proposed study is consistent with the study recommended by FERC. Essex believes this study will be sufficient to inform the Commission’s Environmental Analysis and the MADEP’s issuance of the Project’s new Section 401 Water Quality Certificate.

4.9 State-listed Odonates and Assemblage Study

MassWildlife requested a study of State-Listed Odonates, Baseline Data Collection, and Assessment of Operational Impacts. The goal of this study is to characterize the emerging rare riverine odonate (dragonflies and damselflies) assemblage and its habitat within the affected Project area and assess the Project’s potential impact. Essex is proposing certain PM&Es, as described below, but Essex believes this request does not meet the Commission’s Study Criteria for the following reason:

- **Study request is not necessary because the study request constitutes basic research (Study Criteria Nos. 4 and 5):** Study requests should demonstrate the need for additional, site-specific information for purposes other than general research. Requestors should also describe why existing information is insufficient to inform the development of license requirements and/or contribute to the development of PM&E measures.

Essex is not aware of an identified, site-specific problem with odonate (dragonflies and damselflies) populations and Project effects. The Project currently and as proposed operates as ROR with no bypassed reach, meaning inflows to the Lawrence Project match outflows below the Project. As described in the PAD, impoundment water elevations are maintained at the normal pond elevation of 44.2 ft NGVD. The discharge, water levels, and rate of water level change are dependent on natural incoming Merrimack River flows. The Project is limited to operating in a ROR mode by reacting to and passing inflows, therefore the Project is not fluctuating its upstream impoundment (e.g., store and release or peaking operations) resulting in water elevation changes that may affect potential odonates. As stated above, it is not enough to speculate that a problem may exist or that the “*evidence*” of a problem is simply based on a “*prediction based on opinions*.” Therefore, given the Project’s current and proposed operations, Essex views this study as general research as compared to a study to measure the direct impact of project operations on a known resource.

However, as discussed during the PSP meetings, Essex is proposing to provide PM&E measures to mitigate any potential Project impacts to odonates during occasional unit trips and Project maintenance activities. As discussed during the PSP meeting and in later consultation meetings, stakeholders are concerned with water level fluctuations and odonate populations downstream of the Project. Essex proposes to connect their crest gate system with their turbine units so that when the units trip offline, the crest gate lowers to release flows over the dam. This eliminates delay between flows downstream and turbine shut off, and minimizes the effects of the units tripping offline by maintaining water levels downstream below the dam. With this PM&E, potential Project impacts to odonate larvae or nymphs downstream are likely mitigated. Additionally, stakeholders raised the concern of Project impoundment drawdowns. Essex anticipates developing a PM&E to limit any drawdowns during the listed odonate (dragonfly) egg-laying season. The details of these PM&Es to protect and mitigate any potential Project impacts to odonates will be further refined in the DLA.

4.10 Invasive Plant Baseline Survey

USFWS and MassWildlife requested Invasive Plant Baseline Study. The stated goals of the study are to: (a) characterize and describe the invasive plant species associated with the Project and its area of effect; and (b) determine if and how the Project may be affecting and/or contributing to the establishment and spread of new or existing invasive plant species. Essex believes this request does not meet the Commission’s Study Criteria for the following reasons:

- **There is no evidence of a problem and/or the study request is an attempt to search for a problem or “nexus” (Study Criteria No. 5):** Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question.

Essex is performing three vegetation surveys of the North and South Canals as part of the Recreation Facilities, Use, and Aesthetics Study (Section 16). During these

surveys, Essex will record and map readily identifiable invasive species. However Essex is not adopting this study as requested by stakeholders. Requestors note that more information is needed to understand invasive species in the Project area. However, the presence of invasive species change is a likely result of factors unrelated to the operation of the Project. Performing an invasive plant species survey at the Project as requested is not justified, as it would only represent a snapshot in time and would not be useful for informing conditions associated with normal operations. There are many pathways related to propagation of invasive plant species, such as aquatic recreation (e.g., fishing and boating), land clearing or planting, agricultural activities in the basin, wildlife movement, and flows originating upstream from the Project that can carry invasive species into the reservoir. Essex's ability to control these pathways is limited, and many of the pathways that contribute to the propagation of invasive plant species are unrelated to Project operations or maintenance. As noted in the Commission's AIR, Essex will describe any current or proposed measures used to control non-native, invasive plant species within the Project boundary in the DLA.

The Project currently and as proposed operates as ROR with no bypassed reach, meaning inflows to the Lawrence Project match outflows below the Project. As described in the PAD, impoundment water elevations are maintained at the normal pond elevation of 44.2 ft NGVD. The discharge, water levels, and rate of water level change are dependent on natural incoming Merrimack River flows. The Project is limited to operating in a ROR mode by reacting to and passing inflows. As stated above, it is not enough to speculate that a problem may exist or that the "evidence" of a problem is simply based on a "prediction based on opinions." Applicable to this study request is the Centralia decision (*City of Centralia v FERC*, 213 F.3d 742, 749 (D.C. Cir., 2000)) where the Court of Appeals held that while "*FERC is certainly empowered to require an applicant to conduct a study when there is some evidence of a problem and a study is necessary to determine the extent of the harm,*" an applicant does not have "*a duty to determine if a problem exists.*" Therefore, given the Project's current and proposed operations, Essex views this study for an invasive plant survey as general research as compared to a study to measure the direct impact of Project operations on a known resource.

4.11 CSO and Drinking Water Intake Interactions within Project Area

The MRWC requested a Combined Sewer Overflow (CSO) and Drinking Water Intake interactions within Project Area Study. The goal of this study is to discover how water quality is impacted by CSOs within the Project area and how that affects drinking water treatment for communities withdrawing water from the reservoir and recreational opportunities within the Project area. Essex is not proposing this study because it does not meet the following FERC criteria:

- **There is no evidence of a problem and/or the study request is an attempt to search for a problem or "nexus" (Study Criteria No. 5):** Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question.

- **Study request does not propose a specific methodology, proposes a methodology that is untried or uncertain, or proposed a methodology that will not meet the stated objective or yield the intended results (Study Criteria No 6):** The study request does not provide a methodology. The Commission cannot require a study that lacks definition and methodology to perform the study.

MRWC does not provide any factual evidence that Essex's operations have any effect on water quality or CSOs discharges, and thus, the study request appears to be a search for a Project nexus. The Project is operated as ROR with no bypassed reach, meaning inflows to the Lawrence Project match outflows below the Project. In addition, given the seasonal and annual flows of the Merrimack River, the residence time of water flowing through the Project and its impoundment is limited, which is entirely driven by inflow received from upstream. Essex believes the study request is too broad and uses an undefined methodology that is not likely to provide meaningful results. CSO infrastructure and drinking water intakes are outside of Essex's control, and as such, potential Project effects are unlikely to have any measurable, causal relationship with CSOs impacts, and such a study would not inform the development of license requirements.

Essex is proposing a water quality study with a focus on dissolved oxygen, water temperature, and pH under various river flows, river temperatures, and Project operating conditions to determine the spatial and temporal effects of Project operations on water quality. Essex's proposed study is consistent with the study recommended by FERC. Essex believes this study will be sufficient to inform the Commission's Environmental Analysis and the MADEP's issuance of the Project's new Section 401 Water Quality Certificate.

4.12 Fish Stranding and Ramping Rate Study

MADMF, NHFG, MassWildlife, and USFWS requested a Fish Stranding and Ramping Rate Study. The goal of the study is to provide information on fish stranding at the Project as it relates to the Project's facilities and operation and maintenance. As noted below in Section 9, Essex proposes to adopt Phase 1 – Task 1: Operational Data review of the study request. Essex is also adopting Phase 2 of the requested study, which is an evaluation of the results of Phase 1 and the results of the Three-Dimensional Computational Fluid Dynamics Modeling study. Essex believes this approach is sufficient to understanding effects of Project operations on potential fish stranding below the Project dam. Essex is not proposing to perform Phase 1 Task 2: Field Surveys because it does not meet the following FERC criteria:

- **Study request does not propose a specific methodology, proposes a methodology that is untried or uncertain, or proposed a methodology that will not meet the stated objective or yield the intended results (Study Criteria No 6):** The study request does not provide a methodology. The Commission cannot require a study that lacks definition and methodology to perform the study.

- **Alternative methods or approaches are sufficient to meet the requestor’s stated information needs (Study Criteria No. 7):** Where alternative study methods are sufficient to meet information needs, FERC’s study criteria require consideration of the level effort and cost of requested studies.

As stated by the requestors, Phase 1 Task 2 requires that Essex perform field surveys of potential stranding sites below the Essex Dam immediately following operational changes including “turbine outages, rapid increases in generation, transition from 1 to 2 turbines, rate of crestgate inflation, transition of spill between crestgates, or any operational changes.” During these surveys Essex would document the number, location, and species of fish stranded following these operational events. The methodology is fairly broad—it is not clear what is considered an operational change that triggers the need for a field survey, and requestors do not identify a seasonal timeframe or geographic extent of the surveys. As requested, the study methods assume fish stranding events would occur under any or all of these conditions even though only two stranding events (2019 and 2023) have been identified at the Project. Essex does not believe these extensive surveys would be productive. These surveys also pose an unacceptable level of risk as it would entail persons going below the dam during adverse conditions (e.g. increased spill, night) for likely limited to no information.

As noted below in Section 12, Based on conversations with the MRTC, Essex understands that the primary areas of concern for potential stranding sites are located below the dam at rock outcrops on either side of the dam (left and right abutments). Essex is proposing to use existing aerial imagery, in combination with collected imagery, to identify potential fish stranding sites further downstream below the Essex dam. Essex anticipates installing trail cameras at a location on either side of the dam to capture hourly photographs of the areas over an extended period of time. Essex anticipates consulting with the MRTC following issuance of the SPD on the location of the trail cameras as well as the period of record for installation.

Additionally, in conversations with the MRTC and review of comment letters, there is interest in capturing information regarding the operation of the crest gates. As discussed during the PSP meeting and in later consultation meetings, Essex proposes to connect the crest gate system with the turbine units so that when the units trip offline, the crest gate lowers to release an equivalent amount of flow over the dam. This eliminates delay between flows downstream and turbine shut off, and minimizes the effects of the units tripping offline by maintaining water levels downstream below the dam. With this PM&E, potential Project impacts to fish below the dam are likely mitigated.

The study as proposed by Essex will provide sufficient information on fish stranding at the Project as it relates to the Project’s facilities and operation and maintenance. Essex is adopting Phase 1: Task 1 and Phase 2 of this study as requested by MADMF, NHFG, MassWildlife, and USFWS. Essex is proposing to review Project operations from 2019-2023 to determine the conditions of the 2019 and 2023 stranding events. Documenting the location of potential stranding areas and understanding Project events that led to known stranding events represents a logical first step in assessing the resource issue and potential effects of Project operations. Essex will summarize recommended next

steps in its study report or in the DLA. Such an approach is prudent, consistent with FERC precedent at other Projects, will result in targeted useful information, and will not result in delay in the overall licensing process.

4.13 Upstream Anadromous Fish Passage Assessment

NMFS, USFWS, MADMF, MassWildlife, and NHFG requested formal study requests related to the evaluation of upstream passage effectiveness for migratory fish species. As presented in Section 6 below, Essex is proposing an Upstream Anadromous Fish Passage Assessment. However, Essex is not proposing to evaluate sea lamprey because that part of the study request does not meet the following FERC study criteria:

- **There is no evidence of a problem or how the study would be used to inform license requirements, as well as the study request is an attempt to search for a problem or “nexus” (Study Criteria No. 5):** Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question and how the results of the study would be used to inform license requirements.

Essex does not propose to evaluate the effectiveness of the existing upstream fish passage facilities for sea lamprey as it is not clear how this evaluation would inform license requirements. Unlike alosines, there is no upstream effectiveness goal established for sea lamprey in the 2021 *Merrimack River Watershed Comprehensive Plan for Diadromous Fishes* (MRTC 2021). Upstream at the Lowell Project (P-2790), sea lamprey were omitted from fishway effectiveness testing in the August 12, 2022 Settlement Agreement for Fish Passage “given a lack of available existing information to evaluate and assess passage efficiencies for sea lamprey.” Sea lamprey passed and/or identified at the Project have been in relatively low abundance. As such, the level of effort and additional expense required to complete this portion of the requested study is not commensurate with the number of sea lamprey potentially available for upstream passage. It is not clear how the Project’s license would be modified based on results of an evaluation of sea lamprey.

5 Study Reports and Progress Reports

Essex expects to report on the progress and results of studies within the framework afforded by the ISR and associated ISR Meeting as well as the USR and associated USR Meeting. Based on exact timing of completion of work for each study, Essex may issue draft products between the ISR and USR to the extent practicable. At this time, Essex is proposing to file technical study reports with the Commission and to provide stakeholders access to the study reports consistent with the schedule presented in Table 5-1. Essex notes that adverse weather conditions or other circumstances may necessitate modifications to this schedule. As necessary, Essex will update stakeholders of changes in the schedule in quarterly study progress reports.

Table 5-1. Preliminary Schedule for Study Reporting

Study	Anticipated Date of Final Study Report
1. Upstream Anadromous Fish Passage Assessment	April 26, 2026 (Concurrent with USR)
2. Upstream American Eel Passage Assessment	April 26, 2026 (Concurrent with USR)
3. American Eel Upstream Passage Siting Study	April 26, 2026 (Concurrent with USR)
4. Desktop Entrainment, Impingement, and Turbine Passage Survival Study	April 26, 2026 (Concurrent with USR)
5. Sturgeon Distribution and Project Interaction Study	April 26, 2026 (Concurrent with USR)
6. Diadromous Fish Behavior, Movement, and Project Interaction Study	April 26, 2026 (Concurrent with USR)
7. Project Operations and Fish Stranding Study	April 26, 2026 (Concurrent with USR)
8. Freshwater Mussel Habitat Assessment and Survey	April 26, 2025 (Concurrent with ISR)
9. Water Quality Study	April 26, 2026 (Concurrent with USR)
10. Three-Dimensional Computational Fluid Dynamics (CFD) Modeling	April 26, 2025 (Concurrent with ISR)
11. Recreation Facilities, Use, and Aesthetics Study	April 26, 2026 (Concurrent with USR)
12. Historically Significant Waterpower Equipment Study	April 26, 2025 (Concurrent with ISR)
13. Condition Assessment of Historic Properties and Associated Canal System	April 26, 2025 (Concurrent with ISR)

6 Upstream Anadromous Fish Passage Assessment

6.1 Study Requests

Essex filed a PAD with the Commission on June 16, 2023 and the PSP on November 28, 2023. The Commission’s August 15, 2023 SD1 and November 28, 2023 SD2 identified a variety of aquatic resource issues to be analyzed in the EA for the Project relicensing.

The Commission, NMFS, USFWS, MADMF, MassWildlife, and NHFG subsequently submitted formal study requests related to the evaluation of upstream passage effectiveness for migratory fish species, as shown in Table 6-1. In response to these study requests, Essex is proposing this study.

Table 6-1. Upstream Fish Passage Study Requests

Requestor	Requested Study	Date
FERC	Upstream and Downstream Adult Alosine Passage Assessment (FERC Letter Request No. 5)	October 13, 2023
NMFS	Upstream Anadromous Fish Passage Assessment (NMFS Letter Request No. 7)	October 16, 2023
USFWS	Upstream Anadromous Fish Passage Assessment (USFWS Letter Request No. 2)	October 16, 2023
MADMF	Upstream Anadromous Fish Passage Assessment (MA DMF Letter Request No. 4)	October 13, 2023
MassWildlife	Upstream Anadromous Fish Passage Assessment (MassWildlife Letter Request No. 14)	October 16, 2023
NHFG	Upstream Anadromous Fish Passage Assessment (NHFG Letter Request No. 2)	October 16, 2023

6.2 Goals and Objectives

The goal of the Upstream Anadromous Fish Passage Assessment is to determine the impact of the Lawrence Project on the upstream migration of anadromous adult alosines. Following receipt of comments on the PSP and additional consultation with the resource agencies, this evaluation will focus on the American shad (*Alosa sapidissima*). The specific objectives of this study are as follows:

- Determine approach of upstream migrating American shad from the downstream release location towards the Project fishway under a range of operational/river conditions.
- Determine tailrace residence duration of upstream migrating American shad following arrival downstream of the Project.

- Estimate the nearfield attraction efficiency, entrance efficiency, internal efficiency, and overall efficiency of the existing upstream fish lift under a range of operational/river conditions and with both entrances in the open position.
- Inform on fish lift entry (i.e., frequency, timing, and location of entry events).

6.3 Study Area

The study area includes the mainstem Merrimack River from the Project impoundment to the Haverhill Riverside Park (approximately 6.6 miles downstream of Essex Dam).

6.4 Background and Existing Information

A listing of fish passage studies specific to the Lawrence Project and highlighting the objectives and key findings of each is presented as Table 5.4-3 of the PAD. Assessments of the existing upstream fish lift were limited to two semi-quantitative evaluations of shad passage conducted using underwater videography. Observations made during the two previous evaluations (conducted 1993 and 1996) led to the closure of the "street side" (river right) entrance to the fish lift, and the lift has been operated using only the "river side" (river left) entrance since that time. In consultation with the MRTC, the Licensee has recently re-activated the street-side entrance, which is planned to be fully operational during the 2024 passage season. The study proposed herein will be performed with both fishway entrances opened.

6.5 Project Nexus

The diadromous species identified in this plan are known to migrate within the Merrimack River to points upstream of Lawrence and as a result, the potential exists for Project operations to create delays or prevent upstream passage. Data collected as a part of this study will provide information to conduct an analysis of the Project's effects on the anadromous species and their upstream migration.

6.6 Methodology

The state and federal resource agencies requested the use of a telemetry-based assessment to inform on approach, delay, and passage effectiveness at Lawrence. This Upstream Anadromous Fish Passage Assessment will utilize radio telemetry to address the stated objectives.

6.6.1 Sample Size

An adequate sample size will be essential to meet the objectives of this study. Telemetry studies to address upstream passage must consider multiple factors including handling and transportation effects, fish condition, regurgitation of transmitters as well as site-specific factors such as rates of movement from the release location and losses to predation of fish approaching upstream passage structures. These factors can all

increase the number of test fish required but also must be weighed against the functional limitations of effectively monitoring large numbers of fish within any one detection zone due to collisions among tag signals.

To address these concerns, Essex conducted a minimum sample size analysis to calculate the number of tagged American shad at the Project based on achieving a combined test significance level of 10% and power level of 90% (where $\beta=10\%$) for the following two-sided hypothesis statement:

- H0: Passage rate for sample reaching the (near field attraction zone) = $P_0=20\%$
- H1: Passage rate for sample reaching the (near field attraction zone) = $P_1 \neq 20\%$

Quantitative studies to address upstream passage rates for American shad downstream of Lawrence have not been conducted to date. However, a species restoration study review by Hare et al. (2021) included references to rates of 20% for non-salmonids passing through fishway structures. This estimate was selected as a starting point for the calculation of the minimum sample size. The same study shared that a greater than 70% passage rate is required to maintain high rates of survival.

For the hypothesis test, two types of common errors can occur, Type I and Type II. A Type I error is represented by the value of alpha. The Type I error measures the probability of rejecting the null hypothesis in favor of the alternative even though the null hypothesis is true. A Type II error is represented by beta. It represents the probability of incorrectly not rejecting the null hypothesis even though the alternative hypothesis is true. The complement of that probability (1-beta) is termed the power of the test. The higher the power, the more evidence a researcher has that the sample can correctly detect the alternative hypothesis when the alternative is true.

For the purposes of this analysis, Essex tested a range of hypotheses as the true passage rate could be 5%, 10%, 40% or potentially 80%. Different alpha levels of 5%, 10% and 20% and different minimum sample sizes of 100, 150, 200 and 300 were explored to understand how power levels changed.

The standard for establishing minimum sample size requirements in many medical or ecological studies is to set alpha to 5% and the power to 80% (i.e., $\beta=0.20$). This is termed the five-eighty convention (De Stefano, 2003). However, this convention implies that the cost of the Type 1 error is four times more than the cost of making a Type II error without having a logical basis for these error probabilities.

Since the true passage rate at Lawrence is unknown and a reasonable estimate based on publicly available fish science studies was selected, the Type I error for incorrectly rejecting the null hypothesis of a 20% passage rate need not have an alpha of as low as 5% or as high as 20%. Setting alpha at 10% provides an acceptable risk for rejecting the null hypothesis when it is true while providing for a high-power level of approximately

90% or more for the set of possible alternatives for minimum sample size of 100. For this reason, a minimum sample size of 100 fish is recommended as it achieves statistical rigor, minimizes harm to fish species, and manages balances tagging costs. Table 6-2 provides the results of the power analysis under the null hypothesis of a 20% passage rate for shad. In other words, 100 is the minimum sample size for the set of fish arriving at the near field attraction zone of the Lawrence upstream fishway.

For the purpose of calculating statistical power, HDR assumed a binomial distribution for passage rate (i.e., pass, not pass) for the set of fish arriving at the near field attraction zone of the Lawrence upstream fishway. Power calculations used the exact binomial test by which the significance and power are computed by exact means and not by approximating using the normal or student-t distribution assumptions. The statistical application PASS was used to conduct the minimum sample size analysis.

Upon settling on a minimum sample size to achieve good statistical power to detect meaningful differences between the null hypothesis and possible true alternatives, Essex applied adjustments to the minimum sample size to account for predation and fallback. The formula used to calculate the initial sample size (S) for shad tagged at the downstream release location is as follows:

$$S=(\text{target minimum sample size})/[1-(\text{predation rate} + \text{fallback rate})].$$

For the purposes of evaluating upstream passage of adult American shad at Lawrence during this study, a fallback rate of 33% was assumed (i.e., mid-point of range identified during study plan development for the 2020 fishway effectiveness evaluation at the upstream Lowell Project [FERC No. 2790]).

Visual observations of striped bass in the tailrace downstream of the entrances to the Lawrence fishway have occurred with increasing regularity over the last several passage seasons and concurrent with those observations, adult herring returns at the fish lift have decreased from over 200,000 during 2021 to approximately 6,000 during 2023¹⁵. There is no information available to inform directly on the predation rate of striped bass on adult herring downstream of Lawrence (e.g., abundance estimates of returning alosines or abundance, size structure, or diet of striped bass). Davis et al. (2012) evaluated the impact of striped bass on blueback herring in the Connecticut River during a four-year period (2005-2008) and noted a size dependent interaction between bass and their herring prey. Herring were consumed by striped bass between approximately 14-39 inches with bass between 25 and 39 inches exhibiting the highest probability of containing more than one herring at the time of sampling. Visual observations made by NHFG staff during the spring 2023 herring passage season at Lawrence indicated 500-1,000 bass in the tailrace on May 16³. With no reliable estimate of predation on adult river herring below the Lawrence fishway, a rate of 50% was assumed to as sufficient to provide a buffer for any tag loss resulting from this variable. Due to their larger body size it is not expected that shad would be as susceptible to striped bass predation as are river herring. This is supported by anecdotal NHFG observations from Lawrence which

¹⁵ Lawrence USFWS Inspection Report – FERC Accession No. 20230928-5096

observed a large drop off in the number of striped bass in the tailrace on June 2, 2023 coupled with an absence of river herring and larger numbers of American shad present³. To account for potential predation on smaller bodied male shad, a predation rate of 25% (i.e., ½ that of adult river herring) was assumed for this evaluation.

Assuming a fallback rate of 33% and a predation rate of 25%, the initial sample size for tagging adult American shad downstream of Lawrence is $S=(100)/[1-(25\%+33\%)] = 238$.

Note that this approach does not separate what portion of the predation includes those fish that have also experienced fallback and hence may be double-counting events. This potential double-counting does have the added benefit of producing conservative initial sample size estimates increasing the chances that at least 100 tagged fish reach the region of interest.

Upon completion of tracking the tagged shad, a sample passage rate and confidence interval can be calculated. Table 6-3 provides multiple outcome scenarios depending on the observed passage rate and selected confidence levels of 80%, 90% and 95%. Assuming a final sample size of 100, and starting sample size of 238 shad, no margin of error is greater than ± 10%. For the purposes of evaluating upstream American shad passage at the Lawrence Project, Essex will tag and release a total of 240 individuals.

Table 6-2. Achieved statistical power to detect differences between the assumed population proportion under the null hypothesis of 20% and the alternative population proportions

Alternative Population Proportion	Significance Level											
	5%				10%				20%			
	Sample Size											
	100	150	200	300	100	150	200	300	100	150	200	300
5%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
10%	70%	93%	97%	100%	88%	96%	99%	100%	93%	99%	100%	100%
40%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 6-3. Confidence interval calculations for a sample size of 100 by sample passage rate

Confidence Level	Actual Width	Sample Passage Rate	Confidence Interval	
			Lower Limit	Upper Limit
80%	7%	5%	3%	9%
80%	9%	10%	6%	15%
80%	11%	20%	15%	26%
80%	14%	40%	33%	47%
80%	11%	80%	74%	85%

90%	8%	5%	2%	10%
90%	11%	10%	6%	16%
90%	14%	20%	14%	28%
90%	17%	40%	32%	49%
90%	14%	80%	72%	86%
95%	10%	5%	2%	11%
95%	13%	10%	5%	18%
95%	17%	20%	13%	29%
95%	20%	40%	30%	50%
95%	17%	80%	71%	87%

6.6.2 Radio Telemetry Equipment

Approach, residence, and passage of radio-tagged adult American shad will be evaluated using a set of stationary radio telemetry receivers installed at specific locations at and in the vicinity of the Lawrence dam and powerhouse. Installed radio telemetry equipment will include Orion receivers, manufactured by Sigma Eight, as well as SRX receivers manufactured by Lotek. Receivers will be installed following consideration of the detection requirements for the specific area of coverage, as well as the attributes of the receiver model (i.e., broadband vs. single frequency capability). Several types of antennas will be used for this study, including aerial Yagi antennas and custom-made underwater antennas (dropper antennas). The specific antenna type for each stationary receiver location will be determined in the field.

Transmitters were selected based on relative size and previous performance. Adult shad will be tagged using transmitters manufactured by Sigma-Eight (model TX-PSC-I-80) or equivalent. The transmitter model TX-PSC-I-80 measures approximately 10 x 10 x 27 mm, weighs 4.2 grams, and has an estimated battery life of 64 days when set at a 2.0 second burst rate.

6.6.3 Radio Telemetry Monitoring Stations

Radio telemetry antennas and receivers will be set up at predefined locations at the Project, as well as at points upstream and downstream. Each monitoring station will consist of a data-logging receiver, one or more antennas, and a power source. Monitoring stations will be configured to receive transmitter signals from a designated area continuously throughout the study period. During installation of each station, range testing will be conducted to configure the antennas and receivers in a manner which maximizes detection efficiency at each location. The operation of the system will be confirmed during installation and throughout the study period by using beacon tags. These beacon tags will be stationed at strategic locations within the detection range of either multiple or single antennas and will emit a signal at a programmed time interval. These signals will be detected and logged by the receivers and used to record the functionality of the system throughout the study period. Although each monitoring station

will be installed in a manner which limits the ability to detect transmitters from unwanted areas, the possibility of such detections does still exist. As a result, behavioral data collected in this study (i.e., duration at a specific location or passage route) will be inferred based on the signal strength and the duration and pattern of contacts documented across the detection array.

The locations of proposed monitoring stations for the effectiveness of the existing upstream fish lift at Lawrence are outlined below and presented visually in Figure 6-1 and Figure 6-2. As with any telemetry study, monitoring station locations described here will be evaluated in the field prior to initialization of the study and, if necessary, may be modified to enhance the collection of passage information.

Station 1: Pending landowner permission, Station 1 will be installed at the Haverhill Riverside Park and will consist of a single receiver and aerial antenna oriented perpendicular to the Merrimack River channel. Station 1 will be the lowermost receiver station and detections at this location will be used to confirm departure from the study area by outmigrating tagged fish. Station 1 will be approximately 6.6 miles downstream of Essex Dam and 4.5 miles downstream of Station 2.

Station 2: Pending landowner permission, this station will consist of a single receiver and aerial antenna oriented perpendicular to the river channel and installed on the grounds of the Essex County Correctional Facility. Detections at Station 2 will be used to confirm departure from the study area by outmigrating tagged fish. Station 2 will be located approximately 2.1 miles downstream of Essex Dam. Station 2 will be considered as optional during the initiation of this study as it provides redundant detection information to that collected by Station 1.

Station 3: Station 3 will consist of a single radio receiver and will provide aerial coverage of the “approach” (i.e., the section of the Merrimack River just downstream of Essex Dam and leading up into the fish lift area). Station 3 will likely consist of a single aerial antenna mounted at a shoreline position approximately 550 ft downstream of the back of the Lawrence powerhouse.

Station 4: Station 4 will consist of one radio receiver and aerial antenna to provide coverage of the lower portion of the downstream tailrace area immediately below the Lawrence powerhouse.

Station 5: Station 5 will consist of one radio receiver and aerial antenna to provide coverage of the upper portion of the downstream tailrace area immediately below the Lawrence powerhouse. Detections from Station 5 will be considered as representative of arrival within the nearfield attraction area immediately downstream of the two entrances to the Lawrence fish lift. These fish will be considered as candidates to enter the fishway.

Station 6: This station will consist of a single receiver and underwater drop antenna providing detection information for radio-tagged fish in the area immediately inside of the primary (river side) fish lift entrance (i.e., located on the eastern or left [when viewed looking downstream] side of the fishway).

Station 7: Station 7 will consist of a single receiver and underwater drop antenna providing detection information for radio-tagged fish in the area immediately inside of the secondary (street side) fish lift entrance (i.e., located on the western or right [when viewed looking downstream] side of the fishway).

Station 8: Station 8 will provide detections of radio tagged fish located within the lower fishway entrance flume and towards the hopper. This station will consist of a single receiver and underwater drop antenna. The exact location and configuration will be determined in the field such that it does not interfere with the operation of the lift. The intent of Station 8 is to provide detection information of fish which have successfully passed through an entrance (i.e., Station 6 or 7) and reached the vicinity of the hopper.

Station 9: This station will consist of a single receiver and underwater drop antenna providing detection information for radio-tagged fish in the upstream exit flume of the Lawrence fish lift indicating successful upstream passage via the hopper.

Station 10: Station 10 will consist of a single receiver and antenna providing redundant detection information for radio-tagged fish in the upstream exit flume of the Lawrence fish lift indicating successful upstream passage via the hopper. This station will be positioned at the upstream end of the exit flume at the point where flows converge with the power canal. The specific antenna type and installation method will be determined in the field.

Station 11: Station 11 will consist of one radio receiver and aerial antenna to provide detection information for radio-tagged fish having exited the upstream exit flume of the Lawrence fish lift and moved into the Project forebay.

Station 12: This station will be positioned to inform on radio-tagged individuals which have exited the upstream exit flume of the Lawrence fish lift and moved upstream to the point where they are exiting from the powerhouse forebay. Station 12 will consist of one radio receiver and aerial antenna to provide cross-channel coverage.

Station 13: Station 13 will be installed along the mainstem of the Merrimack River near the midpoint between the Lowell and Lawrence Projects and will consist of a single receiver and aerial antenna oriented perpendicular to the river channel. This station will provide detection information to confirm continued upstream movement of radio-tagged fish as they move away from the Lawrence Project.

Station 14: This station will be the furthest upstream location monitored for radio-tagged test fish and will be installed along the mainstem of the Merrimack River at a point between Station 13 and the Lowell Project. Station 14 will consist of a single receiver and aerial antenna oriented perpendicular to the river channel.

Figure 6-1. Proposed stationary receiver placement for monitoring upstream migration on Merrimack River near Lawrence Project

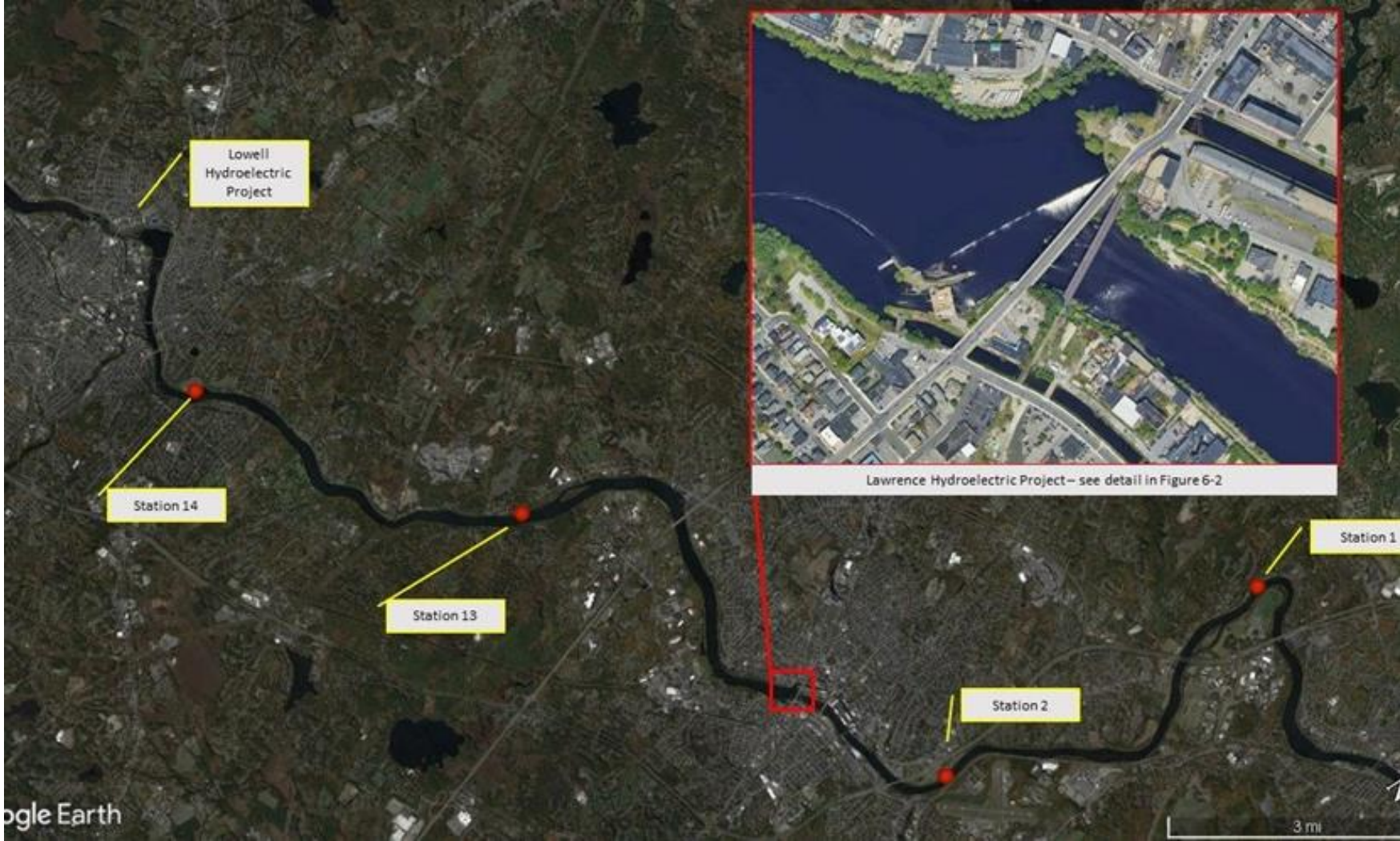


Figure 6-2. Proposed stationary receiver placement for monitoring upstream passage effectiveness at the Lawrence Project



6.6.4 Tagging and Release Procedures

Adult American shad intended to assess the effectiveness of the upstream fish lift at Lawrence will be collected in the Merrimack River downstream of the Project, likely from the reach between the Union Street Duck Bridge and the first crossing of Route 495. Boat electrofish collections of study fish from this reach will be made following the approach used by Gahagan and Bailey (2020) for collection of adult shad in the Charles River. Essex assumes that the required permits will be authorized by the state and federal resource agencies to conduct boat electrofish sampling in this reach for collection of test fish given its designation as critical habitat for the federally listed Atlantic sturgeon¹⁶.

Following capture, fish will be immediately placed in a large, onboard, flow-through live well and the crew will navigate the boat to a safe shoreline location for tagging. Each fish will be visually assessed to ascertain their suitability for tagging. Any individuals exhibiting excessive scale loss or other signs of significant stress will not be considered and will be released back into the river untagged. Individuals deemed acceptable for tagging will be quickly measured (total length, nearest mm), and sex will be determined (when possible) by gently expressing eggs or milt from running-ripe fish. Radio transmitters will be inserted gastrically. To facilitate gastric implantation, transmitters will be affixed to a flexible tube with their trailing antenna running through the hollow center. The transmitter and leading edge of the flexible tube will be pushed through the mouth and down to the stomach. Once in place, the tube will be removed leaving the transmitter antenna trailing from the mouth. Following tagging, adult shad will be immediately released back into the Merrimack River and the coordinates and date/time of release will be recorded.

As described in Section 6.6.1, a total of 240 adult American shad will be targeted for radio-tagging to evaluate the effectiveness of the upstream fish lift at Lawrence. The total number of tagged shad released within a single tagging day will be capped at up to 40 fish in an attempt to minimize the congregation of too many active transmitters at the receiver array associated with the approach, nearfield and fishway at Lawrence. The exact timing of the tagging effort will depend on annual run timing but is anticipated to begin at some point in late-May.

6.6.5 Data Collection

6.6.5.1 Stationary Telemetry Data

Data will be off-loaded from receivers using a laptop computer and will be stored on removable memory sticks. Data downloads will occur at least once weekly during the period from the initial tag and release date until completion of the monitoring period (July 15). Backup copies of all telemetry data will be made prior to receiver initialization. Field

¹⁶ As defined in 82 Federal Register 39160 as “Merrimack River from the Essex Dam (also known as the Lawrence Dam) downstream to where the main stem river discharges at its mouth into the Atlantic Ocean”.

tests to ensure data integrity and receiver performance will include confirmation of file integrity, confirmation that the last record is consistent with the downloaded data (beacon tags will be critical to this step), and lastly, to confirm that the receiver is operational upon restart and actively collecting data post download. Within a data file, transmitter detections will be stored as a single event (i.e., single data line). Each event will include the date and time of detection, frequency, ID code, and signal strength.

6.6.5.2 River and Operational Data

In addition to stationary radio telemetry data, river and Project operations data will be reported for the duration of the evaluation period. Mainstem river temperature will be recorded via a thermal logger installed at the Project. Hourly records of inflow, discharge (generation and spill), unit operations, downstream bypass operation, canal discharge, and extent and location of spill will be obtained from Essex at the completion of the study period. During the upstream passage season, Essex completes a daily fishway inspection log which includes information related to river conditions, flow allocation, unit conditions, and fishway conditions. Information specific to attraction flows and fishway operations (i.e., daily Auxiliary Water Supply (AWS) gate setting, AWS discharge in cubic feet per second [cfs], entrance gate setting [feet], entrance drop [feet], and v-trap opening [inches] will be summarized in the study report.

6.6.6 Analysis and Reporting

6.6.6.1 Data Management

English et al. (2012) provides a framework for an effective database management approach suitable for use during radio telemetry studies. They list the following major components:

1. Rigorous data recording and verification during the tagging process;
2. On-site data verification during the data download process;
3. Basic file management protocols;
4. Logical and simple database structure; and
5. Systematic and efficient data processing procedures, including:
 - a. Rules for assigning detections to zones;
 - b. The identification and filtering of noise records;
 - c. Compression of large volumes of data into summary files;
 - d. Flexible temporal and spatial scales;
 - e. Customized displays for presenting results; and
 - f. Automated database updating protocols.

During tagging of each target species and life stage, a systematic approach will be used for recording all tag codes and other physical and biological data. Data collected during tagging will be recorded manually on field data sheets and later key-punched into electronic format. Simple data verification processes will be performed following data entry to ensure that information contained within the tag database is accurate. During downloads of receiver equipment, detailed records will be maintained to log the condition of each receiver station and antenna and to document download start and end times. Downloaded files will be named following a standardized convention of SSMMDDYY.txt, where SS = the two-digit station ID, MM = month, DD = day and YY = year. Field personnel will save a backup copy of any telemetry downloads prior to receiver initialization. Field tests to ensure data integrity and receiver performance will include confirmation of file integrity, confirmation that the last record is consistent with the downloaded data (beacon tags will be critical to this step), and lastly, to confirm that the receiver is operational upon restart and actively collecting data post download.

Raw data collected as part of this study will include transmitter and biological information on each eel tagged and monitoring station telemetry detections. Additional parameters requiring definition will include a listing of each antenna along with its unique signal strength threshold (i.e., the power level below which detections are likely noise and should be ignored). Similarly, a listing of receivers will be required along with a noise filtering threshold (i.e., the minimum number of expected detections in a specified time period, below which detections are likely to be noise).

Upon defining the project structure and noise filtering, the data for multiple receiver stations can be merged and processed into the single set. Detection zones for the majority of stations associated with this study are spatially independent from one another. In a limited number of cases, the detection zones of two stations may slightly overlap. In those instances, the relative signal strength for a sequential series of detections will be utilized to determine the “break points” where highest signal strength shifts from receiver 1 to receiver 2.

6.6.6.2 Data Analysis – Approach and Passage Metrics

Detection information from Stations 1 through 3 will be used to inform on (1) the proportion of radio-tagged individuals which aborted upstream movements following tagging (as evidenced by detection at Stations 1 or 2) or (2) moved upstream from the release location to approach the Essex Dam (as evidenced by detection at Station 3). The subset of individuals which approach Essex Dam (as evidenced by detection at Station 3) will be further considered in the evaluation of passage at the dam.

For radio-tagged fish detected in the vicinity of the Lawrence fish lift entrances, each unique passage attempt will be defined. A passage attempt will be defined as a movement from the nearfield attraction water area (i.e., Station 5) upstream and through one of the two entrances (Stations 6 or 7). Attempts which end in successful upstream passage will be identified by detection in the upper exit flume (Station 9 or 10). Unsuccessful attempts will be defined by a series of detections at internal fish way receivers (Stations 6, 7, and/or 8) followed by a return to the coverage zone of the near

field receiver (Station 5). For each unsuccessful attempt it will be noted if the individual reached the detection zone nearest to the hopper (i.e., Station 8). The duration of each passage attempt will be calculated as the time from initial detection at the entrance receiver (Station 56 or 7) until detection in the upper exit flume (Station 9 or 10) for test fish successfully passing upstream, or until a subsequent detection is made in the nearfield receiver detection zone (Station 5) for test fish failing to pass upstream.

In addition to evaluation of fish way entries, the stationary telemetry data set will also be examined to inform on the (1) the seasonal and temporal distribution for the arrival of radio-tagged individuals at the Lawrence fishway and (2) the duration of time from initial detection in the downstream Project area until successful upstream passage or outmigration.

6.6.6.3 Data Analysis – Parameter Estimates for Evaluating Passage Success

Detection information obtained from the installed receiver array will be used to construct an encounter history for each individual radio-tagged test fish. These encounter histories will be assembled as the series of sequential detection (“1”)/no detection (“0”) records for each individual fish between the release location and Essex Dam:

- Known release location (=1 for all fish);
- Station 3 – Lawrence approach (0 or 1);
- Station 5 – Lawrence fish lift nearfield (0 or 1);
- Station 6/7 – Lawrence fish lift entrance (0 or 1);
- Station 8 – Lawrence fish lift entrance – hopper area (0 or 1);
- Station 9 – Lawrence fish lift exit flume (downstream end) (0 or 1);
- Station 10 – Lawrence fish lift exit flume (upstream end) (0 or 1);
- Station 11 – Lawrence forebay (0 or 1);
- Station 12 – Lawrence forebay exit (0 or 1);
- Station 13 – Lawrence impoundment (mid-point) (0 or 1); and
- Station 14 – Lawrence impoundment (last station) (0 or 1)

These encounter histories will form the basis of a Cormack Jolly Seber (CJS) model to be constructed in Program MARK (White and Burnham 1999). The CJS model developed for this study will provide estimates for passage success (Φ) and detection (p) probabilities of radio-tagged test fish downstream of Lawrence. The estimates of Φ generated by the CJS model will represent the probability of passage success between a selected monitoring station and the adjacent upstream monitoring station. The detection probabilities will estimate the likelihood that a tagged fish will be detected at a particular monitoring station given that it successfully ascends upstream and reaches that point.

The resulting model will allow for estimation of (1) nearfield attraction, (2) fish lift entrance efficiency, and (3) overall lift efficiency.

- Nearfield attraction: estimated as the probability for a radio-tagged fish to move upstream into the fish lift's near field attraction field (i.e., Station 5) following an initial approach towards the dam (i.e., Station 3).
- Entrance efficiency: estimated as the probability for a radio-tagged test fish to move from the fish lift's nearfield attraction field (i.e., Station 5) to detection at one of the two fish lift entrances (i.e., Station 6 or 7).
- Overall fish lift efficiency: representing successful passage from entry into the Lawrence Project area until entrance into the upper exit flume of the fish lift. The overall effectiveness will be calculated as the joint probability of reach-specific estimates for Stations 3 to 5, 5 to 6/7, 6/7 to 8 and 8 to 9.

In addition to assessing rates of passage associated with the upstream fish lift structure, the CJS model developed as part of this Upstream Anadromous Fish Passage Assessment will also inform on the rate egress for radio-tagged shad departing the powerhouse forebay and passage through the lower half of the Project impoundment.

To evaluate passage success, a suite of candidate models will be developed based on whether passage success, recapture (i.e., detection), or both vary or are constant among stations. Models will include:

- $\Phi(t)p(t)$: survival and recapture may vary between receiver stations;
- $\Phi(t)p(.)$: survival may vary between stations; recapture is constant between stations;
- $\Phi(.)p(t)$: survival is constant between stations; recapture may vary between stations;
- $\Phi(.)p(.)$: survival and recapture are constant between stations;

Where;

- Φ = probability of survival
- p = probability of detection
- (t) = parameter varies
- $(.)$ = parameter is constant

In the ISR, Essex will provide the full list of encounter histories developed for each test fish released as part of this study.

6.7 Schedule, Level of Effort, and Estimated Cost

This study will require a substantial effort and cost to obtain, tag/monitor, and analyze collected data for adult American shad to evaluate the effectiveness of the upstream fish

lift at Lawrence. Cost for the single year of radio tagging, monitoring and analysis described in this RSP is estimated at approximately \$170,000. Due to the scheduled issuance date for the Commissions Study Plan Determination as well as equipment and transmitter requirements for this effort, Essex intends to conduct this study during the spring passage season in 2025.

6.8 Discussion of Alternative Approaches

The proposed methods for this study are consistent with accepted professional practices. The overall approach is commonly used in relicensing proceedings and is consistent with generally accepted methods for and analytical techniques used by federal and state agencies. In addition, the proposed methods for this study are consistent with FERC study requirements under the ILP. No alternative approaches to this study are necessary.

7 Upstream American Eel Passage Assessment

7.1 Study Requests

Essex filed a PAD with the Commission on June 16, 2023 and the PSP on November 28, 2023. The Commission’s August 15, 2023 SD1 and November 28, 2023 SD2 identified a variety of aquatic resource issues to be analyzed in the EA for the Project relicensing. The USFWS, NMFS, MA DMF, MassWildlife, and NHFG subsequently submitted formal study requests related to evaluation of the performance of the existing upstream eel passage structures at the Project, as shown in Table 7-1. In response to these study requests, Essex is proposing this study.

Table 7-1. American Eel Study Requests

Requestor	Requested Study	Date
USFWS	Upstream American Eel Passage Assessment (USFWS Letter Request No. 4)	October 16, 2023
NMFS	Study of Upstream Fish Passage Effectiveness for American Eel (NMFS Letter Request No. 8)	October 16, 2023
MA DMF	Study of Upstream Fish Passage Effectiveness for American Eel (MA DMF Letter Request No. 3)	October 13, 2023
MassWildlife	Study of Upstream Fish Passage Effectiveness for American Eel (MassWildlife Letter Request No. 10)	October 16, 2023
NHFG	Upstream American Eel Passage Assessment (NHFG Letter Request No. 4)	October 16, 2023

7.2 Goals and Objectives

The goal of this study is to evaluate the effectiveness of the existing upstream American eel (*Anguilla rostrata*) passage facilities at the Project. Specifically, this study seeks to:

- Assess attraction to the south side eel trap and north side eel lift.
- Determine the proportion of marked eels entering the south side eel trap or north side eel lift which then successfully ascend upstream (i.e., internal efficiency).
- Review the length frequency distribution of marked eels released downstream of the south side eel trap or north side eel lift with that of the subset which successfully pass upstream via each structure.
- Estimate the travel time for a marked eel to move from the downstream entrance of the south side eel trap's ramp or north side eel lift to the upstream collection facility.
- Estimate the retention effectiveness of the collection traps associated with the existing eel passage facilities at the south side eel trap and north side eel lift.

7.3 Study Area

The study area will include the section of the Merrimack River located immediately downstream of the Essex Dam proximal to the existing upstream eel passage facilities.

7.4 Background and Existing Information

Juvenile upstream eel migration was monitored in the reach downstream of Essex Dam by USFWS during June-August 2002 (Sprankle 2002). Sampling in the study area downstream of the dam included deployment of two portable eel ladders placed adjacent to locations suspected to be present based on bed morphology, flow characteristics, dam construction, etc. A total of 60 days of sampling over the three-month period produced a total of 171 juvenile eels. Eels captured immediately downstream of Essex Dam had a mean length of 94.4 mm (SD = 9.9) or approximately 3.7 inches. Night observations were conducted on two dates (July 2 and August 1) and elvers were observed attempting to ascend the dam on the north side on both dates.

In 2012 the licensee installed a wood and concrete eel trap at the south toe of Essex Dam following consultation with the MRTC that included several years of location testing. A two-phase assessment of the effectiveness of the south side eel trap was performed in 2014 (Normandeau 2015). The assessment consisted of a qualitative visual survey and quantitative internal efficiency assessment. The 2014 assessment observed eel use of the approach channel to the base of the south side eel trap and that large numbers of eels were present at the nearfield area adjacent to the entrance. Internal efficiency rates ranged from 32-55% (36 hours) but were confounded by the presence of non-test eels in the eel pass. The effectiveness of modifications made to the south side eel trap following the 2014 evaluation has not been evaluated to date.

Essex is currently installing an eel lift at the north side abutment of the dam. The effectiveness of the north side eel lift has not yet been assessed.

7.5 Project Nexus

American eel are known to migrate within the Merrimack River to points upstream of Lawrence and as a result, the potential exists for Project operations to create delays or prevent upstream passage. Data collected as a part of this study will provide information to conduct an analysis of the Project's effects on the American eel and their upstream migration.

7.6 Methodology

Evaluation of the existing upstream eel facilities will rely on a combination of qualitative nighttime observations and a quantitative mark-recapture study.

7.6.1 Nighttime Observations – Assessment of Attraction Efficiency

Given the small body size of juvenile eels approaching Lawrence and the lack of available actively transmitting tags that would permit the spatial tracking of marked individuals throughout the Project area, a quantitative estimate of the attraction rate (i.e., what percentage of migrating juvenile eels that approach the Project subsequently locate and enter an eel facility) to the existing upstream eel passage facilities is not attainable. However, attraction to the existing upstream eel passage facilities will be examined qualitatively during a series of nighttime observational surveys conducted at the Project once monthly during June, July, and August.

Nighttime surveys for the south side eel trap will follow the same methodology as was employed during the 2014 effectiveness evaluation. Surveys will consist of examination of both the internal trap components as well as nearfield approach areas (i.e., downstream ledges). Surveys will be conducted no earlier than two hours after sunset. Internal eel pass counts during the visual survey events will be conducted by removal of ramp and resting pool covers and enumeration of all visible eels using red lights to minimize disturbance to juvenile eels. All observed eels will be assigned to one of three length categories (0-6 inches, 6-12 inches, and 12+ inches). Nearfield observations will consist of using spotlights to conduct an examination of the surrounding rock formations from the tail water to the eel trap entrance and will focus on areas of eel concentration, locations where juvenile eels may be attempting to approach the eel trap entrance (including any spat rope or other climbing substrates), and where eels may be attempting to ascend the dam via routes other than the provided passage structure. Similar to internal eel counts, all eels observed during the nearfield surveys will be assigned to one of three length categories. Similar effort will be expended to describe juvenile eel distribution within the entrance area of the north side eel lift. Additional information collected on each survey date will include air and water temperature, moon phase, weather conditions, and Project operations.

7.6.2 Quantitative Evaluation of Internal Efficiency

The initial approach to evaluate the internal passage efficiency of the south side eel trap and north side eel lift (as described in the PSP) proposed to rely on a set of passive integrated transponder (PIT) readers and antennas installed in a manner which would inform on the entrance and exit of tagged juvenile eels from those facilities. The PIT tags proposed for use were 12 mm half duplex (HDX) tags manufactured by Oregon RFID and measured 12.0 mm x 2.12 mm (weight = 0.1 g). Two size classes of juvenile eels were identified for tagging: individuals greater than 150 mm and individuals between 113- and 150-mm. The minimum size threshold of 113 mm was based on previous juvenile eel tagging observations (Mueller et al. 2017; Normandeau 2023).

In their comments on the PSP, the USFWS provided information on juvenile eel body sizes downstream of Lawrence from sampling conducted during July 2015. Of the 761 eels evaluated by USFWS, 755 individuals (99%) measured less than 110 mm, less than the minimum body size required to support a 12 mm PIT tag USFWS, MADMF, and NHFGD expressed concerns that the PIT based methodology proposed in the PSP may not be feasible due to eel sizes downstream of the Project and/or may skew the tagged sample population to be unrepresentative of that at the Project. To alleviate those concerns Essex has eliminated the PIT based approach to assess internal efficiency at the south side eel trap and north side eel lift and will instead rely on a visible mark-recapture approach at those locations. The methodologies for that approach are defined below.

7.6.2.1 Internal Efficiency – South Side Eel Trap

To quantify the internal efficiency of the south side eel trap, Essex will utilize a known number of marked eels placed in a sealed, live-car or plankton-style net at the base of the structure. The specific design of this downstream holding structure will be determined on-site but it is intended to prohibit any juvenile eels within the fishway from exiting via the downstream end of the structure.

Essex will obtain a total of 250 juvenile American eels by dip net from the ledge areas immediately downstream of the dam. Each individual eel will be marked using Visual Elastomer (VIE) tags. To accomplish this, eels will be lightly anesthetized using diluted clove oil to allow for safe handling. Once immobilized, the total length will be recorded. Eels will not be tagged in a manner which selects for body size, but rather to mirror the natural relative size distribution downstream of the dam. Once measured, a colored VIE mark will be inserted at the base of the ventral fin margin. Essex will conduct a total of two release events, with each event consisting of at least 125 marked eels. Study eels will be placed at the downstream entrance to the south side eel trap. Unique VIE color marks will be assigned to each group such that recaptured eels can be identified to release date. The use of color marks will prevent the inadvertent biasing of upstream tank counts due to arrival of juvenile eels which may be located within the upstream eel fishway at the time of test initiation.

The two release events will be conducted over consecutive 24-hour periods. The first set of marked eels will be placed in the downstream holding structure and the south side eel trap will be allowed to operate as designed. At the completion of a 24-hour period, all eels present in the upstream eel tank will be removed and examined using a black light. Eels with VIE tags present will fluoresce, and the total number of eels with a unique color mark will be enumerated. Following removal of the 24-hour upstream trap catch, the second set of marked eels will be placed in the downstream holding structure, and the process will be repeated.

7.6.2.2 Internal Efficiency – North Side Eel Lift

To quantify the internal efficiency of the north side eel lift, Essex will utilize a known number of marked eels placed in the lift hopper. To accomplish this, Essex will obtain a total of 250 juvenile American eels by dip net from the ledge areas immediately downstream of the dam. Like the evaluation of internal efficiency for the south side eel ramp, test eels at the north side eel lift will be marked using VIE (following the same tagging methodology identified above and utilizing a unique color mark for each separate group). Essex will conduct a total of five lift events, with each event consisting of at least 50 marked eels.

Following placement of a group of marked eels in the lift hopper, the lift will be allowed to operate normally so that the bucket raises to the upper deck and discharges into the collection tank. Once the lift has discharged into the collection tank, the number of eels deposited into the tank will be enumerated and a rate of effectiveness will be calculated as the number recovered divided by the number introduced into the structure.

7.6.2.3 Collection Tank Retention Evaluation

In addition to evaluating the internal passage efficiency of the south side eel trap and north side eel lift, the retention efficiency of juvenile eels within the collection tanks at each location will be conducted. The assessment will consist of placing a known number of marked eels ($n = 20$) in the collection bucket at each location during a regular trap check and then conducting a count of the number of marked eels remaining in the collection tank the following morning. This assessment will be conducted on two separate occasions at each location. During each event, the set of 20 juvenile test eels will be measured to the nearest millimeter and marked using a Visual Elastomer (VIE) tag prior to placement within the collection tank. This will allow for the eel trap or lift to operate normally during the overnight period and for differentiation of “test” eels from those which may have entered the eel passage facility volitionally during the retention assessment period.

7.6.3 Data Analysis and Reporting

Internal efficiency will be determined as follows:

- South side eel trap: the percentage of VIE marked eels released at the base of the facility which are subsequently collected from the upstream collection tank at the 24-hour mark.
- North side eel lift: the percentage of VIE marked eels introduced into the hopper which are subsequently collected from the collection tank following a lift cycle.

Internal efficiency will be calculated relative to the original number of marked eels (e.g., in the event any eels released at the base of the south side eel trap escape from that structure during the test period, they will be considered as part of the internal effectiveness calculation).

An estimate of the retention efficiency of the upstream holding tank at both facilities will be calculated as the percentage of marked eels placed directly in that structure at the initiation of the two 24-hour test periods.

If retention efficiency of test eels originally placed in the upstream holding tank is less than 100%, the calculated internal efficiency rate will be presented as a range to note the potential degree of variability due to volitional escapement from the upstream holding tank. For example, if a combined 225 of 250 marked eels (90%) originally placed in the downstream holding structure at the south side eel ramp are present in the upstream collection tank at the end of their respective 24-hour periods and a combined 38 of 40 marked eels (95%) originally placed in the upstream collection tank remain at the end of their respective holding period, then internal effectiveness will be presented as 90-94% when adjusted for holding tank retention (i.e., 225 eels may represent only 95% of the total which reached the collection tank and so is adjusted upwards by 11 eels $[225 \text{ eels} * 0.05 = 11]$ which results in 94% internal efficiency $[236 \text{ eels} / 250 \text{ total eels} = 0.94]$).

Environmental and operational conditions during the effectiveness trials will be recorded and summarized in the final study report.

7.7 Schedule, Level of Effort, and Estimated Cost

The Upstream American Eel Passage Assessment will be conducted during the 2024 passage season. Cost for this assessment as described in this RSP is estimated at approximately \$60,000.

7.8 Discussion of Alternative Approaches

The proposed methods for this study are consistent with accepted professional practices. The overall approach is commonly used in relicensing proceedings and is consistent with generally accepted methods for and analytical techniques used by federal and state agencies. In addition, the proposed methods for this study are consistent with FERC study requirements under the ILP. No alternative approaches to this study are necessary.

8 American Eel Upstream Passage Siting Study

8.1 Study Requests

Essex filed a PAD with the Commission on June 16, 2023 and a PSP on November 28, 2023. The Commission’s August 15, 2023 SD1 and November 28, 2023 SD2 identified a variety of aquatic resource issues to be analyzed in the EA for the Project relicensing. The USFWS, MA DMF, MassWildlife, and NHFG subsequently submitted formal requests related to the conduct of a survey to assess the siting of additional upstream eel passes at the Project, as shown in Table 8-1. Essex is proposing this study in response to these study requests .

Table 8-1. American Eel Study Requests

Requestor	Requested Study	Date
USFWS	American Eel Upstream Passage Siting Study (USFWS Letter Request No. 3)	October 16, 2023
MA DMF	American Eel Upstream Passage Siting Study (MA DMF Letter Request No. 2)	October 13, 2023
MassWildlife	American Eel Upstream Passage Siting Study (MassWildlife Letter Request No. 14)	October 16, 2023
NHFG	American Eel Upstream Passage Siting Study (NHFG Letter Request No. 3)	October 16, 2023

8.2 Goals and Objectives

The goal of this study is to evaluate the potential need for additional permanent upstream American eel (*Anguilla rostrata*) passage facilities at the Project. Specifically, this study is intended to inform on the spatial distribution and relative abundance of juvenile eels downstream of the Project and to identify the potential need for any new locations appropriate for a future upstream eel passage structure(s).

8.3 Study Area

The study area will include the section of the Merrimack River located immediately downstream of the Essex Dam as well as the North and South Canals and their Project structures.

8.4 Background and Existing Information

Juvenile upstream eel migration was monitored in the reach downstream of Essex Dam by USFWS during June-August 2002 (Sprankle 2002). Sampling in the study area downstream of the dam included deployment of two portable eel ladders placed adjacent

to locations suspected to be present based on bed morphology, flow characteristics, dam construction, etc. A total of 60 days of sampling over the three-month period produced a total of 171 juvenile eels. Eels captured immediately downstream of Essex Dam had a mean length of 94.4 mm (SD = 9.9) or approximately 3.7 inches. Night observations were conducted on two dates (July 2 and August 1) and elvers were observed attempting to ascend the dam on the north side on both dates.

In 2012 the Licensee installed a wood and concrete eel pass at the south toe of Essex Dam following consultation with the MRTC which included several years of location testing. A two-phase assessment of the effectiveness of the south side eel pass was performed in 2014 (Normandeau 2015). The assessment consisted of a qualitative visual survey and quantitative internal efficiency assessment. The 2014 assessment observed eel use of the approach channel to the base of the south side eel pass and that large numbers of eels were present at the nearfield area adjacent to the entrance. Internal efficiency rates ranged from 32-55% (36 hours) but were confounded by the presence of non-test eels in the eel pass.

Essex is presently installing a new eel lift at the north side abutment of the dam.

8.5 Project Nexus

American eel are known to migrate within the Merrimack River to points upstream of Lawrence and as a result, the potential exists for Project operations to create delays or prevent upstream passage. Data collected as a part of this study will provide information to conduct an analysis of the Project's effects on the American eel and their upstream migration.

8.6 Methodology

The American Eel Upstream Passage Siting Study will consist of up to two-years of evaluation. Year 1 will consist of three components: visual nighttime surveys, electrofish sample collection, and deployment of temporary eel traps. Following completion of the first year of evaluation, Essex will review findings with the MRTC and determine if an additional Year 2 deployment of temporary eel traps is warranted. Sampling during Year 1 will take place over a period of ten weeks starting in early June and ending in early August.

8.6.1 Nighttime Visual Surveys

A series of visual nighttime surveys to reevaluate the spatial distribution and relative abundance of juvenile eels downstream of the Essex Dam and other Project structures will be conducted once per week for a period of ten consecutive weeks starting in early June. Nighttime visual surveys will be conducted by two to three biologists, within the time frame of approximately two hours after sunset and two hours before sunrise. These visual based surveys will be conducted at locations within the Project area that are safely accessible to project personnel and field staff, and can be characterized by downstream

conveyance of river water that may serve as an attraction flow to migrant eels. Potential survey areas may include the ledge areas adjacent to the southern and northern abutments of Essex Dam, the downstream face of the dam to the extent safely feasible, the powerhouse tailrace, the downstream face of the North and South Canal gatehouses, and the North Canal discharge area¹⁷. Although Essex is open to assessing the spatial distribution of juvenile eels downstream of Project features, any of the potential locations listed above will only be searched pending a determination that there are no significant health or safety risks associated with accessing and entering those locations.

During each weekly survey event, observers will be equipped with spotlights to facilitate eel observations at each safely accessible area. An effort will be made to time each weekly survey to occur on nights when conditions would be optimal (e.g., nights with high cloud cover or low lunar illumination, warmer or rainy nights with minimal wind, or after a rain event). The following will be recorded as part of the record for each survey:

- Date and time of search event,
- List of safely accessible survey areas included in each survey (may vary from week to week based upon site conditions),
- Estimate of numerical abundance and size classes by survey area (where size classes are defined as 0-6", 6-12", and 12+"),
- Weather conditions,
- Air and water temperatures,
- Moon phase, and
- Project discharge (turbines, fish passage facilities).

8.6.2 Electrofish Surveys

relative abundance and body size distribution of juvenile American eels downstream of the Essex Dam will be sampled by electrofishing twice during the ten-week survey period. Similar to data recorded during the visual nighttime surveys, data collection during electrofish sampling will include the presence/absence of juvenile eels, count of individuals, total length (nearest mm), weight (nearest gram¹⁸), duration of sampling (i.e., seconds of sample time to allow for calculation of a catch per unit of effort), and the water conductivity/backpack settings (frequency (Hz), voltage (vDC), etc.). Global Positioning System (GPS) coordinates will be recorded for each safely accessible search

¹⁷ Note: The South Canal outlet passes flow through an underground penstock until it rejoins the Merrimack River beneath the water surface at a point approximately 3,000 feet downstream of Essex Dam. Since there is no physical structure here which will serve to congregate eels for upstream passage it has not been included on the list of potential survey areas.

¹⁸ If greater than 50 individuals are collected from any single sampling area then a subset of individuals (n = 50) will be measured for length and weight. Individuals will be randomly selected from the total catch such that the range of sizes are representative.

location as to where individuals were collected. Electrofish equipment (i.e., backpack, barge, or boat-based) will be determined based on the conditions of the intended sampling location.

Electrofish sampling will be conducted during daylight hours and on a date not scheduled for a nighttime survey. Juvenile eels collected during electrofish sampling will be returned to the habitat where they were collected. Essex Hydro will plan to conduct electrofish surveys during late-June and late-July. However, the exact timing of the two surveys will be dependent on environmental conditions at the site that allow safe access to the targeted sampling locations. Sampling locations visited on each sampling date will include (1) the final set of locations identified for the nighttime visual survey locations (see Section 8.6.1), (2) the Merrimack River from below the dam to a point just downstream of the tailrace confluence, and (3) the lower Spicket River from the terminus of the North Canal to its confluence with the Merrimack River. Electrofish surveys at Lawrence will require an approved sampling permit from MassWildlife.

To provide additional information on the general fish assemblage downstream of Lawrence Dam, all non-anguillid fish species will also be netted during eel electrofish events. Fish will be identified to species, counted, and total length to the nearest mm will be recorded.

8.6.3 Temporary Eel Traps

Essex already operates a permanent upstream eel ramp at the south toe of Essex Dam and anticipates an operational eel lift installed at the north toe of Essex Dam for the 2024 upstream passage season. As a result, the use of temporary traps will focus on safely accessible locations away from the Essex Dam spillway. Essex will install up to three (3) temporary eel ramps for the duration of the ten-week survey period. The placement locations for the two temporary ramps will be determined in consultation with the MRTC during a site visit prior to the start of the ten-week survey period and will be based on site characteristics, access, personnel safety and site security. It is expected that installation locations will be in the vicinity of the downstream side of the North and South canal gatehouses and the downstream side of the outlet gate for the North Canal.

The final trap design will be determined based on the site conditions but will likely consist of a standard ramp design with collection bucket. The ramp will be of a C-channel construction, lined with a standard climbing matrix (e.g., Enkamat, ABS, etc.), and covered to provide predation protection. Ramp length will be a function of site conditions with the intent to maintain a ramp angle of 45 degrees or less. A covered collection box will be installed at the upstream end of the ramp to capture climbing eels. Attraction flow will be provided using a submersible pump or siphon to convey water to the top of the ramp for dispersal through a spray manifold as well as directly to the base of the ramp to serve as attraction flow. The entrance of the eel ramps will be placed above the normal high-water level so that the entranceway is not frequently submerged. As needed, a climbing matrix (Enkamat, trawl netting, etc.) will be added to extend the entrance of the eel ramp into the water, such that it always remains wetted, and the extended portion of

the climbing matrix will be held in place with natural rock substrates to provide cover for eels ascending the ramp.

The eel ramps will operate continuously during the ten-week sampling period and eel catch will be quantified every 1-3 days. In general, traps will be checked each Monday, Wednesday, and Friday. In the event project staff are observing high capture rates of juvenile eels, which increase the potential for a mortality event, Essex will consult with the MRTC on an appropriate course of action (e.g., reduce operation of eel ramps to three 24-hour periods per week, maintain continuous operation with more frequent checks, etc.). Captured eels will be released into the Project impoundment. Data recorded will include the following:

- Date and time of ramp check,
- Count of live eels by size class,
- Count of any observed eel mortalities in collection bucket or on ramp,
- Air and water temperatures,
- Project discharge (turbines, US fishway, DS bypass, spill, North and South Canal),
- Condition of eel ramp (e.g., fishing/not fishing, debris issues, vandalism, etc.), and
- Observations on predator activity in the general area of the ramp.

The retention efficiency of juvenile eels within the collection tanks at each location will be conducted. The assessment will consist of placing a known number of marked eels ($n = 20$) in the collection tank at each location during one of the regular trap checks and then conducting a count of the number of marked eels remaining in the collection tank the following morning. This assessment will be conducted on two separate occasions at each location. During each event, the set of 20 juvenile test eels will be measured to the nearest millimeter and marked using a VIE tag prior to placement within the collection tank. This will allow for the ramp to operate normally during the overnight period and for differentiation of “test” eels from those which may have entered the trap volitionally during the retention assessment period.

8.6.4 Data Analysis and Reporting

The Year 1 report will include counts of juvenile eels in both a tabular and graphical form across the ten-week survey period. In addition, mapping will be provided to highlight the spatial distribution of nighttime observations. If any potential project features identified for nighttime visual surveys can't be searched due to one or more non-mitigatable hazards, Essex will provide a summary in the final report to describe the unsafe conditions and why mitigation was not an option.

Relative size information for each size class of eels will be summarized for observations collected during both the nighttime surveys and back-pack electrofish collections. The

draft report will also summarize survey conditions (i.e., weather, inflow, and Project operations, etc.). Photographs of any areas of congregation noted during the nighttime surveys will be taken during the daytime back-pack electrofish sampling and will be included in the draft report.

Following completion of the Year 1 study report, Essex will consult on the need for additional temporary eel ramp sampling during Year 2.

8.7 Schedule, Level of Effort, and Estimated Cost

Year 1 of the American Eel Upstream Passage Siting Study will be conducted during the 2024 passage season. Should the need for additional temporary trap sampling be required following review and consultation of findings from the Year 1 study, those efforts would occur during the 2025 passage season. Cost for the Year 1 assessment described in this RSP is estimated at approximately \$60,000.

8.8 Discussion of Alternative Approaches

The proposed methods for this study are consistent with accepted professional practices. The overall approach is commonly used in relicensing proceedings and is consistent with generally accepted methods for and analytical techniques used by federal and state agencies. In addition, the proposed methods for this study are consistent with FERC study requirements under the ILP. No alternative approaches to this study are necessary.

9 Desktop Entrainment, Impingement, and Turbine Passage Survival Study

9.1 Study Requests

Essex filed a PAD with the Commission on June 16, 2023 and the PSP on November 28, 2023. The Commission’s August 15, 2023 SD1 and November 28, 2023 SD2 identified a variety of aquatic resource issues to be analyzed in the EA for the Project relicensing.

The FERC subsequently submitted a formal request for a desktop-based evaluation and summary of the potential for entrainment, impingement, and turbine passage survival at the Project, as shown in Table 9-1.

Table 9-1. Aquatic Resource Study Request

Requestor	Requested Study	Date
FERC	Desktop Entrainment, Impingement, and Turbine Passage Survival Study (USFWS Letter Request No. 2)	October 13, 2023

9.2 Study Requests

The goal of this study is to evaluate the potential risk of impingement and entrainment and to provide estimates of passage survival for outmigrating diadromous fish species. Specifically, this study will:

- Describe the physical and operational characteristics of the Project, including the location, dimensions, specifications, and hydraulics of the intake, trashrack, powerhouse, turbines, bypass, and spillway.
- Calculate approach velocities at the intake over a probabilistic range of inflow values representative of the expected out-migration window of target fish species and life stages for comparison to swim speeds.
- Compile and summarize available passage survival data from entrainment and mortality field studies performed for target fish species and life stages at other hydroelectric projects and compare those facility characteristics to Lawrence.
- Generate estimates of project survival by simulating downstream passage for a theoretical number of target fish species and life stages through the Project under a series of inflow values representative of a high, median, and low flow downstream passage condition.

9.3 Study Area

This desktop evaluation will consider the Project facilities including the powerhouse and Essex Dam as well as the North and South Canals and their associated structures.

9.4 Background and Existing Information

Section 5.4.3 of the PAD provides a summary of previously completed fish passage and protection studies, including historical site-specific efficiency evaluations of upstream and downstream passage structures and more recent estimates of project passage and survival for diadromous fish species at the nearby Lowell Project. Essex previously collected downstream passage telemetry information for adult alosines and eels collected opportunistically during the 2019-2020 field season window associated with the FERC relicensing of the Lowell Hydroelectric Project (P-2790). This information will be provided as part of the ongoing Lawrence relicensing process.

9.5 Project Nexus

Diadromous fish moving downstream in the Merrimack River as part of their life cycle encounter the Lawrence Project. Potential effects of Project operations and facilities include fish impingement on the trash racks and entrainment through the generating units. This study will help establish a baseline condition to assist in evaluating entrainment and impingement potential and the expected passage survival of those at the Project. Information gained from this study will inform FERC's environmental assessment of the license application materials.

9.6 Methodology

This desktop evaluation will focus on the current suite of outmigrating diadromous fish species at the Project: adult and juvenile alosines (i.e., alewife, blueback herring, and American shad) and adult American eels.

9.6.1 Description of the Project Facilities and Operations

The desktop assessment report will describe the physical and operational characteristics of the Project that may influence impingement, entrainment, passage, and survival. Physical and operational data to be compiled will include the number, type, and orientation of the turbine units; depth, size, and clear spacing of the trashracks; and other relevant powerhouse/turbine specifications. A probabilistic range of inflow values representative of the expected outmigration window for each target fish species and life stage will be developed and used to calculate the range of expected approach velocities in front of the intake/trashracks at the powerhouse. Approach velocities will be calculated as $Q = V \cdot A$, where Q = flow rate (cfs), V = velocity (ft/s) and A = area (ft²). Operational information detailing the prioritization or sequencing of turbines and spill at the Project will also be included.

9.6.2 Turbine Entrainment/Passage Survival Review

Existing literature on turbine entrainment and mortality studies available for target fish species and life stages from other hydropower sites will be reviewed. Sources of entrainment information considered during this review will include the Turbine Entrainment and Survival Database Field Tests (EPRI 1997); previously conducted HI-Z balloon-tag, mark-recapture survival studies; as well as any other available peer-reviewed or gray literature reported studies. Available information will be presented in tabular format and will include specifics related to the hydroelectric project where the study was conducted, including available turbine parameters as well as rates of passage mortality (initial and/or latent). In addition to summarizing passage results observed elsewhere, this desktop review will provide a summary of findings previously collected downstream passage telemetry information for adult alosines and eels collected opportunistically during the 2019-2020 field season window associated with the FERC relicensing of the Lowell Hydroelectric Project.

Following summarization of previously reported downstream passage survival information, estimates for turbine entrainment survival of non-anguillid fish species at the Project will be generated using the USFWS TBSA tool. The TBSA tool mathematically estimates the fraction of individuals impacted by blade strike as they pass through a turbine unit (Towler and Pica 2019). Model inputs will include the number of runner blades, fish length, runner blade speed, turbine type, runner diameter, turbine efficiency, and total discharge. The TBSA tool will be used to evaluate survival probabilities for a theoretical stock of target fish species and life stages characterized by a user-defined, normally distributed range of body lengths. Blade strike probabilities for adult eels will be estimated using a multiple linear regression model described by Alden (2017). Alden

provides a parameterized multiple linear regression model for axial-style turbines using data derived from direct turbine survival studies conducted at 56 projects. Blade strike probabilities derived from either estimator will be computed using the Project-specific set of turbine parameters.

9.6.3 Project Passage Survival Estimates

Estimates of whole station downstream passage survival of target fish species and life stages migrating through the Project at varying inflows representing high, median, and low water years will be prepared. This will involve the evaluation of route selection for tagged fish observed as part of the previously conducted downstream telemetry studies at the site. Where available, the proportional use of passage routes observed during the field studies will be used to represent the high, median, and low water conditions. In the event one or more of those conditions does not have an adequate number of test fish from which to inform, the estimates will rely on hydrologic data to determine flow routing through the pertinent Project works and an assumption of fish routing proportional to flow. These estimates of proportional use of each potential route of passage will be combined with site-specific and/or calculated turbine survival rates and site-specific or literature-derived spill and bypass survival rates in the TBSA tool. A series of TBSA models incorporating the specific passage opportunities at each flow condition will be generated for each target fish species and life stage.

9.7 Schedule, Level of Effort, and Estimated Cost

It is expected that this *Desktop Entrainment, Impingement, and Turbine Passage Survival Study* will be completed during 2025 and provided as part of the Updated Study Report to be filed with FERC in April 2026. Cost for the desktop passage survival evaluation described in this RSP is estimated at approximately \$30,000.

9.8 Discussion of Alternative Approaches

The proposed methods for this study are consistent with accepted professional practices. The overall approach is commonly used in relicensing proceedings and is consistent with generally accepted methods for and analytical techniques used by federal and state agencies. In addition, the proposed methods for this study are consistent with FERC study requirements under the ILP. No alternative approaches to this study are necessary.

10 Sturgeon Distribution and Project Interaction Study

10.1 Study Requests

Essex filed a PAD with the Commission on June 16, 2023 and the PSP on November 28, 2023. The Commission’s August 15, 2023 SD1 and November 28, 2023 SD2 identified a variety of aquatic resource issues to be analyzed in the EA for the Project relicensing. The USFWS, MA DMF, MassWildlife, and NHF GD subsequently submitted formal requests to determine the presence and movement of sturgeon downstream of and within the Lawrence Project boundary, as shown in Table 10-1. Essex is proposing this study in response to these study requests.

Table 10-1. Aquatic Resource Study Request

Requestor	Requested Study	Date
USFWS	Sturgeon Distribution and Project Interaction Study (USFWS Letter Request No. 7)	October 16, 2023
NMFS	Sturgeon Distribution and Project Interaction Study (NMFS Letter Request No. 3)	October 16, 2023
MassWildlife	Sturgeon Distribution and Project Interaction Study (MassWildlife Letter Request No. 7)	October 16, 2023
NHF GD	Sturgeon Distribution and Project Interaction Study (NHF GD Letter Request No. 7)	October 16, 2023

10.2 Goals and Objectives

The goal of this study is to determine if Atlantic or shortnose sturgeon are interacting with the Lawrence Project. Specifically, this study is intended to inform on the presence of Atlantic and shortnose sturgeon within the Project boundary and in the reach downstream.

10.3 Study Area

The study area will include the section of the Merrimack River located immediately downstream of the Essex Dam, extending downstream to the Lawrence I-495 Bridge (an estimated reach length of 1.5 miles).

10.4 Background and Existing Information

The Merrimack River downstream from the Lawrence Project has an amphidromous population of shortnose sturgeon (Kieffer and Kynard 1993). A study of the overwintering

population of sturgeon in the Merrimack counted 3,786 individuals in 2020-2021 season and 3,424 individuals in the 2022-2023 season (Stantec 2023). Shortnose sturgeon movement in the lower Merrimack has been documented up to the I-495 Bridge in Lawrence (Stantec 2023) with documented spawning occurring near Haverhill between river kilometer 30 and 32 (Kieffer and Kynard 1996). The detections at the I-495 Bridge in Lawrence occurred during the spawning season, suggesting that habitat between the I-495 bridge and the Essex Dam may be used for spawning or pre-spawning habitat. Post-spawn, and juvenile shortnose sturgeon are present in the river throughout the year (Kieffer and Kynard 1993).

The Merrimack River downstream from the Lawrence Project is utilized by Atlantic sturgeon from late May to early October for foraging (Kieffer and Kynard 1993; Wippelhauser et al. 2017). Kieffer and Kynard (1993) found that sub-adult Atlantic sturgeon used only one discrete section of the Merrimack River each year. Sub-adult Atlantic sturgeon during study were determined to frequent the “lower islands: section of the Merrimack River, located between river kilometers 5-10 and approximately 25 km downstream from Essex Dam. Overwintering in the Merrimack River has been documented for one individual (Wippelhauser et al. 2017).

10.5 Project Nexus

The Lawrence Project is located within the historical range for both Atlantic and shortnose sturgeon and the dam and powerhouse define the upstream boundary of designated critical habitat for Atlantic sturgeon. Data collected as a part of this study will provide a baseline to inform on the presence of these species immediately downstream of the dam and to determine if measures are necessary to minimize potential effects for any new license issued for the Project.

10.6 Methodology

The Sturgeon Distribution and Project Interaction Study will consist of active acoustic imaging surveys conducted during the spawning and foraging periods for sturgeon in the Merrimack River (i.e., April through October).

10.6.1 Active Sturgeon Surveys

Active sturgeon surveys will be conducted within the section of the Merrimack River from the area downstream of the Lawrence dam to the I-495 Bridge in Lawrence using an Adaptive Resolution Imaging Sonar Explorer 1800 (ARIS), manufactured by Sound Metrics Corporation (Seattle, WA), to produce high-resolution images. The ARIS unit will be boat-mounted to allow for mobile collection of acoustic imagery to count sturgeon. Figures 10-1 through 10-5 provide some example imagery recorded using the ARIS unit.

A total of five survey events will be spaced throughout the known spawning and foraging season for sturgeon in the Merrimack River. Assuming safe river flow conditions, survey events will be targeted to occur once each between April 15-May 1, May 1-May 15, May

15-May 31, September 1-15 and October 1-15. Each survey event will be completed within a single sampling date and will cover the full 1.5-mile reach. Surveys will be conducted by maneuvering the ARIS unit along parallel transects running longitudinally up and downstream. Acoustic imagery will be recorded for post-survey analysis. A set of three longitudinal transects (i.e., the $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ channel width points) should provide full coverage of the Merrimack River throughout the study reach given the 350–450-foot channel width.

For each survey date, Essex will report the recorded project inflow (cfs), generation flow (cfs), spill flow (cfs) and spill gate status. The water temperature at the time of survey will also be recorded.

10.6.2 Data Analysis and Reporting

All acoustic imagery from each survey event will be reviewed and any recorded instances of sturgeon will be counted. For each sturgeon located, the date and time and location (relative to the dam) will be reported. Total length will be estimated for each identified sturgeon from the acoustic images. The report will include counts of identified sturgeon in both tabular and graphical form across the five survey events. In addition, mapping will be provided to highlight the spatial distribution of observations. The draft report will also summarize survey conditions (i.e., inflow, Project operations, etc.).

10.7 Schedule, Level of Effort, and Estimated Cost

The Sturgeon Distribution and Project Interaction Study will be initiated during September 2024 and two of the five survey events will be completed, representative of the foraging period. The remaining three survey events will be conducted during spring 2025 and will be representative of the spawning period. The cost for the assessment described in this RSP is estimated at approximately \$65,000.

10.8 Discussion of Alternative Approaches

The proposed methods for this study are consistent with accepted professional practices. The overall approach is commonly used in relicensing proceedings and is consistent with generally accepted methods for and analytical techniques used by federal and state agencies. In addition, the proposed methods for this study are consistent with FERC study requirements under the ILP. No alternative approaches to this study are necessary.

Figure 10-1. Example ARIS image showing broken hard-substrate bottom habitat.

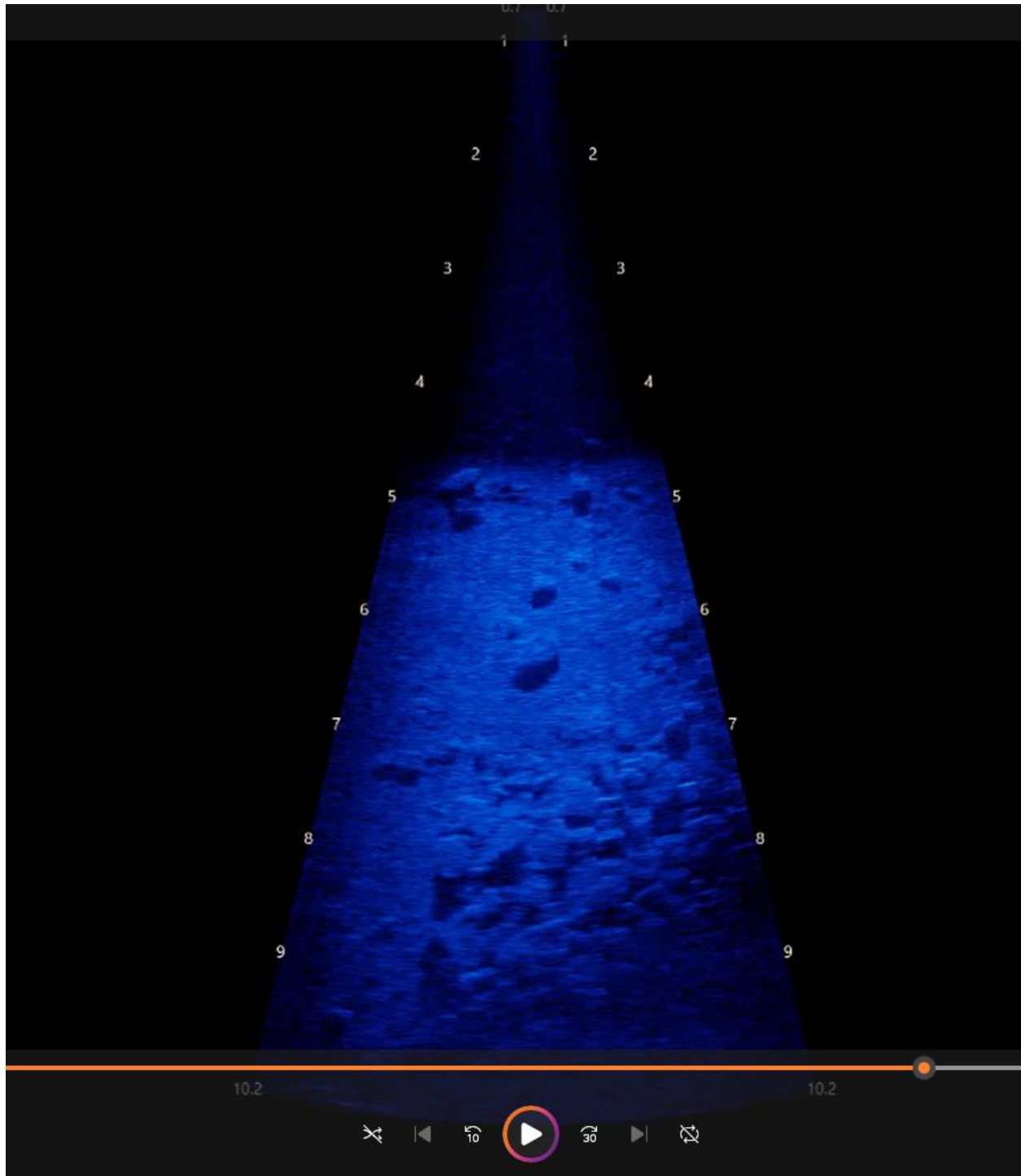


Figure 10-2. Example ARIS image showing submerged log on smooth bottom habitat.

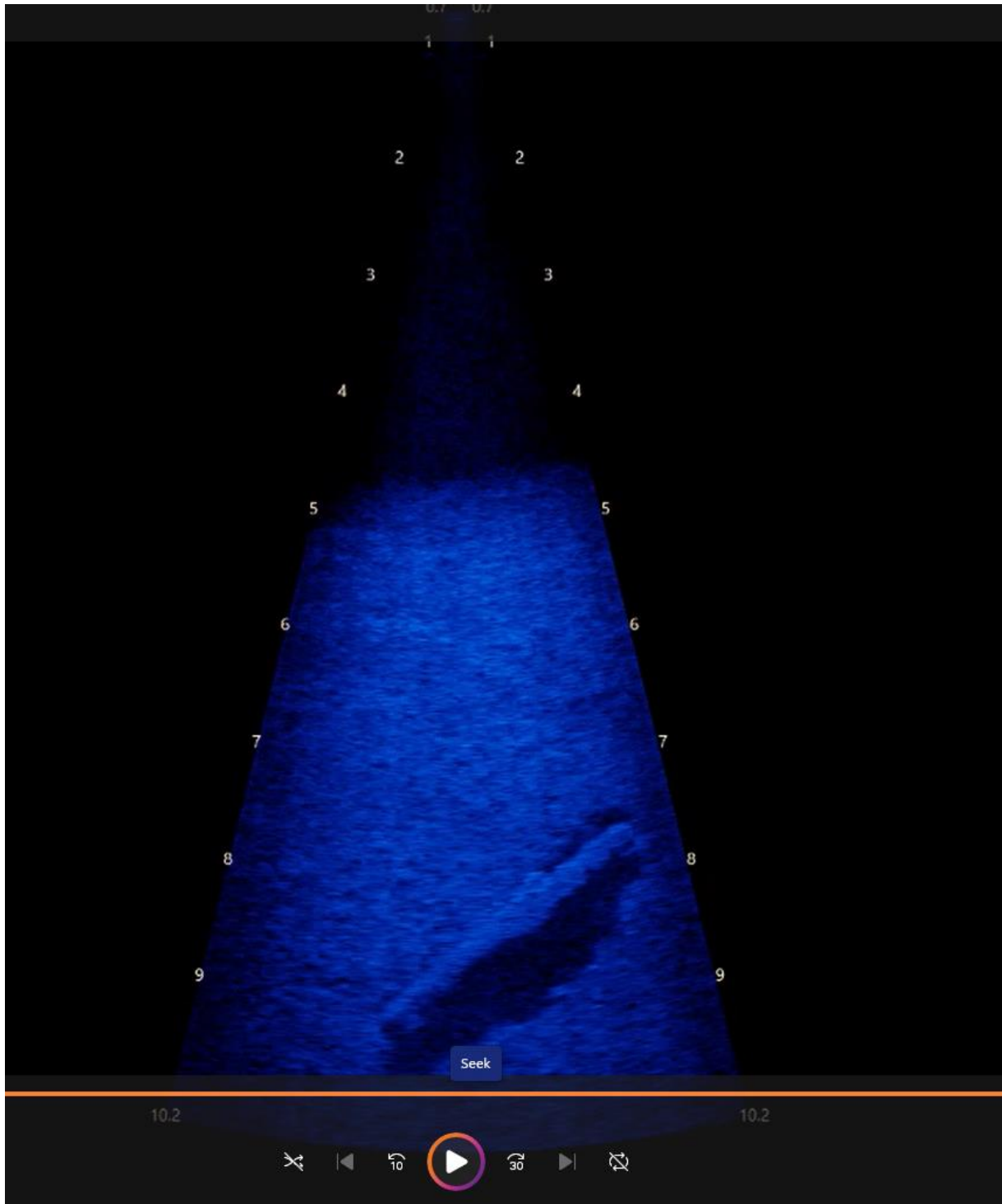


Figure 10-3. Example ARIS image showing sand wave bottom habitat.

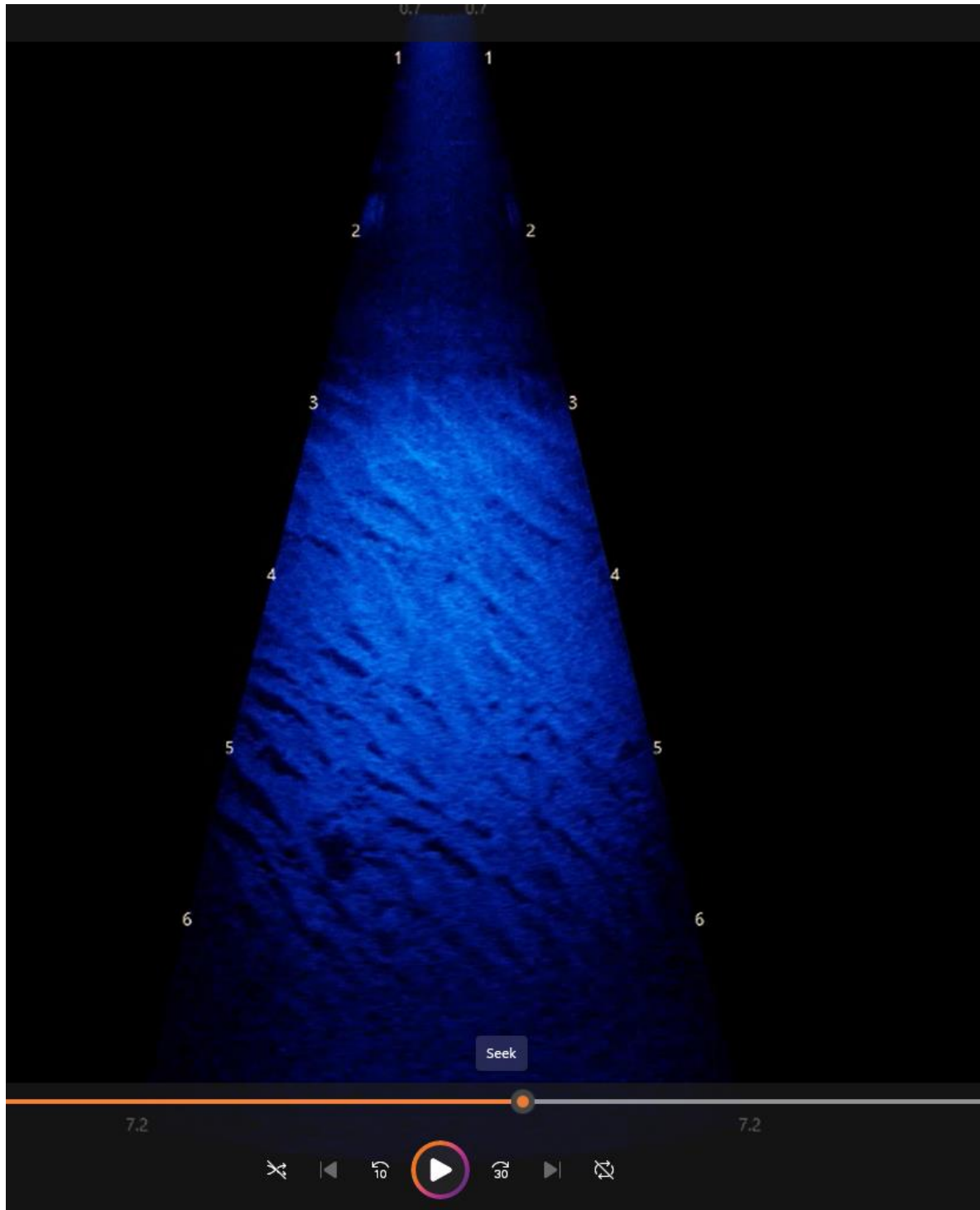


Figure 10-4. Example ARIS image showing discarded tire.

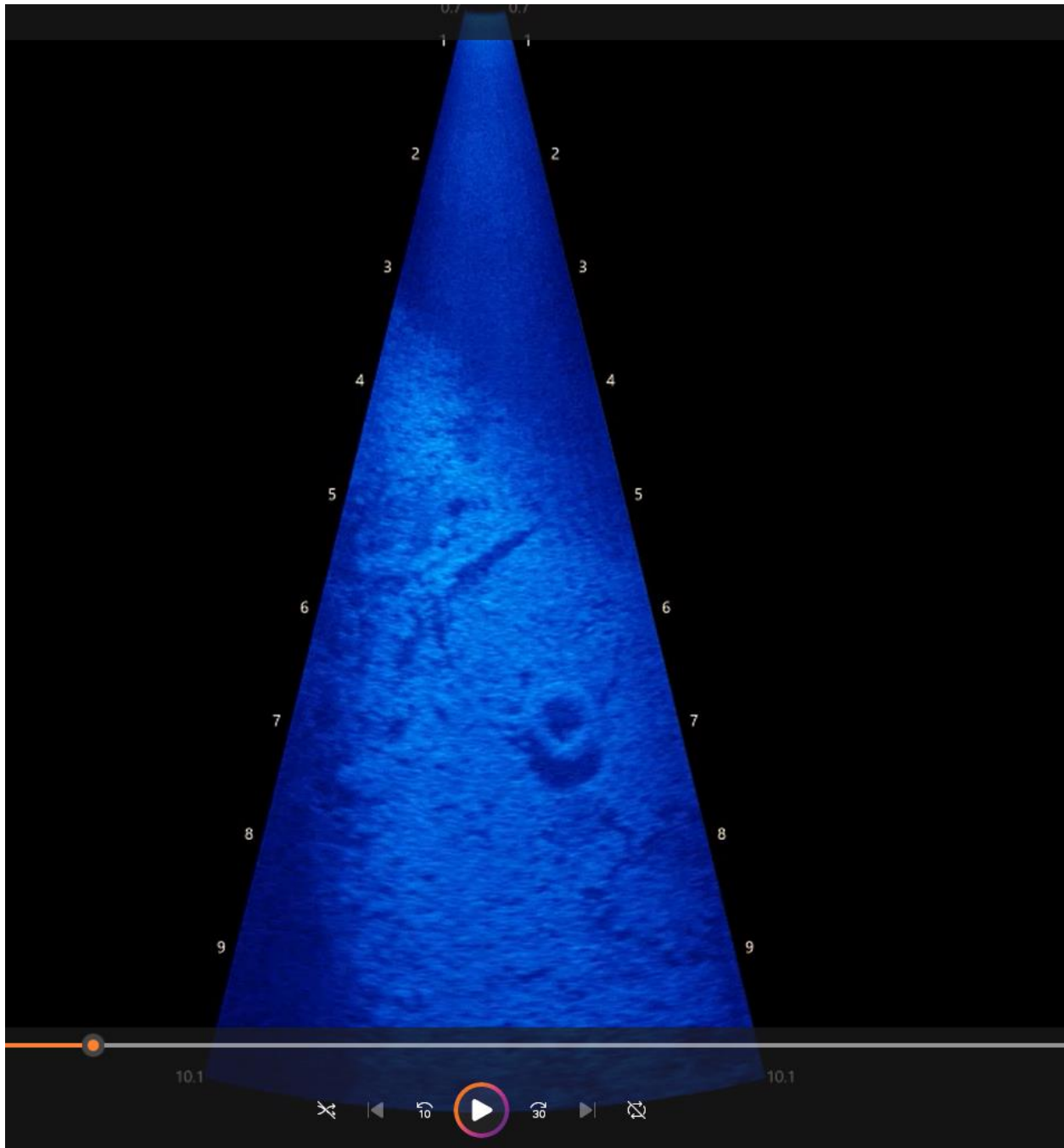
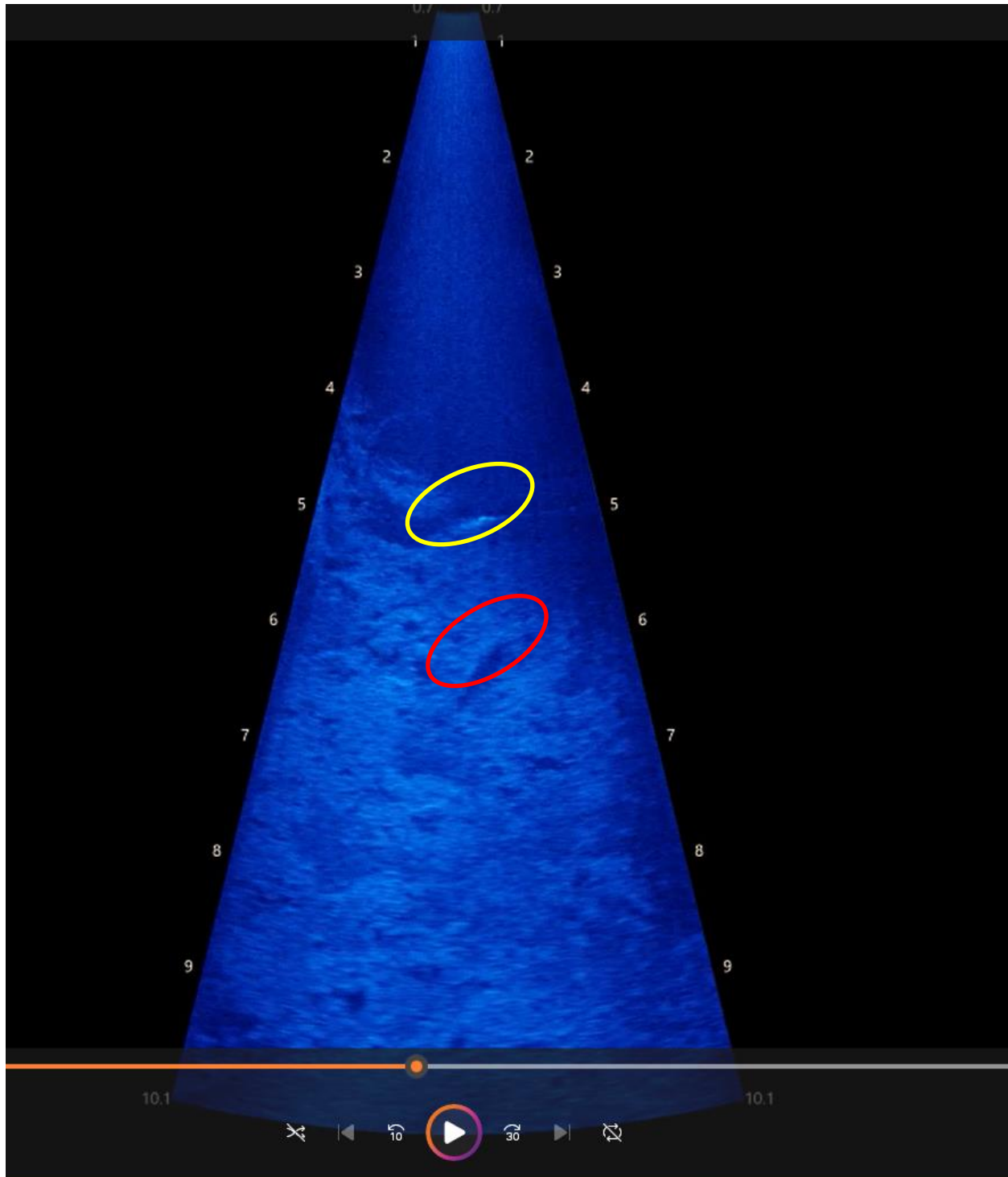


Figure 10-5. Example ARIS image showing midwater fish species (yellow oval) with corresponding bottom shadow (red oval).



11 Diadromous Fish Behavior, Movement, and Project Interaction Study

11.1 Study Requests

Essex filed a PAD with the Commission on June 16, 2023 and the PSP on November 28, 2023. The Commission’s August 15, 2023 SD1 and November 28, 2023 SD2 identified a variety of aquatic resource issues to be analyzed in the EA for the Project relicensing. The USFWS, NMFS, MA DMF, Mass Wildlife, and NHFGD subsequently submitted formal requests to assess Project-related effects on the behavior of diadromous fish species (i.e., alosines and striped bass) in and around the Lawrence tailrace, as shown in Table 11-1. Essex is proposing this study in response to these study requests.

Table 11-1. Aquatic Resource Study Request

Requestor	Requested Study	Date
USFWS	Diadromous Fish Behavior, Movement, and Project Interaction Study (USFWS Letter Request No. 5)	October 16, 2023
NMFS	Diadromous Fish Behavior, Movement, and Project Interaction Study (NMFS Letter Request No. 1)	October 16, 2023
MA DMF	Diadromous Fish Behavior, Movement, and Project Interaction Study (MADMF Letter Request No. 6)	October 16, 2023
Mass Wildlife	Diadromous Fish Behavior, Movement, and Project Interaction Study (Mass Wildlife Letter Request No. 12)	October 16, 2023
NHFGD	Diadromous Fish Behavior, Movement, and Project Interaction Study	October 16, 2023

11.2 Goals and Objectives

The goal of this study is to assess Project-related effects on the behavior of diadromous fish species (i.e., alosines and striped bass) in and around the Lawrence tailrace. Specifically, this study is intended to (1) assess tagged fish distribution and movement in the Project tailrace and proximal downstream reach, (2) determine the extent of alosine behavioral modification due to predator presence and extent of passage related delay, and (3) assess passage outcomes following alosine behavioral modifications as it relates to predator presence.

11.3 Study Area

The study area will include the section of the Merrimack River located immediately downstream of the Essex Dam, extending downstream to the Lawrence I-495 Bridge (an estimated reach length of 1.5 miles).

11.4 Background and Existing Information

The number of alewife and blueback herring passing the Project has decreased from 203,000 fish in 2021, to 50,535 fish in 2022, to 6,129 in 2023. During the 2022 and 2023 upstream fish passage seasons and annual fishway inspections, striped bass were observed in abundance around the Project's tailrace and near the Project's fishway entrance. There is a lack of detailed information on how the species are interacting with one another, the Project, and how Project operations may influence that interaction and upstream fish passage.

11.5 Project Nexus

The diadromous species identified in this plan are known to migrate within the Merrimack River to points upstream of Lawrence and as a result, the potential exists for Project operations to create delays or prevent upstream passage. Data collected as a part of this study will provide information to conduct an analysis of the Project's effects on the target species and their upstream migration.

11.6 Methodology

The Diadromous Fish Behavior, Movement, and Project Interaction Study will require a two-phase approach.

Phase 1 will seek to determine the feasibility of utilizing the Juvenile Salmon Acoustic Telemetry System (JSATS) to monitor tagged fish in the riverine environment downstream of the Lawrence Project. The JSATS technology was developed by the Pacific Northwest National Laboratory (PNNL) and National Oceanic and Atmospheric Administration (NOAA) Fisheries to monitor the behavior, movement, habitat use, and survival of juvenile salmonids migrating out from freshwater in the Pacific Northwest. PNNL notes that JSATS has been previously used to (1) estimate route-specific dam passage, (2) observe predator-prey interactions, and (3) evaluate fish behavior in dam tailraces using high-accuracy, high-efficiency 3-D tracking.

- Pending a successful demonstration of the technology downstream of the Lawrence Dam, Phase 2 will consist of live testing intended to provide an understanding of tagged fish distribution and movement around the Lawrence tailrace and proximal downstream reach.

Section 11.6.1 of this study plan summarizes methodologies to be used during the Phase 1 technology evaluation at Lawrence. Section 11.6.2 of this study plan provides a framework for the eventual fish tagging and movement study. Following the completion of Phase 1 (and assuming the JSATS technology proves fit for evaluating fish movement in the conditions downstream of the Lawrence Dam) Essex will consult with the Merrimack River Technical Committee (MRTC) to finalize study details for Phase 2.

11.6.1 Phase 1: JSATS Feasibility Evaluation

The overall goal of the Diadromous Fish Behavior, Movement, and Project Interaction Study is to assess Project-related effects on the behavior of diadromous fish species (i.e., alosines and striped bass) in and around the Lawrence tailrace. Phase 1 specifically seeks to:

1. Determine whether JSATS is the appropriate tool to address the study goal when considering the hydro-morphological conditions of the Merrimack River and the downstream study area as influenced by the Project facilities and its operations.
2. Validate the detection ranges obtained using the JSATS system with the aim of being able to inform the technical and cost aspects of an adequate study design to address the overall goal and objectives to inform on fish behavior downstream of the Project.

11.6.1.1 Overview of JSATS Technology

The JSATS system is comprised of three major components: acoustic transmitters, receivers, and the associated management/processing software. Each transmitter produces a signal at a fixed interval by inducing high-frequency (416.7 kHz) waves in the water. Submerged hydrophones will receive the signals and convert to an electrical impulse which is relayed to the receiver. The receiver identifies the signal as a unique identification code and then logs them along with the ID of the receiving hydrophone, time and date of the detection, and any other information relayed by the transmitter (e.g., pressure).

When a tagged fish swims within the detection range of multiple JSATS receivers, each receiver will record the unique identifier of the tag and the time of detection. By analyzing the time it takes for the signal to travel from the transmitter to multiple receivers, a technique known as Time Difference of Arrival (TDOA), the system can triangulate the position of a tagged fish. Data from multiple receivers can be collected and processed to reconstruct a fish's location over time. This data can then be used to inform on behavior, movement patterns, and response to environmental changes. This requires that all receivers within the study array can detect the same emitted pulse by the transmitter, while each receiver can have a variable detection capacity due to the background noise existing at its position.

11.6.1.2 JSATS Evaluation: Proposed Equipment

Essex will evaluate the use of the two different JSATS hydrophone/receivers for use at Lawrence. These include the SR3001 Trident Acoustic Receiver Datalogger manufactured by ATS and the Wireless Hydrophone System 4250 manufactured by Lotek (Figure 11-1). The units produced by both manufacturers are compatible with the JSATS transmitters operating at 416.7 kHz. The Lotek 4250 hydrophones are autonomous, with an integrated battery for continuous operation for a six-month period, and store recorded data on an internal SD card. The same principle governs the ATS SR3001 hydrophone, however its continuous operation period (i.e., internal battery life) is closer to six-weeks. Moreover, ATS also manufactures a cabled hydrophone (model SR3017) that offers accessible data storage out of the water as well as remote interface via a modem. Recent works on the Rivers Seine, Meuse, and Allier have noted a much greater (up to four times) detection range and detection rate for the ATS hydrophones versus those manufactured by Lotek (Profish 2022).

Flow speeds within the reach downstream of Lawrence vary spatially and temporally as changes in river discharge and Project operations occur during the passage season. The detection range for any acoustic receiver will be reduced with the increase in the background noise generated by the friction of water on the outer casing of the hydrophones during varied flow conditions. Moreover, it is known that small bubbles in high density can impair both signal propagation and detection. Furthermore, the range of the equipment, as well as the background noise detected by the hydrophone, particularly in the form of ghost detections, can vary depending on the configuration of the civil engineering specific to a site. The feasibility of using JSATS technology at Lawrence will first be validated by the following on-site measurement approach.

11.6.1.3 JSATS Evaluation: Approach

Acoustic receivers will be deployed at six different pilot deployment locations covering a range of flow and channel/infrastructure morphology in the vicinity of the Project powerhouse and dam (Figure 11-2). Pilot deployment locations will include (1) the powerhouse forebay upstream of the outlet from the fish lift exit flume, (2) the powerhouse tailrace, (3) river left downstream of the spillway and adjacent to the Route 28 Bridge, (4) river right in the vicinity of the Route 28 Bridge, (5) center channel downstream of the confluence of spillway and powerhouse discharge, and (6) center channel at a point approximately 600 meters downstream of the spillway (Parker Street Bridge).

To evaluate JSATS hydrophones at each location, an acoustic transmitter will be placed in a piece of polyethylene tubing such that transmitters are protected from impact and are also oriented horizontally with the transmitter tip in contact with the water (Figure 11-3). The tubing will be attached to a thin weighted rope. Dependent on water depth at each site, a set of three transmitters will be spaced along the line such that signals are being propagated from the upper (top 1 meter), middle, and lower (bottom 1 meter) of the water column. For the preliminary site testing it is anticipated that an ATS brand, model SS300 transmitter weighing approximately 3.1 g and an ATS brand model SS400

transmitter weighing approximately 2.0 g, will be used. Test transmitters will be set to a burst rate of 3 seconds. These transmitter sizes will likely be appropriate for use in tagging the final set of target fish species during Phase 2 of the study.

The intent of this testing is to define the detection range for each receiver (at each location) as well as evaluating the detection rate as a function of the distance from the hydrophone. The detection rate will be defined as the ratio of the number of detections recorded by a hydrophone to the number of transmissions from a transmitter during a known duration of time.

$$\text{Detection Efficiency (\%)} = \frac{\text{No. Detections}}{\text{No. Transmissions}}$$

Test transmitters will be deployed at multiple positions relative to each pilot deployment location. To the extent possible, detection efficiency data will be collected at multiple horizontal distances away from each hydrophone. The exact placement of test transmitters will be an iterative process with observations from the initial observation(s) informing the need for subsequent placements. Each test transmitter deployment will consist of a seven-minute period of submergence to have at least five minutes of complete detection per test. Deployment and retrieval times for each test tag location will be recorded. The location of each tag deployment (as well as hydrophone locations) will be geo-referenced.

11.6.1.4 JSATS Evaluation: River Herring Tag Retention Assessment

Two species of river herring, alewife and blueback herring, have been requested by the MRTC as targeted test species for evaluation of behavior downstream of Lawrence. Previously conducted radio-telemetry studies on the Merrimack River have relied on the use of alewife as a surrogate for both river herring species (e.g., evaluation of upstream effectiveness at the Lowell Hydroelectric Project). To better evaluate the feasibility of testing both river herring species, Essex will conduct preliminary testing to evaluate post-tagging transmitter retention and survival for river herring species as part of the Phase 1 feasibility study. Acoustic JSATS transmitters manufactured by ATS can be inserted either gastrically (model SS300) or injected using an 8-gauge needle (model SS400).

A tank-based retention/survival study will be conducted at Lawrence during the 2024 upstream alosine passage season. To accomplish this, a total of 50 adult alewife and 50 adult blueback herring will be obtained from the Lawrence upstream fish lift. A total of 25 individuals of both species will be tagged gastrically using dummy SS300 transmitters and 25 individuals of both species will be tagged using dummy injectable SS400 transmitters. An equal number of each species will be netted from the upstream fish lift and maintained as handling controls in the holding tank. All individuals (test and control) will be marked with a uniquely identifiable Floy tag so that individual fish can be tracked through the hold period.

Following tagging, fish will be maintained in a large, circular tank continuously supplied with ambient Merrimack River water. Tank checks will be conducted once daily for a

period of five days. Any instances of tag loss or mortality will be recorded. At the completion of the five-day holding period, all fish (test and controls) will be netted from the tank and their total length (to the nearest mm) recorded.

11.6.1.5 JSATS Evaluation: Review and Application to the Phase 2 Behavioral Study

The results from the detection efficiency testing will be summarized in a tabular format to characterize the observed range and detection rates for each hydrophone model installed at each pilot deployment location for the set of all transmitter deployment locations. Following completion of the Phase 1 field evaluation, the detection efficiency information will be used to inform a proposed hydrophone deployment strategy which will maximize the likelihood of detecting transmitters within the desired study area.

Findings from the river herring tag retention assessment will be summarized to provide findings based on species, tag model, and attachment technique. Information from this preliminary test will be incorporated into the final methodology identified for Phase 2 of the behavior study.



Figure 11-1. ATS (SR3001 on left and SR3017 in center) and Lotek (WHS 4250 on right) hydrophones. Reference ruler is 30 cm.

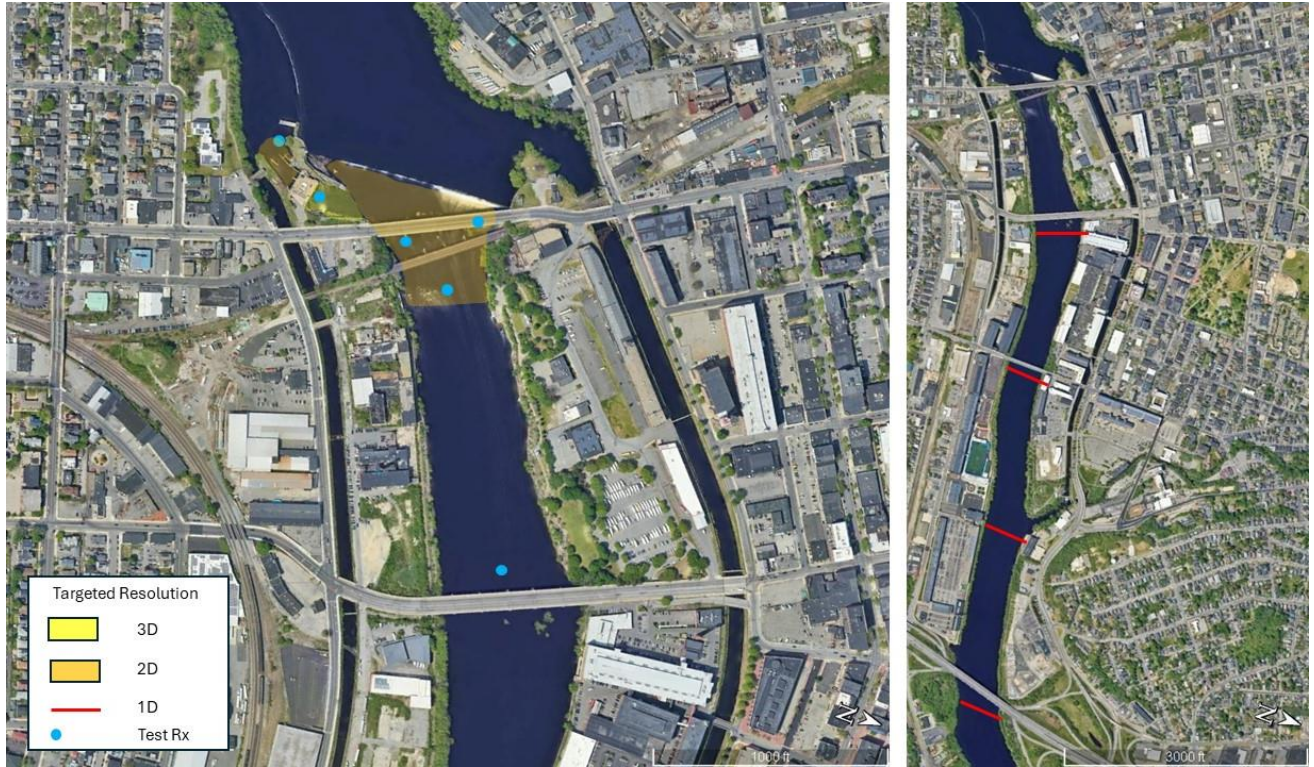


Figure 11-2. Project study reach showing levels of desired resolution (i.e., 1D, 2D, 3D) and approximate position of the six pilot deployment location.



Figure 11-3. View of acoustic transmitter installed horizontally in a plastic protective tube for range testing exercises.

11.6.2 Phase 2: Behavior, Movement, Interaction Assessment

As described above, this section is currently intended to provide a framework for the future development of an approach to conduct an acoustic fish tagging and movement study downstream of Lawrence. Following the completion of Phase 1 (and assuming the JSATS technology proves fit for evaluating fish movement in the conditions downstream of the Lawrence Dam) Essex will consult with the Merrimack River Technical Committee (MRTC) to finalize study details for Phase 2 of the Diadromous Fish Behavior, Movement, and Project Interaction Study.

11.6.2.1 Behavior Evaluation: Geographical Scope

The geographical area of coverage for this study is depicted in Figure 1 and runs from the area immediately downstream of the dam and Lawrence powerhouse to the I495 bridge in Lawrence. The final geographic scope for Phase 2 of the Diadromous Fish Behavior, Movement, and Project Interaction Study will be developed in consultation with the MRTC following review of the Phase 1 findings.

11.6.2.2 Behavior Evaluation: Acoustic Equipment and Deployment Approach

The final equipment selection and receiver placement will be informed by findings from Phase 1 of the Diadromous Fish Behavior, Movement, and Project Interaction Study. Essex will consult with the MRTC during the development of the final study design for Phase 2.

11.6.2.3 Behavior Evaluation: Target Fish Species, Sample Size Determination, and Tagging

As described in Section 11.6.1 for Phase 1 of the Diadromous Fish Behavior, Movement, and Project Interaction Study, Essex will consider the inclusion of both river herring species. Essex also expects that striped bass will be tagged as part of the study. The tagging approach (by species), collection techniques, and release strategies will be determined in consultation with the MRTC following review of the Phase 1 findings. Assuming, the use of a comparable methodology to the identification of an appropriate sample size for adult American shad as part of the development of the Upstream Anadromous Fish Passage Assessment study plan, Essex believes that sample sizes of up to 345 individuals for each river herring species and up to 100 striped bass will be sufficient to inform on behavior and movement (790 tags total). Blueback herring will only be tagged pending a successful outcome to the retention/survival pilot study proposed as part of the Phase 1 evaluation. Once finalized, the study plan for Phase 2 will include details on the final set of proposed transmitter models which may include options such as pressure sensors for determination of fish depth (and subsequent 3D data review). During preliminary discussions on the Diadromous Fish Behavior, Movement, and Project Interaction Study, Essex and the MRTC have discussed the availability of “predation” tags which provide information on predation events on tagged study fish. Preliminary review of this technology indicates these transmitters are available through Innovasea for their 69, 180, and 307 kHz receivers and are not compatible with the JSATS technology being proposed here.

11.6.2.4 Behavior Evaluation: Data Analysis and Reporting

Essex will consult with the MRTC to finalize data analysis and reporting for Phase 2 of the Diadromous Fish Behavior, Movement, and Project Interaction Study once a study design has been finalized following completion of Phase 1.

11.7 Schedule, Level of Effort, and Estimated Cost

Phase 1 of the Diadromous Fish Behavior, Movement, and Project Interaction Study will be initiated during summer 2024. Findings will be compiled and provided to the MRTC in advance of the April 26, 2025, Initial Study Report filing date so that adequate time is available to consult on specific study details associated with Phase 2 of the Study. It is Essex’s intention to complete consultation on the Phase 2 study methodologies in a manner which allows for field efforts to be completed during the 2025 upstream passage season. Findings from Phase 2 will be provided as part of the Updated Study Report filing on April 26, 2026. The cost for Phase 1 as described in this RSP is estimated at \$50,000. The cost for Phase 2 as described in this RSP is estimated to be between \$400,000 and \$650,000 depending on the final study design (i.e., target species, sample size, collection approach, density of receiver array to collect required data, etc). At present, the cost of a single SS300 acoustic transmitter is approximately \$300. If the maximum number of diadromous fish proposed by Essex are tagged (n = 790), transmitters alone will cost approximately \$237,000.

11.8 Discussion of Alternative Approaches

The proposed methods for this study are consistent with accepted professional practices. The overall approach is commonly used in relicensing proceedings and is consistent with generally accepted methods for and analytical techniques used by federal and state agencies. In addition, the proposed methods for this study are consistent with FERC study requirements under the ILP. No alternative approaches to this study are necessary.

12 Project Operations and Fish Stranding Study

12.1 Study Requests

In their October 16, 2023 comments on the PAD/study request letters the MADMF, NHFG, MassWildlife, and USFWS requested a Fish Stranding and Operations Study to evaluate Project operations and potential effects on fish stranding sites. In addition, on October 13, 2023 GLSD requested an evaluation of Project operations and minimum flows.

Essex proposes to adopt Phase 1 – Task 1: Operational Data review of the study request submitted by MADMF, NHFG, MassWildlife, and USFWS. Essex is also adopting Phase 2 of the requested study, which is an evaluation of the results of Phase 1 and the results of the 3D CFD Modeling study. Essex has generally incorporated the GLSD study request into this study plan. Essex believes the desktop study proposed in this RSP in conjunction with existing information and data collected as a part of the CFD study are sufficient to evaluate effects on Project resources. As noted, the MADMF, NHFG, MassWildlife, USFWS, and GLSD submitted formal requests either wholly or in part related Project operations as shown in Table 12-1.

Table 12-1. Aquatic Resource Study Request

Requestor	Requested Study	Date
USFWS	Fish Stranding and Ramping Rate Study (study request #10)	October 16, 2023
MADMF	Fish Stranding Evaluation Study (study request #8)	October 16, 2023
NHFG	Fish Stranding and Ramping Rate Study (study request #9)	October 16, 2023
MassWildlife	Fish Stranding Evaluation Study (study request #15)	October 16, 2023
GLSD	Minimum Flow Requirements	October 13, 2023

12.2 Goals and Objectives

The goals of the study are (1) to provide information on how the Project is operated in a ROR mode, including a review and evaluation of existing operational generation records, minimum flows, Merrimack River flows, and impoundment elevations; and (2) to evaluate influence of Project operations and maintenance on potential fish stranding areas downstream of the dam and Project tailrace. These will be accomplished with a desktop evaluation with the following objectives:

- Summarize the operational conditions of the Project over the five-year period of record (Jan 1, 2019 – December 31, 2023¹⁹), including impoundment elevations, generation records, minimum flows, and maintenance events;
- Develop tables and graphs as appropriate to illustrate how ROR operations, minimum flow requirements, and other operational requirements are maintained at the Project; and
- Analyze the Project operations and results of the CFD Study as they relate to flow conditions, hydraulic processes, and potential fish stranding sites below the Project Dam and powerhouse.

12.3 Study Area

The study area includes the Lawrence Project impoundment, tailrace, spillway, and downstream reach below the Essex Dam.

12.4 Background and Existing Information

Existing relevant and reasonably available information regarding Project operations and fish and aquatic resources are presented in sections 4.4 and 5 of the PAD. In their comment letters, MADMF, NHFG, MassWildlife, and USFWS identify and describe potential fish stranding events below the Project dam in 2019 and 2023.

12.5 Project Nexus

Operation of the Project influences water elevations and river flows within and immediately downstream from the Project boundary and may have effects on aquatic resources below the Project dam and tailrace.

12.6 Study Methodology

Essex proposes to perform this study in two phases, with Phase 1 designed as a desktop analysis of Project operations and Merrimack River flows and Phase 2 as a desktop evaluation of the combined results of Phase 1 and the results from the CFD Modeling study. Each step is described in more detail below:

¹⁹ Potential data gaps may occur as a result of changes to Project ownership.

12.6.1 Phase 1 – Operational Data Review

Essex will review, compile and analyze historical operational data for the past five years (Jan 1, 2019 – December 31, 2023). These data will include the following, where available: 1) impoundment elevation; 2) unit status (i.e. online/offline); 3) Project inflows as estimated from the United States Geological Survey (USGS) gage Merrimack River at Lawrence, MA – 01100500 and data as provided by the National Weather Service (NWS) Station Merrimack River at Lawrence located at Union St (Duck) Bridge²⁰; 4) crest gate operations; 5) individual unit flows; 6) total powerhouse outflow, including outflows from fish passage facilities; 7) total estimated outflow below the Project; 8) tailrace elevations²¹; and 9) flows downstream at (USGS) gage *Merrimack at Haverhill, MA – 01100693*.

Where existing information is available, Essex will document maintenance or operational incidents leading up to the 2019 and 2023 fish stranding events identified by MADMF, NHFG, MassWildlife, and USFWS.

Based on conversations with the MRTC, Essex understands that the primary areas of concern for potential stranding sites are located below the dam at rock outcrops on either side of the dam (left and right abutments). Essex will use existing aerial imagery, in combination with collected imagery, to identify potential fish stranding sites further downstream below the Essex dam. Essex anticipates installing trail cameras at a location on either side of the dam to capture hourly photographs of the areas over an extended period of time.²² Essex anticipates consulting with the MRTC following issuance of the SPD on the location of the trail cameras as well as the period of record for installation.

The above data will be reviewed to provide a description of flows, water levels, and generation in a concise narrative with additional tables and graphs as appropriate to illustrate how operational requirements are maintained at the Project.

12.6.2 Phase 2 – Project Operations and CFD Modeling

Using the Operational Data Review performed for Phase 1, Essex will analyze the results of the CFD study and the Diadromous Fish Behavior, Movement, and Project Interaction Study to examine potential fish stranding sites below the Project dam. Phase 2 will incorporate the bathymetry, depth, and 3D flow data collected as part of the CFD study, and 2D and 3D data collected as part of the Diadromous Fish Behavior Study to map potential stranding sites and describe operational influences (if any). As necessary to complement the CFD information, Essex will review and interpret aerial imagery of the

²⁰ <https://water.weather.gov/ahps2/hydrograph.php?wfo=box&gage=lawm3>

²¹ Outflows from the North Canal and South Canal is not measured, but is believed to be generally limited to leakage < 100 cfs per canal.

²² For an example of imagery collected by trail cameras below a dam, see Appendix D - Whitewater Flow Documentation Report at: <https://elibrary.ferc.gov/eLibrary/filedownload?fileid=23289171-C736-C03C-A585-85E0B180000>

Project area to better define the potential fish stranding sites further downstream below the Essex dam.

12.7 Analysis and Reporting

Essex anticipates that the Project Operations and Fish Stranding Study report will include the following elements:

- Project information and background,
- Study area,
- Methodology,
- Study results,
- Analysis and discussion,
- Any agency correspondence and or consultation, and
- Literature cited.

12.8 Schedule, Level of Effort, and Estimated Cost

The Phase 1 of this desktop assessment of Project operations can be conducted during the 2024 study season. Phase 2 of this desktop assessment will be conducted during the 2025 study season following completion of the CFD Modeling study. Essex anticipates filing the final report concurrent with the USR. The preliminary estimated cost for this study is \$50,000.

13 Freshwater Mussel Habitat Assessment and Survey

13.1 Study Requests

Essex filed a PAD with the Commission on June 16, 2023 and a PSP on November 28, 2023. The Commission’s August 15, 2023 SD1 and November 28, 2023 SD2 identified a variety of aquatic resource issues to be analyzed in the EA for the Project relicensing.

The USFWS and Mass Wildlife subsequently submitted formal requests related to the downstream passage of migratory fish species, as shown in Table 13-1. In response to these study requests, Essex is proposing this study.

Table 13-1. Mussel Survey Study Request

Requestor	Requested Study	Date
USFWS	Freshwater Mussel Survey (USFWS Letter Request No. 11)	October 16, 2023
MassWildlife	Freshwater Mussels and Non-Native Corbicula, Baseline Data Collection (MassWildlife Letter Request No. 2)	October 16, 2023

13.2 Goals and Objectives

The goal of the Freshwater Mussel Habitat Assessment and Survey is to determine the presence, location, and species of freshwater mussels that inhabit Project-affected aquatic habitats. This study will consist of both field and desktop-based tasks. The specific field-based objectives of this study are as follows:

- Conduct field surveys to characterize the distribution, composition, and relative abundance of freshwater mussels and non-native bivalves in the Lawrence Project impoundment.
- Assess potential host-fish for documented freshwater mussel species through review of relevant publications and concurrent fish data collected in the Project area²³.

13.3 Study Area

The study area will include the mainstem Merrimack River from the upper extent of the Project impoundment (9.8 miles upstream of Essex Dam and immediately downstream of the Lowell hydroelectric project [FERC No. 2790]) to the Lawrence I-495 Bridge located approximately 1.5 miles below Essex Dam.

13.4 Background and Existing Information

Surveys were previously performed in the Merrimack River by MassWildlife in the Haverhill reach downstream from the Project in 1996-1997. Surveys covered a limited area from just upstream of Hales Island (Haverhill) and downstream of the I-495 bridge in Haverhill. As described in the previously conducted MassWildlife surveys and from citizen scientist observations, mussel species which occur in the Merrimack River include Eastern Elliptio (*Elliptio complanata*), Eastern Floater (*Pyganodon cataracta*), Alewife Floater (*Utterbackiana implicata*; SGCN) and Eastern Lampmussel (*Lampsilis radiata*; SGCN). One historical record of the State Special Concern Eastern Pondmussel (*Sagittunio nasutus*; MESA) also occurs within the Merrimack River. Freshwater mussel populations found in nearby tributaries to the Project include the above listed species including extant populations of *S. nasutus*, and historical records of the State Special Concern Tidewater Mucket (*Atlanticoncha ochracea*) and State Endangered Brook Floater (*Alasmidonta varicosa*). Based on these records and species extant in the Connecticut River, the other similar large river in Massachusetts, the Project-affected area has the potential to support multiple state-listed species and Massachusetts' SGCN particularly *U. implicata*, *L. radiata*, *S. nasutus*, *A. ochracea*, and the State Endangered Yellow Lampmussel (*Lampsilis cariosa*).

²³ In response to comments provided on the PSP, Essex has updated the American Eel Upstream Passage Siting Study to include the collection of fish assemblage data (i.e., species, count, total length information) from the reach between Lawrence Dam and the confluence with the Spicket River for all species encountered.

13.5 Project Nexus

Freshwater mussels are known to occur in the project area and as a result, the potential exists for project operations to affect individual mussels, available habitat, and their fish hosts. Data collected as a part of this study will provide information to conduct an analysis of the Project's effects on the target species and fish hosts.

13.6 Methodology

13.6.1 Field Sampling

The objectives of this freshwater mussel habitat assessment and survey are to determine the (1) the initial species composition, relative distribution, and abundance of freshwater mussel species, (2) assess the available habitat within the nearshore areas, and (3) document the presence/absence of *Corbicula* (a non-native, invasive species) in the designated survey areas.

Survey methodology will consist of semi-quantitative, timed searches using snorkel or view bucket and diving depending on water depth. The MassWildlife Freshwater Mussel Survey Guidelines were reviewed as part of this study plan development. It should be noted that the MassWildlife does not define projects associated with water usage or level fluctuation in their guidelines. This project would be considered atypical for the purposes of the MassWildlife methodologies. Therefore, the proposed study plan will follow the survey rates and data collection methodologies consistent methodologies outlined in Smith, et al, 2001. It is not anticipated that any direct impacts to mussels would occur because of the project operations and no mussel relocations would be required.

Therefore, no mussel relocation recipient areas will be reviewed as part of this mussel survey effort. Details of the proposed methodologies are described below.

A semi-quantitative freshwater mussel survey of the previously described Project areas as well as below and above the hydroelectric facility will be conducted during the approved freshwater mussel survey window (i.e., between May 15 and September 30) and will consist of visual and tactile surveys of the river bottom by several biologists using mask and snorkel and diving where necessary in the impounded area. For search locations within the Project impoundment, the targeted survey range will cover up to seven (7) feet of water depth from the existing water level at the time of the survey. This represents the likely range of effects when considering operations and maintenance drawdowns of up to 5-6 feet at the Project. Survey crews will be prepared to dive selected areas which will exceed water depths of 3 ft. Search locations downstream of the Essex Dam will cover up to 3 feet of water depth as based on the observed range of potentially Project-induced water level fluctuations as recorded at the USGS gage 01100500 for the time period August 2013 to present.

Within each survey area, surveyors will start at the downstream limit of the selected area and slowly progress upstream in a meandering pattern, visually searching for mussels while ensuring all area within the transect is covered. Given the shallow areas, cells or

transects may be oriented parallel to the shoreline to maximize the search areas along the shallower margins at a selected locations in the impoundment. Areas of fine or loose substrates will be probed by hand and aquatic and emergent vegetation will be moved or probed in search of mussels. Under no circumstances will surveys be conducted in areas which represent safety concerns for divers (e.g., within 500 feet of the dam or within the South Canal).

At each search location, the crew will identify all live mussels observed and return them to the river bottom. Two representative photographs of all live species observed will be recorded (dorsal and lateral views). Care will be taken to minimize exposure of live mussels to air during processing (no longer than 5 minutes). Total shell length (in millimeters [mm]) will be recorded for any imperiled species observed. Up to 50 individuals of common species (e.g., Eastern elliptio) will be measured. Relative abundances will be recorded in areas of highly dense mussel communities using data from the transect intervals and spot dives. Observations of freshwater mussel sex, gravidity, or lure display will be noted. Habitat parameters such as substrate and cover type, average stream width (bypass channel) and depth, aquatic vegetation, and presence of invasive mollusk species such as *Corbicula* or zebra/quagga mussels will also be noted on field data sheets. No quantitative sampling (i.e., quadrat sampling) will be conducted as part of this survey.

The following data will be recorded for each interval or cell:

- total survey time expended;
- numbers and shell length of any state-listed species (up to 50 per species);
- numbers of other live mussel species (relative abundances for common species observed in high numbers – e.g. > 0.5/square meter);
- shell lengths for up to 50 individuals for common species;
- two photographs of each live species observed (dorsal and lateral views);
- GPS coordinates for transects and spot dives;
- maximum water depth per transect interval/spot dive;
- water clarity;
- estimate of substrate composition (Wentworth Scale);
- estimate of large woody debris per transect interval; and
- estimate of aquatic vegetation presence percentage per interval/spot dive.

Up to 31 transects will be established at representative locations within the Project area reach. The site locations represented in Figure 1 identify preliminary reach locations targeted for evaluation. Survey teams will review each reach before selecting a final

transect location in search of heterogenous substrate that supports mussel communities. As a targeted survey design for potential effects associated with a run of river operation, site selection will be adjusted in the field to cover suitable and productive mussel habitat areas and not randomly selected to best maximize the mussel distribution assessment. Center channel areas that remain watered during operation and maintenance events (e.g., deeper than seven feet) are not targeted as part of this survey.

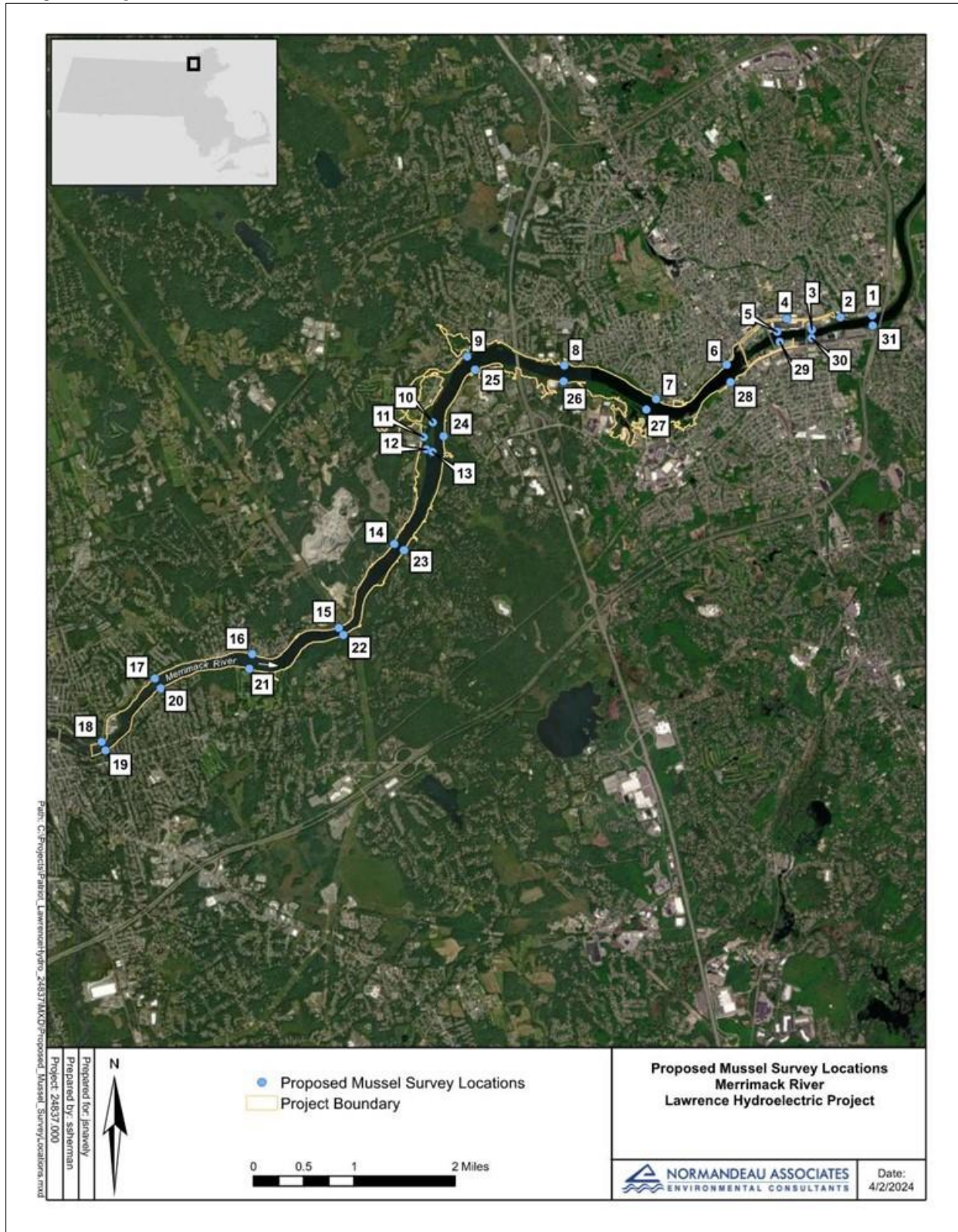
Each search location will be 50 meters in length and oriented parallel to the shoreline with focus on areas most likely to be affected by water level fluctuations down to seven feet of water depth. Given the amount of ledge and bedrock habitat, shoreline locations will be selected in the field based on the likelihood to support mussels. Project staff will survey each search location to assess habitat as well as search for evidence of live mussel populations. Mussel searches will be conducted using both visual and tactile search methods. The width of each 50-meter segment will depend on river contours and bathymetry (maximum width of 5 meters) and will depend on the number of surveyors per transect and habitat type. Habitat and mussel catch will be recorded for each 10-meter transect interval. Each surveyor will search a one-meter-wide area along the transect (1 surveyor = 1 meter; 2 surveyors = 2 meters, etc.). Survey rates will range from 0.5 to 1 minute per square meter in suitable mussel habitat. Faster survey rates will be applied in areas of unproductive habitat (e.g., poor clay or silt areas, ledge, etc.).

In addition, up to 50 spot dives (aka serpentine transects) will be used to further assess observed mussel communities adjacent to or in between transect areas. Spot dives are a standard survey practice and intended to further define mussel distributions in the project area by following productive habitat detect additional species often overlooked by random designs. Coordinates for the start and end of each spot dive will be recorded in 10-minute timed intervals. Habitat and mussel catch data will also be recorded for each spot dive location as described above.

13.6.2 Analysis and Reporting

The results of the mussel survey will be submitted to FERC as a part of the Initial Study Report. The discussion of any effects of Project operation on mussels and proposed measures to protect and enhance populations will be provided in the Draft License Application.

Figure 13-1. Proposed freshwater mussel search locations within the Lawrence Project Impoundment



13.7 Schedule, Level of Effort, and Estimated Cost

Cost to complete the *Freshwater Mussel Habitat Assessment and Survey* is estimated at \$70,000. It is anticipated that the project will be completed during the 2024 study season.

13.8 Discussion of Alternative Approaches

The proposed methods for this study are consistent with accepted professional practices. The overall approach is commonly used in relicensing proceedings and is consistent with generally accepted methods and analytical techniques used by federal and state agencies. In addition, the proposed methods for this study are consistent with FERC study requirements under the ILP. No alternative approaches to this study are necessary.

14 Water Quality Study

14.1 Study Requests

Essex filed a PAD with the Commission on June 16, 2023, and the PSP on November 28, 2023. The Commission’s August 15, 2023 SD1 and November 28, 2023 SD2 identified a variety of aquatic resource issues to be analyzed in the EA for the Project relicensing.

The Commission and MADEP subsequently submitted formal requests related to project effects on water quality, as shown in Table 14-1.

Table 14-1. Water Quality Study Request

Requestor	Requested Study	Date
FERC	Water Quality Study (FERC Schedule B Study Requests)	October 13, 2023
MADEP	Water Quality Study (MADEP Attachment A)	October 16, 2023

14.2 Goals and Objectives

The goal of this study is to collect sufficient data to understand current water quality conditions at the Project, assess the designated uses for the two Assessment Units (MA84A-03 and MA84A-04) potentially affected by the Project, and assess any effects of Project operations on water quality in the affected Assessment Units. Specifically, this study seeks to:

- Measure dissolved oxygen (DO), water temperature, pH, and Secchi disk depth at the deepest known spot in the impoundment.
- Measure DO, water temperature, and pH at fifteen locations under various river flow, river temperature, and project operating conditions to determine the spatial and temporal effects of project operations on water quality. Monitoring locations will include:
 - Five locations upstream of the Project dam.
 - One location in the tailrace.
 - Three locations downstream of the Project dam.
 - Two locations each in both the North and South Canal.
 - Two locations in the Spicket River.
- Collect water samples for laboratory analysis of nutrients and chlorophyll-a conditions upstream of the Project dam.
- Collect water samples to characterize water clarity conditions (i.e., turbidity, total suspended solids, and true color) above and below the dam.

- Evaluate the current macroinvertebrate community at locations upstream and downstream of the Project dam.

14.3 Study Area

The study area will include two hydrologic Assessment Units (AU; MA84A-03 and MA84A-04), specifically the sections of the Merrimack River located immediately upstream of the Essex Dam, the Essex Dam Project development area including the main channel, tailrace, North Canal, South Canal, flow diversion structures, and the Merrimack River immediately below the Project. AU MA84A-03 is an 8.8-mile reach from the Lowell regional wastewater utilities outfall at Duck Island, Lowell to Essex Dam. AU MA84A-04 is a 10.0-mile reach from the Essex Dam downstream to the confluence of the Merrimack and Little Rivers in Haverhill, Massachusetts. The 3.2 mile reach of the Merrimack River from the Pawtucket Dam in Lowell to the Duck Island outfall is AU MA84A-02.

14.4 Background and Existing Information

There are limited available water quality data for the Merrimack River in the vicinity of the Project, as presented in Section 5.3.7 (Existing Water Quality Data) of the PAD. Previously collected data indicate that DO and temperature in the Merrimack River may occasionally exceed water quality standards in the vicinity of the Project; however, the data are greater than 5 years old, limited spatially and temporally, and do not include data from the North and South Canals and their outlets. MADEP and FERC recognize the need for more comprehensive and current water quality information to evaluate the condition of the potentially affected surface waters relative to water quality standards, and to evaluate the Project effects on water quality.

14.5 Project Nexus

Project operations have the potential to affect water quality in the two identified Assessment Units relative to existing and designated uses; however, there is insufficient existing information to determine the current water quality status of potentially affected surface waters and the associated effects of Project operations on water quality. The proposed water quality study will document the current surface water quality conditions in the vicinity of the Project and will document the effects of Project operations on water quality. The proposed study will assist the participating agencies in identifying measures to avoid, minimize, or mitigate potential water quality effects of Project operations in order to support the existing and designated uses established in the applicable water quality standards.

14.6 Methodology

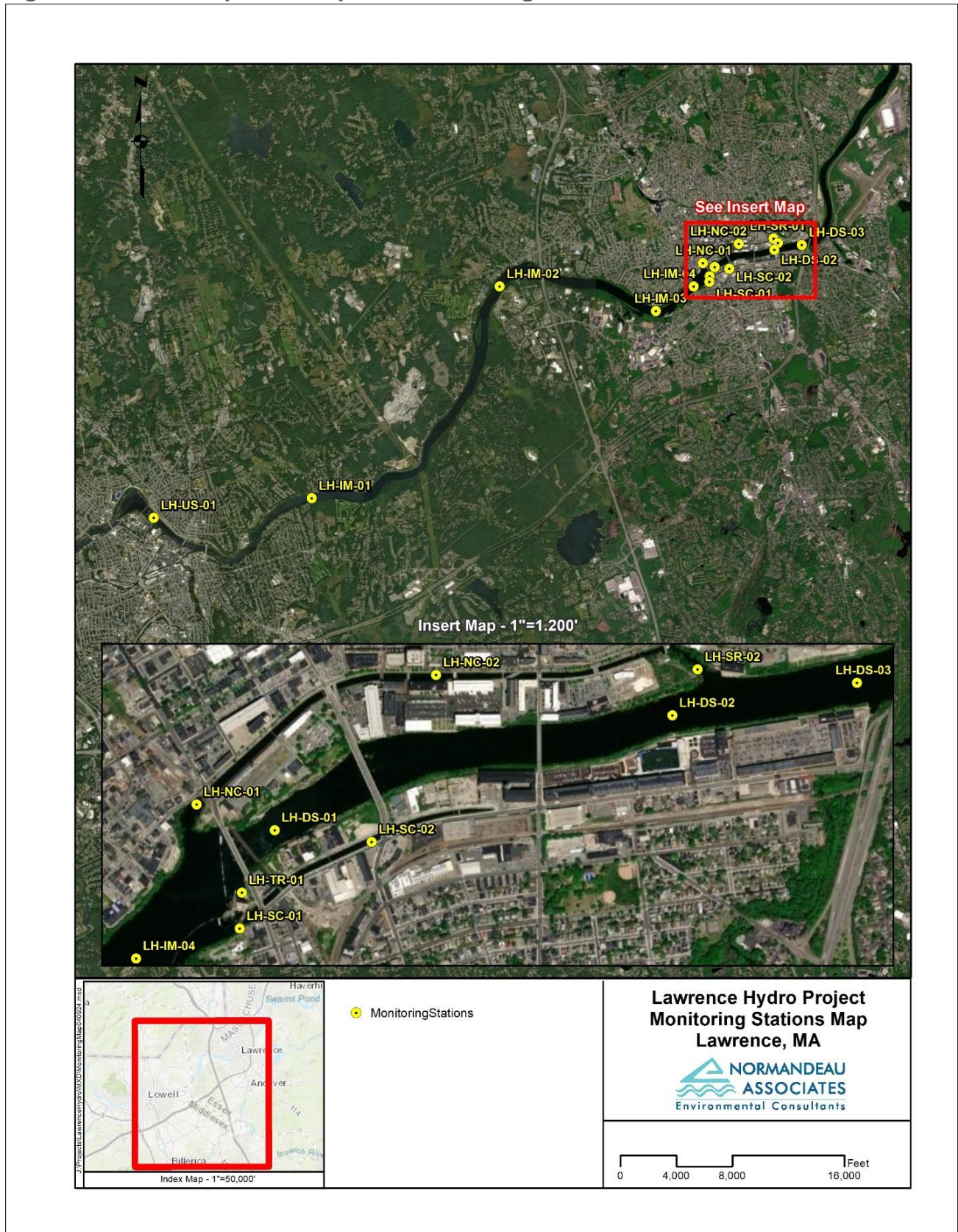
Essex will conduct a water quality study over a four-month period during June-September documenting water quality conditions in the Project area under a range of flow and operating conditions. Data collection will occur at 15 proposed locations, consistent with agency requests, in the vicinity of the Project. The preliminary monitoring locations are presented in Figure 14-1 and Table 14-2 below. Final monitoring locations may be adjusted based on site access and site conditions at the time of deployment and all final monitoring station locations will be documented with GPS position and site photographs, along with any useful supporting information such as water depth and channel width, as appropriate. The impoundment's deepest spot upstream of the boat barrier will need to be field-located by measuring water depth at multiple locations in the lower impoundment.

Table 14-2. Proposed Water Quality Monitoring Locations

Station ID	Description	Latitude, Longitude
LH-US-01	Upstream of the impoundment in a riverine section that is not influenced by project operation	42.652981, -71.313136
LH-IM-01	Project impoundment, upper	42.656763, -71.271162
LH-IM-02	Project impoundment, middle	42.698153, -71.221091
LH-IM-03	Project impoundment, lower	42.693216, -71.179584
LH-IM-04	Project impoundment, deepest spot	42.698024, -71.169515
LH-TR-01	River reach below dam	42.699958, -71.165288
LH-DS-01	Main channel below confluence of spill flow and tailrace	42.701778, -71.163975
LH-DS-02	Main channel between outlet of South Canal and confluence with Spicket River	42.705112, -71.148110
LH-DS-03	Main channel in vicinity of Lawrence I-495 Bridge	42.706045, -71.140742
LH-NC-01	North Canal, at gatehouse	42.702544, -71.167081
LH-NC-02	North Canal, mid-canal	42.706319, -71.157520
LH-SC-01	South Canal, at gatehouse	42.698890, -71.165386
LH-SC-02	South Canal, mid-canal	42.701417, -71.160107
LH-SR-01	Spicket River upstream of North Canal discharge	42.707320, -71.148269
LH-SR-02	Spicket River downstream of North Canal discharge and upstream of confluence with Merrimack	42.706463, -71.147092

This study will include near-continuous water quality monitoring with deployed instruments (Onset Hobo U26-001 DO & temperature logger, Onset Hobo MX2501 pH & temperature logger, and Onset Hobo U20-001 water level logger [used for barometric pressure reference]) at each of the 15 proposed monitoring locations. Vertical profiles of DO and water temperature will be collected weekly throughout the four-month study at Monitoring Station LH-IM-04 (the deepest location in the impoundment). A YSI ProDSS multi-parameter water quality data sonde will be used for measuring vertical profiles and for quality control (QC) readings to evaluate the calibration and performance of the deployed data loggers. Secchi disk depth will be measured concurrent with the water quality profiles at Station LH-IM-04 to assess water clarity in the impoundment. In addition, water samples will be collected on five occasions during the study period for laboratory analysis of nutrient and water clarity.

Figure 14-1. Site Map with Proposed Monitoring Locations



14.6.1 Continuous Water Quality Data Logging

Continuous logging instruments will be deployed with an anchor and buoy system and will be located within the epilimnion of the water column (under stratified conditions) or at a mid-depth position (under unstratified conditions). Stratification will be determined with a mobile water quality instrument during deployments/redeployments. Loggers installed at locations within the North and South Canals will be suspended via a cable or pipe mount dependent on-site access and site conditions. Deployed instrumentation will be set to collect water quality data at 15-minute intervals and will remain deployed for the entirety of the study period of June 1 - September 30. The deployed instruments will be retrieved weekly to download data and to maintain, clean, and calibrate the instruments. An additional water quality instrument (YSI ProDSS, also used for vertical profiles and determining thermal stratification) will be used for independent calibration checks of the continuously deployed instrumentation as detailed in Section 11.6.4 QA/QC protocols. Calibration of the deployed loggers will occur weekly using 100% water saturated air for dissolved oxygen. The barometer used for determining oxygen saturation values at calibration and for calculating oxygen saturation values in the data record (i.e., from oxygen concentration values) will be a water level pressure logger dry-mounted at the site as an atmospheric pressure reference. Calibration of the additional QC meter will be conducted each field day prior to use.

<i>Continuous Dissolved Oxygen Temperature, and pH Monitoring</i>	
Parameter(s):	Dissolved oxygen (mg/L and % saturation), temperature, and pH
Sampling Frequency:	Data loggers will record at 15-minute intervals
Duration:	4 months (June 1 through September 30)
Study Area:	Merrimack River upstream and downstream of the Lawrence Hydroelectric Project, the associated North and South Canals, and the Spicket River upstream and downstream of the North Canal outlet.
Stations:	15 stations – LH-US-01, LH-IM-01, LH-IM-02, LH-IM-03, LH-IM-04, LH-TR-01, LH-DS-01, LH-DS-02, LH-DS-03, LH-NC-01, LH-NC-02, LH-SR-01, LH-SR-02, LH-SC-01, LH-SC-02.
QA/QC Protocol:	Weekly calibration, cleaning, and QC readings
Instrument Specifications:	Onset Hobo U26-001 DO & temperature logger, Onset Hobo MX2501 pH & temperature logger, and Onset HOB0 U20-001 water level data logger (for barometric pressure)

14.6.2 Vertical Profiles of DO and Water Temperature

Water quality measurements taken as a vertical profile through the water column will be collected weekly during site visits at the Project impoundment (monitoring station LH-IM-04, impoundment deepest spot). Bathymetry data are not available at this time for the Lawrence impoundment; however, if bathymetric data are made available for the impoundment prior to the field study those data will be used to help locate the deepest location in the impoundment. Lack that information, an in-situ bathymetric survey will need to be completed at the time of the study to determine the deepest location in the Lawrence Dam impoundment. Depth measurements with a fish finder will be taken at regular intervals along the centerline of the Merrimack River from the buoy line above the dam upstream up to 0.5 mile or as necessary to determine the deepest impoundment zone in the river. The impoundment deep spot will be further refined by returning to the centerline deep spot, then sweeping across the river in a grid pattern making regular depth measurements to locate the deepest accessible point above the dam. The depth will be confirmed with a weighted tape measure then marked with a GPS position.

A YSI ProDSS multi-parameter water quality sonde will be used to measure dissolved oxygen and water temperature as a vertical profile at 0.1 meter below the surface, 0.5 meters below the surface, then every 0.5 meters down to 1.0 meter above the bottom. If the impoundment is deeper than 15 meters, the measurement interval will be increased to every 1 meter of depth below the thermocline, if present. Measurements at each depth interval will be allowed to stabilize prior to recording. Prior to use each field day, the YSI ProDSS will be calibrated following manufacturer guidelines using the water saturated air method for DO calibration (temperature measurements will use the default factory calibration). Vertical profile data will be recorded manually on a field data sheet and/or field notebook. Upon completion of the task, the field data sheets will be processed manually, and the data will be electronically stored in a project database.

<i>Vertical Profiles to Measure Dissolved Oxygen and Temperature</i>	
Parameter(s):	Dissolved oxygen (mg/L and % saturation) and temperature
Protocol:	Measurements taken at 0.1m below surface, 0.5m below surface, then every 0.5m below surface. Final depth measurement is 1.0 m above the river bottom.
Sampling Frequency:	Once per week
Duration:	4 months (June 1 through September 30)
Study Area:	Merrimack River impoundment above Lawrence Dam.
Stations:	1 station – LH-IM-04 (impoundment deepest spot).

QA/QC Protocol:	Calibration prior to use each field day and calibration check after use. 1 field replicate per every 10 measurements.
Instrument Specifications:	YSI ProDSS water quality data sonde with barometric pressure and depth

14.6.3 Secchi Disk Depth

Secchi disk depth will be measured at the Project impoundment deep spot monitoring station (LH-IM-04) concurrent with vertical profiles. An underwater viewer will be used to view the Secchi disk. The Secchi disk depth will be the average of the visible depth while lowering and raising the disk.

<i>Secchi Disk Depth Measurements</i>	
Parameter(s):	Secchi Disk Depth
Protocol:	The reported Secchi disk depth will be the average depth at which the Secchi disk markings are visible while lowering and then raising the disk through the water column. A view tube may be used if sun glare affects the ability to see under water.
Sampling Frequency:	Once per week, concurrent with vertical profiles
Duration:	4 months (June 1 through September 30)
Study Area:	Merrimack River impoundment above Lawrence Dam.
Stations:	1 station – LH-IM-04 (impoundment deepest spot).
QA/QC Protocol:	1 field replicate per every 10 measurements.
Instrument Specifications:	Secchi disk with 1 ft markings visible on the equipment line.

14.6.4 Water Sample Collection for Laboratory Analysis of Nutrients and Chlorophyll-a

Water samples will be collected at three monitoring stations in the project area to characterize nutrient and chlorophyll-a conditions immediately above the project impoundment (LH-US-01) and at two stations within the project impoundment (LH-IM-02 and LH-IM-03) and analyzed for total phosphorus (TP), total nitrogen (TN), and chlorophyll-a. Samples will be collected during five separate sampling events between

June and September. TN and TP samples will be collected from the near-surface (i.e., 25% of total depth) with a Van Dorn or equivalent sampler. Chlorophyll-a samples will be collected as a depth-integrated composite sample for the upper 2 m of the water column. An integrated core sample is collected using weighted tubing to extract an equal volume of water from all depths. All samples will be preserved, stored, handled, and delivered to the participating analytical lab according to lab specifications.

<i>Water Sample Collection for Laboratory Analysis of Nutrients and Chlorophyll-a</i>	
Parameter(s):	Total Phosphorus, Total Nitrogen, and water column Chlorophyll-a
Protocol:	TP and TN samples will be collected from the upper 25% of the water column using a Van Dorn bottle sampler. Chlorophyll-a samples will be collected using an integrated core tube to extract sample water from the upper 2m of the water column.
Sampling Frequency:	5 events total, approximately 1 event per every 4 weeks
Duration:	4 months (June 1 through September 30)
Study Area:	Merrimack River immediately upstream of impoundment and within the impoundment above Lawrence Dam.
Stations:	3 stations – LH-US-01, LH-IM-02, LH-IM-03.
QA/QC Protocol:	1 field replicate per every 10 samples.
Equipment Specifications:	Van Dorn type bottle sampler with spring closure and weighted messenger for remote operation. Integrated core sample tubing with weighted opening.

14.6.5 Water Sample Collection for Laboratory Analysis of Turbidity, TSS, and True Color

Water samples will be collected at four monitoring stations in the project area to characterize water clarity conditions above and below the dam and samples will be analyzed for Turbidity, Total Suspended Solids (TSS), and True Color. Samples will be collected during five monthly sampling events between June and September. Samples will be collected from the near-surface (i.e., 25% of total depth) with a Van Dorn or equivalent sampler. Turbidity will be measured in the field with a turbidity meter and will utilize the same sample water collected for laboratory analysis of TSS and Color. All

samples will be preserved, stored, handled, and delivered to the participating analytical lab according to lab specifications.

<i>Water Sample Collection for Laboratory Analysis of Turbidity, TSS, and Color</i>	
Parameter(s):	Turbidity, Total Suspended Solids, and True Color
Protocol:	Samples will be collected from the upper 25% of the water column using a Van Dorn bottle sampler. TSS and Color samples will be transferred to laboratory sample bottles. TSS samples will be field measured using a portable turbidity meter.
Sampling Frequency:	5 events total, approximately 1 event per every 4 weeks
Duration:	4 months (June 1 through September 30)
Study Area:	Merrimack River immediately upstream of impoundment, within the impoundment above Lawrence Dam, below the dam, and below the Project canal outflows.
Stations:	4 stations – LH-US-01, LH-IM-03, LH-DS-01, and LH-DS-03.
QA/QC Protocol:	1 field replicate per every 10 samples.
Equipment Specifications:	Van Dorn type bottle sampler with spring closure and weighted messenger for remote operation. Oakton TN-100 Turbidity Meter.

14.6.6 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrate (BMI) sampling will be conducted using the Large River Bioassessment Protocol for Benthic Macroinvertebrate Sampling (LR-BP) as described in the USEPA guidance document *Concepts and Approaches for the Bioassessment of Non-wadeable Streams and Rivers* (Flotemersch et al. 2006²⁴). BMI sample collections will occur at two locations; one upstream of the Project impoundment and one downstream of the Project dam. Essex will consult with Mass DEP on the final placement of the BMI sampling locations.

²⁴ Flotemersch, J. E., J. B. Stribling, and M. J. Paul. 2006. *Concepts and Approaches for the Bioassessment of Non-wadeable Streams and Rivers*. EPA 600-R-06-127. US Environmental Protection Agency, Cincinnati, Ohio.

The LR-BP specifies a reach length of 500 meters (m). At each site, there are a total of six transects. Transect A is located at the downstream end of the reach with the remaining five transects at 100 m, 200 m, 300 m, 400 m and 500 m upstream. At each transect, a 10-m sample zone (5 m on each side of transect) on each bank defines where macroinvertebrates will be collected. The zone extends from the edge of water to the point where water depth exceeds 1 m. Six sweeps, each 0.5 m in length, are collected within the zone using a D-frame net (500- μ m mesh). Each sweep covers 0.15 m² of substrate (six sweeps will cover an area of 0.9 m²). The six sweeps will be proportionately allocated based on available habitat within the 10-m sample zone. Each transect has two zones (one on each bank) and samples from the entire reach will be composited into a single sample. This results in each sample containing debris and organisms from 12 separate zones (total of ~12 m²) that represent the 500-m reach.

Sample material will be composited for the entire site, and then placed into a sieve bucket to drain excess water and allow washing of fine sediments. Large objects (e.g., rocks, woody debris) will be inspected, attached invertebrates picked from them, and the objects are returned to the river. Each piece of substrate will be gently washed or scrubbed to remove attached organisms and removed from the sieve bucket after cleaning. Following sieving, samples will be transferred to a suitable container and preserved with ethanol (70% final concentration) or a 10% buffered formalin solution.

Macroinvertebrate samples will be sent to a benthic taxonomy laboratory where taxonomists will sort, identify, and enumerate each sample. Sorting will continue until a total of 500 organisms have been removed. Sorted organisms will be analyzed using stereo-zoom and compound microscopes then identified and enumerated to the lowest practical taxon, generally genus and species, dependent on their age and condition using published taxonomic keys.

Flotemersch et al. (2006) provide a list of metrics by which to evaluate (1) richness and diversity, (2) composition and evenness, (3) pollution intolerance, and (4) functional feeding groups. Scores for each metric will be generated for the two BMI sampling locations.

14.6.7 Quality Assurance/Quality Control (QA/QC) Protocols

Prior to deployment, redeployment, or use for spot measurements, water quality instruments will be cleaned, inspected for fouling, damage, or other performance affecting conditions, and calibrated according to manufacturer recommendations and established best practices. A log of calibration data will be maintained to establish a project record of instrument performance history. Calibration acceptance criteria are presented in Table 14-3. All calibration information will be included in the final water quality report and any post-deployment calibration checks that fail the QA/QC targets will be flagged and noted in the report. Field replicate samples will be collected during the study at a frequency of 1 replicate per every 10 samples. Field replicates apply to vertical profile measurements and Secchi disk depth measurements. The field replicates will provide a QC assessment of field sampling methods and any potential sampling errors.

Table 14-3. Field Meter Calibration Method, Frequency, and Acceptance Criteria

Parameters	Frequency of Calibration	Calibration Acceptance Criteria
Dissolved Oxygen	<p><u>Instantaneous readings</u> Prior to each measurement</p> <p><u>Datasonde Deployments</u> Datasonde must be calibrated before deployment and at least weekly (or more frequently if meter fouling is likely to occur).</p>	<p><u>Instantaneous readings</u> Record the calibration value in % saturation and after one-minute record the % saturation reading and compare to the calibration value.</p> <p>The dissolved oxygen % saturation reading should be $\pm 5.0\%$ of dissolved oxygen % saturation calibration value.</p> <p><u>Datasonde Deployments</u> After the datasonde is calibrated, record the datasonde instantaneous mg/L reading immediately after calibration and the Oxygen Solubility in Water Value based on concurrent water temperature and barometric conditions.</p> <p>The difference between the datasonde instantaneous reading immediately after calibration and the Oxygen Solubility Water Value must be no greater than ± 0.2 mg/L. If the difference is greater, recalibrate.</p> <p><u>Datasonde Retrieval</u> After removal from water, set up the datasonde so that it is under 100% saturated air conditions. After dissolved oxygen readings have stabilized, record the datasonde instantaneous mg/L reading and the Oxygen Solubility in Water Value based on concurrent water temperature and barometric conditions.</p> <p>The difference between the datasonde instantaneous reading immediately after calibration and the Oxygen Solubility Water Value must be no greater than ± 0.5 mg/L.</p> <p>If the datasonde is going to be redeployed, and it hasn't been more than 1 week since the last calibration, recalibrate if the difference is greater than ± 0.2 mg/L. If it has been 1 weeks since the last calibration, recalibrate regardless of the difference.</p>
Temperature	Not Applicable	Not Applicable
pH	<p><u>Instantaneous readings</u> Three-point calibration prior to each measurement (4.00, 7.00, and 10.00 calibration standards)</p> <p><u>Datasonde Deployments</u> Datasonde must be calibrated before deployment and at least weekly (or more frequently if meter fouling is likely to occur).</p>	<p><u>Instantaneous readings</u> Record calibration slope prior to each measurement. Slope should be between 95% - 105%. If slope is out of range, the meter should be recalibrated.</p> <p><u>Datasonde Deployments</u> After three-point calibration record the datasonde reading of the standards used. Reading should be ± 0.05 pH units from each calibration standard. If the difference is greater, recalibrate.</p> <p><u>Datasonde Retrieval</u> Datasonde should measure the standards used in the calibration. Datasonde readings should be ± 0.3 pH units from each calibration standard.</p> <p>If the datasonde is going to be redeployed, and it hasn't been more than 1 week since the last calibration, recalibrate if the difference is greater than ± 0.3 pH units. If it has been 1 week since the last calibration, recalibrate regardless of the difference.</p>

Instrument performance will be evaluated using side-by-side QC readings between deployed meters and a handheld meter (YSI ProDSS used for vertical profiles). The acceptance criteria for simultaneous measurement differences between instruments is presented in Table 14-4, below. The final water quality report will include a summary table that includes the relative percent difference and absolute difference values from side-by-side QC reading data pairs and data pairs that fail the QA/QC acceptance criteria will be noted in the report. If an instrument fails the acceptance criteria, then further evaluation is warranted and may require flagging data or removing data from the final dataset.

Table 14-4. Data QC Acceptance Criteria

Parameters	Frequency of Measurement Checks*	Acceptance Criteria (i.e., maximum difference between the handheld and datasonde measurements)* RPD – Relative Percent Difference ABS – Absolute Difference
Dissolved Oxygen	Handheld measurements should be taken at the time of datalogger deployment, once a week throughout the deployment and at the time the datalogger is removed. Handheld measurements should be taken as close as possible to the location of the datalogger.	RPD between handheld measurement and datalogger should be ≤ 10%. If RPD is > 10% the absolute value of the difference between the handheld measurement and the datalogger measurement should be ≤ 0.4 mg/l or ≤ 4% saturation.
Temperature	Same as above	RPD between handheld measurement and datalogger should be ≤ 10%. If RPD is > 10% the absolute value of the difference between the handheld measurement and the datalogger measurement should be ≤ 0.5 °C.
pH	Same as above	The absolute value of the difference between the handheld measurement and the datalogger measurement should be ≤ 0.3 pH units
Specific Conductance	Same as above	± 5 µS/cm or ± 3% of the measured value, whichever is greater
<p>*Adjacent measurements with the handheld meter are taken at same location and depth as the datasonde. ** The relative percent difference (RPD) is equal to the following:</p> $RPD = \frac{ x_1 - x_2 }{\frac{x_1 + x_2}{2}} \times 100\%$ <p>where x_1 is the original sample concentration, and x_2 is the replicate sample concentration</p>		

The continuous monitor sonde data will be stored electronically in the data logger and downloaded in the field to a handheld device or laptop computer. All data downloaded to the handheld device or computer will be transferred to the Normandeau computer network and subsequently formatted and quality controlled. Field data recorded on data

sheets will be processed, quality controlled, and stored with the other project data. Data analysis will be completed using software such as Microsoft Excel, Microsoft Access, Matlab, Aeronautical Reconnaissance Coverage Geographic Information System (ArcGIS), and/or Statistical Analysis Software (SAS) software. All project data will be stored on the Normandeau network which is backed up nightly.

14.6.8 Flow and Operations Data

Operations data for the Project, including impoundment water surface elevation at the Project dam, crest gate settings, estimated flows diverted to the North and South Canals, fish passage facility flows, outflow from the turbines, and power generation at each generating unit will be provided for the study period by Essex. Flow through the turbines will be determined from power output and established power-flow regressions for each unit. Impoundment water surface elevations are measured continuously with pressure transducers deployed on the Project headworks.

Flow records will be developed for the study period and will include inflow to the Lawrence Dam impoundment, outflow through the turbines and into the Project tailrace, fish passage facility flows, and estimated spill flows and through the North and South Canals. Turbine outflow will be determined from power output of individual turbine units and established power-flow relationships.

Inflow will be developed for the Project impoundment by prorating (adjusting for drainage area) the 15-minute data obtained from the nearest USGS gage in the watershed (USGS 01100500 MERRIMACK RIVER AT LAWRENCE, MA²⁵). Flow data will be compiled in a spreadsheet. Spill flows will be assumed to be equal to inflow less outflow through the turbines, fish passage facilities and estimated flows in the North and South Canals.

14.6.9 Data Analysis and Reporting

A report will be completed and submitted to the participating agencies that includes graphics and tables presenting the data collected and will provide a narrative of our findings. Any anomalous or indicative events will be highlighted. All quality-controlled water quality data obtained as part of this study will be presented, as will a comparison of measured data to state water quality standards, a comparison of water quality between different stations and at different flow and temperature conditions to evaluate Project operations on water quality, as well as copies of field logs and QC data, and a site map showing final station locations. A table summarizing all deviations from the approved study plan will be provided in the report. All study data including results, QA/QC data, calculations, etc. will be provided to the participating agencies in a working Microsoft Excel spreadsheet. Data will be summarized and presented in a manner that clearly demonstrates the spatial and temporal effect of Project operations (in terms of flow,

²⁵ <https://waterdata.usgs.gov/monitoring-location/01100000/#parameterCode=00060&period=P7D&showMedian=false>

impoundment elevation and power generation) on surface water quality and if applicable surface water quality standards are met.

14.7 Schedule, Level of Effort, and Estimated Cost

Prior to the onset of the Water Quality Study, Essex will develop and submit a Quality Assurance & Performance Plan (QAPP) to the MADEP Watershed Planning Program for review and approval. Due to the expected issuance date of the Commission’s Study Plan Determination (i.e., May 10, 2024), development of the QAPP may not leave sufficient time 2024 for a complete field sampling season, so it is likely that this study will be conducted during the 2025 field season from June 1 – September 30. The cost for this assessment as described in this RSP is estimated at approximately \$120,000.

14.8 Discussion of Alternative Approaches

The proposed methods for this study are consistent with accepted professional practices. The overall approach is commonly used in relicensing proceedings and is consistent with generally accepted methods for and analytical techniques used by federal and state agencies. In addition, the proposed methods for this study are consistent with FERC study requirements under the ILP. No alternative approaches to this study are necessary.

15 Three-Dimensional Computational Fluid Dynamics (CFD) Modeling

15.1 Study Requests

The Commission’s August 15, 2023 SD1 identified a variety of aquatic resource issues to be analyzed in the EA for the Project relicensing. The MADMF, MassWildlife, NHFG, NMFS, and USFWS submitted formal requests for a 3D CFD modeling study of the Project’s fish passage facilities, approaches, and routes, as shown in Table 15-1.

Table 15-1. Aquatic Resource Study Request

Requestor	Requested Study	Date
MADMF	Fishway Hydraulic Modeling Study (CFD) (study request #1)	October 16, 2023
MassWildlife	Fishway Hydraulic Modeling Study (CFD) (study request #8)	October 16, 2023
NHFG	Hydraulic Modeling Study (study request #8)	October 16, 2023
NMFS	Hydraulic Modeling Study (study request #2)	October 16, 2023

Requestor	Requested Study	Date
USFWS	Hydraulic Modeling Study (study request #8)	October 17, 2023

15.2 Goals and Objectives

The goal of this study is to determine the flow field conditions that exist in and around the Lawrence Project’s upstream and downstream migratory fish passage routes. This is anticipated to aid in the interpretation of conditions for the guidance of migrating fish to and through the fish passage facilities. The objectives of this study are to:

- Develop and calibrate 3D models of areas pertinent to fish passage structures including the Essex Powerhouse forebay and downstream bypass, tailrace, and fish lift;
- Simulate various operational conditions using each model; and
- Produce a series of color contour maps depicting flow fields relating to attraction and hydraulics.

15.3 Study Area

The study area includes upstream of the Essex Powerhouse intakes and dedicated fish bypass in the forebay, downstream of fishway entrances in the tailrace, and internally within the fish lift.

15.4 Background and Existing Information

Existing studies pertaining to upstream and downstream migratory fish passage are summarized in Section 5.4 of the PAD. Diadromous upstream fish passing through the Lawrence Project via the fish lift have been counted through the viewing windows since 1983. River herring (alewife and blueback herring) counts have varied, with an annual low of 51 documented fish passing through the Lawrence lift in 1996 and a record high of 417,420 in 2016. American shad counts were relatively stable throughout the duration of the period of record, peaking at 89,467 in 2015. Normandeau Associates, Inc. conducted a series of five investigations focused on diadromous fish in the Merrimack River over a period of time from 1993 through 1996. The results of these studies revealed that upstream passage of American Shad was not very effective, suggesting that improvements are needed for the Projects fish lift system. Additionally, a study conducted in 1996 revealed that the downstream passage route of Atlantic salmon smolt was largely through the Project turbines, suggesting poor entrance efficiency in the fish bypass.

In 2016, Essex purchased new radio telemetry equipment to assist the USFWS monitoring at three sites to assess the downstream movement of radio tagged adult eels released at the Merrimack River Project upstream (Cleantech 2017). In 2017 Essex deployed telemetry equipment at six locations at the Lowell Project and two locations at

the Lawrence Project to again track the movement of radio-tagged eels released at the Merrimack River Project through the Lawrence Project facilities. In early 2022, a crowder system was installed within the fish lift system to facilitate the trapping and trucking of migratory species to upper portions of the Merrimack River watershed by the MRTC.

The results of studies conducted at the Lawrence project outline potential issues with entrance efficiency in the downstream fish bypass, trap efficiency in the upstream fish lift, and project operations on fish passage route selection. There are no existing 3D models for the Project's fish passage facilities.

15.5 Project Nexus

Diadromous fish migrating upstream and downstream in the Merrimack River as part of their life cycle encounter the Lawrence Project. Potential effects of Project operations and facilities include upstream and downstream passage effectiveness and efficiency. The development of CFD models relative to the fish passage facilities will provide information regarding hydraulic conditions related to the passage routes.

15.6 Study Methodology

CFD models will be developed, and simulations of various operational conditions will be run to investigate the hydraulic conditions of the fish passage structures and their approach areas. In order to complete this study, several tasks will be completed: Bathymetric survey and 3D velocity data collection, model construction and calibration, and model simulation runs.

15.6.1 Bathymetric Survey

Essex preliminarily proposes to model areas pertinent to fish passage, as described herein, but anticipates conducting a working group meeting(s) with the MRTC in the summer/fall of 2024 to discuss the appropriate domains and mesh size of areas to be surveyed and modeled. If necessary for model development, surveys will be conducted using an Acoustic Doppler Current Profiler (ADCP) or Ortho imagery Light Detection and Ranging (LiDAR) to collect bathymetry, depth, and 3D flow data. Velocity data within the fish lift entrances will be collected with an ADCP, LiDAR, or Acoustic Doppler Velocimeter.

15.6.2 Model Construction and Calibration

Essex proposes to construct 3D models for three areas pertinent to fish passage:

- The Essex Powerhouse forebay and downstream bypass;
- The Essex Powerhouse tailrace and;
- The Essex Powerhouse fish lift.

The field collected bathymetry data and Project elevation data will be used to construct 3D surfaces of the riverbed in the forebay and downstream bypass, tailrace, and fish lift study areas. Project drawings will be used to develop 3D representation of the fish passage structures and other pertinent Project facilities and compiled into a full computer aided drawing (CAD) representation for each of the model areas. The CAD files will then be used to build 3D hydraulic models. Then field collected water surface and flow data will be used to run calibration/validations scenarios.

15.6.3 Model Simulation Runs

The calibrated and validated models will be used to run simulations under various input operational scenarios. Essex has developed a suite of potential simulation runs based on stakeholder study requests but anticipates conducting working group meeting(s) to discuss scenarios to be simulated. Proposed simulations include:

15.6.3.1 Essex Powerhouse Forebay and Downstream Bypass Model

With downstream bypass set at normal operating conditions at recommended settings:

- River flow 1,000 cfs, typical unit setting
- River flow 3,000 cfs, typical unit setting
- River flow 8,000 cfs, both units full generation
- River flow 16,000 cfs, both units full generation

15.6.3.2 Essex Powerhouse Tailrace Model

Tailrace model with fish lift at recommended settings:

- River flow 1,000 cfs, typical unit setting
- River flow 3,000 cfs, typical unit setting
- River flow 8,000 cfs, both units full generation
- River flow 16,000 cfs, both units full generation

15.6.3.3 Essex Fishway Model

With attraction water system flow to be calculated by the model with both entrances operating.

- River flow 1,000 cfs, typical unit setting (i.e., low tailwater condition)
- River flow 8,000 cfs, both units full generation
- River flow 12,000 cfs, both units full generation
- River flow 24,000 cfs, both units full generation (i.e., high tailwater condition)

15.7 Analysis and Reporting

A report will be developed to include maps, cross-sections, and other representations of the simulation results that are relevant to the study objectives, as well as a summarization of findings relevant to the objectives of the study. Essex anticipates that the 3D CFD Modeling study report will include the following elements:

- Project information and background,
- Study area,
- Methodology,
- Study results,
- Analysis and discussion,
- Any agency correspondence and or consultation, and
- Literature cited.

15.8 Schedule, Level of Effort, and Estimated Cost

Essex anticipates holding a working group meeting with the MRTC following the issuance of the SPD to review and refine the appropriate domains and mesh size of areas to be surveyed and modeled. Essex anticipates collecting the bathymetric data in the summer/fall of 2024. Due to diverse locations and accessibility of the areas to be surveyed in the forebay, tailrace, fish bypass and within the fish lift, potentially four bathymetric and flow data collection surveys will be needed. Separate CFD models will be constructed, and the recommended simulations run in the winter of 2024/2025. Essex anticipates filing the final report concurrent with the ISR.

The preliminary estimated cost for this study is \$170,000 – \$200,000.

16 Recreation Facilities, Use, and Aesthetics Study

16.1 Study Requests

The Commission’s November 28, 2023 Scoping Document 2 identified various recreation and aesthetic resources to be analyzed in the Commission’s EA. GWL, FERC, and the NPS submitted formal requests related wholly or in part to recreation use and aesthetics in the Project area as shown in Table 16-1. Other stakeholders submitted informal study requests or comments. This study plan was updated based in a February 22, 2024 meeting with the City of Lawrence, GWL, LCW, and Lawrence Conservation Commission, as well as FERC’s comments on the PSP.

Table 16-1. Recreation Use and Needs Study Requests

Requestor	Requested Study	Date
GWL	Recreation, Land Use, and Aesthetic Resources	October 13, 2023
FERC	Recreation Facilities, Use, and Aesthetics	October 13, 2023
NPS	Recreation, Land Use, and Aesthetic Resources	October 13, 2023
NPS	Vegetation and Aquatic Trash Management Study	October 13, 2023

- GWL requested a series of studies to evaluate the adequacy of existing access to areas in and adjacent to Project lands, the condition of existing recreational facilities, increased access for recreation to and within the canals, including the development of new recreational structures and improvements to existing recreational facilities. GWL also requested an assessment of land use and property ownership to identify entities responsible for the operation and maintenance of recreational facilities.
- FERC requested a series of studies pertaining to the effects of continued Project operation on recreational use and aesthetic resources in the Project area, the adequacy of existing recreational access, and the adequacy and capacity of existing recreational facilities. FERC also requested an assessment of the effects of Project operations on the accumulation of debris and vegetation in relation to the canal and canal walls. In addition, FERC requested an evaluation of how visitors currently use the Project areas and if the facilities are Americans with Disabilities Act (ADA) accessible.
- The NPS requested a study to evaluate increased access for recreation to and within the canals, including the development of new recreational structures and improvements to existing recreational facilities.

16.2 Goals and Objectives

The goals of this study are to (a) document existing recreation facilities and recreational activities that occur at the project, (b) determine the adequacy and capacity of existing recreational facilities to accommodate current and future recreational needs, and (c) identify areas within the canal system where vegetation growth on historic canal walls and waterborne trash occur.

The specific objectives of the study are to:

- Identify existing recreation facilities within and adjacent to the project boundary;
- Quantify current recreational use based on consultation with stakeholders, regional and statewide plans, and other available data;
- Identify proposed recreational uses based on surveys and consultation with stakeholders;
- Identify areas of aesthetic concern related to concentrated trash with the canals and vegetation growth on historic canal walls; and
- Gather information on the condition of Essex's recreation facilities and identify any need for improvement.

16.3 Study Area

Essex proposes a general study area that includes the FERC Project Boundary and adjacent recreation facilities.

16.4 Background and Existing Information

Existing relevant and reasonably available information regarding recreation in the Project vicinity was summarized in Section 5.8 of the PAD. The Merrimack River provides extensive recreational opportunities. Activities such as boating, canoeing, kayaking, rowing, fishing, and swimming take place on the river. The surrounding vicinity is used for walking, hiking, cross-country skiing, picnicking, bird watching, nature study, and overall enjoyment of scenic views. There are several parks and conservation areas located in the vicinity of the Project. These parks offer a variety of amenities including walking trails, picnic areas, gazebos, park benches, fishing access, a boat trailer ramp, and a visitors' center.

A list of the recreational facilities in the vicinity of the Project is provided in Table 5.8-1 of the PAD. The Lawrence Redevelopment Authority, on behalf of Massachusetts Department of Conservation and Recreation (MADCR), developed a greenway and pedestrian walkway along the length of the North Canal. On the north side of the North Canal is the Lawrence Heritage State Park, owned and managed by MADCR, which features a visitors' center and Visitor Center Park. Between the North Canal and the Merrimack River exists Pemberton State Park, maintained by the City of Lawrence,

which provides a trailer boat ramp, fishing access, a gazebo, park benches, and walking trails. Further downstream of Pemberton State Park is Nunzio DiMarca Park,²⁶ which has walking trails, a picnic area, and a gazebo. The Spicket River Greenway is a 3.5-mile-long walking path with connecting parks that extends from Manchester Street Park to Nunzio DiMarca Park. The Riverwalk Complex has been undergoing redevelopment since 2012 and has included renovation of the mill buildings along Merrimack Street and development of the Riverwalk multi-use recreational trail.

Upstream of the Project is the Lawrence Riverfront State Park, which provides extensive trails, pedestrian bridges, a trailer boat launch, picnic area, playground, gazebo, basketball court, and a street hockey rink. The Abe Bashara Boathouse is located within Lawrence Riverfront State Park and provides sailing lessons, watercraft rentals, and a docking system. The Methuen Riverside Boat Ramp is located approximately 2.7 miles upstream and provides a trailer boat launch and fishing access. The Merrimack River Trail extends on the south shore of the impoundment and includes part of the Bay Circuit Trail, a 230-mile-long trail that traverses the outskirts of Boston. Several municipal parks, conservation lands, boathouses, private boat docks, and athletic facilities are located along the impoundment. A complex of conservation lands is located on river-right approximately 4 miles upstream. Additionally, the Boys and Girls Club of Lawrence, Raymond J. Martin Riverside Park, Phillips Academy Boathouse, Merrimack College Boathouse, Trull Brook Golf Club, and Hickory Hill Golf Course are located along the impoundment. The Clean River Project is located on river-left of the impoundment and offers boat tours of the Merrimack River. The Merrimack Valley Seaplane Base is located west of the Merrimack-Methuen Bridge.

The City of Lawrence contains several recreational opportunities, including parks, athletic facilities, youth facilities, and public pools. There are several plans for redevelopment by various stakeholders in the vicinity of the Project that would provide greater access to the Merrimack River and surrounding area. The Lawrence Rail Trail is proposed as a multi-use recreational path with connecting greenspaces that would cross the Merrimack River, providing pedestrian access to Downtown Lawrence and facilities along the Merrimack River (MassDOT undated). Several other trails are proposed, including a trail along the northern shoreline of the impoundment (City of Lawrence 2017).

16.5 Project Nexus

The principal facilities that comprise the Lawrence Project are located in a largely urban area and adjacent to recreational facilities including Lawrence Heritage State Park, Riverfront State Park, Pemberton Park, and Nunzio DiMarca Park. Project facilities, including the canal system and historic infrastructure, attract tourists and feature prominently in recreational activities within the parks. Project operations have the potential to affect recreational use and aesthetics within the various parks in the Project area and the City of Lawrence. The results of this study, in conjunction with existing

²⁶ Previously known as Ferrous Park / Ellen Swallow Richards Park.

information, can be used to inform resource discussions within the license application materials.

16.6 Methodology

Essex intends to conduct a Recreation Facilities, Use, and Aesthetics Study in accordance with the specific methods described below.

16.6.1 Literature Review

Prior to conducting a field inventory, Essex will conduct desktop research and a literature review to identify and describe recreational uses in the Project area. As a component of this research, Essex will review existing recreational uses, facilities management plans (as applicable), limitations, and regulations applicable to the Project area including, but not limited to:

- The Massachusetts Statewide Comprehensive Outdoor Recreation Plan (SCORP)
- The City of Lawrence Open Space and Recreation Plan (OSRP)
- The Lawrence Canal District Revitalization Strategy (2007)
- The City of Lawrence Canal Wall Assessment (2019)
- The Lawrence Gateway Project (2004)
- The Merrimack Street Land Use Planning Study
- The Reviviendo Gateway Initiative Campaign (2002)
- The Massachusetts Recreational Trails Program Guide
- Merrimack River Study: Rowing Community (2019)
- Merrimack River Watershed Assessment Study, Final Phase I Report (2006)
- Merrimack River Recreation Survey (2023)
- Merrimack River Users Survey (2021)
- Merrimack River Trail, Reconnaissance Planning Report (2011)
- A Land Conservation Plan for the Merrimack River Watershed of New Hampshire and Massachusetts (2014)
- The City of Lawrence Parks and Open Space and Recreation Plan (2017- 2024)
- The Groundwork Lawrence Environmental and Open Space Improvements
- The City of Lawrence Capital Improvement Plan (2019-2023)
- Essex's internal use records of frequency of tours of the North Canal Carriage House²⁷; and
- Publicly available geospatial data from the State of Massachusetts and City of Lawrence.

As identified by GWL in their October 13, 2023 comment letter and study requests, the literature review will include a description of known efforts to extend the Merrimack River Trail and build the pedestrian bridge across the North Canal, and includes an analysis of

²⁷ Since tours of the North Canal Carriage House are by appointment only, Essex will quantify current recreational use based on their internal records of tours.

easements and land ownership based on publicly available information (or information provided to Essex).

Additionally, Essex will issue a data request to interested stakeholders to provide relevant documentation or applicable guidance documents for inclusion in the literature review. Stakeholders to be contacted as part of this data request include: GWL, NPS, Lawrence Redevelopment Authority, City of Lawrence, MADCR, Lawrence Community Works, Greater Lawrence Community Boating, Andover Village Improvement Society, Lawrence Conservation Commission, City of Lawrence Recreation Department, Abe Bashara Boathouse, the Town of Andover, Andover Trails Committee, Inc., and the Town of Methuen. Requested data will include visitor use records, guidance documents, maintenance records, engineering plans, and any relevant or pertinent information provided by stakeholders.

16.6.2 Identification of Focus Group Participants and Focus Group Meetings

Essex will establish a focus group to include a representative(s) from community organizations and governmental agencies. The preliminary list includes: GWL, NPS, Lawrence Redevelopment Authority, City of Lawrence, MADCR, Lawrence Community Works, Greater Lawrence Community Boating, Andover Village Improvement Society, Lawrence Conservation Commission, City of Lawrence Recreation Department, the Town of Andover, and the Town of Methuen.

As noted below, the Focus Group Participants will have the opportunity to participate in the selection of formal and informal facilities to be included in the field inventory, to attend the subsequent field inventory, and participate in the selection of representative sites to be included in the field reconnaissance and visitor-intercept surveys. Essex also anticipates holding a final focus group meeting to discuss the results prior to filing the final report with the Commission.

16.6.3 Field Inventory

Essex will work with the Focus Group Participants to determine which existing formal and informal recreational facilities within or adjacent to the Project Boundary should be included in the Field Inventory, for a maximum of 16 sites total.²⁸ While Essex understands formal recreation facilities (e.g. established facilities such as Abe Bashara Boathouse, Merrimack River Trail, and Lawrence Riverfront State Park) within and adjacent to the Project Boundary, Essex is seeking input from the Focus Group Participants to identify informal recreational facilities (e.g. river access areas, informal trails) to be documented by the field Inventory.

²⁸ Essex recommends including the same 10 sites selected for the Field Reconnaissance and Visitor-Intercept Surveys below in Section 1.6.4.

Focus Group Participants will be invited to attend the field inventory. The field inventory will include a brief description of the site, a catalog of the facilities and amenities provided at the site, photographs of the site, and an estimate of parking capacity provided at the site. Locations of recreational facilities will be recorded and mapped using GPS. Essex will document the current condition of each site with a written description and georeferenced photographs. Essex will also record other relevant and applicable information for each recreational facility including:

- A description of the type and location of existing recreation facilities;
- Property Ownership;
- The type of recreation provided (boat access, angler access, picnicking, etc.);
- Existing amenities and sanitation;
- The type of vehicular access and parking (if any);
- Any recreational use observed at the time of the field inventory;
- Suitability of facilities to provide recreational opportunities and access for persons with disabilities (i.e., compliance with current ADA standards for accessible design);
- Georeferenced photographic documentation of recreation facilities; and
- On-site comments provided by Focus Group Participants.

16.6.4 Field Reconnaissance and Visitor-Intercept Surveys

Essex will conduct field reconnaissance and visitor-intercept surveys with respondents at the following representative formal and informal recreation facilities during the prime recreational season from May 1, 2025 through October 1, 2025:

- The Lawrence Heritage State Park - Formal
- Pemberton State Park - Formal
- The Merrimack River Trail - Formal
- The Lawrence Riverfront State Park - Formal
- The Spicket River Greenway - Formal
- Nunzio DiMarca Park - Formal
- Abe Bashara Boathouse - Formal
- Three representative informal recreation sites determined in consultation with the Focus Group Participants

The seven representative formal sites above were selected due to their known importance to the community (as evidenced by study requests and comment letters). Three representative informal recreation sites will be determined in consultation with the Focus Group Participants.

Surveys will be conducted during normal daylight hours. Essex intends to conduct surveys on two random weekdays and two random weekend days on a monthly basis

between May and October during the study season. Essex will also randomize the order in which the sites are attended to capture different use during different times of day.

Essex expects that one team of two technicians will rotate between each of the recreation sites and will spend approximately one hour at each site conducting surveys/interviews. Essex will conduct in-person surveys of individual recreationists and groups. Prior to rotating to the next site, technicians will record relevant conditions, including observed recreational activities, estimated number of vehicles, and number of recreational users. General information regarding date, time, and weather conditions will also be recorded by technicians. Field technicians will assess safety conditions upon arrival of each site, and technicians reserve the right to withdraw from the site and move to the next. Essex will document these occurrences, if any, in the final report.

Essex will develop survey questions based on general concepts and guidance from the U.S. Forest Service's (USFS) National Visitor Use Monitoring Handbook (USFS 2007) and questions that were asked during recreation studies for other relevant hydropower relicensings. The survey/interview will address topics such as (but not necessarily limited to):

- General user information;
- Age group, resident/visitor;
- Purpose and duration of visit;
- Distance traveled;
- Day use/overnight lodging;
- History of visiting the site or area;
- Types of recreational activities respondents participated in or plan to participate in during their visit; including types of recreational equipment transported;
- Reasons for choosing the site or area;
- Areas of concern regarding vegetation growth on historic canal walls and waterborne trash; and
- Other recreational sites that respondents visited or intent to visit during their trip.

16.6.5 Visual Survey for Vegetation and Waterborne Trash

Essex will survey the North Canal and South Canal on foot or by boat to visually inspect and document vegetation and waterborne trash within the study area. Essex anticipates conducting one vegetation survey during the middle of Spring (e.g., mid-May), another survey during the height of the growing season in early summer (e.g., late June or early July) and a survey for vegetation at the end of the growing season (e.g., August/September), for a total of three vegetation survey dates. During vegetation field surveys, technicians will record readily identifiable species including native and non-native species.

If conditions are appropriate, Essex will simultaneously perform the two surveys for waterborne trash, with one survey date during, or as close as possible to, the height of the spring runoff, typically in April or May. Observations will be recorded regarding vegetation type, depositional setting, and evidence and location of waterborne trash. Data collected during this portion of the survey will include detailed field notes, site sketch maps, and photographic documentation. Essex will map vegetation growth along the historic canal walls and concentrations of waterborne trash using GPS. Using the results of this task, Essex will develop maps showing locations of large accumulations of vegetation and waterborne trash present in the study area.

16.7 Analysis and Reporting

- Essex will prepare a report summarizing the results of the Recreation Facilities, Use, and Aesthetics Study to include information presenting the results of the literature review, field inventory, field reconnaissance and visitor-intercept surveys, and visual surveys for vegetation and waterborne trash. Essex anticipates the Recreation Facilities, Use, and Aesthetics Study Report will include the following elements:
- Project Introduction and Background,
- Study Area,
- Methodology,
- Study Results,
- Analysis and Discussion,
- Location maps, Geographic Information System (GIS) analysis, and photos,
- Any agency correspondence and consultation, and
- Literature cited.

The results of the study will be used to evaluate the potential effects of continued operation of the Project on recreation and aesthetic resources and recreational activities in the Project area and form the framework for a Recreation Management Plan.

16.8 Schedule, Level of Effort, and Estimated Cost

Essex anticipates conducting background literature reviews and consultation with stakeholders immediately following issuance of the SPD. Essex anticipates conducting the field inventory in the summer of 2024 and the vegetation and waterborne trash surveys in 2024. Given the issuance of the SPD in May 2024, Essex anticipates performing the field reconnaissance and surveys in 2025. Essex anticipates filing the final study report concurrent with the USR.

Essex anticipates that this study will cost approximately \$120,000 to complete.

17 Historically Significant Waterpower Equipment Study

17.1 Study Requests

The Commission's August 15, 2023 SD1 identified various historic resources and cultural properties issues to be analyzed in the EA for the Project relicensing. The Commission requested the Historically Significant Waterpower Equipment Study and GWL requested an evaluation of historic Project works and their National Landmark eligibility. Additional stakeholders requested studies pertaining to historical resources, and informal comments were received from stakeholders.

17.2 Goals and Objectives

The goal of the study is to identify and document historically significant waterpower equipment located within the canals and canal gatehouses, and identify the potential for future interpretation, exhibition, and preservation methods of identified resources, in consultation with the Massachusetts Historical Commission, which serves as the state historic preservation office (Massachusetts SHPO), the Lawrence Historical Commission, and other interested parties.

The specific objectives of this study are as follows:

- Consult with the Massachusetts SHPO, the Lawrence Historical Commission, and other interested parties and conduct a site visit to identify historically significant waterpower equipment of interest to stakeholders for potential future interpretation, exhibition, or as scrap equipment to maintain and operate other historic machinery;
- Photo-document historically significant waterpower equipment identified in consultation with the Massachusetts SHPO, the Lawrence Historical Commission, and other interested parties;
- Conduct background research on the history of identified waterpower equipment, including designer/engineer, dates of manufacture and use, and an explanation of how the equipment was or is used; and
- Document current ownership of historically significant waterpower equipment.

17.3 Study Area

The study area includes the Project's historic canal system and the Project's civil works within the Project Boundary.

17.4 Background and Existing Information

The Lawrence Hydroelectric Project is located along the Merrimack River in Lawrence, Massachusetts, and the Project consists of facilities including the Essex Dam, or the Great Stone Dam, the Project impoundment, intake canal, powerhouse, turbines and generators, the North Canal, the South Canal, tailrace, fish passage structures, transmission line, and recreational facilities. The City of Lawrence was founded in 1845 and later incorporated in 1847 with the incorporation of the Essex Company as a planned mill town. Between 1845 and 1896 the construction of the Great Stone Dam (1848), the North Canal (1848), the Locks and Wasteway (1845), and the South Canal (1866/1896) was conducted to secure rights and leases to waterpower. All of the initial construction by the Essex Company was designed by Charles Storrow, Chief Engineer and Treasurer of the Essex Company. The modern hydroelectric facility, including the intake canal, powerhouse, turbines and generators, tailrace, fish passage structures, transmission line, and recreational facilities were constructed pursuant to the current FERC license and were commissioned in 1981.

The City of Lawrence is named after Abbott Lawrence, the Essex Company's President and Chief Stockholder, who oversaw the design and development of Lawrence into a mill city. Abbott Lawrence later served as United States Minister to the United Kingdom from 1849 to 1852 and provided \$50,000 to establish the Lawrence Scientific School at Harvard College (now the Harvard John A. Paulson School of Engineering and Applied Sciences). Certain facilities such as, the Great Stone Dam, the North Canal, and the North Canal Locks and Wasteway are listed in the National Register of Historic Places (NRHP) and are contributing elements to the North Canal Historic District listed in the NRHP on November 13, 1984, and later amended to include the Morehouse Bakery on May 8, 2009. The South Canal may be potentially eligible for listing in the NRHP according to Criterion C, given the canal's distinctive type, period, and method of construction. The remaining Project facilities do not meet the criteria for listing in the State Register of Historic Places (SRHP) or for the NRHP.

17.5 Project Nexus

The Lawrence Hydroelectric Project is an operating hydroelectric project that requires routine maintenance. Essex maintains, repairs, and replaces mechanical and control equipment at the Project on an as-needed basis. Additionally, Essex continuously evaluates the maintenance and operation of Project facilities to maximize operational efficiency and safety.

As described above, several Project facilities are located within the North Canal Historic District. Activities such as replacing mechanical equipment or controls or discontinuing maintenance of equipment that is no longer required for safe and efficient Project operations may have an adverse effect on historically significant waterpower equipment.

17.6 Study Methodology

17.6.1 Site Visit and Consultation

Essex will coordinate a site visit and visual inspection of historical Project facilities, including the canal gatehouses and canal civil works. For this task, Essex will retain an architectural historian or other professional experienced in historic surveys. Essex will capture photographs of any machinery and equipment more than 50 years in age, within the canals and canal gatehouses (also capturing the spatial arrangements and other details that reveal a machine's function), and any other equipment or facilities identified during consultation. Massachusetts SHPO, Lawrence Historical Commission, and any other interested stakeholders will be invited to attend this site visit.

Essex will provide a summary of the site visit and a list of identified historical equipment (e.g. more than 50 years in age) to the Massachusetts SHPO, Lawrence Historical Commission, and any other interested stakeholders for review and comment. Essex will also provide a list of equipment identified as historically significant that is recommended for additional documentation as noted below. Essex notes that not all historical equipment may be deemed historically "significant".

17.6.2 Photography and Documentation

17.6.2.1 Photography

Essex will digitally photo-document historically significant waterpower equipment (if any) identified during the site visit and/or in consultation with stakeholders. For this task, Essex will retain an architectural historian or other professional experienced in photo-documenting historic industrial and mechanical equipment. While specific photos will depend on the nature and type of equipment, Essex intends to generally capture the following photographs for equipment:

- Existing machinery and equipment, also capturing the spatial arrangements;
- Machinery details that reveal a machine's function; and
- General views and details of structural framing systems.

17.6.2.2 Documentation

To the extent possible, Essex will research, document, and summarize relevant information of the history of significant waterpower equipment, including designer/engineer, dates of manufacture and use, and an explanation of how the equipment was or is used. This historical research and documentation will be conducted by a qualified architectural historian with experience conducting research and documentation of historic industrial equipment. Essex will also document current equipment ownership.

17.7 Analysis and Reporting

Essex will develop a Report on Historically Significant Waterpower Equipment that includes photographs and the historical documentation of waterpower equipment. The report will also summarize current equipment ownership. Essex anticipates the Historically Significant Waterpower Equipment Study Report will include the following elements:

- Project Information and Background,
- Study Area,
- Methodology,
- Study Results,
- Analysis and Discussion,
- Location maps, GIS analysis, and photos,
- Any agency correspondence and consultation, and
- Literature cited.

Essex anticipates developing a Historic Properties Management Plan (HPMP) to describe how the licensee will consider and manage historic properties within the Project's area of potential effects during the term of the new license. Information presented in the Report on Historically Significant Waterpower Equipment will inform the development of the HPMP.

17.8 Schedule, Level of Effort, and Estimated Cost

The Commission will issue their SPD around May 2024. Essex anticipates that the site visit and consultation with stakeholders will take place in the summer of 2024. Photography and documentation of historically significant waterpower equipment is expected to be conducted in the fall of 2024, and Essex anticipates filing the Report on Historically Significant Waterpower Equipment with the Commission concurrent with the ISR on April 26, 2025. Essex estimates the cost of the Historically Significant Waterpower Equipment Study to be approximately \$35,000.

18 Condition Assessment of Historic Properties and Associated Canal System

18.1 Study Requests

The Commission's August 15, 2023 SD1 and November 28, 2023 SD2 identified various historic resources issues to be analyzed in the EA for the Project relicensing. FERC and LCW recommended a Condition Assessment of Historic Properties and Associated Canal System Study and NPS and LCW requested a Water Level and Flow Effects on Historic Resources Study. Other stakeholders, including GWL, requested studies or filed informal comments pertaining to historical resources.

18.2 Goals and Objectives

The primary objective of this study is to evaluate the potential effects of project operation on historic resources within the project's Area of Potential Effects (APE) in consultation with the Massachusetts SHPO, Lawrence Historical Commission, and other interested parties. Specific objectives of the study are:

- Determine the extent to which project operations, including water flow in the North and South Canals, have an effect on historic properties;
- Conduct a condition and structural assessment of the North and South Canals; and
- Identify potential impacts of current and proposed project operations on historic resources.

18.3 Study Area

The study area includes the Project's canal system and associated Project infrastructure within the FERC Project Boundary in the City of Lawrence, including the North Canal and South Canal, North Canal Gatekeeper's House, the Great Stone (Essex) Dam, Locks and Wasteway, and a series of bridges (Upper Pacific Bridge, Lower Pacific Bridge, Washington Mills Canal Bridge, Union Street Bridge over North Canal, Boston and Maine North Canal Railroad Bridge, Broadway Bridge, Upper Pacific Cotton Mill Pedestrian Bridge, Amesbury Street Pedestrian Bridge, Washington Mills Building #1 Bridge, Pemberton Mill Bridge and Pemberton Mill Bridge II, Central Bridge, and North Canal Bridge-Central Bridge).

18.4 Background and Existing Information

The Lawrence Hydroelectric Project is located along the Merrimack River in Lawrence, Massachusetts, and the Project consists of facilities including the Essex Dam, or the

Great Stone Dam, the Project impoundment, intake canal, powerhouse, turbines and generators, the North Canal, the South Canal, tailrace, fish passage structures, transmission line, and recreational facilities. The City of Lawrence was founded in 1845 and later incorporated in 1847 with the incorporation of the Essex Company as a planned mill town. Between 1845 and 1896 the construction of the Great Stone Dam (1848), the North Canal (1848), the Locks and Wasteway (1845), and the South Canal (1866/1896) was conducted to secure rights and leases to waterpower. All of the initial construction by the Essex Company was designed by Charles Storrow, Chief Engineer and Treasurer of the Essex Company. The modern hydroelectric facility, including the intake canal, powerhouse, turbines and generators, tailrace, fish passage structures, transmission line, and recreational facilities were constructed pursuant to the current FERC license and were commissioned in 1981. Table 5.10-2 of the PAD identifies Historic Architectural Resources within Approximately 1,000 Feet of the Project.

The City of Lawrence is named after Abbott Lawrence, the Essex Company's President and Chief Stockholder, who oversaw the design and development of Lawrence into a mill city. Abbott Lawrence later served as United States Minister to the United Kingdom from 1849 to 1852 and provided \$50,000 to establish the Lawrence Scientific School at Harvard College (now the Harvard John A. Paulson School of Engineering and Applied Sciences). Certain facilities such as the Great Stone Dam, the North Canal, and the Locks and Wasteway are listed in the NRHP and are contributing elements to the North Canal Historic District listed in the NRHP on November 13, 1984, and later amended to include the Morehouse Bakery on May 8, 2009. The South Canal may be potentially eligible for listing in the NRHP according to Criterion C, given the canal's distinctive type, period, and method of construction. The remaining facilities do not meet the criteria for listing in the SRHP or for the NRHP.

18.5 Project Nexus

Operation of the Project, including manipulation of the Essex Dam crest gate, canal headgates, spillways, and other Project features affects water levels and flows in the historic canal system. This study would assess the impacts of Project operations on historic buildings and structures that comprise the canal system.

18.6 Study Methodology

18.6.1 Document Review of Existing Conditions

As noted by FERC, the generally accepted practice is to review existing documentation and site conditions. Essex will review available architectural and engineering evaluations of historic canal structures available from the City of Lawrence, Massachusetts SHPO, and other stakeholders, including documentation of previous maintenance and repairs to characterize existing conditions. Essex will incorporate the following efforts as a component of this review:

- Delineation of the APE in consultation with the Massachusetts SHPO;

- Conduct a site visit to historic canal structures to identify issues related to project operation and maintenance, vegetation and debris, and the flow and water levels on historic structures, including non-project historic inlet gates and National Register-eligible bridges within the Project boundary.
- Identify properties that have previously been affected by project operation and maintenance, vegetation and debris, and the flow and water levels.
- Document dimensions of significant structural features of these properties relative to the water levels in the canals so that the effects of flow into the canals and changes in water levels can be assessed.
- Conduct a desktop structural engineering assessment of the North and South Canals, including a visual inspection and review of available engineering and architectural drawings, maintenance records, and structural modifications.

Essex will consult with Massachusetts SHPO on this proposed methodology and the anticipated effects on cultural resources.

18.6.2 Assessment of Water Levels, Flows, and Project Effects

Essex will compare the results of the document review of existing conditions and the water level, flow, and operational data collected in 2024 – 2025 to identify potential Project-related effects on the historic canal system infrastructure.

18.7 Analysis and Reporting

Essex will develop a Report on the Condition Assessment of Historic Properties and Associated Canal System that identifies any Project-related flow or water level effects on the historic canal system infrastructure. Essex anticipates the Condition Assessment of Historic Properties and Associated Canal System Report will include the following elements:

- Project Information and Background,
- Study Area,
- Methodology,
- Study Results,
- Analysis and Discussion,
- Location maps, GIS analysis, and photos,
- Any agency correspondence and consultation, and
- Literature cited.

Essex anticipates developing an HPMP to describe how the licensee will consider and manage historic properties within the Project Boundary of potential effects during the term of the new license.

18.8 Schedule, Level of Effort, and Estimated Cost

The Commission will issue their SPD around May 2024. Essex anticipates that a review of existing documents and site conditions will be initiated in the summer of 2024 and the site visit performed in the fall of 2024. Essex anticipates filing the final report concurrent with the ISR on April 26, 2025.

Essex estimates the cost of the Condition Assessment of Historic Properties and Associated Canal System Study to be approximately \$75,000.

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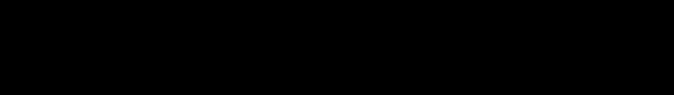
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Appendix A – Comments on the PSP



Martha Morgan, Groton, MA.
Office of the Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

FERC Docket No. P-2800-054

Project Name: Lawrence Hydroelectric Project

Please check one of the following headings:

- Comments on Pre-Application Document
- Study Request
- Comments on Scoping Document 1
- Request for Cooperating Agency Status

Comments on Proposed Study Plan

- Communications to and from Commission Staff

COMMENTOR'S NAME

Martha Morgan, Water Programs Director

MAILING ADDRESS (OPTIONAL)*

Nashua River Watershed Association
592 Main Street
Groton, MA 01450

* This information will be entered into the Commission's public record.

COMMENTS (PLEASE PRINT) - additional space is available on the back of this page

The Nashua River Watershed is the third largest tributary to the Merrimack River. The Nashua River watershed at-large is a key component of migratory fish restoration in the Merrimack River watershed, due in part to the extensive lentic and lotic fish nursery habitat found throughout the watershed. Reiterating our comments on the Scoping Document, we strongly request that relicensing of the Project be contingent upon improved fish passage at the Project, as the current fish passage counts at the Project are dismal and the need for improved passage is urgent.

NRWA supports all requests for studies by the relevant agencies: USFWS, NMFS, NOAA, MADMF, MADEP, MassWildlife, and NHFG.

The impacts of the project on the EJ Community of City of Lawrence should be taken into account; therefore, the Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience should be studied.

Management of the impoundment has had clear impacts to the boathouse at Riverfront State Park, the home for the Greater Lawrence Boating Program. Riverbank erosion has

been severe, and needs to be studied, and remedial solutions identified.

Studies to evaluate the project impacts on historical structures, and to identify steps to enhance such should be conducted. All options to enhance recreational opportunities in the project area should be evaluated and advanced.

NRWA shares the Merrimack River Watershed Council's concern about the three CSO discharges and the Lowell WWTP discharge to the reservoir for the dam, and the need for a study to evaluate the CSO and Drinking Water Intake interactions within the Project Area.

NRWA agrees with the need for an Invasive Plant Baseline Survey. Invasive plants in the Nashua River Watershed exclusively occur in the impoundments above the dams. The slowing of the river and increased boat traffic make the introduction of invasive species most likely to occur in these reaches. The project proponent states that "Performing an invasive plant species survey at the Project is not justified, as it would only represent a snapshot in time." We argue that this survey would be helpful in documenting when and where the invasive plants show up. The surveys should be conducted every 5 years.

Water Quality Study - NRWA strongly agrees with MADEP that the water quality study include phytoplankton samples, algae, nutrients, sediment sampling, and toxicants. Not including these parameters ignores the fact that dam impoundments, even run-of-river dams, act as "sinks" for all of these parameters.

Thank you for the opportunity to comment.

Martha Morgan

Water Programs Director

Nashua River Watershed Association



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

March 8, 2024

Debbie-Anne Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

RE: Comments on Proposed Study Plan for Lawrence Hydroelectric Project (P-2800)

Dear Acting Secretary Reese:

On November 28, 2023, Essex Company, LLC (“Essex” or “Potential Applicant”), a subsidiary of Patriot Hydro, LLC, filed their Proposed Study Plan (PSP) for the Lawrence Hydroelectric Project (Project) with the Commission.¹ The PSP outlines studies that Essex is proposing to conduct to inform relicensing. Concurrently, on November 28, 2023, the Commission issued Scoping Document 2 (SD2) for the Project.² The SD2 describes the Commission’s current view of environmental resources affected by the Project, as well as issues and alternatives to be considered in the NEPA document. As part of the Integrated Licensing Process, the National Marine Fisheries Service (NMFS) has an opportunity to comment on the Scoping Document(s) and PSP.

Essex’s PSP addresses some interests identified in our study requests³ and proposes not to conduct other studies, in whole, or in part. In addition, there are aspects of the proposed studies that would benefit from modifications. The studies that Essex did propose to undertake are necessary to understand the ongoing effects of the Project. Foremost, we want the Potential Applicant to adopt the necessary studies with a study design that will produce results with a high degree of confidence. Certain study elements — for example, the number of test fish and sampling conditions — are critical to the quality and utility of the resulting data. To ensure high confidence in the data collected and results generated, we provide recommendations for increasing the number of test fish in the passage and survival studies, ensuring high detection rates for telemetered fish, and completing each study during periods of normal Project operations. If the study design and timing fail to meet our recommendations, the resulting data may have diminished or negligible utility and necessarily lead to requests for additional years of study.

Critical to this review process is an understanding of the effects of the Project on species under our jurisdiction, including those listed under the Endangered Species Act, for the term of any

¹ FERC Accession # [20231128-5122](#)

² FERC Accession # [20231128-3049](#)

³ FERC Accession # [20231016-5181](#)



potential license. Our responsibilities to endangered species are codified under the Endangered Species Act (ESA) (16 U.S.C. §1531 et seq.) of 1973, as amended, which requires Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed species or destroy or adversely modify designated critical habitat. The requested *Sturgeon Habitat Mapping and Assessment Study*, *Sturgeon Distribution and Project Interaction Study*, and the *Climate-Related Project Impacts on Shortnose Sturgeon Habitat* studies address the potential for the Project to injure or kill sturgeon as well as negatively affect sturgeon habitat during the term of a new license. Additionally, several of these studies are integral to, or may be leveraged to support other requested studies. NMFS requests these studies to inform the terms of our Section 18 prescription and to facilitate consultation as required by Section 7 of the Endangered Species Act and as required by Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act. We anticipate that without the information collected in these studies, it will be difficult for FERC to prepare a Biological Assessment that contains a thorough evaluation of the effects of the action on ESA listed species and designated critical habitat and may make development of NMFS's Biological Opinion, including any Incidental Take Statement and associated Reasonable and Prudent Measures, more challenging. We also consider that information from these studies will facilitate FERC insuring that their proposed action is not likely to jeopardize the continued existence of any ESA listed species or result in the destruction or adverse modification of designated critical habitat, as required by ESA Section 7(a)(2).

Information generated from these studies will support the operation, mitigation, and potential design needs for the proposed Project in an environment known to be changing due to the effects of climate change. Specific to the climate study, understanding the future environmental condition, which has become standard practice across government agencies, will also support an economically-viable Project that supports the local communities. Our staff and our NOAA science partners are available and willing to discuss the details of these studies study to ensure their value for all parties.

Attached for consideration are our detailed comments on the PSP. If you have any questions or need additional information, please contact Ben German (978-281-9353 or benjamin.german@noaa.gov).

Sincerely,



Christopher Boelke
Chief, New England Branch
Habitat and Ecosystem Services

cc: Service List

Attachment A

National Marine Fisheries Service Comments on Essex's Proposed Study Plan (November 28, 2023)

GENERAL COMMENTS

In a number of studies not adopted, Essex provides an interpretation of FERC's Study Criteria as justification for not proposing such studies. Study Criterion No. 5 is frequently cited with the following interpretation:

There is no evidence of a problem and/or the study request is an attempt to search for a problem or "nexus" (Study Criteria No. 5): Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question.

NMFS asserts this interpretation is patently inconsistent with both the letter and intent of study criteria No. 5. NMFS was unable to locate a single occurrence of the phrase "the study request is an attempt to search for a problem" in FERC's Study Criteria or associated guidance.

Furthermore, in each of the eight studies we requested, a clear nexus was provided including how the data produced by the study would be used to develop license articles, PM&E measures, 10(j) recommendations, and/or fishway prescriptions. In many cases, the data we seek through these study requests are necessary for FERC to conduct its NEPA analysis and complete a Section 7 consultation in a timely manner that does not jeopardize the continued existence of listed species. In general, Essex did not address the nexuses we established in our study requests, choosing instead to lean heavily on the flawed interpretation above as justification.

Furthermore, FERC addressed this topic in their Final Rule, re Hydroelectric Licensing under the Federal Power Act under RM02-16 (Order 2002).⁴ Paragraphs 98 and 108 of that issuance clearly articulate FERC's position on this topic, and support the appropriateness of our requests (including the provided nexuses) as filed:

98. CHRC counters that a study might be required to establish the existence of a nexus. Taken to its extreme, CHRC's position would have us approving study proposals that amount to mere speculation. We think a common sense approach to demonstrating a nexus between project operations and resource impacts, informed by the professional judgment of qualified agency, Commission, and tribal staff, should ensure that this criterion is reasonably applied.

108. Various industry commenters recommend that we add a criterion requiring a requester to discuss whether or not a resource problem has been identified that relates to the request.[104] This proposed criterion is too subjective. A principal feature of hydroelectric licensing in recent decades has been disagreements between license applicants and others concerning the extent to which proposed or existing projects have negative effects on natural and other resources. Whether an identified impact is or is not a problem, and the extent of the problem, are often matters of perspective. Moreover,

⁴ FERC Accession # [20030724-3002](#)

the finding of a "problem" is not a required predicate for Commission action under the comprehensive development standard of FPA Section 10(a)(1). Rather, that standard contemplates license conditions for the "protection, mitigation, and enhancement" of fish and wildlife . . . , and for other beneficial public uses, including irrigation, flood control, water supply, and recreational and other resources." [emphasis supplied][105]

Study Criteria No. 4 is also frequently cited in Essex's PSP with the following interpretation:

Study request is not necessary because existing information is sufficient to answer the questions posed (Study Criteria No. 4): Requestors should also describe why existing information is insufficient to inform the development of license requirements. Study requests should demonstrate the need for additional, site specific information for purposes other than general research.

However, NMFS maintains that existing information is insufficient to any questions posed. Previous research in the Merrimack watershed on shortnose and Atlantic sturgeon is limited to several studies focused on downstream habitat use and Massachusetts Department of Transportation (MassDOT) monitoring related to planned bridge replacements. While these studies are relevant to sturgeon and the Merrimack watershed, they are too narrowly tailored to provide a basis for extrapolating the baseline of the species in this area or an analysis of ongoing effects of the Project on sturgeon. Therefore, NMFS reaffirms the need, and renews its request, for the NMFS-requested studies not adopted by Essex (provided below).

With regard to run-of-river operations (ROR), Essex asserts that as a ROR project:

it is not clear how the Project's ROR operations would be modified under a new license based on the results of the [Sturgeon Distribution and Project Interaction] study.

There are a variety of operational scenarios that can be employed within a ROR paradigm. These may include changes in crest gate operations or various spill scenarios (e.g. where the inflow is routed and discharged). Importantly though, potential license conditions do not have to be operational modifications, and have included population assessments, development and implementation of species protection plans, and substrate enhancement projects. For example, if downstream habitats are embedded, or scoured due to a lack of gravel recruitment and sediment transport (given the presence of the sediment sink created by the Great Stone Dam) then spawning substrate rehabilitation may be appropriate. Below are several examples of measures at FERC-licensed, ROR hydroelectric projects that aren't limited to operational modifications:

Holyoke (P-2004)⁵

a plan to meet the upstream and downstream passage needs of shortnose sturgeon, and a study of the effectiveness of measures taken (Condition No. 26);

⁵ FERC Accession # [19990823-0460](#)

The plan must include provisions to protect and enhance shortnose sturgeon habitat in the project area and allow safe passage at the project. Measures to protect and enhance shortnose sturgeon, must at a minimum be based on the results of the ongoing shortnose sturgeon studies, and any measures developed upon completion of those studies and after consultation with NMFS.

Within one year after the NMFS (in accordance with the Endangered Species Act) develops its final recommendations, submit to the MADEP a plan to meet sturgeon upstream and downstream passage need, timing and measures and a schedule for implementation in consultation with MADFW, the USFWS and the NMFS. The licensee shall implement the plan as approved by the MADEP. Within one year after installation, the licensee shall conduct and submit to the MADEP a study of the effectiveness of the measures taken. Potential effects from the NMFS recommendations could include but not be limited to: (a) changes in zone of passage timing, (b) changes in zone of passage minimum flows, (c) changes in minimum flows in the bypass reach, and (d) additional downstream facilities.

Santee Cooper Hydroelectric Project (P-199)⁶

To protect the federally endangered shortnose sturgeon and Atlantic sturgeon, the Authority proposes to develop and implement a species protection and enhancement plan for sturgeon within the project's action area.

A spawning habitat survey and characterization of the Santee River downstream from Santee Dam (NMFS prescription VII.B.1);

An assessment of the sturgeon population(s) in the Cooper and Santee Rivers downstream from Pinopolis and Santee Dams (NMFS prescription VII.B.2);

A spawning habitat survey and characterization of the lake habitat upstream of Santee Dam (NMFS prescription VII.B.3);

St. Lawrence-FDR Power Project (P-2000)⁷

The Ecological Agreement was executed by NYPA, FWS, NYSDEC, and NYRU. Section 2.1 provides for NYPA to construct, operate, and maintain various Habitat Improvement Projects (HIPs) within the project boundary, as set forth in Appendix A to that Agreement.

*The lake sturgeon (*Acipenser fulvescens*) is a State-listed (threatened) aquatic species that occurs in the area affected by the Project. Section 702 of 6 NYCRR provides for the protection of aquatic habitat. The Lake Sturgeon Spawning Beds HIP required under this Certification is expected to provide aquatic habitat-benefits to lake sturgeon. Specifically, the monitoring program required for the Lake Sturgeon Spawning Beds HIP should*

⁶ FERC Accession # [20230120-3061](#)

⁷ FERC Accession # [20031023-3050](#)

provide the Department with Information regarding the effectiveness of the habitat improvements relative to the needs of lake sturgeon

It is our observation that Essex has an inappropriately narrow interpretation of “nexus”, and is advocating for FERC to use that interpretation, coupled with an oversimplified view of the Project’s effects and the suite of actions that can take to address them, to challenge the basic scientific needs that NMFS and FERC have for data surrounding this Project. This approach has not been conducive to a collaborative licensing process and may cause undue delays thereto. Therefore, we reaffirm our request for each of the studies included in our study request submitted on 16 October, 2023.⁸

REQUESTED STUDIES NOT ADOPTED

NOT ADOPTED STUDY #1: DIADROMOUS FISH BEHAVIOR, MOVEMENT, AND PROJECT INTERACTION STUDY

Anthropogenic barriers such as dams interrupt the natural migration corridor and influence fish behavior as a result. The existing fishway at the Lawrence Hydroelectric Project is configured such that any fish seeking to pass upstream of the Project must enter and navigate through the tailrace to locate either a six-foot-wide entrance or a four-foot-wide entrance (when operating) to gain access to the lower flume of the fishway and the lift beyond. Both the tailrace and fishway entrances concentrate fish and create delay. These factors leave upstream migrants vulnerable, provide optimal conditions for predatory fish to exploit, and may result in avoidance behavior for alosines (e.g., abandoning efforts to pass the Project). In addition, the hydraulic conditions in the tailrace have the potential to disorient migrating fish exacerbating delay and predator exploitation. We request an alosine (i.e., American shad, alewives, and blueback herring) and striped bass movement study to understand fish distribution and behavior in the tailrace and the downstream migration corridor associated with Project-related concentration and delay.

Goals and Objectives

Essex indicated in the introduction of Section 4 of the PSP that they were not proposing the Diadromous Fish Behavior, Movement, and Project Interaction Study “at this time”, but did state that they recognize the importance of the goals of the study to assess migratory fish behavior in and around the Lawrence tailrace. While Essex did not propose this study, they also did not include it as a sub-section with the other studies not adopted where justification was presented related to FERC’s study criteria guidelines, instead noting they “anticipate developing the details of this study in consultation with the MRTC at a [unspecified] more appropriate time.” This leaves the study in an uncertain position where it has been neither proposed nor formally not adopted with supporting justification. Essex did opine that they feel this study would be “greatly informed by, and is also largely contingent on, the results of the Three-Dimensional Computational Fluid Dynamics (CFD) Modeling Study.” We do not share this opinion and it is unclear from the information provided in the PSP why Essex feels the CFD results are needed to inform the Diadromous Fish Behavior, Movement, and Project Interaction Study, or in what way(s) the latter would be largely contingent on the former. The CFD and Diadromous Fish Behavior, Movement, and Project Interaction Study are fully-separate analyses that do not share goals or methodology. Nonetheless, if Essex still feels strongly that the CFD results are needed

⁸ FERC Accession # [20231016-5181](#)

in advance of this study, there remains sufficient time to prioritize that analysis and have it completed well before the field studies which are anticipated to occur during the 2025 passage season. This leaves nearly 12 months from the study plan determination in April 2024 to complete the CFD analysis and have results in hand for the 2025 study season.

Study Methodology

Paragraph 4 of Section 4 (page 15) of Essex's PSP incorrectly states that our requested Diadromous Fish Behavior, Movement, and Project Interaction Study recommends both two-dimensional and three-dimensional acoustic tracking of migratory species. In fact, our request is not prescriptive of acoustic or radio telemetry, this flexibility in methodology was intentional and was included to allow Essex some latitude with approach and to facilitate synergy with other requested studies. Notwithstanding, we agree that 3D acoustic telemetry would provide the most useful data and is our preferred approach to this study. Similar studies were conducted at the upstream Lowell Hydroelectric Project⁹ over a decade ago which provided excellent behavioral data for American shad in the tailrace (Alden 2011; Blue Leaf Environmental and Alden 2013). With advances in telemetry technology over the past decade, we see no reason why this study requested at Lawrence cannot produce comparable, if not better data than the Lowell behavioral studies.

We provide the following recommendations that should be considered to determine the appropriate type and number of tags to deliver the data we seek. A successful study plan should incorporate:

- A telemetry technology/system that will allow for many fish to simultaneously occupy the study area, employing high frequency, high transmission rate tags. The selected tags should maximize transmission rate and detectability in high-noise environments while minimizing data loss through tag collisions.
- A routine tagging program throughout the migratory season that includes tagging of both the predator and prey species to determine the behavior of both. Tag allocation should be much higher for the prey species. The Potential Applicant should minimize tag burden and handling affects to the degree possible.
- Monitoring of environmental variables and Project operations throughout the length of the study.

Level of Effort and Cost

Essex posited that this study will cost an estimated \$750,000–\$1,000,000, which is substantially higher than our estimate of \$500,000. Our estimate was based on the number of tags requested, and on actualized costs for similar studies conducted at other hydroelectric projects in the region. Given synergies that would be gained if this study were to be conducted concurrently with other adopted studies (e.g. the Upstream Anadromous Fish Passage Assessment) that would also require an array of receivers, it is our opinion that this study could be conducted for much less than Essex's estimate. This potential opportunity to share resources, as appropriate, among the suite of studies to be conducted also supports the approach of completing the study now and not delaying to an unspecified later time.

⁹ FERC P-2790, this facility was developed around the same time as the Lawrence Project and has a similar powerhouse footprint and tailrace design.

NOT ADOPTED STUDY #2: STURGEON DISTRIBUTION AND PROJECT INTERACTION STUDY

The Merrimack River is within the range of Endangered Species Act (ESA) listed Atlantic sturgeon (threatened and endangered Distinct Populations Segments (DPSs); 77 FR 5913 and 77 FR 5880) and shortnose sturgeon (endangered; 32 FR 4001). The Merrimack River supports a spawning population of shortnose sturgeon (Kieffer and Kynard 1996). The river reach from the Essex Dam (i.e., Great Stone Dam) downstream to the ocean is designated critical habitat for the Gulf of Maine DPS of Atlantic sturgeon (82 FR 39160), and Atlantic sturgeon from multiple DPSs occur in the Merrimack River. The continued operation of the Lawrence Hydroelectric Project under a new license may affect shortnose and Atlantic sturgeon and critical habitat designated for Atlantic sturgeon.

Hydroelectric project operations have the potential for take (defined in the ESA as to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct”) of these species, which is prohibited by Section 9 of the ESA. ESA Section 7 consultation is necessary if the proposed relicensing may affect listed species or critical habitat; through this consultation, an appropriate Incidental Take Statement, exempting otherwise prohibited incidental take of ESA listed sturgeon, could be issued. We have no records of any ESA consultation occurring in the past for the Project and are not aware of any studies that have taken place on potential effects of the Project on either sturgeon species or their habitat. We request a study to determine presence and movement of sturgeon downstream of and within the Lawrence Project boundary to determine if reasonable and prudent measures are necessary to minimize effects for any new license issued for the Project, and if so, to inform the development of such measures. This study will also provide information necessary for the Essex and FERC to develop a Biological Assessment to support a request for Section 7 consultation.

Goals and Objectives

Sturgeon currently have access to the base of the Project. If present, sturgeon may be affected by the Project, e.g., injury and stranding, and require measures to avoid and minimize effects associated with the operation and maintenance of the Project and fishway. License conditions are not limited to changes in project operations, and, if measures such as a sturgeon protection and handling plan are necessary, they would be informed by the results of this study. Actions in such a plan may include protocols for handling, reporting, and dewatering turbine units for maintenance to prevent injury or mortality to sturgeon. For example, FERC-licensed hydroelectric project that have adopted similar measures include Ellsworth (P-2727),¹⁰ Brunswick (P-2284),¹¹ Cataract (P-2528),¹² and Santee Cooper (P-199).¹³ This study is a baseline data collection to inform potential protection measures. Based on the results of this study and the other sturgeon studies, other license conditions may be necessary for sturgeon such as habitat protection or improvement projects and operational modifications to prevent stranding.

Study Methodology

Essex cites the recent Stantec report (2023) as evidence that sturgeon are not approaching the Project. However, existing information from the Stantec report demonstrates that sturgeon are reaching the I-495 bridge in Lawrence and may be moving farther upstream. Four sturgeon out of the 50 (8%) tagged sturgeon were detected at the I-495 bridge in Lawrence in 2020 and 2021. If the proportion of tagged individuals detected at the I-495 bridge in Lawrence is representative of the

¹⁰ Accession # [20180928-5080](#)

¹¹ Accession # [20231221-3024](#)

¹² Accession # [20181017-3037](#)

¹³ Accession # [20230922-3033](#)

movements of the amphidromous population in the Merrimack, then the minimum number of individuals from the overwintering population of shortnose sturgeon to approach the Project would be 302 individuals for 2021-2022 and 273 for 2022-2023, respectively. This provides many opportunities for an ESA-listed population to interact with the Project, but without telemetry and sidescan sonar (SSS) deployed at the Project, no baseline data is available to inform license conditions. Additionally, two of the tagged sturgeon detected at the Lawrence I-495 bridge were in the area of the uppermost acoustic receiver over multiple days in late March and April. This is ample time for the sturgeon to swim upstream and interact with the Project. In 2021, all sturgeon detections occurred before or during the spawning season, suggesting a searching behavior for spawning habitat.

Telemetry and fixed array SSS have previously been coupled and used to quantify sturgeon abundance and movement (Izzo et al. 2021). This framework provides a tested methodology that could be adapted to the Project tailrace, spillway, and downstream of the Project.

An appropriate assessment of sturgeon presence and occupancy to determine Project interactions is not possible with the available information. For this reason, we reaffirm our request for this study and stand by the proposed methodology to use telemetry and fixed array SSS to detect sturgeon at and downstream of the Project.

NOT ADOPTED STUDY #3: STURGEON HABITAT MAPPING AND ASSESSMENT STUDY

The Merrimack River is within the range of ESA listed Atlantic sturgeon (threatened and endangered DPSs) and shortnose sturgeon (endangered), and the reach downstream of the Project is designated critical habitat for the Gulf of Maine DPS of Atlantic sturgeon. The Lawrence Hydroelectric Project is a barrier to the upstream migration of sturgeon, and restricts freshwater spawning, rearing, foraging, and overwintering habitat within the 29-mile reach below the Project. The Project also traps sediment in the impoundment and prevents natural, downstream transport of sediment and bedload. Sediment trapped in the impoundment by the Project may be inundating historical sturgeon habitat. Conversely, the dam may prevent downstream transport, leading to depauperate habitat lacking the necessary spawning and rearing substrate such as cobble, rock, and gravel, or degraded by embedded sand and fine-sediment (i.e., habitat lacking well-oxygenated, interstitial spaces suitable for egg incubation and hatching). We request a bathymetric habitat assessment and mapping study to quantify the Project effects on sturgeon habitat in the Project boundary and downstream of the dam.

Goals and Objectives

Essex asserts that there is no evidence of a problem/understanding of how the study would be used to inform license requirements as well as the study request is an attempt to search for a problem or “nexus.” Essex also states that the existing information is sufficient to answer the questions posed in this study request. There are five studies that NMFS has identified that focus on or encompass sturgeon habitat in the Merrimack River:

1. Annual Movements of Shortnose and Atlantic Sturgeons in the Merrimack River, Massachusetts (Kieffer and Kynard 1993);
2. Spawning of the Shortnose Sturgeon in the Merrimack River, Massachusetts (Kieffer and Kynard 1996);
3. A Biological Assessment of shortnose sturgeon (*Acipenser brevirostrum*) (NMFS 2010);

4. Movements of Atlantic Sturgeon of the Gulf of Maine Inside and Outside of the Geographically Defined Distinct Population Segment (Wippelhauser et al. 2017);
5. Merrimack River Shortnose Sturgeon Monitoring, 2020-2022 (Stantec 2023).

The earlier studies (Kieffer and Kynard 1993; Kieffer and Kynard 1996) investigated sturgeon movement, habitat usage, spawning, and resident population size. During that time, peaking operations at upstream hydroelectric and storage Projects affected the hydrology of the Merrimack River that do not reflect the existing environmental conditions. The improved hydrologic regime in the Merrimack River may result in altered habitat usage and movements among other potential drivers of sturgeon behavior affected by Project operations. Several of the studies included habitat mapping for sections of the Merrimack River, however a comprehensive habitat mapping and assessment survey is necessary to fill in data gaps and investigate Project effects on sturgeon habitat within the geographic scope of the Project. For this reason, we reaffirm our request for this study and stand by the proposed methodology to survey sturgeon habitat in the impoundment and downstream of the Project. The information from this study would be used to inform the ESA Section 7 consultation and protection, mitigation, and/or enhancement measures for Atlantic or shortnose sturgeon, none of which Essex has in its current license. Measures could include aquatic habitat enhancements and fish passage.

Study Methodology

In a sturgeon habitat mapping study conducted by Litts and Kaeser (2016), they developed a method that could cover 25-50 km a day with the sidescan sonar. This suggests that the study requires two to three days of sidescan sonar fieldwork to collect the image data in the impoundment and downstream extent of the Merrimack River. Additional field days are necessary to validate the imagery and collect hydraulic model calibration data. Johnston et al (2019) provide modeling approaches to conduct the HSI to understand habitat suitability in the mapped areas.

The hydraulic model can derive from the existing National Flood Insurance Program to run simulations of representative seasonal flow conditions to characterize habitat suitability. To understand the hydraulic variables that are part of HSI, the Potential Applicant could download the existing FEMA NFIP HEC-RAS model and run simulations in 1D or 2D to characterize depth-averaged velocity and depth under various flow conditions for the mapped habitat.

NOT ADOPTED STUDY #4: CLIMATE RELATED PROJECT IMPACTS ON SHORTNOSE STURGEON HABITAT

The Merrimack River is within the range for ESA listed shortnose sturgeon (endangered). The Lawrence Hydroelectric Project is a barrier to the upstream migration of shortnose sturgeon, and restricts freshwater spawning, rearing, foraging, and overwintering habitat to within the 29-mile reach below the Project. Saltwater is fatal to sturgeon during early life stages (e.g., eggs and Age-0), and access to suitable freshwater habitat is essential for survival and recruitment.¹⁴ As climate-related impacts are expected to continue, including sea level rise (SLR), increased water temperatures, and variability in river flow; upstream migration of the Merrimack River salt wedge and changing hydrological conditions may reduce and degrade existing shortnose sturgeon habitat (Hare et al. 2016; Farr et al. 2021). We request a hydrodynamic water quality modeling study using established climate projections to understand the hydrological impacts of upstream salt wedge migration during the term of a new license on shortnose sturgeon habitat affected by the Lawrence Hydroelectric

¹⁴ See: [Atlantic Sturgeon - General Life Stage/Behavior Descriptions](#) and [Shortnose Sturgeon - General Life Stage/Behavior Descriptions](#)

Project.

Goals and Objectives

The goal of this study is to determine the risks of increased Project effects (e.g., habitat degradation and contraction) during the term of a new license (2028-2078) on shortnose sturgeon overwintering, spawning, and rearing habitat downstream of the Project. The information collected from study request #3 — Sturgeon Habitat Mapping and Assessment Study — is essential to characterize existing and potential habitat in this study. Habitat suitability indices (HSI) are available for shortnose sturgeon and the hydrodynamic model would provide the information necessary to evaluate if environmental conditions during the license term will degrade or eliminate the existing habitat necessary for the spawning population of shortnose sturgeon in the Merrimack River. Our request is to quantify the specific conditions (i.e., salinity, temperature, and flows) that will contribute to our understanding of essential ecological processes for shortnose sturgeon within the geographic scope of the Project, and Project effects on those conditions.

Essex elected to not adopt this study and claims that the request constitutes basic research/there is no evidence of a problem or how the study would be used to inform license requirements, as well as the study request is an attempt to search for a problem or “nexus,” and cites guidance from the Council on Environmental Quality (2016) that states,

in accordance with NEPA’s rule of reason and standards for obtaining information regarding reasonably foreseeable effects on the human environment, agencies need not undertake new research or analysis of potential climate change impacts in the proposed action area but may instead summarize and incorporate by reference the relevant scientific literature.

This guidance has since been superseded by CEQ guidance issued in 2023¹⁵ that removes the clause on not needing to undertake new research or analysis of potential climate change impacts. In addition, the revised CEQ guidance states:

agencies should identify and use information on future projected GHG emissions scenarios to evaluate potential future impacts (such as flooding, high winds, extreme heat, and other climate change-related impacts) and what those impacts will mean for the physical and other relevant conditions in the affected area. Such information should help inform development of the proposed action and alternatives, including by ensuring that proposed actions and alternatives consider appropriate resilience measures, environmental justice issues, and existing State, Tribal, or local adaptation plans. When relying on a single study or projection, agencies should consider any relevant limitations and discuss them.

The hydrologic changes this study will quantify are necessary information for assessing climate change-related impacts in the lower Merrimack River. The outcomes of this study will be used to inform license conditions to support the recovery and resilience of sturgeon in the Merrimack River. See our general comments for the potential actions Essex could take beyond modifications to ROR

¹⁵ [National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change](#)

operations.

Essex also asserts that,

Effects should generally not be considered if they are remote in time (such as this request), geographically remote, or the product of a lengthy causal chain. FERC precedent uniformly maintains that climate change studies are not needed in hydropower licensing proceedings.

It is FERC's determination as to what is considered remote in time as well as what studies will yield reliable data that can be used to develop license requirements on a project by project basis. Our study request is to investigate climate effects that are likely to occur within the licensing term, therefore, within the temporal scope of a new license and not remote in time. The precedent Essex cites in relation to climate study requests is an inappropriate rationale by which to reject this study. This study is specific in the climate effects it is investigating (i.e., saltwater intrusion, temperature, and flows), which will be compared to habitat suitability indices (Crance 1986) and other relevant literature (Smith et al. 1995; Kynard et al. 2000; Farrae et al. 2014; Johnston et al. 2019; Pendleton et al. 2019; Kazyak 2020) for sturgeon to assess the potential for habitat contraction, degradation, and loss during the license term. Some of the necessary information is already available (e.g., sturgeon spawning habitat and the location of the salt wedge location) and the previous two study requests with help fill in critical data gaps. Known effects of climate change, such as sea level rise, are accelerating at a heightened rate in the northeast compared to other parts of the country (Boon 2012), which further supports the need to complete this study.

The documented location of the salt wedge in the Merrimack River is between RM 10 and 12 (Kieffer and Kynard 1993; CDM 2003). It currently overlaps with shortnose sturgeon overwintering habitat, and with its proximity and similar streambed elevation to spawning habitat, it is essential to undertake this study to understand the impacts of saltwater intrusion and hydrodynamic changes during the term of a new license (Figure 1). Ralston et al. (2010) found that, "Unlike scaling for other tidal salt flux mechanisms that depend only on tidal amplitude, the halocline asymmetry depends on both river discharge and tidal velocity. The salinity intrusion length and stratification in the Merrimack vary more with event-to-seasonal shifts in river velocity than with spring-neap changes in tidal amplitude," supporting the need to create a hydrodynamic model that assess flow and temperature changes in the Merrimack.

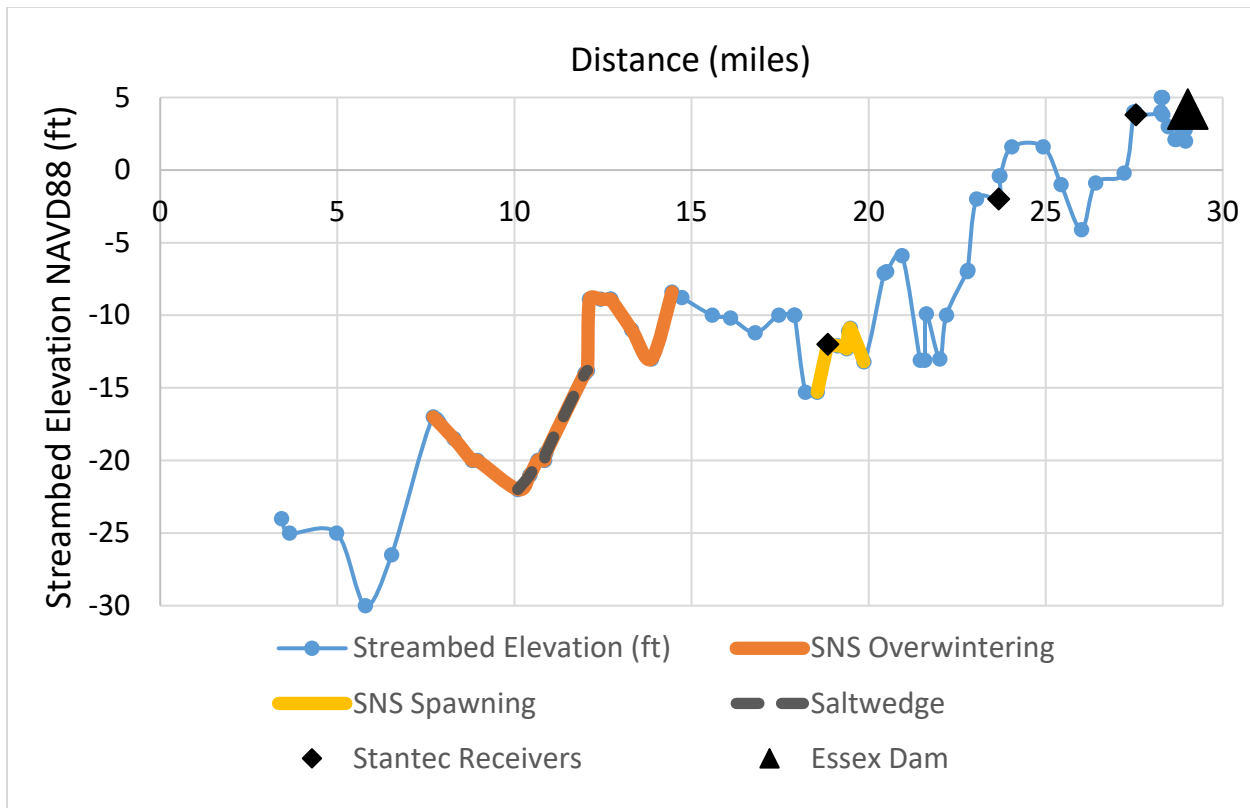


Figure 1. Streambed profile from Newburyport Lighthouse to the Essex Dam with the locations of known sturgeon habitat, salt wedge, Stantec receivers, and the Essex Dam denoted. This figure was created using FEMA Flood Insurance Studies for the Merrimack River in Essex County, MA¹⁶, and information from Kieffer and Kynard (1993) and Stantec (2023).

Study Methodology

A numerical model of the Merrimack River estuary was built and calibrated by researchers at the Woods Hole Oceanographic Institute (Ralston et al. 2010). The model investigated the tidally-varying circulation, stratification, and salt flux mechanisms of the shallow salt wedge in the Merrimack River estuary. This model may be expanded up and used with minimal effort to simulate future locations of the salt wedge in the Merrimack River up to the Essex Dam. Or, an equivalent model could also be developed but may require additional effort and cost.

NOT ADOPTED STUDY #6: DOWNSTREAM FISH PASSAGE AND PROTECTION ASSESSMENT

Essex is not proposing to conduct the requested Downstream Fish Passage Assessment citing a proposal for PM&E measures to include a narrow-spaced trashrack to exclude fish from turbine passage. We look forward to discussing the design of this proposed measure, and agree that such a measure with full exclusion for adult diadromous species would eliminate the need to conduct a downstream passage study for adult diadromous species that includes both field-testing and

¹⁶ [Flood Insurance Study Essex County, Massachusetts](#)

desktop entrainment, impingement, and turbine passage methodologies. Juvenile target species still warrant assessment, as this PM&E measure may not be protective of all life stages.

Additionally, there are two other important passage routes that were included in our request and not addressed in the PSP and would also not be addressed with this PM&E measure. Both the existing bypass and spillway passage routes would still need to be evaluated with or without full exclusion. Essex acknowledged the former in the PSP stating the “the existing downstream fish bypass survival for emigrating diadromous species (i.e., adult and juvenile alosines and adult American eel) will need evaluation at a later date.” This study component should be accomplished concurrently with other adopted studies to inform downstream passage measures that will be prescribed. Similarly, the spillway passage route needs to be evaluated. We have a poor understanding of the risks of injury or mortality associated with spillway passage at Essex Dam, and have little information related to how commonly that route is utilized by downstream migrants. Both of these study components are critical to assess the need for improvements to downstream fish passage and protection facilities that provide safe, timely, and effective passage and survival, and should be incorporated into the Revised Study Plan (RSP).

Under the proposed operating conditions, there are three main routes of passage at the Lawrence Project: over the spillway, through the fish bypass, and through the turbines. To evaluate Project effects on downstream passage, we need to understand the following for each target species and life stage:

- Downstream route selection probability
- Downstream route survival probability
- Downstream migratory delay

Each of these factors may change under different operating conditions (e.g., during times of more spill, more fish may use the spillway route). Eliminating one route of passage for one life stage does not provide enough information to determine Project effects on downstream passage. To determine route selection probability, we will need a telemetry study of adult and juvenile alosine (recommend using shad) with releases throughout the passage season. For route survival, we can use the detection histories with statistical models to estimate survival for routes that are commonly used. For routes that do not have a large enough sample size for a statistical analysis, we will need to augment with a route specific survival study using balloon tags or sensor fish. This can be staged with year one being a comprehensive downstream telemetry study followed by year two being route specific data acquisition where it is needed. For delay estimation, we will use time-to-event analysis (Castro-Santos and Haro 2003) with the tagging data (i.e., detection histories with covariate monitoring).

ADOPTED REQUESTED STUDIES

ADOPTED STUDY #2: HYDRAULIC MODELING STUDY

The proposed study that Essex outlines in Section 12 of the PSP meets our expectations for understanding the near-field hydraulics of the powerhouse and fish passage facilities. We look forward to the working group meetings to maximize the benefit from the three dimensional hydraulic model simulations.

ADOPTED STUDY #7: UPSTREAM ANADROMOUS FISH PASSAGE ASSESSMENT

The proposed study that Essex describes in Section 6 of the PSP should provide valuable data to further our understanding of how fish are interacting with the Project and existing fishway components. We do have some concerns related to tag allocation. NMFS recommends sea lamprey be included in this study, as previously requested. The only information we have related to sea lamprey at the Project is count data from the fishlift, which does not characterize their movements through the Project area. Tag numbers would not need to be nearly as high as those necessary for alosines. The absence of numerically-specific upstream passage effectiveness goals does not negate the need to evaluate Project effects on sea lamprey or the Project's ability to provide safe, timely, and effective fish passage. NMFS's overarching management goal for Merrimack River sea lamprey, as outlined in the Comprehensive Plan,¹⁷ is to restore and maintain sustainable runs for human and ecological benefits. Information from the proposed study, as requested, will support an assessment of the Project's effects on the safe, timely, and effective upstream passage of sea lamprey and inform the need for potential license conditions to improve passage conditions. Therefore, we do not support Essex's proposal to omit sea lamprey from the proposed Upstream Anadromous Fish Passage Assessment, and we encourage Essex to consider including lamprey in this study in their RSP.

For alosines, Essex is proposing to tag 165 adult American shad and 185 adult river herring for a total of 350 tags. These sample sizes proposed in the PSP for upstream passage are too low and no statistical evidence was given to support the proposed sample size. While Essex provided some justification for numbers of fish expected to fall back post-tagging given results at Lowell, they neglected to relate that these low rates still resulted in sample sizes that were unable to produce informative results even though they tagged 150 individuals with radio transmitters in that study. In the referenced Lowell relicensing study, the passage efficiency results had a greater than 10 percent uncertainty with a 75 percent confidence interval, which does not provide sufficient evidence for conditioning agencies to recommend appropriate PM&E measures. Further, while the Lowell study experienced low fall back rates, the literature on alosines suggests that post-tagging fallback can be between 24-71% (Beasley and Hightower 2000; Bailey et al. 2004; Aunins and Olney 2009; Aunins et al. 2013; Grote et al. 2014; Gahagan and Bailey 2020). The proposed fallback rates (33% for shad and 21% for alewife) are taken from the low end of ranges that may occur, especially given the collection methodology (boat electro-fishing) will impact the tagged fish at a greater level than the collection methods for the Lowell study (where fish were obtained with nets from the Lawrence fish lift).

To properly justify a meaningful sample size, Essex should perform simulations within their chosen modeling framework (program MARK has been used in similar studies and was discussed at the PSP meeting) to identify an initial sample size that will yield less than 10% uncertainty at a 90% or greater confidence interval around a point estimate of passage at each model time or location step (i.e., antenna location) in the study. These simulations should be run for realistic values (i.e., supported by literature) that reflect high stress sampling methods and complex antenna environments, combinations of fallback, post-tag mortality, and detection efficiencies at all antenna locations.

¹⁷ FERC Accession # [20210617-5016](#)

In terms of post-tag mortality, Essex made a good faith effort to plan for predation on tagged fish. However, predation is likely not the primary issue at hand. We hypothesize, the primary reason that river herring passage has dropped two orders of magnitude is not that the herring are being eaten; it is that they are not able to successfully pass the dense predatory conditions created by the hydraulics and confined area of the Project's tailrace. Any fish seeking to reach the lift and make passage must negotiate this dense concentration of predators. Accounting for this effect is likely to require obtaining useful data on as few as 1 in 100,000 fish. This point is not intended to influence decisions on sample size for river herring, rather it should highlight the urgent need for the Diadromous Fish Behavior, Movement, and Project Interaction Study that Essex has opted not to propose, as well as the extreme disadvantage the Project is putting on the resource in question and the active restoration efforts of the management agencies.

Regarding antenna locations, for each decision point in the zone of passage through the Project, sufficient detections in key locations are needed to calculate a probability with confidence. Essex should use all sites proposed in the PSP and augment the array with coverage for the following areas:

- Area below the Duck Bridge as fish approach the Project flows (below proposed Station 3);
- Coverage for the entire area below the spillway to identify area of false attraction under all flow conditions encountered during the study (between proposed Stations 3 and 4);
- Area between the rock face on river right and the stone abutment separating the spillway and powerhouse flows to identify fish that have entered the flow field of the powerhouse and fishway (between proposed Stations 3 and 4);
- Coverage of the start of the northern (river side) fishway entrance flow field (between proposed Stations 3 and 4);
- Two antennas upstream of Station 9 to identify fish that drop back into the intake and bypass flows after exiting the exit flume and those that eventually depart the immediate vicinity of the powerhouse;
- Two antennas at the upstream limit of the Project's impoundment to strengthen detection probability and help determine predation and delay in the impoundment.

Please see below the modified Figure 6-2 from the PSP to illustrate the added antennae needed surrounding the powerhouse and spillway:

Figure 6-2. Proposed stationary receiver placement for monitoring upstream passage effectiveness at the Lawrence Project



ADOPTED STUDY #8: STUDY OF UPSTREAM FISH PASSAGE EFFECTIVENESS FOR AMERICAN EEL

NMFS supports and does not have any comments at this time on the Upstream American Eel Passage Assessment study, as proposed by Essex.

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OFFICE OF ENERGY PROJECTS

Project No. 2800-054 – Massachusetts
Lawrence Hydroelectric Project
Essex Company, LLC

Via FERC Service

Mr. Kevin Webb
Licensing Manager
Essex Company, LLC
670 N. Commercial Street, Suite 204
Manchester, NH 03102

**Subject: Staff Comments on the Proposed Study Plan for the Lawrence
Hydroelectric Project, P-2800**

Dear Mr. Webb:

We have reviewed Essex, LLC's (Essex) proposed study plan for the Lawrence Hydroelectric Project (project) filed on November 28, 2023, and attended the study plan meetings on January 4 and 5, 2024. Pursuant to 18 C.F.R. § 5.12 of the Commission's regulations, we are providing staff's comments on the proposed study plan in the enclosed schedule A. We are also providing comments on requested studies not adopted in Essex's proposed study plan in the enclosed schedule B. We appreciate the opportunity to comment on the proposed study plan for the project. If you have any questions, please contact Bill Connelly at (202) 502-8587 or william.connelly@ferc.gov.

Sincerely,

for Emily Carter, Chief
New England Branch
Division of Hydropower Licensing

Enclosure: Schedule A – Comments on the Proposed Study Plan
Schedule B – Comments on Requested Studies Not Adopted

SCHEDULE A
COMMENTS ON THE PROPOSED STUDY PLAN

Study 6. Upstream Anadromous Fish Passage Assessment

1. In section 6.6.1, *Sample Size*, Essex states that telemetry studies must consider multiple factors, including handling and transportation effects, fish condition, and regurgitation of transmitters, as well as site-specific factors, such as fallback¹ rates and predation, when determining sample sizes to meet study objectives. Essex proposes to tag a total of 185 adult river herring and 165 adult American shad so that at least 100 radio-tagged individuals of each species reach the near field attraction zone of the Lawrence Project's upstream fishway after accounting for losses due to fallback and predation.²

During the proposed study plan meeting, false attraction to the spillway and potential flow barriers in the tailrace were identified as additional site-specific factors that may require consideration when determining sample size to ensure that data from enough tagged fish is collected to meet study objectives. Failure to account for site-specific characteristics in the study design may result in failure to satisfy the study objectives. Therefore, please clarify in the Revised Study Plan (RSP) why these additional site-specific factors were not included in the sample size calculation.

2. In section 6.6.3, *Radio Telemetry Monitoring Stations*, Essex proposes installing 10 monitoring stations to meet study objectives. During the proposed study plan meeting, additional monitoring stations were discussed that would improve the likelihood of meeting study objectives. Examples of these discussions included adding a monitoring station between receiver 3 and 4 to examine nearfield attraction to the upstream fishway, splitting station 3 to examine the proportions of alosines that move along each riverbank while approaching the project, and adding additional monitoring stations in the forebay to determine forebay residence time. At the meeting, Essex agreed to make modifications to the number of monitoring stations to accommodate these requests. In the RSP, please provide additional information on the locations of these newly proposed monitoring stations and how these new monitoring stations will improve the likelihood of meeting the study objectives.

¹ The term "fallback" refers to when tagged fish move downstream and leave the study area after being released instead of continuing upstream to spawn.

² See section 6.6.1 of the Proposed Study Plan (PSP).

Study 13 Recreation Facilities, Use, and Aesthetics Study

3. In section 13.6.1, *Literature Review*, Essex proposes to conduct a literature review to identify and describe recreational uses in the project area. Essex also proposes to issue a data request to interested stakeholders to obtain relevant documentation or applicable guidance documents for inclusion in the literature review.

To ensure the literature review covers all publicly available information, we recommend that you include the following documents and surveys in the Literature Review:

Alliance of Climate and Environmental Stewards. 2019. 2019 Merrimack River Study: Rowing Community. Available online at: https://uploads-ssl.webflow.com/62e3e8d59b4e723b9503389b/62e3e8d59b4e721671033b1f_Rower%20Report%202019-11-01%20Rev%201.pdf. Accessed February 1, 2024.

_____. 2021. Project, Merrimack River Users Survey. Available online at: <https://www.aces-alliance.org/post/merrimack-river-users-survey>. Accessed February 1, 2024.

Merrimack River Watershed Council. 2023. Merrimack River Recreation Survey Available online at: <https://merrimack.org/survey/>. Accessed February 1, 2024.

Merrimack Valley Planning Commission and the Essex National Heritage Commission. December 2011. Merrimack River Trail, Reconnaissance Planning Report. Available online at: <https://mvpc.org/wp-content/uploads/MRT-final-report-and-maps-Dec-2011.pdf>. Accessed February 16, 2024.

The Merrimack Conservation Partnership. A Land Conservation Plan for the Merrimack River Watershed of New Hampshire and Massachusetts. April 2014. Available online at: <https://merrimackconservationpartnership.org/resources/conservation-plan/>. Accessed February 16, 2024.

U.S. Army Corps of Engineers, New England District. 2006. Merrimack River Watershed Assessment Study, Final Phase I Report. Available online at: <https://www.nae.usace.army.mil/portals/74/docs/topics/merrimacklower/phaseifinal.pdf>. Accessed February 1, 2024.

Also, in the RSP, we recommend that you expand the reach of your data request to include additional stakeholders with public recreation and conservation land and recreational facilities within and adjacent to the project boundary, including the following stakeholders: the Town of Andover, Massachusetts; Andover Trails Committee, Inc.; and the Andover Village Improvement Society.

4. In section 13.6.2, *Field Inventory*, Essex proposes to conduct a field inventory to document existing project and non-project recreational facilities within or adjacent to the project boundary. Essex also includes a list of relevant and applicable information to be collected at each project and non-project recreation facility including a description of the recreation type and location, property ownership, recreational use and capacity, and georeferenced photographs. The proposed study, however, does not indicate whether the condition of each facility will be assessed, evaluated, and recorded.

At the January 4, 2024, study plan meeting, Essex stated that it would assess the condition of each project and non-project recreational facility as part of the study. Therefore, we recommend that the RSP describe how the current condition of each existing project and non-project recreational facility will be assessed and documented. Staff recommends that the current **condition** of each site be documented with a written description and georeferenced photographs.

5. In section 13.6.3, *Visual Survey for Vegetation and Waterborne Trash*, Essex proposes to conduct a single visual survey of the North Canal and South Canal to document vegetation and waterborne trash within the study area. Essex proposes to complete this single survey for vegetation and waterborne trash at the end of the growing season (e.g., August/September); however, a single survey for vegetation and waterborne trash conducted during the end of the vegetative growing season may provide only a limited understanding of the presence and effects of vegetation and waterborne trash within the North and South Canals. Adding additional survey days would improve the understanding of where and when vegetative growth and waterborne trash contribute to diminishing visual aesthetics.

Staff recommends that the RSP add, at a minimum, two additional survey dates for vegetation surveys throughout the growing season, including one survey date during the middle of Spring (e.g., mid-May) and another survey date during the height of the growing season in early summer (e.g., late June or early July) for a total of three vegetation survey dates. Staff also recommends including one additional survey date for waterborne trash during, or a close as possible to, the height of the spring runoff, typically in April or May.

SCHEDULE B
COMMENTS ON REQUESTED STUDIES NOT ADOPTED

Desktop Entrainment, Impingement, and Turbine Passage Survival Study

6. Section 4.2.1 of Commission staff's November 28, 2023 Scoping Document 2 identified the effects of project operation and maintenance on fish impingement and turbine entrainment as a resource issue that would be addressed in Commission staff's National Environmental Policy Act (NEPA)³ document. In Commission staff's October 13, 2023 letter requesting additional information on the Pre-Application Document and additional study requests, staff requested that Essex complete a Desktop Entrainment, Impingement, and Survival Study to assess impingement and entrainment risk and to provide estimates of passage survival for emigrating diadromous species (i.e., adult and juvenile alosines, and adult American eel) through the project's two horizontal, Kaplan bulb turbines. In the PSP cover letter, Essex states that it does not propose to conduct the Desktop Entrainment, Impingement, and Turbine Passage Survival Study, but instead proposes to develop protection, mitigation, and enhancement (PM&E) measures to limit or prevent fish entrainment through the project turbines.

Section 5.18(b)(5)(ii)(B) of the Commission's regulations requires Essex to provide sufficient information in any license application to analyze issues, including but not limited to, those identified during the scoping process, that will need to be addressed in the NEPA document. As stated in Commission staff's study request, there is insufficient information on entrainment or impingement potential at the project to adequately assess, pursuant to sections 4(e) and 10(a) of the Federal Power Act, potential project effects to migratory fish species and the benefits and costs of any PM&E measures Essex, or other entities, may propose. Therefore, we recommend a Desktop Entrainment, Impingement, and Turbine Passage Survival Study.

Downstream American Eel Passage Assessment, Juvenile Alosine Downstream Passage Assessment, and Upstream and Downstream Adult Alosine Passage Assessment

7. Section 4.2.1 of Scoping Document 2 identified the effects of project operation and maintenance on the passage of migratory fish species as a resource issue that would be addressed in the NEPA document. In Commission staff's October 13, 2023 letter, we requested studies to evaluate the effects of the project on migrating adult American eels (i.e., Downstream American Eel Passage Assessment), juvenile alosines (i.e., Juvenile Alosine Downstream Passage Assessment), and adult alosines (i.e., Upstream and Downstream Adult Alosine Passage Assessment). To determine if project operation

³ 42 U.S.C. §§ 4321-4370(f).

negatively impacts survival and production of these species, the goals of Commission staff's requested studies are to assess: (1) passage survival through the existing downstream fish passage facility, the North and South Canals, and/or spill; (2) route selection; and (3) potential for passage delays.

In the proposed study plan cover letter, Essex states that it does not propose to conduct any downstream fish passage studies because its proposed future PM&E measures will mitigate fish entrainment through the project turbines. Instead, Essex proposes to evaluate survival through the existing downstream fish passage facility at a later date. While Essex proposes to evaluate survival through one passage route (i.e., the existing downstream fish passage facility), Essex does not propose to evaluate survival through the other potential downstream routes available to migratory fish that were identified in Commission staff's study requests (i.e., the North and South Canals, spill over the project dam, and the project turbines). In addition, Essex does not propose to evaluate downstream passage route selection, potential for passage delay, and passage efficiency, which Commission staff need to assess potential project effects to migratory fish species and any proposed, recommended, or required fish passage enhancement measures.

Section 5.18(b)(5)(ii)(B) of the Commission's regulations requires Essex to provide sufficient information in any license application to analyze issues, including, but not limited to, those identified during the scoping process that will need to be addressed in the NEPA document. As stated in Commission staff's study request, there is insufficient information on downstream fish passage survival, route selection, and passage delay at the project to adequately assess, pursuant to sections 4(e) and 10(a) of the Federal Power Act, potential project effects to migratory fish species or the effects of any PM&E measures Essex, or other entities, may propose. Therefore, we recommend the Downstream American Eel Passage Assessment, Juvenile Alosine Downstream Passage Assessment, and Upstream and Downstream Adult Alosine Passage Assessment studies.

Recreation Facilities, Use, and Aesthetics Study

8. In section 4.13, *Requested Studies Not Adopted – Recreation Facilities, Use, and Aesthetics Study*, Essex does not propose to conduct visitor use surveys or personal interviews at project and non-project sites during peak recreation season. However, without this information, we may not be able to accurately quantify current recreational use or evaluate the adequacy of existing recreational facilities to meet current and future recreational needs in the NEPA document.

Therefore, we recommend that the RSP identify the proposed methods and procedures that would be used to quantify visitors' use, needs, and experiences at project and non-project recreational facilities. In addition, we recommend identification of

public and stakeholder attitudes toward conditions and a discussion on the need for improvements of project recreational facilities and adjacent Essex-owned lands. Staff continues to recommend that Essex develop an interview/survey questionnaire to gather visitor use data that would request the following information, at a minimum: (1) age group; (2) local resident or visitor; (3) distance traveled/home zip code; (4) purpose and duration of visit; (5) day use or overnight lodging; (6) frequency or history of visiting the site or area; (7) types of recreational activities respondents participated in or plan to participate in during their visit, including primary and secondary recreation activities; (8) types of recreational equipment respondents brought or transported with them during their visit; (9) reasons for choosing the site or area; (10) other recreational sites that respondents visited or intend to visit during their trip; and (11) if there any areas of concern regarding vegetation growth on historic canal walls and trash.



The Commonwealth of Massachusetts

Division of Marine Fisheries

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Director

Debbie-Anne Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

RE: Comments on Proposed Study Plan for the Lawrence Hydroelectric Project P-2800-054

Dear Acting Secretary Reese:

This letter, pursuant to 18 CFR 5.12, provides the Massachusetts Division of Marine Fisheries' (MA DMF) comments on Essex Company, LLC's (Essex) Proposed Study Plan (PSP) for the relicensing of the Lawrence Hydroelectric Project (Project; P-2800-054). The Project is located on the Merrimack River in in the City of Lawrence, Essex County, Massachusetts. Essex filed the PSP with the Federal Energy Regulatory Commission (Commission) on November 28, 2023,¹ and held a proposed study plan meeting on January 4 – 5, 2024.

Of the 8 studies requested by MA DMF on October 16, 2023,² Essex adopted, in whole, or in part, five, and did not adopt three. For many of the studies not adopted, proposed by MA DMF or other stakeholders, Essex provides FERC's own Study Criterion 5 as justification. As specified in the Commission's regulations at 18 CFR 5.9(b)(5) study criterion 5 states that a study request must:

"Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;"

However, Essex, at its own volition, chose to evaluate our requested studies against the following erroneous criteria:

"There is no evidence of a problem and/or the study request is an attempt to search for a problem or "nexus" (Study Criteria No. 5): Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question. This "nexus" between the Project's operation and a resource impact must be supported by some evidence of a specific resource impact, not just a belief that an impact might be occurring. Additionally, the study request should

¹ Accession Number 20231128-5122.

² Accession Number 20231016-5011.

not be a request to search for an impact in the absence of any evidence that one is occurring. If the study request is an attempt to search for a Project effect, or a nexus, then it does not meet the criteria for a study request.” and “**Study request constitutes basic research and/or is not likely to inform the development of license conditions (Study Criteria No. 5):** Study requests should demonstrate the need for additional, site-specific information for purposes other than general research.”

Essex’s approach to the Commission’s study criteria is clearly inconsistent with the letter and intent of study criterion 5 and the Commission’s associated guidance documents.³ Furthermore, in each of the four affected studies requested, we provided a clear nexus between project operations and potential effects on the resource to be studied and articulated how the study data could be used to inform the development of license requirements. In general, Essex did not address the nexuses established in the MA DMF’s study requests; instead, it chose to lean its own fabricated study criterion 5 to base its rejection.

During the proposed study plan meeting held on January 4, 2024, MA DMF staff questioned Essex’s deviation from 18 CFR 5.9(b)(5) (criterion 5) of the Commission’s regulations. Essex asserted that it developed its criterion 5 based on the Commission’s study criterion 5, case law,⁴ and Commission precedence.

In its Final Rule, *Hydroelectric Licensing under the Federal Power Act* under RM02-16 (Order 2002),⁵ establishing the Integrated Licensing Process, the Commission specifically condemn Essex’s approach and articulates its position on this topic. Specifically, in response to comments received during the rulemaking process, the Commission states in paragraph 98 and 108:

“98. CHRC counters that a study might be required to establish the existence of a nexus. Taken to its extreme, CHRC’s position would have us approving study proposals that amount to mere speculation. ***We think a common sense approach to demonstrating a nexus between project operations and resource impacts, informed by the professional judgment of qualified agency, Commission, and tribal staff, should ensure that this criterion is reasonably applied.***” [emphasis added].

“108. ***Various industry commenters recommend that we add a criterion requiring a requester to discuss whether or not a resource problem has been identified that relates to the request.[104] This proposed criterion is too***

³ Understanding the Study Criteria, Integrated Licensing Process and A Guide to Understanding and Applying the Integrated Licensing Process Study Criteria; Available at: <https://ferc.gov/sites/default/files/2020-04/UnderstandingtheStudyCriteriaILP.pdf>, and <https://ferc.gov/sites/default/files/2020-04/AGuidetoUnderstandingandApplyingtheIntegratedLicensingProcessStudyCriteria.pdf>, respectively (Accessed February 28, 2024).

⁴ In the PSP, Essex relies upon cherry-picked information from *City Centralia v. FERC*, No. 99-1273 (D.C. Cir. 2000) which pre-dates the Commission’s Final Rule (Order 2000) that established the Integrated Licensing Process.

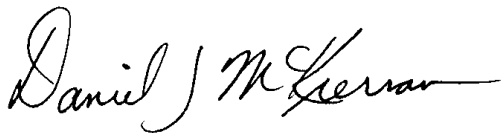
⁵ Accession Number 20030724-3002.

subjective. A principal feature of hydroelectric licensing in recent decades has been disagreements between license applicants and others concerning the extent to which proposed or existing projects have negative effects on natural and other resources. ***Whether an identified impact is or is not a problem, and the extent of the problem, are often matters of perspective. Moreover, the finding of a "problem" is not a required predicate for Commission action under the comprehensive development standard of FPA Section 10(a)(1)...*** [emphasis added].

In the attached Appendix A, we respond to Essex's reasons for not adopting certain study requests, but only to the extent they are based on the Commission's study criteria outlined in 18 CFR 5.9, and provide comments on the studies it does propose.

We appreciate this opportunity to comment and look forward to working with the Commission and Essex in the development of the revised study plan and subsequent license application. If you have any questions regarding this letter or our attached comments on the PSP, please contact Ben Gahagan at ben.gahagan@mass.gov or (978) 491-6233.

Sincerely,



Daniel J. McKiernan
Director

Attachments: Appendix A – Study Requests

cc: Curt Mooney; Patriot Hydro: cmooney@patrio hydro.com
Richard Malloy; Patriot Hydro: rmalloy@patrio hydro.com
Kevin Webb; Patriot Hydro: kwebb@patrio hydro.com
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REQUESTED APPENDIX A – STUDY REQUESTS

REQUESTED STUDIES NOT ADOPTED

MA DMF Study Request 5: Downstream Migratory Species Passage Assessment

Summary of Proposed Study Plan

As discussed in Section 4 of the Proposed Study Plan (PSP), Essex Company, LLC (Essex) after review of the requested studies, and with the intent of reducing, the need for, and/or scope of studies, altered its licensing proposal. Essex now proposes to replace the Lawrence Hydroelectric Project's (Project) existing trashracks with a narrow-spaced trashrack design to limit fish entrainment into Project works and to develop this protection, mitigation, and enhancement measure (PM&E) in consultation with the Merrimack River Technical Committee (MRTC) for inclusion in its draft license application (DLA) for the Project. As a result, Essex is not proposing MA DMF's requested *Downstream Fish Passage Assessment* study (Study Request 5). In the PSP, Essex states that the existing downstream fish bypass facility should be evaluated later.

MA DMF Response

Essex's approach to propose PM&E's in lieu of conducting studies to evaluate existing conditions, has merit and is supported by the MA DMF. However, the goal of the MA DMF's Study Request 1 is to assess behavior, passage success, immediate and latent survival, and internal and external injury of target species as they encounter the Project during downstream migrations through *all* downstream passage routes.⁶ Essex's proposed PM&E measure only addresses one viable passage route, turbine passage. Other potential downstream routes include the Project's spillway, North and South canal gatehouses and canal systems, and the Project's downstream fish bypass. While we agree that Essex's proposal to install a narrow spaced trashrack would eliminate the need to assess turbine entrainment and passage survival through the Project's intake, at this time, the proposed PM&E measure does not address all downstream passage routes; and therefore, we continue to support our Study Request 1 for the remaining passage routes at the Project and ask that Essex include a *Downstream Fish Passage Assessment*, commensurate of its licensing proposal, in the Revised Study Plan (RSP).

⁶ Target species and life stages are juvenile and adult American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), and adult American eel (*Anguilla rostrata*).

MA DMF Study Request 6: Diadromous Fish Behavior, Movement, and Project Interaction Study

Summary of Proposed Study Plan

Section 4 of the PSP also states that Essex is not proposing MA DMF's requested *Diadromous Fish Behavior, Movement, and Project Interaction Study* (Study Request 6). Essex notes that our Study Request 5 would be best developed after it can be informed by its proposed *Three-Dimensional Computational Fluid Dynamic (CFD) Modeling* (PSP Section 12; CFD Modeling Study), included in Section 12 of the PSP. However, the PSP does not articulate how the CFD Modeling Study results would inform the development of a *Diadromous Fish Behavior, Movement, and Project Interaction Study*.

MA DMF Response

Essex's position on our Study Request 5 is unclear. While the PSP implies a study may be developed in the future, Essex did not commit to doing so, the PSP clearly states it is not proposed, and the PSP does not include a process for the development of that study. We note that the PSP did not address the study criteria outlined in 18 CFR 5.9 in its discussion of our Study Request 5 and its reasoning for not adopting the requested study. For the reasons discussed in our Study Request 5, the MA DMF continues to seek the development and implementation of the *Diadromous Fish Behavior, Movement, and Project Interaction Study* and asks that Essex include the requested study in its RSP.

Additionally, MA DMF provides the following recommendations that should be considered to determine the appropriate type and number of tags to deliver the needed data. A successful study plan should incorporate:

- A telemetry technology/system that will allow for many fish to simultaneously occupy the study area, employing high frequency, high transmission rate tags. The selected tags should maximize transmission rate and detectability in high-noise environments while minimizing data loss through tag collisions.
- A routine tagging program throughout the migratory season that includes tagging of both the predator and prey species to determine the behavior of both. Tag allocation should be much higher for the prey species. Essex should minimize tag burden and handling affects to the greatest degree possible.
- Monitoring of environmental variables and Project operations throughout the length of the study.

MA DMF Study Request 7: Fish Passage Improvement and Feasibility Assessment

Summary of Proposed Study Plan

In Section 4.2 of the PSP, Essex indicates it did not adopt MA DMF's requested *Fish Passage Improvement and Feasibility Assessment* (Study Request 7), at this time, because the requested study would evaluate potential PM&E measures that may not be necessary. The PSP notes that the proposed fish passage studies are intended to evaluate the effectiveness of the existing fish passage facilities. If those studies indicate enhancements for fish passage are needed, the PSP acknowledges that potential next steps could be articulated in the DLA.

MA DMF Response

In general, we accept Essex's proposed approach to our requested *Fish Passage Improvement and Feasibility Assessment* (Study Request 7). The development and implementation of our Study Request 7 now, would proactively support a review of fish passage alternatives at the Project, even though Essex is not currently proposing any modification to the existing fish passage facilities. While MA DMF suspects the existing fish passage facilities are woefully inadequate, little data exists to confirm a need for improvements to the Project's fish passage facilities, at this time. As such, MA DMF understands why Essex may find implementation of our Study Request 7 to be premature. We do not agree, however, that next steps should simply be identified in its DLA. Instead, following a review of study results of Essex's proposed *Upstream Fish Passage Assessment*, *Upstream American Eel Passage Assessment*, Sections 6 and 7 of the PSP, respectively, and MA DMF's requested *Downstream Fish Passage Assessment* and MA DMF's requested *Diadromous Fish Behavior, Movement, and Project Interaction Study*, we ask, pursuant to 18 CFR 5.15(c)(1), that Essex's Initial Study Report (ISR) propose, if appropriate, our Study Request 7. If, at that time, the MA DMF and Essex disagree on the need for our Study Request 7, the MA DMF will ask that our *Fish Passage Improvement and Feasibility Assessment* be conducted, pursuant to 18 CFR 5.15(c)(4).

REQUESTED STUDIES ADOPTED

MA DMF Study Request 4: Upstream Anadromous Fish Passage Assessment (PSP Section 6)

In Section 6 of the PSP, Essex provides its proposed *Upstream Anadromous Fish Passage Assessment* study plan. The proposed study is largely consistent with MA DMF's Study Request 2, except Essex does not propose to evaluate the effectiveness of upstream fish passage facilities for sea lamprey (*Petromyzon marinus*). In Section 4.14 of the PSP, Essex states that it does not propose to assess sea lamprey because (1) the 2021 *Merrimack River Watershed Comprehensive Plan for Diadromous Fishes* (MRTC 2021) does not provide upstream effectiveness goals for sea lamprey, and (2) there is lack of available existing information to evaluate and assess passage efficiencies for sea lamprey. MA DMF recommends sea lamprey be included in this study, as previously requested. The only information we have related to sea

lamprey at the Project is count data from the fish lift, which does not characterize their movements through the Project area or the passage effectiveness of the Project. The absence of numerically-specific upstream passage effectiveness goals does not negate the need to evaluate Project effects on sea lamprey or the Project's ability to provide safe, timely, and effective fish passage. MA DMF's overarching management goal for sea lamprey in the Merrimack River, as outlined in the Comprehensive Plan,⁷ is to restore and maintain sustainable runs for human and ecological benefits. Information from the proposed study, as requested, will support an assessment of the Project's effects on the safe, timely, and effective upstream passage of sea lamprey and inform the need for potential license conditions to improve passage conditions. Therefore, we do not support Essex's proposal to omit sea lamprey from the proposed Upstream Anadromous Fish Passage Assessment, and we encourage Essex to consider including lamprey in this study in their RSP.

Comments

In Section 6.6.1, *Sample Size*, Essex proposes to observe 100 radio tagged individuals of each target fish species. To accomplish this and based on a presumed rate of fallback, and an assumed rate of mortality and predation for adult American shad, adult alewife and blueback herring (collectively, river herring), Essex proposes to tag 165 American shad and 185 river herring. This approach is flawed for several reasons, including:

- Section 6.6.1 provides no supporting information to indicate that a sample size of 100 individuals observed below the project for each group targeted would generate statistically significant results. To properly justify a meaningful sample size, Essex should perform simulations with program MARK (as specified in Section 6.6.6.3 *Data Analysis – Parameter estimates for Evaluating Passage Success*) to identify a sample size where the point estimate and corresponding 95% or 75% confidence interval overlapped the true survival or passage value (see Molina-Moctezuma and Zydlewski 2020).⁸ These simulations should be run for realistic (meaning values from the literature that reflect high stress sampling methods and complex antenna environments) combinations of fallback, post-tag mortality, and detection efficiencies. The minimum number of samples needed to yield reliable results should then be applied to what might be expected at the *most upstream* station to produce viable results for total Project passage, meaning attrition through all components of passage should be accounted for in the number arriving at the most downstream point of the study.
- Essex's method of arriving at a necessary samples size is incorrect and produces tagging numbers that would not be expected to yield 100 fish at the Project. Essex calculated sample size by starting at 100 and asked what was 50% of that number, meaning with

⁷ FERC Accession # [20210617-5016](#)

⁸ Molina-Moctezuma, A. and Zydlewski, J. 2020 An interactive decision-making tool for evaluating biological and statistical standards of migrating fish survival past hydroelectric dams. River Research and Applications. <https://doi.org/10.1002/rra.3616>

alewife and a mortality rate of 50% they added 50 tags. However, to get the correct number of tags the question is not what is 50% of 100, it is what number would yield 100 after a loss of 50%? As an equation, it would be presented as

$$100 = x * (1 - 0.5)$$

where solving for x would resolve to

$$x = \frac{100}{0.5} = 200$$

If you treated mortality and fallback sequentially, you would then calculate the 21% fallback $x = \frac{200}{1-0.21} = 253$. This will still be an underestimate as fallback and *tagging* mortality are not sequential, they are simultaneous. In the case of alewife, Essex has not decomposed mortality from their expected predation and tagging mortality, but if we considered all tagging effects (i.e., mortality and fallback) additive the needed amount of tags to get 100 tagged river herring to the project would be 345. So, the actual number needed based on their expected mortality and fallback rates would be between 253 and 345. For shad, the tags needed based on the rates in the PSP can be calculated additively, meaning $x = \frac{100}{1-(0.25+0.33)} = 238$. While the number of total tags required to complete this study would lead to tag interference if all fish survived and approached the Project, it is important to remember that at no point would all these tags be expected to be in the region of interest (above Station 3) as tag releases would be staged over the season and the actual required sample sizes would still be expected to yield Essex's proposed 100 tags in that area. If this is still an overwhelming concern, we recommend the study be split to evaluate different target species groups over two upstream migration seasons.

- The fallback and mortality rates used in the PSP were justified as being similar to what was experienced by tagged fish in the recent studies at the Lowell Project. However, those fish were collected by dip net from the exit channel of the Lawrence fishway while the fish for the current study will be electro-fished. These methods differ greatly in that fish that had already ascended the Lawrence Project selected for individuals that were highly motivated and in adequate condition to aggressively migrate upstream. The condition of fish tagged below Lawrence would be unknown but unlikely to select for 100% of fish that would be passing Lawrence. Secondly, electrofishing is more stressful to fish than dip-netting, meaning there will likely be greater post-tagging effects on fish in this study. The alosine tagging literature has mortality rates between 17-75% and fallback between 24-71% (Beasley and Hightower 2000, Bailey et al. 2004, Aunins and Olney 2009, Aunins et al. 2013, Grote et al. 2014, Gahagan and Bailey 2020)⁹

⁹ Beasley, C. A., and J. E. Hightower. 2000. Effects of a low-head dam on the distribution and characteristics of spawning habitat used by Striped Bass and American Shad. *Transactions of the American Fisheries Society* 129:1316–1330.

Bailey, M. M., J. J. Isely, and W. C. Bridges. 2004. Movement and population size of American Shad near a low-head lock and dam. *Transactions of the American Fisheries Society* 133:300–308.

- Our Study Request 5 treated alewife and blueback herring as separate species to be assessed. The proposed study plan combines these species and addresses them as one. While alewife and blueback herring are similar species, they do exhibit different migratory behaviors and should be evaluated independently. We recognize the consideration raised in Section 6.6.1 that increasing “...the number of test fish required...must be weighed against the functional limitations of effectively monitoring large numbers of fish within any one detection zone due to collisions among tag signals.” If upon adopting our recommendations, it is determined that poor data will be the result, instead of conducting the study in one migratory season, we recommend the study be split to evaluate different target species groups over two upstream migration seasons.

In summary, we recommend that section 6.6.1 of the RSP (1) include a simulation or power analysis and justification for the number of targeted observed radio tagged individuals, (2) apply the correct equations to calculate sample sizes that would be expected to yield the target number of fish, (3) re-consider expected mortality and fallback rates where appropriate, (4) treat alewife and blueback herring as separate species, and (5) consider the need for multiple study seasons to support data integrity.

In Section 6.6.3, *Radio Telemetry Monitoring Stations*, Essex proposes to establish and monitor 10 monitoring stations. However, as demonstrated in Figure 6-2 of the PSP, none of the proposed monitoring stations would be situated to monitor (1) how fish approach the Project, (2) false attraction to the Project’s spillway, (3) milling or disorientation in the tailrace, or (4) fish passage success and escapement through the Project’s headpond. As such, MA DMF recommends the addition of the following monitoring station(s):

- Area below the Duck Bridge as fish approach the Project flows (below proposed Station 3, covering the approach to the immediate project flows);
- Coverage for the entire area below the spillway to identify area of false attraction under all flow conditions encountered during the study (between proposed Stations 3 and 4);
- Area between the rock face on river right and the stone abutment separating the spillway and powerhouse flows to identify fish that have entered the flow field of the powerhouse and fishway (between proposed Stations 3 and 4, identifying fish that have

Aunins, A., and J. E. Olney. 2009. Migration and spawning of American Shad in the James River, Virginia. *Transactions of the American Fisheries Society* 138:1392–1404.

Aunins, A. W., B. L. Brown, M. Balazik, and G. C. Garman. 2013. Migratory movements of American Shad in the James River fall zone, Virginia. *North American Journal of Fisheries Management* 33:569–575.

Grote, A. B., M. M. Bailey, and J. D. Zydlewski. 2014. Movements and demography of spawning American Shad in the Penobscot River, Maine, prior to dam removal. *Transactions of the American Fisheries Society* 143:552–563.

Gahagan, B.I., and M. M. Bailey. 2020. Surgical implantation of acoustic tags in American shad to resolve riverine and marine restoration challenges. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science* 12:272-289.

- entered the tailrace and are available for passage);
- Coverage of the start of the northern (river side) fishway entrance flow field (between proposed Stations 3 and 4);
- Two antennas upstream of Station 9 to identify fish that drop back into the intake and bypass flows after exiting the exit flume and those that eventually depart the immediate vicinity of the powerhouse;
- An antenna at the upstream limit of the Project's impoundment help determine predation and delay in the impoundment and a second antenna upstream of that to provide a viable detection probability for the antenna at the limit of the impoundment. It is possible that the proposed Station 10 could function as one of these antennas or be moved to do so.

Please see below the modified Figure 6-2 from the PSP to illustrate the added antennae needed (red ellipses) surrounding the powerhouse and spillway:

Figure 6-2. Proposed stationary receiver placement for monitoring upstream passage effectiveness at the Lawrence Project



MA DMF Study Request 3: Study of Upstream Fish Passage Effectiveness for American Eel (PSP Section 7)

In Section 7 of the PSP, Essex provides its proposed *Upstream American Eel Passage Assessment* study plan. The proposed study is mostly consistent with MA DMF's Study Request 4. In the following section, we provide our comments on Essex's proposed *Upstream American Eel Passage Assessment* (PSP Section 7).

Comments

Section 7.3 *Study Area* defines the study area as "...the section of the Merrimack River located immediately downstream of the Essex Dam and the existing upstream eel passage facilities." This geographic scope is too large and should be reduced accordingly. We recommend modifying Section 7.3 as follows:

The study area will include the section of the Merrimack River located immediately downstream of the Essex Dam, *proximal* to ~~and~~ the existing upstream eel passage facilities.

In Section 7.6.2.2 *Eel Tagging and Releases*, notes that up to 500 juvenile eel will be tagged with a 12 millimeter (mm) passive integrated transponder (PIT) tags. The study proposes to tag two size classes of eels, individuals less than or equal to 150 mm and those greater than 150 mm. Given the size of the 12 mm PIT tags, the study plan appropriately establishes an eel minimum size threshold of 113 mm.

Juvenile eel sampling conducted by United States Fish and Wildlife Service (USFWS) at the Project in 2015, indicates the majority of eel at the site are 110mm or shorter. Of the 761 eels captured in the Project's eel ladder on July 29, 2015, 755 were less than 110 mm, none were between 110 mm and 120 mm, and 6 were over 120 mm. Given this information, MA DMF is concerned that the proposed study methodology will skew the tagged sample population such that it is not representative of the eels utilizing the upstream passage facilities at the Project. As a result, MA DMF recommends the proposed study include a contingency marking/tagging and recapture methods (e.g., visual elastomer tags) in the event the size of eels captured during the study plans' implementation is like that experienced during USFWS' 2015 sampling effort.

MA DMF Study Request 2: American Eel Upstream Passage Siting Study (PSP Section 8)

In Section 8 of the PSP, Essex provides its proposed *Upstream American Eel Passage Siting Study* plan. The proposed study is generally consistent with MA DMF's Study Request 2. In the following section, we provide our comments on Essex's proposed *Upstream American Eel Passage Assessment* (PSP Section 8).

Comments

In Section 8.6.1 *Nighttime Visual Surveys*, of its PSP, Essex proposes to conduct nighttime surveys to reevaluate the spatial distribution and relative abundance of juvenile eels downstream of the Essex Dam and other Project structures. Essex provides a list of "potential" survey areas noting that they "...will only be searched pending a determination that there are no significant health or safety risks associated with accessing and entering those locations." We note that the downstream face of the Project's dam and tailrace are excluded from the list of survey areas and recommend the RSP include them in the list of Project features where nighttime visual surveys occur. Conducting environmental surveys in and around hydroelectric projects is inherently dangerous, and MA DMF appreciates Essex's commitment to the protection and safety of personnel. MA DMF expect Essex to take every precaution necessary to keep personnel safe through the development of proper safety protocols, provision of any necessary personal protective equipment (PPE), and training. MA DMF asks that survey locations only be removed if the hazards cannot be mitigated and that Section 8.6.4 *Data Analysis and Reporting* of the RSP include provisions for reporting why any survey areas, for any sampling method, are removed from survey and all measures considered to mitigate the potential hazard(s) but determined to be inadequate.

Section 8.6.2 *Electrofishing Surveys* of the PSP, states that backpack electrofishing surveys will be conducted downstream of Essex Dam. Section 8.6.2, however, does not specify the area(s) for electrofishing surveys to occur. To provide a more robust estimate of the relative abundance and body size distribution of juvenile American eels found in the Project's vicinity and waters, MA DMF recommends the RSP include electrofishing surveys within (1) the Merrimack River from the Project's dam to the tailrace, (2) within the Spicket River from its confluence with the Merrimack River to the terminus of the North Canal, and (3) within the North and South canals in their entirety. Electrofishing survey techniques should not be limited to backpack electrofishing and may include other electrofishing methods (e.g., boat electrofishing) as environmental factors (e.g., water depth, substrate, etc.) may dictate. We also recommend section 8.6.2 of the RSP note that any eel captured during canal electrofishing surveys be released to the Project's impoundment if agreed upon by the Massachusetts Division of Fisheries and Wildlife.

The PSP, in Section 8.6.3 *Temporary Eel Traps*, states that up to two temporary eel traps will be deployed in locations determined in consultation with the MRTC and in consideration of site access, personnel safety, and site security. MA DMF recommends Section 8.6.3 of the RSP be revised to provide for a minimum of three temporary eel traps to be deployed as follows: at the

downstream side of the North and South canal gatehouses, and at the downstream side of the terminus of the North Canal at the Spicket River. Precise placement of the trap ramps and the need for additional traps should be determined in consultation with the MRTC prior to the start of the ten-week survey period.

MA DMF Study Request 8: Stranding Evaluation Study (accepted PSP Section 9)

In Section 9 *Project Operations and Fish Stranding Study* of the PSP, Essex proposes to conduct a desktop evaluation of existing Project operational data for a five-year period of record. As proposed, the analysis would include a review of detailed Project operational data, minimum flows, Merrimack River flows, and impoundment elevation, and the results of its *Three-Dimensional Computational Fluid Dynamic (CFD) Modeling* study proposed in Section 12 of the PSP. Essex proposes to review Project operations from 2019-2023 and determine the conditions of the 2019 and 2023 stranding events identified in MA DMF's requested *Fish Stranding and Ramping Rate Study* (Study Request 8). As discussed in Section 4.12 *Fish Stranding and Ramping Rate Study* of the PSP, Essex does not propose MA DMF's requested field surveys because it finds our study methodology too broad, noting that MA DMF did not specify the operational changes that would trigger the field surveys. In addition, Essex contends that our requested study methods assumes that fish stranding events may occur under any or all operational changes even though only two stranding events were identified in our Study Request 8. In the following section, we provide our comments on Essex's proposed *Project Operations and Fish Stranding Study* and its comments on our Study Request 8.

Comments

In addition to the Essex's proposed desktop evaluation, MA DMF's Study Request 8 included field surveys. Specifically, Phase 1, Task 2 of our requested study included the following field components:

- Survey and map potential stranding sites and topography of the habitat beneath the Project's spillway within the zone of tailwater surface elevation fluctuation.
- Examine potential stranding sites in the study area at an appropriate time interval after an operational change.¹²
- Provide time lapse photography to monitor potential stranding sites.
- Monitor and document depth at potential stranding sites before and after an operational change, such as a reduction in spill as a crestgate is inflated, to identify areas that become rapidly isolated or dewatered in a manner that may strand fish when they are present.

- Document the number, location, and species of fish stranded, and detailed project operations that caused the stranding event. In addition, the conditions of the study/stranding area should be photo-documented.
- Document the number and species of fish stranded within the turbine bays, draft tubes, and upstream and downstream fish passage facilities during routine maintenance activities.

Essex notes that only two stranding events were identified in our Study Request 8 and finds that our requested study methods assumes that fish stranding events may occur under any or all operational changes. We respectfully disagree. Our requested study does not presume that fish stranding occurs under all Project operational changes. To the contrary, our study request seeks to identify which operational scenarios or aspects of those scenarios that do result in fish stranding events. This information could then be used to inform PM&E measures that avoid these conditions. There are two known events in recent history that by chance the New Hampshire Fish and Game Department (NHFGD) was present to document. This does not imply that the project operational conditions associated with these two events are the only scenarios that result in fish strandings at the Project. Without our requested field surveys and actively looking for stranded fish in conjunction with changes in project operations, the proposed study will only provide data on the two discrete events documented by NHFGD and will not inform license conditions that avoid or mitigate all stranding events that may be caused by project operations. Finally, MA DMF's Study Request 8 also sought information on fish strandings associated with routine project maintenance. Essex's PSP Section 9 study would not provide any information on fish strandings within the turbine bays, draft tubes, and upstream and downstream fish passage facilities, or the canal systems during routine project operation and maintenance activities. As a result, MA DMF recommends that Essex's RSP Section 9 include the requested field surveys outlined in our Study Request 8, Phase 1, Task 2 and the Project's associated canal system.

Essex's proposal to use its proposed CFD modeling study to further evaluate potential fish stranding in the Project's vicinity is consistent with MA DMF's Study Request 8. However, the geographic scope for CFD modeling downstream of the Project, as *proposed* in the PSP Section 12.3 Study Area, is limited to areas downstream of fishway entrances within the tailrace, and internally within the fish lift. In contrast, Essex's PSP Section 9.3 Study Area identifies the geographic scope of the proposed *Project Operations and Fish Stranding Study* to be the tailrace, and the downstream reach below the Essex Dam. Therefore, the geographic scope of the CFD modeling study is inadequate to inform the analysis proposed by Essex in the PSP Section 9 study. For this reason, MA DMF recommends that the RSP's Section 12.3 be revised to include the Merrimack River from the downstream face of the Project's dam to the downstream side of the Union Street Bridge. We provide additional comments on Essex's proposed CFD modeling study in *Three-Dimensional Computational Fluid Dynamics (CFD) Modeling* (PSP Section 12) below.

MA DMF Study Request 1: Three-Dimensional Computational Fluid Dynamics (CFD) Modeling (PSP Section 12)

The Section 12 *Three-Dimensional Computational Fluid Dynamics (CFD) Modeling* proposed by Essex would develop three-dimensional models of discrete areas associated with the Project's fish passage structures including the powerhouse forebay, downstream bypass, tailrace, fish lift, and fishway entrances. Essex's proposal is consistent with some aspects of MA DMF's requested Hydraulic Modeling Study (Study Request 1) but provides a smaller geographic scope than articulated in our request. In the following section we provide our comments on Essex's proposed *Three-Dimensional Computational Fluid Dynamics (CFD) Modeling* study.

Comments

MA DMF's Study Request 1 articulated a need to understand the complex flow fields in the Project's vicinity. This information coupled with data from our requested *Downstream Fish Passage Assessment* (Study Request 5), *Upstream Anadromous Fish Passage Assessment* (Study Request 4), *Upstream American Eel Passage Assessment* (Study Request 3), *Diadromous Fish Behavior, Movement, and Project Interaction Study* (Study Request 6), and the *Fish Stranding and Ramping Rate Study* (Study Request 8) will inform an analysis of Project effects on these aquatic resources and the development of potential PM&E measures to address those effects. Essex's PSP recognizes the benefit of the CFD modeling study in Section 4.1, where it states that the Proposed Section 12 CFD modeling study complements its proposed *Upstream Anadromous Fish Passage Assessment* (PSP Section 6), the *American Eel Upstream Passage Siting Study* (PSP Section 8), and the *Project Operations and Fish Stranding Study* (PSP Section 9). While this statement could be true, Essex's proposed CFD modeling study and its associated geographic scope constrains modeling results such that, as proposed it will only inform an assessment of upstream anadromous fish passage. As discussed above, the PSP's Section 9 *Project Operations and Fish Stranding Study* specifies that CFD modeling results will be integrated to inform that study. Unfortunately, for reasons discussed therein, the proposed CFD modeling will not support Essex's *Project Operations and Fish Stranding Study* either.

With a proper geographic scope CFD model results can inform an analysis of fish behavioral data collected by other proposed and requested studies. As discussed above, MA DMF recommends that Essex's RSP include MA DMF requested Studies 5 and 6, and Essex's proposed PSP Sections 6, 8, 9, and 11 with our recommended modifications. As a result, and to support an analysis of the Project's effects on aquatic resource and the development of potential license conditions, MA DMF recommends the RSP include a Hydraulic Modeling Study with a geographic scope consistent with our Study Request 1.



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March 11, 2024

NHESP 23-0072

Debbie-Anne A. Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, N.E., Room 1A
Washington, DC 20426

Lawrence Hydroelectric, FERC No. 2800
Essex Company, LLC
Merrimack River, Massachusetts

COMMENTS ON PROPOSED STUDY PLAN

Dear Acting Secretary Reese:

Essex Company, LLC (Essex) filed a Proposed Study Plan (PSP) for the Lawrence Hydroelectric Project on November 28, 2023. The Commission concurrently issued Scoping Document 2 (SD2) for the Project. Per the Integrated Licensing Process, a study plan meeting was held by Essex on January 4 and 5, 2024 which was attended by MassWildlife staff. As part of the Integrated Licensing Process, the MA Division of Fisheries and Wildlife (MassWildlife) has the opportunity to comment on SD2 and the PSP.

MassWildlife is the state agency responsible for the protection, management, and conservation of freshwater fish and wildlife resources of the Commonwealth. MassWildlife 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; 321 CMR 10.00; MESA). MassWildlife restores, protects, and manages land for wildlife to thrive and for people to enjoy. As such, we are one of the state agencies that monitor operations at hydroelectric projects within the Commonwealth, as well as comment on proposed hydroelectric facilities.

On October 16, 2023, MassWildlife submitted requests for seventeen (17) studies. Essex's PSP addresses some interests identified in our study request and adopted 5 (five) of our study requests, proposes to not conduct eleven (11) requested studies, and adopted one (1) study in part.

Study Criterion No. 4

Of the seventeen (17) studies requested by MassWildlife, Essex did not adopt eleven (11) studies. Essex asserted their own Study Criterion 4 as justification for not adopting five (5) of MassWildlife's requested studies.

As rationale for not adopting studies, Essex states: "Study request is not necessary because existing information is sufficient to answer the questions posed (Study Criterion No. 4): Requestors should also describe why existing information is insufficient to inform the development of license requirements. Study

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requests should demonstrate the need for additional, site specific information for purposes other than general research.”

In every MassWildlife study request, all available information was summarized, and each study request states why that information is not sufficient to understand the baseline conditions or ongoing effects.

Essex cites studies ongoing in the watershed as sufficient. For example, work being conducted on Shortnose Sturgeon addresses a specific set of projects – namely – replacement of 2-3 bridges below the Essex Dam that will be physical construction projects. The studies are designed to address the proximate questions about impacts from those projects on sturgeon during construction over the several years of the infrastructure work; these studies do not consider impacts from the Essex dam or its operation. While the data collected by the Massachusetts Department of Transportation may have some utility to the licensing process, it is not sufficient in scope or to rely upon by Essex to understand their ongoing project effects. MassWildlife disagrees with Essex that there is sufficient information for the studies not to be adopted.

Study Criterion No. 5

For ten (10) of the studies not adopted by Essex, Essex asserts its own Study Criterion 5 as the basis for not adopting these studies. Essex uses their own wording for Study Criterion 5, one example copied below:

[T]here is no evidence of a problem and/or the study request is an attempt to search for a problem or “nexus” (Study Criterion No. 5). Under FERC policy and regulations, as study requestor must substantiate a connection between the Project operations and effects on the resource in question. This “nexus” between the Project’s operation and a resource impact must be supported by some evidence of a specific resource impact, not just a belief that an impact might be occurring. Additionally, the study request should not be a request to search for an impact in the absence of any evidence that one is occurring. If the study request is an attempt to search for a Project effect, or a nexus, then it does not meet the Criterion for a study request.” and “Study request constitutes basic research and/or is not likely to inform the development of license conditions (Study Criterion No. 5): Study requests should demonstrate the need for additional, site-specific information for purposes other than general research.

FERC’s regulations state that Criterion 5 is:

Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements” (18 CFR §5.9(b)(5).

Essex refers to the City of Centralia v FERC (D.C. Circuit Court 2000) decision. However, there are significant factual differences that undermine the relevance of this decision to Essex’s position. The Courts were asked to weigh the evidence submitted by a party to proceeding that there was no problem against a request to install a barrier or conduct study on the same matter by NOAA-NMFS. In the end, the Courts found the evidence on the record of no delay at the powerhouse sufficient to weight in favor of not requiring the barrier or study. In contrast, no party has presented evidence on the record that there is no “problem” relevant to the MassWildlife submitted studies not adopted. Thus, the relevance of this decision to the requested studies is unclear to MassWildlife. Further, and perhaps more importantly, the City of Centralia decision was issued three-years before the ILP process rulemaking.

During the ILP process and rulemaking, Criterion 5 was explicitly addressed and, we assume, would be controlling:

Paragraph 98: [W]e think a common sense approach to demonstrating a nexus between project operations and resource impacts, informed by the professional judgment of qualified agency, Commission, and tribal staff, should ensure that this criterion is reasonably applied¹ [emphasis added].

Paragraph 108: *Various industry commenters recommend that we add a criterion requiring a requester to discuss whether or not a resource problem has been identified that relates to the request...This proposed criterion is too subjective. A principal feature of hydroelectric licensing in recent decades has been disagreements between license applicants and others concerning the extent to which proposed or existing projects have negative effects on natural and other resources. **Whether an identified impact is or is not a problem, and the extent of the problem, are often matters of perspective. Moreover, the finding of a "problem" is not a required predicate for Commission action under the comprehensive development standard of FPA Section 10(a)(1). Rather, that standard contemplates license conditions for the "protection, mitigation, and enhancement" of fish and wildlife...** , and for other beneficial public uses, including irrigation, flood control, water supply, and recreational and other resources (emphasis added).*² [emphasis added]

In FERC's Guidance Document³ for the ILP published in 2012, it states,

A **reasonable** connection between project construction or operation and potential effects on the resource in question is a threshold requirement that must be demonstrated for the Commission to require that an applicant gather the requested information. [emphasis added]

MassWildlife finds no support for Essex's approach to Study Criterion 4 or 5, in fact, we believe FERC policy and guidance clearly supports FERC's own criterion.

In each of the studies submitted by MassWildlife, a clear nexus was provided along with a clear pathway for the collected data to inform license articles, PM&E measures, and or 10(j) recommendations. In several cases, the data requested was also requested by FERC to utilize for the NEPA analysis. In lieu of addressing MassWildlife's study requests, Essex repeated their interpretation of Criterion 5 providing little more than the above quoted phrase and did not address the nexuses established in the Study Requests.

¹ Docket No. RM02-16-000; Order No. 2002, Hydroelectric Licensing under the Federal Power Act, Issued July 23, 2003. Action: Final Rule. Accession 20030724-3002. Page 30, Paragraph 98.

² Idem, Paragraph 108.

³ A Guide to Understanding and Applying the Integrated Licensing Process Study Criterion. (2012). Federal Energy Regulatory Commission Office of Energy Projects. <https://www.ferc.gov/sites/default/files/2020-07/guide-study-criterion.pdf> {last accessed 2/24/2024}

Run-of-River

Essex has not provided evidence that the Lawrence Project is operated in a manner that meets the run-of-river (ROR) Criterion. A ROR project, as defined by the Federal Energy Regulatory Commission's (Commission or FERC) Hydropower Primer (2017), is one that releases water at roughly the same rate as the natural flow of the river. Consequently, inflow to the Project impoundment and releases from the dam should be roughly the same and concurrently maintain constant water levels within the impoundment. Neither the Essex PSP nor PAD provided streamflow and impoundment water level data as evidence that the Project is operated as ROR. This information is critically needed for agencies to understand current and ongoing project operations and potential environmental effects. Requests for streamflow and water level data were made to Essex on several occasions by MassWildlife. To date, Essex has not provided information about flows in and out of their project demonstrating that they are ROR despite repeated requests and agreement by Essex to provide this information during the Study Plan Meeting.⁴

As the basis for not adopting several MassWildlife studies, Essex confounds a ROR operational regime with being neutral to the river and resources. The existence of a dam and reservoir(s) in a river, alone, disrupt the longitudinal habitats of rivers, as well as the species that rely upon those habitats. Dams have been documented to change natural water temperatures, alter water chemistry, introduce lentic habitats in systems where they would otherwise be lacking, alter sediment transportation, impact fish passage, and many other effects⁵. Creation of lentic habitats in rivers alter species compositions and communities - allowing lentic species to persist where they should not be present. Impoundments in riverine system can create habitat to benefit invasive species that would otherwise not be present in the system or struggle to find sufficient suitable habitat (e.g., Water chestnut in the Pepperell Hydro impoundment, P-12721; hydrilla in the Holyoke Dam impoundment, P-2004).

While ROR operations can avoid some impacts associated with peaking operations, they still share many important impacts. Effects from ROR operations are well represented on the record for FERC projects (e.g. Morrisville Project P-2629, bank erosion; Dalles hydroelectric Plant P-2069, fish passage; Pejepscot Hydroelectric P-4784; Pepperell Hydro P-12721, invasive water chestnut). Such effects are ongoing and continue to impact populations and systems on an ongoing basis.

Run-of-river facilities are often touted as being environmentally friendly in the belief that, unlike large hydroelectric dams, they do not flood large areas of land, dramatically transform river ecosystems, nor emit greenhouse gases. Yet a growing body of academic literature shows that ROR plants do indeed have a major negative impact on river ecosystems. They often cause drops in water flow and changes in water

⁴ We note that the MassWildlife and Stakeholder have made repeated requests for flow data to understand the operation of the project, which despite being promised at the study plan meeting, have not been forthcoming. See ascension 20240222-5140.

⁵ See extensive literature review in Kuriqi, Alban & Pinheiro, António & Sordo-Ward, Alvaro & Bejarano, Maria & Garrote, Luis. (2021). Ecological Impacts of Run-of-River Hydropower Plants-Current Status and Future Prospects on the Brink of Energy Transition. Renewable and Sustainable Energy Reviews. 142. AND Anders, David, Helen Moggridge, Philip Warren & James Shucksmith. (2015). The impacts of 'run of river' hydropower on the physical and ecological condition of rivers. Water and Environment Journal (29, 2015): 268-276.

temperature which in turn drive declines in fish populations. Their reservoirs can also be significant emitters of greenhouse gases. Access roads and transmission lines cause habitat fragmentation and destruction, and increase sedimentation in the river. These all negatively impact the land and river ecosystem.⁶

For example, in the Merrimack River, reported to be labelled the “Sturgeon River” in historic maps, sturgeon were historically found up to Old Derryfield (Manchester), New Hampshire⁷. The construction of the dams in the river directly prevent the fish from spawning in their historic upstream areas as they cannot swim past the dams. This is an effect of the physical presence of the dam, along with the infrastructure and operational methods that are ongoing and present impacting Sturgeon in the River.

Essex also mistakenly proposed that ROR operations preclude need of additional studies and leave no room for additional mitigation of ongoing environmental effects (PSP public meeting, January 2024). MassWildlife is aware of several mitigation measures that have been adopted to address ongoing Project environmental effects. For example, the Trinity River Restoration Project conducts gravel augmentation downstream of Trinity Dam for sturgeon and other fish species, in order to compensate for sediments retained behind the dam.⁸

Agreeing to the contention that a ROR dam has no impacts and no ability to avoid or minimize impacts would undermine FERC’s licensing process and state- and federal- agency environmental initiatives for fluvial habitats and species throughout the United States.

Responses to the Study Plan Meeting and SD2

Environmental Projections.

During the January 2024 Study Plan Meeting, Commission staff requested specific information about projections of air and water temperatures, precipitation, streamflow, and sea level rise specific to the Project. MassWildlife will submit this information to the Commission shortly after the end of the PSP comment period. We will provide descriptions of data sources, models used, and variables evaluated for each projection. Projections use reliable predictions of precipitation, snowmelt, evapotranspiration, and annual runoff patterns for 2030, 2050, 2070. Analysis of this information will help MassWildlife and the Commission evaluate ongoing and reasonably foreseeable future impacts upon and resulting from Project operations. For instance, the analysis would facilitate understanding of how Project operations may change if summer river flows are expected to significantly decrease (>20%), as well as help identify cumulative effects from these changes. Given the magnitude of environmental changes expected, ongoing environmental effects from the Project will be changing throughout the life of the new license, essentially shifting the baseline information necessary to evaluate Project effects. The MassWildlife PSP provided methods for evaluating these effects.

⁶ EnergyBC.Run of River Power - Energy BC

⁷ Kynard and Kieffer 2009

⁸ Trinity Project gravel augmentation. <https://www.trrp.net/restoration/gravel-augmentation/> (last accessed 3/6/2024)

Species Lists for SD2

SD2 (page 8 & 9). FERC staff stated, “including the eastern elliptio, eastern floater, alewife floater, eastern lampmussel, eastern pondmussel, tidewater mucket, yellow lampmussel, and brook floater...it is unclear if all the mussel species identified by MassWildlife are known to occur in the Merrimack Basin.” Overall mussel data is summarized in Appendix B, Table 1. Below, species are divided between the Merrimack River Basin and Merrimack River mainstem in Massachusetts.

- Known extant mussel species that reside in the Merrimack River Basin (within Massachusetts) include Alewife Floater (*Utterbackiana implicata*), Eastern Lampmussel (*Lampsilis radiata*), Eastern Floater (*Pyganodon cataracta*), Eastern Pondmussel (*Sagittunio nasutus*), Eastern Elliptio (*Elliptio complanata*), Creeper (*Strophitus undulatus*), Triangle Floater (*Alasmidonta undulata*), Brook Floater (*Alasmidonta varicosa*), Eastern Pearlshell (*Margaritifera margaritifera*), and Tidewater Mucket (*Atlanticoncha ochracea*).
- Known extant mussel species within the Merrimack River mainstem in MA include Eastern Floater, Eastern Elliptio, and Alewife Floater from very limited survey and incidental observations. Additional species that potentially could be present in the Merrimack River mainstem that have been recorded in nearby waterbodies include Eastern Lampmussel, Tidewater Mucket, and Eastern Pondmussel. Yellow Lampmussel (*Lampsilis cariosa*) has never been documented in the Merrimack River Basin; however, it exclusively occupies big river habitat in MA, (e.g., Connecticut River, Gulf of Maine rivers) and may have gone undetected previously from very low sampling effort.

We note that MassWildlife's requested mussel study (MassWildlife Study #2) would collect information about mussels occurring within the impoundment, canals and downstream of the Project. This would provide FERC information about freshwater mussels and suitable habitat occurring within the river. The MassWildlife's requested Study #4: Fish Assemblage Study would address the presence and passage or challenges of passage for suitable host fishes as well as provide information regarding the general ecology of the lower Merrimack River. Collectively, information about the habitat, occurrences and passage will add to information in the watershed to allow MassWildlife and FERC to address and analyze the direct and cumulative effects of project operation and maintenance on mussel species.


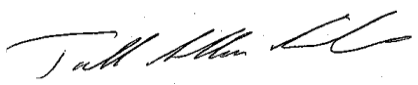
SD2, page 15. FERC states “Essex does not propose decommissioning, nor does the record to date demonstrate there are serious resource concerns that cannot be mitigated if the project is relicensed.” We note that there are serious resource concerns currently stated on the record, including upstream fish passage, sturgeon passage, dewatering and killing of mussels during maintenance drawdowns, and other information supplied as part of the Study Request process.

Responses to PSP

In Attachments A and B, MassWildlife responds to Essex's reasons for not adopting certain study requests, but only within the Commission's study Criterion outlined in 19 CFR 5.9. Detailed responses are provided for MassWildlife Study Requests 1-8, 12, 13, 17 and 18.

Other members of the MRTC will respond to the Fishway Hydraulic Modeling Study (CFD), American Eel Upstream Passage Siting Study, Study of Upstream Fish Passage Effectiveness for American Eel, Upstream Anadromous Fish Passage Assessment, and Fish Stranding and Ramping Rate Study. MassWildlife is fully supportive of their responses.

We appreciate this opportunity to comment and look forward to working with the Commission and Essex Company in the development of the license application. Information generated from these studies will support the operation, mitigation, and potential design needs for the proposed project in an environment experiencing climate change. If you have any questions regarding this letter or our attached study requests, please contact Misty-Anne Marold at misty-anne.marold@mass.gov, Rebecca Quiñones at rebecca.quinones@mass.gov.

Sincerely,	
	
Jesse Leddick Assistant Director for the Natural Heritage & Endangered Species Program MA Division of Fisheries and Wildlife	
	
Todd Richards Assistant Director for the Fisheries Program MA Division of Fisheries and Wildlife	

Attachment A
MA Division of Fisheries and Wildlife Comments on
Essex Proposed Study Plan: Studies Not Adopted

Invasive Plant Baseline Study: Survey, Mapping and Assessment (MassWildlife Study Request 1)

Summary of Proposed Study Plan

In section 4.10 of the PSP, Essex does not adopt MassWildlife's requested study plan claiming that we did not address the Commission's study Criterion 5. Essex goes further to state, "*the presence of invasive species change is a natural occurrence and/or a likely result of factors unrelated to the operation of the Project.*" The PSP stated that Essex will describe any proposed measurement to control invasive plants within the Project's boundary in the draft licensing document (DLA).

MassWildlife's Response

MassWildlife's Study Request would characterize current baseline conditions of invasive species needed to assess the continuing Project effects and potential PM&E measures to address such effects. Artificial impoundments, reservoirs, and canals, as areas of altered natural flows, are more vulnerable to invasion and establishment of invasive species than natural systems. For example, artificial impoundments tend to have less abundant and less diverse plant communities and more disturbed habitats, priming them for invasion by invasive species. Land disturbances from past and ongoing Project maintenance, as well as that for future maintenance, favor establishment of invasive plants over native plants. Using citizen reported data from iNaturalist⁹, there are nineteen (19) invasive species reported within 200 feet of the Merrimack River between the upstream Essex Dam and downstream to the first major grade break. Of these, 17 of 19 are species found within habitats found around the Project and area of influence. Continued Project operations during the next license term will continue these ongoing Project effects. Studies to establish baseline conditions during relicensing are common and supported by the Commission's Guidance Document¹⁰. Measures to address invasive species are often included in license conditions. While the PSP suggests that Essex may propose measures to control invasive plants, without baseline information about invasive species, it is unclear how such measures will be informed. Therefore, MassWildlife asks that Essex include our INVASIVE PLANT BASELINE STUDY: SURVEY, MAPPING AND ASSESSMENT (STUDY REQUEST 1) in the Revised Study Plan (RSP).

State-listed Odonates and Assemblage, Baseline Data Collection and Assessment of Operational Impacts (MassWildlife Study Request 3)

⁹ Information summarized from iNaturalist observations as 2/28/2024 of invasive species reported during informal observations. Reports of invasive plants tend include mostly terrestrial and "showy" invasives; often under-reporting aquatic invasives and difficult to identify plants. Geography of the summary was the upper limit of the impoundment downstream to the Basiliere Bridge (Route 125, Haverhill).

¹⁰ A Guide to Understanding and Applying the Integrated Licensing Process Study Criterion. (2012). Federal Energy Regulatory Commission Office of Energy Projects. <https://www.ferc.gov/sites/default/files/2020-07/guide-study-Criterion.pdf> {last accessed 2/24/2024}

Summary of Proposed Study

In section 4.9 of the PSP, Essex does not adopt MassWildlife's requested study plan (Study Request 3) claiming that MassWildlife did not address the Commission's study Criterion 5. In response to Study Request 3's statement on the absence of daily and subdaily discharge or water level records within the Project area, Essex states that they operate in a run of river mode such that the *"Project is not fluctuating its upstream impoundment...resulting in water elevation changes that may affect potential odonates"*. Essex did not propose any alternative study on odonates or macroinvertebrate communities.

MassWildlife Response

MassWildlife's study would characterize the emerging rare¹¹ riverine odonate (dragonflies and damselflies) assemblage and habitats. The study requested water flow and elevation data sufficient to understand the relationship between odonate emergence/eclosure and project operations. This study is a necessary component of assessing the potential effects of Project operations on State-listed and special conservation status odonate populations and habitat use. Odonates are a critical element of aquatic ecosystems both for their role as aquatic prey and predator, but also for their role as aerial prey and predator during the adult flight period. We strongly disagree with Essex's application of their own criterion 5 (see cover letter). We will address other elements of their response below.

Essex continues to state that the project is operated as run-of-river, where inflows equal outflows, but data to support that statement has not been submitted on the record (see cover letter). As just one example deviation from run-of-river, and information submitted on the record, is that Essex performs maintenance drawdowns in the impoundment and plans to include routine maintenance drawdown in the next license. The timing, rate of change, and magnitude of these drawdowns and other potential flow alterations are critical for impact assessment to rare odonate populations within the impoundment and downstream of the dam. Previous FERC studies at Turner's Fall Dam on the Connecticut River (P-1889, Relicensing Study 3.3.10) demonstrate how altered flows risk inundation and hence mortality of several rare odonate species during their brief and highly vulnerable eclosion periods. This includes a similar species assemblage found in the Merrimack River including the State Endangered Riverine Clubtail, which is likely most impacted from operations because of its short eclosion distance from the waterline.

Furthermore, it's unknown how the odonate composition and relative abundance are distributed by available river habitat driven directly and indirectly by Project operations including lentic conditions in the impoundment (e.g., slower water velocity, fine sediment accumulation, increased water temperatures, see MassWildlife Run-Of-River comment above). The requested study provides the necessary baseline data to establish protection, mitigation, and enhancement measures for future Project operations. The Commission required the completion of odonate studies for other re-licensing of, most recently for the Turner's Falls Dam (FERC No. P-1889, Biodiversity 2015), and the Wilder Hydroelectric Dam (P-1892), Bellows Falls Hydroelectric Project (P-1855), Vernon Hydroelectric Project (P-1904) (Study 25 Dragonfly and Damselfly Inventory and Assessment for the latter three). MassWildlife's study request is consistent with these studies and the Commission's study request criterion. Therefore, MassWildlife asks that Essex

¹¹ Rare is used to include both MESA and SGCN species, see note 2 and 3

include our State-listed Odonates and Assemblage, Baseline Data Collection and Assessment of Operational Impacts (Study Request 8) in the RSP.

Fish Assemblage Assessment (MassWildlife Study Request 4)

Summary of Proposed Study

In Section 4.1 of the PSP, Essex rejects MassWildlife's requested Fish Assemblage Assessment. Essex states that (1) "Study request is not necessary because existing information is sufficient to answer the questions posed and the study request constitutes basic research (Study Criterion Nos. 4 and 5)..." In defense of this position, the PSP states that "the Merrimack River..., is one of the most understood and managed rivers in the Northeast." The PSP notes that the existing fishery resources of the Merrimack River are "exhaustively summarized" in Section 5.4 of the PAD and that MassWildlife failed to explain how the existing information is inadequate to meet MassWildlife's requested study's goals and objectives. The PSP finds that our study request did not identify any data gaps or specify why the existing information is inadequate. As such, Essex found that our study request is a "...generic request for general basic research unrelated to the Project and is not likely to inform the development of license requirements" and that existing information is adequate to characterize existing fish resources in support of the Project's licensing process. The PSP also states that "MassWildlife do not mention the recent and robust Fish Assemblage Study that was performed upstream at the Lowell Project in 2020 (Normandeau 2021). USFWS and MassWildlife do mention 2009 surveys at the Lawrence Project, the results of which are consistent with the Lowell Fish Assemblage Study and the information provided in the Project PAD."

MassWildlife's Response

MassWildlife addressed Essex's approach to Criterion 5 (see cover letter) and will address other elements herein. While the PSP indicates the existing fishery resources are "*exhaustively summarized*" in the PAD, Section 5.4.2 Existing Fish and Aquatic Resources only identifies migratory fish species found in the Project's vicinity. The PAD's Table 5.4.1 identifies a total of 49 fish species found within the Merrimack River watershed from its headwaters in the White Mountains of New Hampshire to its mouth at the Atlantic Ocean, approximately 117 miles of river that traverses from high mountain grades through multiple hydroelectric dams with their own operational parameters and out to and including tidally influenced and tidal sections of the river. Within this length will be a mixture of migratory and resident fishes with variable habitat needs. The goal of MassWildlife's Study Request 4 is to establish the existing and baseline of fish species within the vicinity of the Project.

Determining species occurrence, distribution, and abundance of fish species will clarify what species occur in the project influenced area, both spatially and temporally relative to habitats which may be affected by Project operations. This information will also 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.

1. Essex further states that “requestors should also describe why existing information is insufficient to inform the development of license requirements and/or contribute to the development of PM&E measures.”

The only relevant data to the Project was collected by MassWildlife in 2009 through boat electrofishing. This sampling effort encompassed less than 1 percent of the available habitat and focused on only one of the habitats present in the river, mid-depth pools. Consequently, the data produced by the 2009 surveys are not considered representative of a complete species assemblage of habitats potentially impacted by Project operations. A study that yields robust representation of the fishes in the project area requires sampling of all habitat types, using a variety of sampling techniques, as outlined in the MassWildlife study request.

2. In the PSP, Patriot states that “MassWildlife do not mention the recent and robust Fish Assemblage Study that was performed upstream at the Lowell Project in 2020 (Normandeau 2021). USFWS and MassWildlife do mention 2009 surveys at the Lawrence Project, the results of which are consistent with the Lowell Fish Assemblage Study and the information provided in the Project PAD.”

Essex argues that the Fish Assemblage Study performed upstream at the Lowell Project in 2020 (Normandeau 2021) are consistent with the PAD and offers additional, adequate information. MassWildlife reviewed the Normandeau (2021) Fish Assemblage Study for the Lowell Project. The study was conducted upstream of the Lowell project. This study offers some good, general fish information relative to the lower Merrimack River, but it is an inappropriate analog for the Lawrence Project. The Lawrence Project is located 11 miles downstream of the Lowell Project and is characterized by a different suite of habitat types (e.g., larger drainage area, tidally influenced freshwater habitats). Fishes in the Lawrence Project vicinity are cumulatively impacted the upriver dams and the Lawrence Project, both through physical habitat effects and passage challenges. Fish assemblages reflect differing river habitats as well as in response to the cumulative effects of anthropogenic impacts on those habitats, including from the presence of dams and their impoundments. It is well-established that fish assemblages change according to their longitudinal location within river systems (Vannote et al. 1980, Sedell et al. 1989, Doretto et al. 2020). Also, dams and their impoundments can increasingly alter fish assemblages from historical configurations in ways that can diminish biodiversity and reduce species persistence (Poff et al. 2007, Liemann et al. 2012, Cooper et al. 2017). The Essex PSP did not provide appropriate information to describe fish assemblages, nor provide adequate alternatives to providing this information through the adopted studies.

3. Essex states that “agency representatives with jurisdiction over the Merrimack River fisheries [including MassWildlife] and the Lawrence upstream and downstream fish passage structures have a comprehensive understanding of the fish communities associated with the Project.” They state that “representatives of the MRTC regularly visit the Project’s upstream fish lift and have firsthand knowledge of the fish species that enter the lift...Essex believes that available information is adequate to characterize existing fish resources.”

MassWildlife is a member of the MRTC and disagrees that there is comprehensive understanding of the fish communities associated with the Project. The PSP inaccurately represented existing knowledge of fish communities associated with the Project. While fish counts at the passage structures can provide insight on fish species that pass through the Project and are counted, fish counts do not offer any

information about fishes that may approach the passage structures and not enter them, nor do they consider fishes and their habitats impacted by Project operations due to factors beyond by passage. Fish passage data cannot provide an accurate description of fish communities experiencing ongoing Project effects, rather, it provides information about fish that are passing through the passage structures. In order to develop relevant license conditions, fish assemblage information needs to include *all* fishes associated with the Project area and effects. Therefore, Project-specific fish assemblage information continues to be necessary.

4. The PSP states, “MassWildlife do not provide any data gaps or sufficiently pose a problem with the existing information provided, and it is unlikely that there have been any significant changes to this reach that would make previous evaluations no longer accurate...As such, potential Project effects are unlikely to have any measurable, causal relationship with general fish species composition.”

MassWildlife identified both data gaps and problems with the existing information in the submitted Fish Assemblage Study Request. The Essex PSP did not provide evidence that “*potential Project effects are unlikely to have any measurable, causal relationship with general fish species composition.*” Supporting data was not provided by the Essex PSP nor is known to exist by MassWildlife subject matter experts (R. Quiñones, pers. comm. 2024, C. Slater, pers. comm. 2024).

Further, the existence of the dam and impoundment result in ongoing effects to the fisheries and downstream habitats. For instance, retention of sediments behind dams starves downstream habitats from the full spectrum of sediments found naturally, while also cementing existing sediments (Kondolf 1997, Graf 2006, Schmutz and Sendzimir 2018 and references therein). These impacts to sediment distribution have been documented even when dams are ROR (Fantin-Cruz et al. 2016). Furthermore, changes to sediment transfer due to dams and their operations are known to result in decreased fish diversity as well as decreased spawning success of a variety of lithophilic species (aka gravel-loving species), including sturgeon and lamprey. Species of both sturgeon and lamprey are known to occur in the Project area but their distribution, abundance and potential interactions with the Project are unknown. MassWildlife’s Fish Assemblage Study, as well as our requested sturgeon studies¹², would provide the information necessary to address these data gaps.

5. MassWildlife delineated habitats between the Lowell dam and the Highway 95 bridge at Salisbury Point (Essex PSP) as the area for the fish assemblage study. Essex argued that this “*nearly 41-mile stretch of river, most of which is outside the Project boundary,...has little or no nexus to the Project operations.*”

Dams and impoundments alter water quality and downstream habitats (as in Poff et al. 2007, Fantin-Cruz et al. 2016, Abbott 2023). Dams have been documented to increase water temperatures, decrease oxygen concentration, alter nutrient transfer, and result in more abundant invasive species within impoundments

¹² MassWildlife Study Request 7: Sturgeon Distribution and Project Interaction Study; Study Request 16: Sturgeon Habitat Assessment and Mapping Study; Study Request 17: Project Impacts on Sturgeon Spawning and Rearing Habitat from Future Conditions

and downstream habitats. Studies by the Massachusetts Division of Ecological Restoration (e.g., Abbott 2023) found that some dams in Massachusetts can significantly increase water temperatures and decrease dissolved oxygen concentrations for several miles downstream. The PAD and PSP offer no information about thermal habitats or species assemblages associated with the project and its effects, nor the extent of those effects. MassWildlife identified Salisbury Point as the shift from freshwater to saltwater influenced habitats.

Here and in our study request, we provide a clear nexus between Project operations and fish assemblages within and downstream of the Project. MassWildlife's Fish Assemblage Study is necessary to determine if *"potential Project effects are unlikely to have any measurable, causal relationship with general fish species composition (Essex PSP)."* No evidence was provided in the Essex PAD or PSP to support their assertion that Project operations are unlikely to affect fish species. Furthermore, the Essex PSP did not propose any alternative studies to provide the necessary information to support or refute this claim.

6. The PSP states, "In lieu of a generic fish assemblage study that is better suited for a river that is less understood or managed, Essex is proposing downstream passage measures and a suite of targeted studies related to upstream diadromous fish passage including an upstream anadromous fish passage assessment, an upstream American eel study, and a Project Operations and Fish Stranding Study."

Reliance of studies focused only on diadromous species will not fully describe the fish assemblage potentially impacted by the project as diadromous species only represent a small fraction (<30%; Hartel et al. 2002) of the fish species historically found in the lower Merrimack River. Focusing efforts from the start on a limited subset of the fishery and then only addressing their passage and habitat needs fails to provide information and analysis for the remaining ~70% of fish species.

The baseline information requested through this study will help assess ongoing Project effects on the structure, distribution, and abundance of fish species. The information will help MassWildlife and other agencies 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.), the Clean Water Act (33 U.S.C. §1251 et seq.), and the Massachusetts Endangered Species Act. Therefore, we ask that Essex include MassWildlife's Fish Assemblage Study in its RSP.

4.0 Evaluation of Potential Project Impacts on the Merrimack River and Floodplain Habitats throughout the Term of a New License (Study Request 5)

Summary of Proposed Study

In 4.7 of the PSP, Essex did not adopt MassWildlife's study. They stated that the "Study request constitutes basic research/there is no evidence of a problem or how the study would be used to inform license requirements, as well as the study request is an attempt to search for a problem or "nexus" (Study Criterion No. 5)". Essex states that the study request does not provide a methodology that will meet the stated objective or yield the intended result, stating "Study request constitutes basic research and/or is not likely to inform the development of license conditions...(Study Criterion No 6)". Essex describes that the Project passes river flow immediate downstream of the Project's spillway and adjacent powerhouse and there is a steady state of water that flows through the canals and that the Project is not diverting

natural flows. They also state that the Project's impoundment is held at a constant elevation on an annual basis. Finally, they seek the Commission to use its discretion to not require the study.

MassWildlife Response

No information exists on the effects of project operations on key components of Merrimack River ecology, including floodplains. The PAD mentions associated aquatic resources (e.g., list of fish species) but does not state or evaluate how the Project may impact habitats under current and future conditions. Furthermore, the PAD does not consider how climate change may exacerbate project impacts nor how it may alter future project operations and capacity. MassWildlife addressed Essex's approach to Criterion 5 (see cover letter) and will address other elements below.

1. "The study request does not provide a methodology. The Commission cannot require a study that lacks definition and methodology to perform the study..."

MassWildlife disagrees with Essex's statement that MassWildlife's study failed to propose specific methodology for evaluating current and future impacts to sediment transport, water temperature, nutrient cycling, streamflow, and inland flooding. Methodologies with citations and links to manuals for each requested Task are detailed in the study request. However, we welcome discussion of how methods and collections may be aligned to simultaneously meet different agencies' PSP goals. For instance, the measures of water quality parameters, such as temperature and sediment composition, could be collected using methods outlined in the Massachusetts Department of Environmental Protection's PSP and still meet the goals of this study.

2. The PSP states, "[w]hile Essex acknowledges the importance of climate change, it is unclear how such a hypothetical analysis would inform license conditions for this ROR Project. Potential climate and hydrologic changes that may occur over the course of a 30- to 50-year license are far too speculative to allow for a quantitative evaluation as requested. The state of the science is such that climate change forecasts do not exist that could reliably predict how precipitation, snowmelt, evapotranspiration, ice out, and annual runoff patterns may change 30 to 50 years from now."

The state of climate science has dramatically grown in the recent years and is such that we can predict climate change impacts with "*high confidence*" (IPCC 2023, NCA 2023). Climate change forecasts currently exist that predict climate change impacts on Massachusetts temperature, precipitation, and hydrology throughout the life of a new license. For instance, mean summer water temperatures in the lower Merrimack River are expected to increase by about 6°F by 2070 (<https://www.usgs.gov/apps/ecosheds/ice-northeast/>). Extreme low flows at the Project are expected to decrease by 21% in the same timeframe (A. Delsantos and R. Palmer, pers. comm. 2024)¹³. As stated above responding to SD2, MassWildlife will provide projections of air and water temperatures, precipitation, streamflow, and sea level rise specific to the Project to the Commission. Projections use

¹³ This information is available from the ResilientMass Climate Hub at resilientma.com and through our partners at the Northeast Climate Adaptation Science Center (R. Palmer, A. Delsantos) and US Geological Survey (J. Fair, B. Letcher, J. Walker), as mentioned in the MassWildlife PSP.

reliable predictions of precipitation, snowmelt, evapotranspiration, and annual runoff patterns for 2030, 2050, 2070.

3. From Essex PSP: *“As already noted, the National Environmental Policy Act defines “effects” as changes to the human environment from the proposed action that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action. Effects should generally not be considered if they are remote in time (such as this request), geographically remote, or the product of a lengthy causal chain.”* Essex further states that *“FERC has determined that climate change studies are not likely to yield reliable data that can be used to develop license requirements.”*

The PSP erroneously characterized the need for climate change consideration in Federal actions, including FERC relicensing, as well as FERC’s determination on climate change studies. In 2023, the Council on Environmental Quality declared that *“climate change is a fundamental environmental issue, and its effects on the human environment fall squarely within NEPA’s purview (CEQ 2023).”* They further called for proposals to be *“designed in consideration of resilience and adaptation to a changing climate”* and [assess] *“the effects of climate change on a proposed action and its environmental impacts” [by] “analyzing reasonably foreseeable climate effects” [with] “best available science.” “Climate change analysis also enables agencies to evaluate reasonable alternatives and mitigation measures that could avoid or reduce potential climate change-related effects and help address mounting climate resilience and adaptation challenges.”*

FERC has included analysis of climate change effects in evaluations of hydropower projects. For example, FERC analyzed climate projections 30-50 years into the future in their Environmental Assessment for the Rollinsford Hydroelectric Project (FERC Project No. P-3777-011). They state *“that Hare et al. (2016) identified American shad and river herring as highly vulnerable to the anticipated effects of climate change due to their habitat specialization, dependence on both freshwater and marine resources, sensitivity to water temperatures, and complex spawning cycle. Commerce also states that the effects of climate change in New England may be compounded since the areas surrounding many river basins where shad and river herring are found are heavily populated and have been affected by the effects of agriculture, industrialization, and urbanization, including dams and hydropower development. Commerce states that, for the reasons listed above, the compounding effects of climate change should be evaluated as part of the environmental analysis of the Rollinsford Project.”* American shad and river herring in the Lawrence Project area belong to the same management units (or stocks) as those associated with the Rollinsford Project; they are also similarly affected by compounding stressors from climate change, urbanization, industrialization, dams and hydropower development. It would be illogical to require analysis of climate effects on the northerly portion of the management unit, as was required for Rollinsford Project, but not for the southerly portion. Consequently, MassWildlife contends that evaluation of the interaction of climate change and the Lawrence Project is needed as part of FERC’s environmental analysis to understand the effects and ongoing effects of this Project.

The PSP also states that the effects of climate change are “remote” in time. First, the duration of FERC licenses are 30-50 years, so the timescale for analysis is appropriate. Further, they are not geographically remote as the study request and specific tasks therein have been scaled to the Project’s area of effect, which is sub-set of the watershed. Further, the effects are not the product of a lengthy causal chain as they can *directly* impact ongoing and reasonably foreseeable future Project operations and effects. Therefore, MassWildlife requests that Essex include our requested study, Evaluation of Potential Project Impacts on the Merrimack River and Floodplain Habitats throughout the Term of a New License (MassWildlife Study Request 5), in the RSP.

Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem (MassWildlife Study Request 6)

Summary of Proposed Study Plan

In 4.6 of the PSP, Essex does not adopt MassWildlife’s study because the “Study request constitutes basic research/there is no evidence of a problem or how the study would be used to inform license requirements, as well as the study request is an attempt to search for a problem or “nexus” (Study Criterion No. 5)”. Further, Essex states, “Study request does not propose a specific methodology, proposes a methodology that is untried or uncertain, or proposed a methodology that will not meet the stated objective or yield the intended results (Study Criterion No 6).” They characterize potential climate effects described in the study request as too speculative to allow for the evaluation requested and that the methodology is not rigorous or well-defined.

MassWildlife Response to Study Plan

MassWildlife responded to the general approach to Criterion 5 in our cover letter. We will address specific comments in Essex’s summary herein.

MassWildlife and The Nature Conservancy (TNC) identified potential Project-related impacts to the City of Lawrence and the Merrimack River ecosystem in their study requests. Of primary concern is inland flooding likely exacerbated by the Project on the upstream and north side of the dam during high flow events and electrical brown-outs resulting from aging infrastructure (MVPC 2018). The proposed study would analyze alternatives to status quo project operations that could alleviate such impacts via license requirements and mitigation measures. Given that high flow events are expected to increase in frequency, duration and magnitude throughout the life of a new license (A. Delsantos and R. Palmer, U.S. Geological Service, pers. comm. 2024), the study is necessary to fully evaluate reasonably foreseeable climate change effects.

This study would also inform FERC’s environmental analysis. The study aligns with CEQ’s guidelines for consideration of climate change in NEPA reviews. The guidelines state that the review must consider alternatives to the proposed action that eliminate or mitigate direct, indirect and cumulative climate change impacts to the human environment, “including environmental justice impacts.” Furthermore, the evaluation “can inform possible adaptation measures to address the effects of climate change, ultimately enabling the selection of smarter, more resilient action.” MassWildlife’s study request outlined one method, a desktop analysis, that could be used to complete the study.

Essex's assertion that "potential climate effects described in the study request are too speculative to allow for the evaluation requested" is addressed in our response to Essex's rejection of MassWildlife's Study Request 5, the section immediately above.

Fish Passage Improvement and Feasibility Assessment (MassWildlife Study Request 11)

Summary of Proposed Study Plan

In Section 4.2 of the PSP, Essex did not adopt MassWildlife's requested *Fish Passage Improvement and Feasibility Assessment*, at this time, because the requested study would evaluate potential PM&E measures that may not be necessary. The PSP notes that the proposed fish passage studies are intended to evaluate the effectiveness of the existing fish passage facilities. If those studies indicate enhancements for fish passage are needed, the PSP acknowledges that potential next steps could be articulated in the DLA.

MassWildlife Response to Proposed Study Plan

MassWildlife generally accepts Essex's proposed approach to our requested Fish Passage Improvement and Feasibility Assessment (Study Request 6). The development and implementation of our Study Request 11 now, would proactively support a review of fish passage alternatives at the Project, even though Essex is not currently proposing any modification to the existing fish passage facilities. While MassWildlife suspects the existing fish passage facilities are woefully inadequate, little data exists to confirm a need for improvements to the Project's fish passage facilities, currently. As such, MassWildlife understands why Essex may find implementation of our Study Request 11 to be premature. We do not agree, however, that next steps should simply be identified in its DLA. Instead, Essex's Initial Study Report (ISR) should propose our study request, if appropriate, following a review of study results of Essex's proposed Upstream Fish Passage Assessment, Upstream American Eel Passage Assessment, Sections 6 and 7 of the PSP, respectively, and the requested Downstream Fish Passage Assessment and requested Diadromous Fish Behavior, Movement, and Project Interaction Study, Study Requests 1 and 5, respectively.

Diadromous Fish Behavior, Movement, and Project Interaction Study (MassWildlife Study Request 12)

Summary of Proposed Study Plan

Section 4 (page 14, paragraph 4) of the PSP states that Essex is not proposing the MassWildlife study request (MassWildlife Study Request 12). Essex notes that the study would be best developed after it can be informed by its proposed Three-Dimensional Computational Fluid Dynamic (CFD) Modeling (PSP Section 12; CFD Modeling Study).

MassWildlife Response to the Study Plan

Essex's position on our Study Request 12 is unclear. While the PSP implies a study may be developed in the future, Essex did not commit to doing so, the PSP clearly states it is not proposed, and the PSP does not include a process for the development of that study. This leaves the study in an uncertain position

where it has been neither proposed nor formally not adopted with supporting justification. Essex did state that they feel this study would be “*greatly informed by, and is also largely contingent on, the results of the Three-Dimensional Computational Fluid Dynamics (CFD) Modeling Study.*” We do not share this opinion and it is unclear from the information provided in the PSP why Essex feels the CFD results are needed to inform the Diadromous Fish Behavior, Movement, and Project Interaction Study, or in what way(s) the latter would be largely contingent on the former. The CFD Study and Diadromous Fish Behavior, Movement, and Project Interaction Study are fully-separate analyses that do not share goals or methodology. Nonetheless, if Essex still feels strongly that the CFD results are needed in advance of this study, there remains plenty of time to prioritize that analysis and have it completed well before the field studies which are anticipated to occur during the 2025 passage season. For the reasons discussed in our Study Request 12, MassWildlife continues to seek the development and implementation of the Diadromous Fish Behavior, Movement, and Project Interaction Study and asks that Essex include the requested study in its RSP.

Downstream Migrating Species Passage Assessment (MassWildlife Study Request 13)

Summary of Proposed Study Plan

As discussed in Section 4 of the PSP, Essex now proposes to replace the Project’s existing trashracks with a narrow-spaced trashrack design to limit fish entrainment into Project works and to develop this PM&E in consultation with the Merrimack River Technical Committee for inclusion in its DLA for the Project. As a result, Essex is not proposing MassWildlife’s requested *Downstream Migrating Species Passage Assessment* study. In the PSP, Essex states that the existing downstream fish bypass facility should be evaluated later.

MassWildlife’s Response

Essex’s approach of proposing PM&E’s *in lieu* of conducting studies to evaluate existing conditions, has merit and is supported by MassWildlife in concept. However, the goal of the MassWildlife’s Study Request 13 is to assess behavior, passage success, immediate and latent survival, and internal and external injury of target species (i.e., juvenile alosines and adult American Eel) as they encounter the Project during downstream migrations through **all** downstream passage routes. Essex’s proposed PM&E measure only addresses one viable passage route, turbine passage. Other potential downstream routes include the Project’s spillway, North and South canal gatehouses and canal systems, and the Project’s downstream fish bypass. While we agree that Essex’s proposal to install a narrow spaced trashrack would eliminate the need to assess turbine entrainment and passage survival through the Project’s intake, at this time, the proposed PM&E measure does not address all downstream passage routes; and therefore, we continue to support our Study Request 13 for the remaining passage routes at the Project and ask that Essex include a *Downstream Fish Passage Assessment*, commensurate of its licensing proposal, in the RSP.

Sturgeon Distribution and Project Interaction Study (MassWildlife Study Request 7)

Summary of Proposed Study Plan

In 4.4 of the PSP, Essex does not adopt the requested study citing their interpretation of Criterion 5, “*There is no evidence of a problem or how the study would be used to inform license requirements, as well as the*

study request is an attempt to search for a problem or “nexus” (Study Criterion No. 5).” They also state “Study request is not necessary because existing information is sufficient to answer the questions posed (Study Criterion No. 4).” Essex states that the study result would not inform potential license conditions as they operate as run-of-river. states that “it is not clear as to how the requested study would inform the Project’s influence on any potential habitat or fish species downstream of the Project.” Essex states the acoustic tagging study of 50 shortnose sturgeon (Stantec 2003) that reported four detections in the I-495 Bridge in Lawrence total in 2020 and 2021 is sufficient to demonstrated that sturgeon are not approaching the Project. Further, they state that no sturgeon are known to have been lifted past the Project. They further state that due to expected low densities of sturgeon, the 2-year side-scan study is likely to product inadequate sample sizes. Finally, the PSP states that Essex “is also not proposing to perform acoustics telemetry studies given that the lack of indication that sturgeon reach the Project, and an acoustics telemetry study assumes, without evidence, sturgeon might be interacting with the Project in a myriad of ways that need study.”

MassWildlife Response to the Study Plan

The goal of MassWildlife’s Study is specifically to determine how Atlantic and shortnose sturgeon (*Acipenser oxyrinchus oxyrinchus* and *Acipenser brevirostrum*, respectively; collectively, sturgeon) interact with the Project to identify potential means of take resulting from the Project’s operation and maintenance. The PSP clearly demonstrates a lack of information on this subject. While the PSP asserts that no acoustic tagged sturgeon have been documented in the Project’s vicinity upstream of the I-495 bridge, the PSP neglects to mention that the most upstream acoustic receiver was located at that bridge and no means of detecting the sturgeon at the Project existed. Effects on sturgeon that currently have access to the base of the dam may be injured or stranded, for example, during operation of the Project and fishway. License conditions are not limited to changes in project operations, and, if measures such as a sturgeon protection and handling plan are necessary, they would be informed by the results of this study. Actions in a plan may include protocols for handling, reporting, and dewatering turbine units for maintenance to prevent injury or mortality to sturgeon. For example, FERC-licensed hydroelectric project that have adopted similar measures include Ellsworth (P-2727),¹⁴ Brunswick (P-2284),¹⁵ Cataract (P-2528),¹⁶ and Santee Cooper (P-199).¹⁷ This study is a baseline data collection to inform potential protection measures.

Essex cites the Stantec (2023) report as evidence that sturgeon do not approach the project. However, if the proportion of tagged individuals represents a sample of the amphidromous population in the Merrimack, then the individuals from the overwintering population of shortnose sturgeon to approach the Project would be 302 individuals for 2021-2022 and 273 for 2022-2023, respectively. This provides many opportunities for sturgeon to interact with the Project, but without telemetry or side-scan sonar deployed at the Project, no baseline data is available to inform license conditions. Additionally, two of the tagged sturgeon detected at the Lawrence I-495 bridge, which was the most upstream receiver in the study, were in the area over multiple days in late March and April. This is ample time for the sturgeon to

¹⁴ Accession # [20180928-5080](#)

¹⁵ Accession # [20231221-3024](#)

¹⁶ Accession # [20181017-3037](#)

¹⁷ Accession # [20230922-3033](#)

swim upstream and interact with the Project. In 2021, all sturgeon detections occurred before or during the spawning season, suggesting searching behavior for spawning habitat.

Our Study Request 7 fully addressed the Commission's study Criterion demonstrating the need for information and acknowledged that the resulting information could be used to inform license conditions, including the potential need for upstream fish passage of sturgeon. Essex's concern that a sub-sample of dates would not provide sufficient information on the sturgeon population or distribution downstream of the Project should be addressed through study design and methodology. Telemetry and fixed array SSS have previously been coupled and used to quantify sturgeon abundance and movement (Izzo et al. 2021). This framework provides a tested methodology that could be adapted to the Project tailrace, spillway, and downstream of the Project.

An appropriate assessment of sturgeon presence and occupancy to determine Project interactions is not possible with the available information. MassWildlife continues to support our study request and asks that Essex include the requested *Sturgeon Distribution and Project Interaction Study* in the PSP.

Sturgeon Habitat Assessment and Mapping Study (MassWildlife Study Request 16)

Summary of Proposed Study Plan

In 4.3 of the PSP, Essex does not adopt the requested study citing their interpretation of Criterion 5, "*There is no evidence of a problem/understanding or how the study would be used to inform license requirements, as well as the study request is an attempt to search for a problem or "nexus" (Study Criterion No. 5).*" They also state "*Study request is not necessary because existing information is sufficient to answer the questions posed (Study Criterion No. 4).*" Essex states the acoustic tagging study of 50 shortnose sturgeon (Stantec 2003) that reported four detections in the I-495 Bridge in Lawrence total in 2020 and 2021 is sufficient to demonstrate that sturgeon are not approaching the Project. Further, they state that no sturgeon are known to have been lifted past the Project.

MassWildlife Response to the Study Plan

The Project is a barrier to the upstream migration of sturgeon, and restricts freshwater spawning, rearing, foraging, and overwintering habitat within the 29-mile reach below the Project. The Project also traps sediment in the impoundment and alters natural downstream sediment transport. Sediment trapped in the impoundment by the Project may be inundating historical sturgeon habitat. Conversely, dams may prevent downstream transport, leading to depauperate habitat lacking the necessary spawning and rearing substrate such as cobble, rock, and gravel, or degraded by embedded sand and finer sediments (i.e., habitat lacking well-oxygenated, interstitial spaces suitable for egg incubation and hatching). MassWildlife requests a bathymetric habitat assessment and mapping study to quantify the Project effects on sturgeon habitat in the Project boundary and downstream of the dam.

Under the current hydraulic regime of the Project, which is proposed for the next license, only two existing studies exist that focus on or encompass sturgeon habitat in the Merrimack River¹⁸.

1. Movements of Atlantic Sturgeon of the Gulf of Maine Inside and Outside of the Geographically Defined Distinct Population Segment (Wippelhauser et al. 2017)
2. Merrimack River Shortnose Sturgeon Monitoring, 2020-2022 (Stantec 2023).

The improved hydrologic regime in the Merrimack River may result in altered habitat usage and movements among other potential drivers of sturgeon behavior affected by Project operations. Several of the studies included habitat mapping for sections of the Merrimack River, however a comprehensive habitat mapping and assessment survey is necessary to fill in data gaps and investigate Project effects on sturgeon habitat within the geographic scope of the Project.

Therefore, MassWildlife requests that Essex includes our study request entitled, Sturgeon Habitat Assessment and Mapping Study (MassWildlife Study Request 16), in the RSP. The information from this study would be used to inform protection, mitigation, and/or enhancement measures for sturgeon, none of which Essex has with its current license. Measures could include aquatic habitat enhancements, protective measures during maintenance and operations, and fish passage.

Project Impacts on Sturgeon Spawning and Rearing Habitat from Future Conditions (MassWildlife Study Request 17)

Summary of Proposed Study Plan

In 4.3 of the PSP, Essex did not adopt the requested study citing their interpretation of Criterion 5, “*There is no evidence of a problem/understanding or how the study would be used to inform license requirements, as well as the study request is an attempt to search for a problem or “nexus” (Study Criterion No. 5).*” Essex further cites guidance from the Council on Environmental Quality (2016) that states:

“in accordance with NEPA’s rule of reason and standards for obtaining information regarding reasonably foreseeable effects on the human environment, agencies need not undertake new research or analysis of potential climate change impacts in the proposed action area but may instead summarize and incorporate by reference the relevant scientific literature.”

Essex also claims:

Effects should generally not be considered if they are remote in time (such as this request), geographically remote, or the product of a lengthy causal chain. FERC precedent uniformly maintains that climate change studies are not needed in hydropower licensing proceedings.

¹⁸ Earlier studies all occurred when peaking operations were occurring upstream: Kieffer and Kynard 1993, Kieffer and Kynard 1996. The improved hydrologic regime in the Merrimack River may result in altered habitat usage and movements among other potential drivers of sturgeon behavior affected by Project operations

MassWildlife Response to the Study Plan

The Lawrence Hydroelectric Project is a barrier to the upstream migration of shortnose sturgeon, and restricts freshwater spawning, rearing, foraging, and overwintering habitat to within the 29-mile reach below the Project. Saltwater is fatal to shortnose sturgeon during early life stages (e.g., eggs and Age-0), and access to suitable freshwater habitat is essential for survival and recruitment.¹⁹ As climate-related impacts are expected to continue, including sea level rise (SLR), increased water temperatures, and variability in river flow; upstream migration of the Merrimack River salt wedge and changing hydrological conditions may reduce and degrade existing shortnose sturgeon habitat (Hare et al. 2016). MassWildlife requests a hydrodynamic water quality modeling study using established climate projections to understand the hydrological impacts of upstream salt wedge migration during the term of a new license on shortnose sturgeon habitat affected by the Project.

Essex's use of the CEQ (2016) guidance has been superseded by CEQ guidance in 2023 that removes the clause on not needing to undertake new research or analysis of potential climate change impacts. The hydrologic changes this study will quantify are necessary information for assessing climate change-related impacts in the lower Merrimack River. The information collected from study request #16 — Sturgeon Habitat Assessment and Mapping Study — is essential to characterize existing and potential habitat in this study. Habitat suitability indices (HSI) are available for shortnose sturgeon and the hydrodynamic model would provide the information necessary to evaluate if environmental conditions during the license term will degrade or eliminate the existing habitat necessary for the spawning population of shortnose sturgeon in the Merrimack River.

MassWildlife's study request is to investigate climate effects that are likely to occur within the licensing term, therefore, within the temporal scope of a new license and not remote in time as Essex claims. This study is specific in the climate effects it is investigating (i.e., saltwater intrusion, temperature, and flows), which will be compared to habitat suitability indices (Crance 1986) and other relevant literature (e.g., Kynard et al. 2000; Farrae et al. 2014; Johnston et al. 2019) for sturgeon to assess the potential for habitat contraction, degradation, and loss during the license term. Some of the necessary information is already available (e.g., sturgeon spawning habitat and the location of the salt wedge location) and the previous two study requests with help fill in critical data gaps. Known effects of climate change, such as sea level rise, are accelerating at a heightened rate in the northeast compared to other parts of the country (Boon 2012), which further supports the need to complete this study.

Therefore, MassWildlife requests that Essex includes our study request entitled, Project Impacts on Sturgeon Spawning and Rearing Habitat from Future Conditions (MassWildlife Study Request 17), in the RSP. The information from this study would be used to inform protection, mitigation, and/or enhancement measures for sturgeon, none of which Essex has with its current license. Measures could include aquatic habitat enhancements, protective measures during maintenance and operations, and fish passage.

¹⁹ [Shortnose Sturgeon - General Life Stage/Behavior Descriptions](#)

Attachment B
MA Division of Fisheries and Wildlife Comments on
Essex Proposed Study Plan: Studies Adopted in Part

Freshwater Mussel and Non-native Corbicula Baseline Data Collection and Operational Impacts (MassWildlife Study Request 2)

Summary of Proposed Study Plan

In Section 10 of the PSP, Essex proposed a freshwater mussel study plan that aimed to partially adopt MassWildlife's Study Request. The PSP study area proposed was within the Merrimack mainstem from the Essex Dam downstream to immediately downstream of the Lawrence Project. The study area will also include the North Canal and South Canal of the Lawrence Project. Survey methodology will consist of semi-quantitative, timed searches using snorkel or view bucket and diving depending on water depth. The proposed study plan will follow the survey rates and data collection methodologies consistent methodologies outlined in Smith et al. (2001).

MassWildlife Response of Proposed Study Plan

MassWildlife appreciates that Essex acknowledges the likely presence of freshwater mussels associated with the Project. However, the reduced geographic area, excluding areas downstream and significant portions of the impoundment, are problematic.

Scope and Intent

The first main objective of MassWildlife's requested study is to *"conduct field surveys to characterize the distribution, composition, and relative abundance of freshwater mussels and non-native bivalves in the impoundment, canals, and reaches downstream of the Essex Dam influenced by Project operations."* Essex proposes mussel surveys focused in the *"project impoundment to inform the potential effect of occasional impoundment drawdowns..."* that are typically 5 feet below normal pool levels (PSP 10.5 Project Nexus). MassWildlife supports studying impoundment drawdown impacts to freshwater mussels; however, Essex has shifted and narrowed the scope of MassWildlife's requested study to focus only on the impoundment mussel assemblage and only the portion of habitat within the drawdown exposure zone. This approach is not only inadequate to estimate potential impacts of impoundment drawdowns but omits needed survey effort to collect baseline data throughout all Project-affected areas including depths throughout the impoundment, reaches downstream of the dam, and the North and South canals. MassWildlife does not agree that surveys as described by Essex are sufficient to meet our Study Objectives or to characterize mussels within the project's area of effect and thus to understand ongoing impacts of the project. Surveys must be done in all areas of the Project effect: impoundment, downstream and canals.

This reflects Essex's interpretation of Criterion 5 and significant understatement of ongoing Run-of-River impacts to habitat conditions and hence mussel assemblages upstream and downstream of the dam. (see general Criterion 5 and Run-of-River comments above). For example, fine sediment accumulation in the impoundment and sediment coarsening downstream of the dam are known drivers of mussel species composition, distribution, and abundance (Haag et al. 2012). Project-affected areas have not been sampled for mussels in the past and require surveys to provide baseline data to inform potential

protection, mitigation, and enhancement measures. Further, Essex's sole focus on impoundment drawdown impacts informs their proposed survey design that fails to obtain baseline freshwater mussel assemblage and habitat conditions in all areas affected by the Project. Therefore, as originally requested, MassWildlife recommends performing field habitat assessments and mussel surveys within suitable and representative mussel sites identified in preliminary field habitat assessment in the impoundment, canal, and downstream Project-affected reaches to meet baseline data needs. MassWildlife also recommends additional surveys and/or sites to sufficiently estimate the impact of impoundment drawdowns (see comments below).

Host Fishes

The second main objective from MassWildlife's requested study plan is to:

assess potential host-fish for documented freshwater mussel species through review of relevant publications and concurrent fish data collected upstream, downstream, and passing through the Essex Dam.

Essex altered this objective in the proposed plan to:

assess potential host-fish for documented freshwater mussel species through review of currently available fish data collected for the Merrimack River upstream, downstream, and passing through the Essex Dam.

As proposed, Essex's PSP study cannot determine if fish passage at the dam, historically designed and focus on very specific diadromous species, may be driving mussel distributions upstream and downstream of the dam. First, the Essex fails to identify the *source* of fish data for mussel host-fish assessment and therefore, MassWildlife cannot determine if the fish data is sufficient to achieve this objective. Essex's "*review of currently available data*" suggests the use of existing fish data that likely underrepresents the extant fish assemblage. We address this in more detail in our response herein to Essex not adopting MassWildlife Fish Assemblage Assessment. Second, the PSP study does not include field mussel surveys downstream of the dam. Without both upstream and downstream fish and mussel assemblage baseline data, Essex cannot sufficiently assess the impact of the dam as a barrier to fish and consequently mussel species distributions (i.e., dispersal) (Watters 1996) or ongoing effects from Project operations.

Drawdown Area of Exposure vs. Baseline Elevations off Crest

One of the objectives of the MassWildlife study was to understand the impact from drawdowns, which is discussed in the PSP. However, the pool elevation varies based on flows (PAD, Section 4.4).

Table 4.4-1 Pneumatic Crest Gate System Operational Scheme

Approximate River Flow (cfs)	Crest Gate Status	Target Pond Level (ft NGVD)	Unit Operation
0 – 8,000	Full elevation	44.2 (Normal pond)	Pond level control
8,001 – 52,000	Crest gate lowers as flow over the spillway increases, maintaining water level at normal pond	± 44.2 ft	Full available output
>52,000	Fully lowered	Rises above 44.2 ft as flows over spillway increase	Full available output

We were unable to find information in the PAD or PSP that describes the water surface elevation during past drawdowns or associated with proposed maintenance drawdown. The PSP uses the crest elevation of 44.2 feet as a reference point for the up to 4 feet areas of exposure. However, if a drawdown is initiated when the pool elevation is lower (e.g., 41.2 feet) then the area of exposure also shifts down in elevation for the additional foot of surface elevation change. Thus, it is unclear if surveys measured 0-4 feet off the crest elevation represent the actual areas of exposure from drawdowns, which is critical to collecting accurate data. MassWildlife does not object to using the crest or normal pool as a reference point, but needs clarity of the proposed area to represent the area of exposure captured in the proposed 0-4 ft survey elevations.

Number and Distribution of Transects/Sites (PSP 10.61)

The PSP is focused on impoundment drawdown impacts, such that sites are confined to depths ≤ 4 ft (note our comments above about the reference point). This design significantly underrepresents potential viable mussel habitat in big river systems (e.g., Biodiversity 2015, Kaeser et al 2019) and does not meet the need of collecting baseline mussel data throughout all Project-affected areas (i.e., MassWildlife's first main objective in requested study). Preliminary surveys are first needed in the impoundment, canals, and downstream to assess habitat and relative mussel abundance for site establishment and subsequent mussel and habitat data collection. Depth should not be a limitation for preliminary surveys to establish sites for further mussel investigation. Preliminary surveys can be conducted by visual assessment via snorkel and SCUBA, and/or via habitat mapping using side scan sonar (e.g., Kaeser et al. 2019).

Essex proposes 21 sites in the impoundment equating to approximately 2 sites/mile. However, no information is provided in the PSP about the locations or distribution of potential habitat, which may be patchy, to support their proposal. Determining the number of sites first requires information about the amount and distribution of available habitat, determined by preliminary habitat assessment surveys. The purpose of the surveys is to search all available habitat (or a reasonable sub-set of the habitats). Placing *a priori* limitation on the survey effort before knowledge of the habitat is gained could result in dramatically underrepresenting the mussel assemblage, or expending effort in areas where no mussels are expected. Further, in the canals, more sites are likely necessary to adequately represent mussel populations (e.g. in the North Canal, ~2 sites/mi might yield only one or two sites within the canals).

Essex provided insufficient information to determine their use of fixed distances between sites and fixed survey transects. As above, field survey effort should follow preliminary habitat assessment surveys. The habitat assessments are then used to inform the number, distribution and spacing of site selection. Using arbitrary fixed plots could result in under-representing the mussel assemblage or expending effort in areas where no mussels are expected.

The PSP study plan would only collect impoundment data in areas of less than 4 feet in depth to represent the drawdown zone. However, the PSP proposes no method to contextualize that data by comparing to areas of suitable habitat not subject to the drawdowns. Therefore, MassWildlife recommends adding sites at depths unimpacted by the drawdowns in addition to sites within the drawdown exposure zone. Exposed and unexposed surveys should be paired within a site and can fit the site dimensions proposed by Essex (e.g., 50-m long and 5-m wide).

Survey Details

- PSP 10.6.1, Figure 10-1 - Special consideration for site selection should be given to areas downstream of islands, tributary confluences, coves, and mesohabitats of stable and suitable substrate composition of mussel habitat. Areas to consider but are not limited to Pine Island, Fish Brook confluence, Richardson Brook confluence, Trull Brook confluence, and Bartlett Brook confluence.
- PSP 10.6.1 – Essex proposes survey site dimension of 50-m long with a maximum width of 5m. Survey's should aim for at least 3 person hours per site with a minimum of 50-m long sites. However, sites should not have pre-defined area dimensions and should rather be determined by the extent of suitable habitat, mussel bed distribution, and density. MassWildlife supports surveys parallel to the bank moving upstream but would consider alternative survey designs (e.g., transects/plots perpendicular to flow). Based on work conducted in other rivers, mussel habitat occurs in patches of variable size and shape, thus linear transects can miss important habitat and cause biologists to spend time in areas of unsuitable habitat.
- PSP 10.6.1 – Essex proposes mussel measurements that are insufficient to assess basic evaluation of species population condition. MassWildlife recommends accurate counts of all mussel species identified as Species of Greatest Conservation Need (SGCN) in the 2015 Massachusetts State Wildlife Action Plan (**Table 1**). Counts for non-SGCN species (i.e., Eastern Elliptio, Eastern Floater) can be estimated especially if abundances are high (e.g., >1,000 individuals). For mussel SGCN that are not state-listed (e.g., Alewife Floater, Eastern Lampmussel), the first 50 individuals per site should be measured for shell length and assessed for shell condition. All state-listed species should be counted, measured, and assessed for shell-condition. If not directly measured, surveyors should note the presence of juvenile mussels (e.g., <30-40mm) for all species to provide evidence of recent reproduction. The presence and relative abundance (i.e., range estimates) of non-native mollusks, notably Asian Clam (*Corbicula*), Zebra and Quagga mussels (*Dreissena*), should also be recorded.
- PSP 10.6.1 – Essex proposes habitat parameters to estimate, however more clarity is needed. Previous mussel work in large rivers estimated percentages of submerged and emergent aquatic vegetation, benthic algae, count of large woody debris, and classification of water velocity. In addition to collecting minimum and maximum water depth, surveyors should also collect 5 representative water depths per surveyor. The same approach can be applied to substrate composition by recording the dominant substrate at 5 representative points per surveyor to calculate site percentages. Surveyors should also report estimated canopy cover using a spherical densiometer, water temperature, and mesohabitat percentages (e.g., riffle, run, pool).

These environmental parameters are typically collected in standard mussel surveys in Massachusetts and provide baseline environmental site characterization.

- PSP 10.6.2 – All raw data shall be made available to MassWildlife.
- PSP 10.6.1 & 10.7 – Essex should meet with MassWildlife prior to discuss proposed mussel sampling sites and survey protocols before the study begins. Field identification of many state-listed species requires considerable expertise and field experience. Therefore, all study plans that involve field surveys and identification of state-listed species in Massachusetts must comply with the following:
 - a. MassWildlife requires pre-approval of the candidate biologist prior to conducting surveys.
 - b. The selected biologists shall submit written survey protocols for MassWildlife approval prior to initiation of field work. Survey protocols shall list the specific taxonomic characteristics for definitive identification as well as the characteristics of similar or easily confused species. Photo-documentation is required.
 - c. Interaction with, handling, collection or of state-listed species requires the selected biologist submit a request for a state-issued Scientific Collection Permit. Failure to be in possession of a valid state-issued Collection Permit is a violation of the Massachusetts Endangered Species Act. Collection Permits are issues for each project and location, so permits issued to parties for other sites or purposes (e.g. academic use) are not valid for this purpose.

Therefore, MassWildlife requests that Essex includes our study request, as written in the RSP. Freshwater Mussel and Non-native Corbicula Baseline Data Collection and Operational Impacts

Table 1: All mussel species of Massachusetts according to their status under the MA Endangered Species Act (MESA), status as a Species of Greatest Conservation Need (SGCN) identified in the 2015 MA State Wildlife Action Plan, their occurrence in the Merrimack River watershed, and potential to occur in the Merrimack River.

Mussel Species	MESA Status	Massachusetts SGCN	Recorded in Merrimack River Watershed	Potential to be found in Merrimack River
Brook Floater (<i>Alasmidonta varicosa</i>)	Endangered	Yes	Yes	No
Yellow Lampmussel (<i>Lampsilis cariosa</i>)	Endangered	Yes	No	Yes
Eastern Lampmussel (<i>Lampsilis radiata</i>)	Not Listed	Yes	Yes	Yes
Eastern Elliptio (<i>Elliptio complanata</i>)	Not Listed	No	Yes	Extant
Eastern Floater (<i>Pyganodon cataracta</i>)	Not Listed	No	Yes	Extant
Alewite Floater (<i>Utterbackiana implicata</i>)	Not Listed	Yes	Yes	Extant
Eastern Pondmussel (<i>Sagittunio nasutus</i>)	Special Concern	Yes	Yes	Yes
Creeper (<i>Strophitus undulatus</i>)	Special Concern	Yes	Yes	Low
Triangle Floater (<i>Alasmidonta undulata</i>)	Not Listed	Yes	Yes	Low
Tidewater Mucket (<i>Atlanticoncha ochracea</i>)	Special Concern	Yes	Yes	Yes
Eastern Pearlshell (<i>Margaritifera margaritifera</i>)	Not Listed	Yes	Yes	No
Dwarf Wedgemussel (<i>Alasmidonta heterodon</i>)	Endangered	Yes	No	No

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March 8, 2024

Debbie-Anne Reese, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1 A
Washington, DC 20426

Re: Comments proposed study plan for Lawrence Hydroelectric Project Relicensing (FERC No. 2800)

Dear Secretary Reese:

Groundwork Lawrence (GWL) is a community-based organization whose mission is “to bring about the sustained regeneration, improvement, and management of the physical environment by developing community-based partnerships which empower people, businesses, and organizations to promote environmental, economic, and social well-being.” Increasing access to high quality open spaces for the residents of Lawrence has been central to our work over the past twenty-five years. This work has intersected with the Lawrence Hydroelectric Project in significant ways.

GWL provides the following comments for FERC’s consideration regarding the proposed study plan:

1. Over the past two decades GWL has made repeated requests to the project owner for access to project lands to develop recreational amenities. To enable the development of recreational amenities on project lands above and below the dam as well as along the canals, GWL requests the study plan identify / complete any FERC required investigations, provide design guidelines or precedents to support design development, and establish a road map for right of way acquisition and park implementation.
2. The Massachusetts Department of Conservation and Recreation along with the City of Lawrence have played important roles developing and stewarding of recreational amenities within the project area. GWL is proud to have played an important role in these efforts as well. We request the proposed study plan identify locations where the project owner should be responsible for owning and maintaining new recreational amenities. Specifically, GWL requests the study plan investigate ways to incorporate a pedestrian connection at the end of the north canal at the lower locks by integrating a shared use path into the project’s existing infrastructure.
3. GWL supports efforts by other stakeholders to for the study plan to advance an “Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem.” This alternative analysis should evaluate statutory historic preservation opportunities, innovative management options such as the Augusta Canal Authority, and ways to increase the utility of the project’s canals. The alternatives analysis should protect the role the head pond plays as source of drinking water.

GWL is hopeful the project’s relicensing will increase recreational opportunities, protect and enhance the historic operations of the project, and restore Merrimack River fish passage to address the environmental injustices associated with the management of the Lawrence Hydroelectric Project.

Sincerely,

A handwritten signature in black ink, appearing to read "Lesly", is placed over a light gray rectangular background.

Lesly Melendez
Executive Director

March 11, 2024

Debbie-Anne Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

**Subject: Lawrence Hydroelectric Project, FERC Project No. 2800
Comments on Proposed Study Plan**

Dear Acting Secretary Reese:

Pursuant to the Federal Energy Regulatory Commission's (Commission or FERC) regulations 18 C.F.R. § 5.12, The Nature Conservancy (TNC) is providing comment on Essex Company's (Essex) Proposed Study Plan (PSP) for the relicensing of the Lawrence Hydroelectric Project (FERC No. 2800), filed on November 28, 2023.

On January 4 and 5, 2024, two TNC staff attended the PSP meeting to discuss the content of the PSP and the studies that Essex opted to exclude from the PSP. At this meeting, Essex had stated their intention to hold working group meetings to discuss and further develop the PSP; however, to our knowledge, only one meeting was held to present the recreation plan to a select group of interested parties. Therefore, the comments below are in reference exclusively to the November 28, 2023 PSP and comments made by Essex and other stakeholders at the January 4-5, 2024 PSP Meeting.

General Comments

We strongly support Essex's desire to consolidate elements of various study requests into single studies "to increase efficiencies in how data is collected and analyzed." Our comments and recommendations below are reflective of this overall goal to be cost and labor efficient with study implementation.

In their comments, Essex has indicated that many studies did not meet several of FERC's seven study criteria to guide study development. Per FERC's March 2012 "Guide to Understanding and Applying the Integrated Licensing Process Study Criteria"¹, these criteria were developed to "ensure that any studies that are requested are needed for the project in question", and to "help formulate a well-structured and informed study request that can help focus discussions about the merits and applicability of a study to evaluate the effects of a project."

¹ <https://www.ferc.gov/sites/default/files/2020-04/guide-study-criteria.pdf>

In many instances, Essex indicated that requested studies did not meet Study Criteria No. 5, or the “Project Nexus” criteria which, according to 18 CFR § 5.9(b)(5), requires that a study request “explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license conditions.” According to FERC’s guidance document,² this section of a study request should “clearly explain the connection between the project and its potential effect on the applicable resource.” Essex frequently stated that study requests did not meet this “Project Nexus” criteria for reasons that included “there is no evidence of a problem”, or the study request is “an attempt to search for a problem” or “constitutes basic research” or “is not likely to inform the development of license conditions.” Essex supports this interpretation with a 2000 case opinion by the U.S. Court of Appeals for the District of Columbia Circuit in *City of Centralia vs. FERC*. However, in a subsequent Final Rule re: Hydroelectric Licensing under the Federal Power Act,³ issued by FERC on July 23, 2003, the Commission clearly states in Paragraph 108, “...the finding of a ‘problem’ is not a required predicate for Commission action under the comprehensive development standard of FPA Section 10(a)(1). Rather, that standard contemplates license conditions for the ‘protection, mitigation, and enhancement of fish and wildlife..., and for other beneficial uses, including irrigation, flood control, water supply, and recreational and other resources.’ [emphasis supplied]”

Based on FERC’s ruling, we therefore respectfully disagree with Essex’s interpretation of Study Criteria No. 5. In our comments that follow, we will attempt to provide additional clarity around nexus and how study results could inform license conditions, but we will not attempt to address whether or not there is evidence of a ‘problem.’

In partnership with MADWF, The Nature Conservancy submitted two studies: “Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem” and “Evaluation of Potential Project Impacts on the Merrimack River and Floodplain Habitats Throughout the Term of a New License.” The following comments relate to Essex’s justification and rationale for not adopting these studies and our corresponding suggestions for revising the Proposed Study Plan.

In addition, we strongly support the comments provided by Groundwork Lawrence, the Merrimack River Watershed Council, the Massachusetts Division of Fisheries & Wildlife, the Massachusetts Division of Marine Fisheries, the National Marine Fisheries Service, the U.S. Fish & Wildlife Service, and the New Hampshire Fish and Game Department. We particularly echo Groundwork Lawrence’s concerns about preserving recreational and historical value of river-adjacent infrastructure and emphasize the importance of strong community engagement to understand the values and priorities of the people living near the dam and its impoundment.

² <https://www.ferc.gov/sites/default/files/2020-04/guide-study-criteria.pdf>

³ FERC Accession # [20030724-3002](#)

Evaluation of Potential Project Impacts on the Merrimack River and Floodplain Habitats Throughout the Term of a New License

The goal of this requested study was to assess project effects on hydrology, hydraulics, and associated ecosystem components and functions (i.e., temperature, sediment, nutrient regimes), as well as related effects on the local community (e.g., flooding impacts).

In its PSP, Essex indicated that this study request did not meet either Study Criteria No. 5 (Project Nexus) or Study Criteria No. 6 (Proposed Methodology) of FERC's ILP Study Criteria that guide study development.

Related to Study Criteria No. 5, the nexus of this study is that the Lawrence Hydroelectric Project is dependent upon a dam that spans the width of the Merrimack River, and therefore affects the hydrology and hydraulics of the river, both upstream and downstream of the Project. Dams are known to impact river hydrology and hydraulics, even if they are classified as run-of-river projects⁴⁵⁶. Run-of-river projects are even known to alter sub-daily variation in flow regimes⁷⁸.

Regarding potential flooding impacts, we indicated in our study request that The Nature Conservancy's Nature-Based Solutions Mapping tool (also referred to as the "Coastal Resilience Mapping tool", though it includes high-quality data for the entire state), identified Essex Dam as a project "that increases the potential severity of inland flooding, and for which restoration would minimize the risk, protect nearby life and property, and benefit aquatic and terrestrial organisms and water quality." The Nature-Based Solutions Mapping Tool is available at <https://maps.coastalresilience.org/massachusetts/>⁹. The "restore for inland flood resilience" layer of the tool assesses dams, culverts, and developed areas with potential for wetland or riparian zone restoration based on their potential to reduce hazards due to climate change. This analysis highlights the Essex Dam location as a high-priority area where restoring aquatic connectivity would increase inland flood resilience. This prioritization is based on dams which fall in the upper 25th percentile of the Massachusetts Department of Ecological Restoration's (DER) Restoration Potential Model from 2019¹⁰.

⁴ Kuriqi, Alban, António N. Pinheiro, Alvaro Sordo-Ward, María D. Bejarano, and Luis Garrote. "Ecological impacts of run-of-river hydropower plants—Current status and future prospects on the brink of energy transition." *Renewable and Sustainable Energy Reviews* 142 (2021): 110833. <https://doi.org/10.1016/j.rser.2021.110833>.

⁵ Gibeau, Pascale, Brendan M. Connors, and Wendy J. Palen. "Run-of-River hydropower and salmonids: potential effects and perspective on future research." *Canadian Journal of Fisheries and Aquatic Sciences* 74, no. 7 (2017): 1135-1149. <https://doi.org/10.1139/cjfas-2016-0253>.

⁶ Almeida, Rafael M., Stephen K. Hamilton, Emma J. Rosi, Nathan Barros, Carolina RC Doria, Alexander S. Flecker, Ayan S. Fleischmann, Alexander J. Reisinger, and Fábio Roland. "Hydropeaking operations of two run-of-river mega-dams alter downstream hydrology of the largest Amazon tributary." *Frontiers in Environmental Science* 8 (2020): 120. <https://doi.org/10.1016/j.rser.2021.110833>.

⁷ Ibid.

⁸ Zimmerman, Julie KH, Benjamin H. Letcher, Keith H. Nislow, Kimberly A. Lutz, and Francis J. Magilligan. "Determining the effects of dams on subdaily variation in river flows at a whole-basin scale." *River research and applications* 26, no. 10 (2010): 1246-1260. <https://doi.org/10.1002/rra.1324>.

⁹ Full methodologies and data inputs for the tool are available at <https://tnc.app.box.com/file/480549394941?s=jfwouhde4z9ik712p5v72iv5vylrd6an>

¹⁰ <https://www.mass.gov/info-details/ders-restoration-potential-model-tool-description>

On multiple occasions, including in their justification for not including this study in the PSP, Essex has indicated that the Lawrence Project does not have impacts on the river flow regime and associated elements (e.g., temperature, sediment, nutrients) or on hydraulics associated with project infrastructure because it is classified as a run-of-river project. However, they have not provided data to support this claim. Further, they indicated in their justification (p. 25 of the PSP) that “the Project’s impoundment is held at a constant elevation on an annual basis.” While this may be a language error, it is worth noting that annual data, and even daily data¹¹, are not sufficient for evaluating the impacts of a project classified as run-of-river. Furthermore, average reservoir impoundment levels are not indicative of impacts to temperature, sediment, nutrient regimes, or to the hydraulic effects of project infrastructure during high-flow events.

In order for FERC to accurately assess project effects of the Lawrence Hydroelectric Project as part of their NEPA review, this data will need to either be provided by Essex or collected through a study. Depending on the results of this data, license conditions could include changes in project operations or physical modifications to the project to mitigate altered flow, temperature, sediment, or nutrient regimes, and potential flooding impacts on the local community.

Essex also indicated that they would not incorporate the impacts of climate change into their studies because these future conditions are “far too speculative to allow for a quantitative evaluation” and “climate change forecasts do not exist that could reliably predict how precipitation, snowmelt, evapotranspiration, ice out, and annual runoff patterns may change 30 to 50 years from now” (PSP, pp. 25-26). However, since as early as 2008, scientists have recognized that the past does not accurately predict the future, especially when it comes to water resources.¹² In the intervening years, the science of climate projections has progressed significantly, with advanced models capable of predicting future weather patterns with a high level of confidence and able to model existing conditions given only past conditions and climate forcing data. There are many experts with extensive experience in providing detailed, defensible climate projections for planning and alternatives evaluations in Massachusetts. If identifying and evaluating a qualified expert is a barrier, The Conservancy is willing to provide support in this matter.

Reliable climate projection data are available from reputable, peer reviewed sources at a wide range of scales. The United Nations’ Intergovernmental Panel on Climate Change (IPCC) and the U.S. Government’s National Climate Assessment (NCA) each provide high-quality datasets that predict future precipitation, evapotranspiration, runoff, and other relevant patterns at specific intervals between now and the end of the century, well beyond 2080. In many cases, these have been downscaled to regions to reflect the global variability in these impacts. The Commonwealth of Massachusetts has developed models that reflect this variability at an even more refined scale.

¹¹ Zimmerman et al. 2010. <https://doi.org/10.1002/rra.1324>.

¹² Milly, P. C. D., Julio Betancourt, Malin Falkenmark, Robert M. Hirsch, Zbigniew W. Kundzewicz, Dennis P. Lettenmaier, and Ronald J. Stouffer. “Stationarity Is Dead: Whither Water Management?” *Science* 319, no. 5863 (February 2008): 573–74. <https://doi.org/10.1126/science.1151915>.

- The IPCC Working Group I Interactive Atlas (<https://interactive-atlas.ipcc.ch/>) provides multiple emissions and time scenarios to show temperature and precipitation projections at a regional (Eastern North America) scale under a range of emissions and warming scenarios.
- The NCA Interactive Atlas has made high-quality climate projection data available for the public: <https://atlas.globalchange.gov/pages/about-atlas>, including extensive documentation of the scenarios, models, and uncertainties present in each¹³. This data is available at the county level across the United States.
- NCA’s focused report on the northeast (<https://nca2023.globalchange.gov/chapter/21/>) found that precipitation in the region has “increased in all seasons and extreme precipitation events (defined as events with the top 1% of daily precipitation accumulations) have increased by about 60% in the region—the largest increase in the US.”¹⁴
- Massachusetts uses a sophisticated set of specific, peer-reviewed forecasts to understand how climate change will impact weather patterns at several intervals between 2030 and 2090. The ResilientMass Maps and DataCenter has made this data, downscaled for Massachusetts from Global Climate Models (GCM) and a Stochastic Weather Generator at a HUC8 watershed scale, available to the public via the ResilientMass Maps and Data Center. The Massachusetts dataset predicts that by 2050, the maximum daily precipitation in Lawrence will increase by 14.5 - 16.5% over the baseline period. <https://resilientma-mapcenter-mass-oeea.hub.arcgis.com/>

Understanding the positive and negative impacts of these reasonably predicted hydrologic changes on the dam’s function and operations and the surrounding area will be crucial throughout the life of the dam.¹⁵ The expected increases in extreme precipitation events over the next several decades may pose new or different stressors to the dam or could find unexpected benefits of the dam for flood risk in surrounding communities. This high-quality climate data is critical to understanding how climatic conditions throughout the license period will affect the impact of the dam (positive, neutral, and negative) and related license conditions under the expected hydrologic regimes throughout the life of the license.

Further, FERC’s Scoping Document 2¹⁶ for this project clearly states that the NEPA document “will assess reasonably foreseeable effects that changes in precipitation patterns temperature could have on the project.” Based on the current state of climate science, there are more than

¹³ Basile, S., A.R. Crimmins, C.W. Avery, B.D. Hamlington, and K.E. Kunkel, 2023: Appendix 3. Scenarios and datasets. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. <https://doi.org/10.7930/NCA5.2023.A3>

¹⁵ Whitehead, J.C., E.L. Mecray, E.D. Lane, L. Kerr, M.L. Finucane, D.R. Reidmiller, M.C. Bove, F.A. Montalto, S. O'Rourke, D.A. Zarrilli, P. Chigbu, C.C. Thornbrugh, E.N. Curchitser, J.G. Hunter, and K. Law, 2023: Ch. 21. Northeast. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. <https://doi.org/10.7930/NCA5.2023.CH21>

¹⁶ FERC Accession # [20231128-3049](https://www.ferc.gov/record-keeping/20231128-3049)

sufficient data and models available to reliably predict climate and precipitation patterns for the next 30 years, 50 years, and beyond. This data must be incorporated into the proposed studies in order for them to adequately reflect reasonably foreseeable effects and develop license conditions that will be effective for the life of the license.

Related to Study Criteria No. 6, Essex stated that the study request “does not provide a methodology,” but does not provide details further than this, and it’s unclear how the methodology we provided does not meet FERC criteria. While the study methodology will certainly need to be refined and further developed for the PSP, we included almost 3 pages of proposed methods, including several citations and references with further details. As stated previously, we fully support Essex’s desire to consolidate elements of various studies into single studies “to increase efficiencies in how data is collected and analyzed,” and would certainly be willing to discuss how to be cost and labor efficient with study development and implementation.

Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem

This goal of this requested study was to identify and evaluate alternatives to benefit the resilience of the local community and Merrimack River ecosystem to extreme weather and other impacts of climate change. This study was discussed at length during the January 4-5, 2024 PSP Meeting in Lawrence. As stated at that meeting, we understand that this is a non-traditional study request to develop and evaluate project alternatives, as project alternatives in the FERC relicensing process are generally taken into consideration after studies have been conducted and results of those studies are evaluated to determine project impacts. However, we wanted to create a productive and transparent dialogue with Essex focused on finding solutions to benefit multiple objectives for the project. We also wanted to clearly indicate our desire to ensure that the Lawrence Hydroelectric Project serves a comprehensive set of interests, including those of Essex, the resource agencies, local and regional non-profit organizations, and most importantly, the local community that is directly impacted by the decisions made by Essex, FERC, and the conditioning authorities.

As indicated in their comments, Essex will not undertake a study to evaluate project alternatives at this stage. However, we did gain the impression that Essex *may* be open to dialogue as we continue to gain an understanding of both the benefits and impacts of this project, both at present and into the reasonably foreseeable future. At the PSP meeting, Essex indicated interest in other projects where project operators have worked with interested parties to develop creative solutions that benefited multiple project objectives. We will work to collate some practical examples and provide these to Essex in the near future.

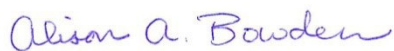
The Nature Conservancy is committed to tackling the dual global threats of climate change and biodiversity loss and believe in a future where both people and nature – the community of Lawrence and the Merrimack River – thrive. While hydropower is a low-carbon energy source that will undoubtedly have a role in the clean energy transition, it is also a major cause for global

freshwater biodiversity decline¹⁷¹⁸¹⁹. Because of this, it is imperative that we very carefully consider both the climate mitigation value and the freshwater biodiversity impacts for decisions regarding hydropower development, operation, modification, and removal.

At this time, it is unclear whether the value that Essex contributes to the New England clean energy transition is commensurate to its ongoing impacts on the Merrimack River ecosystem. Is 16 MW (potentially less) of power generation worth the ongoing decline of the Merrimack River ecosystem? Are there alternative ways to configure the project that will provide renewable energy to the grid while restoring critical functions of the river ecosystem and bringing value to the community of Lawrence, including protection from the impacts of climate change? These are the questions that we will be looking to better understand, and that we hope to discuss in open and productive dialogue with Essex, as this relicensing process moves forward.

Thank you for this opportunity to offer comments on the Proposed Study Plan for the license renewal of the Lawrence Hydroelectric Project. If you have any questions regarding the comments herein, please contact Emma Gildesgame (617-532-8310 or emma.gildesgame@tnc.org).

Respectfully submitted,



Alison A. Bowden
Director of Science and Strategy
The Nature Conservancy in Massachusetts



Emma Gildesgame
Climate Adaptation Scientist
The Nature Conservancy in Massachusetts

¹⁷ Reid, Andrea J., Andrew K. Carlson, Irena F. Creed, Erika J. Eliason, Peter A. Gell, Pieter TJ Johnson, Karen A. Kidd et al. "Emerging threats and persistent conservation challenges for freshwater biodiversity." *Biological reviews* 94, no. 3 (2019): 849-873. <https://doi.org/10.1111/brv.12480>.

¹⁸ Darwall, William, Vanessa Bremerich, Aaike De Wever, Anthony I. Dell, Jörg Freyhof, Mark O. Gessner, Hans-Peter Grossart et al. "The Alliance for Freshwater Life: A global call to unite efforts for freshwater biodiversity science and conservation." *Aquatic Conservation: Marine and Freshwater Ecosystems* 28, no. 4 (2018): 1015-1022. <https://doi.org/10.1002/aqc.2958>.

¹⁹ Tickner, David, Jeffrey J. Opperman, Robin Abell, Mike Acreman, Angela H. Arthington, Stuart E. Bunn, Steven J. Cooke et al. "Bending the curve of global freshwater biodiversity loss: an emergency recovery plan." *BioScience* 70, no. 4 (2020): 330-342. <https://doi.org/10.1093/biosci/biaa002>.



Matthew J. Connolly

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March 11, 2024

By Email and Electronic Filing (to: ferconline.ferc.gov)

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street NE
Room 1A
Washington, DC 20426

Re: Lawrence Hydroelectric Project (P-2800)—Comments on Proposed Study Plan

Dear Secretary Bose:

Please find attached the Comments on Proposed Study Plan submitted by the Greater Lawrence Sanitary District in this matter.

Very truly yours,

/s/Matthew J. Connolly

Matthew J. Connolly

MJC:

Encl

cc: Kevin Webb, Patriot Hydro
Matthew Rolnick, FERC
6534777.1



LEADERS IN WASTEWATER
MANAGEMENT

Cheri R. Cousens, P.E.
Executive Director

ANDOVER
Christopher Cronin

LAWRENCE
Thomas Connors
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March 11, 2024

By Email and Electronic Filing (to: ferconline.ferc.gov)

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street NE
Room 1A
Washington, DC 20426

Re: Lawrence Hydroelectric Project (P-2800)—Comments on Proposed Study Plan

Dear Secretary Bose:

On behalf of the Greater Lawrence Sanitary District (GLSD), I am writing to submit the following comments on the Proposed Study Plan for the Lawrence Hydroelectric Project (Lawrence Dam). In brief, GLSD supports the applicant's inclusion of a project operations and flow study described in Section 9 of the Proposed Study Plan, and requests changes to the proposed study period and scope.

Background

GLSD Facility

GLSD is a Massachusetts water pollution abatement district that operates a wastewater treatment facility on behalf of its member communities: the environmental justice community of Lawrence, the Massachusetts municipalities of Methuen, Andover, North Andover, and Dracut, and Salem, New Hampshire. The facility is located in North Andover, downstream of the Lawrence Dam.

The facility discharges into the Merrimack River pursuant to a National Pollutant Discharge Elimination System (NPDES) permit issued jointly by the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (MassDEP). The river flow is critical to the facility's operations and the district's ability to comply with its NPDES permit. For example, EPA and MassDEP determine the facility's discharge limits based on "[t]he most severe hydrologic condition at which water quality criteria must be applied." 314 Code Mass. Regs. 4.03(3). This condition for rivers and streams "is the lowest mean flow for seven consecutive days to be expected once in ten years." *Id.* This is also known as the "7Q10" low-flow rate. The 7Q10 used for the facility's current NPDES permit is 871 cubic feet per second (cfs).

Lawrence Dam Minimum Flow Requirements and Proposed Changes

The current and proposed minimum flow for the dam is 951 cfs "unless and until the reservoir water surface elevation is reduced below the crest of the dam, thereupon, the

minimum flow shall equal the inflow to the reservoir.” This minimum flow is 80 cfs higher than the 7Q10 rate set in the facility’s NPDES permit. The Scoping Document also says that the proposal seeks to reduce the impoundment/reservoir behind the dam by about 6 feet: “Essex proposed to modify the project boundary around the project’s impoundment from a 50-foot National Geodetic Vertical Datum 1929 (NGVD29) contour to the normal water level of 44.17 feet NGVD29, which would reduce the acreage included in the project boundary around the impoundment by approximately 33 percent.”

GLSD’s October 2023 Request for Study

Because river flows are critical to GLSD’s operations (as well as those of other wastewater treatment facilities downstream of the dam) and the downstream environment, in October 2023 GLSD submitted a study request as part of the NEPA review.¹ GLSD requested a study analyzing (1) the effect Essex’s proposed changes will have on the dam’s ability to meet the minimum flow requirements in the license; (2) the periods that the Lawrence Dam met the 951 cfs minimum flow limits under the current license, and for periods when flows were below the limit, what the causes were (such as drought conditions, planned maintenance, unplanned maintenance, etc.); and (3) measures Essex can take to ensure it meets (and hopefully exceeds) the 951 cfs limit under the proposed new license.

Applicant’s Proposed Study

Essex claims that it has “generally incorporated the GLSD study request” in Section 9 of its plan, titled “Project Operations and Fish Stranding Study.” The goals of the proposed study “are (1) to provide information on how the Project is operated in a run-of-river (ROR) mode, including a review and evaluation of existing operational generation records, minimum flows, Merrimack River flows, and impoundment evaluations; and (2) to evaluate influence of Project operations and maintenance on potential fish stranding areas downstream of the dam and Project tailrace.” The proposed period for the review of operational conditions of the Project is Jan. 1, 2019 – Dec. 31, 2023.

GLSD’s Requested Changes

GLSD supports the Project Operations study and requests two changes. *First*, the proposed review of the operational conditions should be January 1, 1989 – December 31, 2023 (35 years). 1989 is the beginning date EPA used when determining the 7Q10 rate in GLSD’s current NPDES permit. Further, 1989-2004 is the approximate period when the dam flows had the most significant occurrences of not meeting the 951 cfs minimum flow limit. In particular, the years 1991, 1993, 1995, 1999, and 2001 had consecutive low flow values below the permit’s minimum flow limit. It is important to understand the causes of these low flow periods and whether dam operations contributed to the below minimum flows.

Second, and relatedly, GLSD requests that the study expressly (1) analyze whether Essex’s proposed reduction of the impoundment/reservoir behind the dam will affect the dam’s ability to meet the minimum flow requirements, and (2) evaluate operational or other changes that would

¹ The comments are attached to the Proposed Study Plan on pages 141-145.

improve the dam's ability to meet the 951 cfs minimum limit. It is not clear from the proposed study whether these issues will be analyzed.

Conclusion

Thank you for your consideration. Please let me know if you have any questions or need any further information.

Sincerely,

Cheri Cousens

Cheri Cousens P.E.
Executive Director
Greater Lawrence Sanitary District
240 Charles Street
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United States Department of the Interior

FISH AND WILDLIFE SERVICE



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March 11, 2024

Debbie-Anne Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

RE: Comments on Proposed Study Plan for the Lawrence Hydroelectric Project P-2800-054

Dear Acting Secretary Reese:

This letter provides the U.S. Fish and Wildlife Service's (Service) comments on Essex Company, LLC's (Essex) Proposed Study Plan (PSP) for the relicensing of the Lawrence Hydroelectric Project (Project; P-2800-054). The Project is located on the Merrimack River in in the City of Lawrence, Essex County, Massachusetts. Essex filed the PSP with the Federal Energy Regulatory Commission (Commission) on November 28, 2023,¹ and held a proposed study plan meeting on January 4 and 5, 2024. We are providing comments pursuant to 18 CFR 5.12.

On October 16, 2023, the Service submitted 11 study requests² consistent with the content required in the Commission's regulations at 18 CFR 5.9(b). Essex adopted, in whole or in part, six of the Service's requests. Essex did not adopt five of the studies, and the PSP provides "Study Criterion 5" as justification for not adopting four of the five:

- **"There is no evidence of a problem and/or the study request is an attempt to search for a problem or nexus" (Study Criteria No. 5):** Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question. This "nexus" between the Project's operation and a resource impact must be supported by some evidence of a specific resource impact, not just a belief that an impact might be occurring. Additionally, the study request should not be a request to search for an impact in the absence of any evidence that one is occurring. If the study request is an attempt to search for a Project effect, or a nexus, then it does not meet the criteria for a study request." and

¹ Accession Number 20231128-5122.

² Accession Number 20231016-5221.

- **“Study request constitutes basic research and/or is not likely to inform the development of license conditions (Study Criteria No. 5):** Study requests should demonstrate the need for additional, site-specific information for purposes other than general research.”

We believe that Essex’s rationale in Study Criteria No. 5, and Essex’s defense of Study Criteria No. 5 at the January 4, 2024, study plan meeting, are inconsistent with 18 CFR 5.9(b), the Commission’s associated guidance documents,³ and case law.⁴ All of our requested studies (1) provide a clear nexus between project operations and potential effects on the resource to be studied, and (2) articulate how the study data could be used to inform the development of license requirements. In general, we consider Essex’s attention to the Service’s description of, and support for, the nexus between project operations and effects on the resource to be studied to be incomplete.

Further, in its Final Rule establishing the Integrated Licensing Process, *Hydroelectric Licensing under the Federal Power Act* under RM02-16 (Order 2002),⁵ the Commission articulates its position on this topic. Specifically, in response to comments received during the rulemaking process, the Commission states in paragraph 98 and 108:

“98. CHRC counters that a study might be required to establish the existence of a nexus. Taken to its extreme, CHRC's position would have us approving study proposals that amount to mere speculation. We think a common sense approach to demonstrating a nexus between project operations and resource impacts, informed by the professional judgment of qualified agency, Commission, and tribal staff, should ensure that this criterion is reasonably applied.”

“108. Various industry commenters recommend that we add a criterion requiring a requester to discuss whether or not a resource problem has been identified that relates to the request.[104] This proposed criterion is too subjective. A principal feature of hydroelectric licensing in recent decades has been disagreements between license applicants and others concerning the extent to which proposed or existing projects have negative effects on natural and other resources. Whether an identified impact is or is not a problem, and the extent of the problem, are often matters of perspective. Moreover, the finding of a "problem" is not a required predicate for Commission action under the comprehensive development standard of FPA Section 10(a)(1)...”

³ Understanding the Study Criteria, Integrated Licensing Process and A Guide to Understanding and Applying the Integrated Licensing Process Study Criteria; Available at: <https://ferc.gov/sites/default/files/2020-04/UnderstandingtheStudyCriteriaILP.pdf>, and <https://ferc.gov/sites/default/files/2020-04/AGuidetoUnderstandingandApplyingtheIntegratedLicensingProcessStudyCriteria.pdf>, respectively (Accessed February 22, 2024).

⁴ The PSP uses selective information from *City Centralia v. FERC*, No. 99-1273 (D.C. Cir. 2000) which pre-dates the Commission’s Final Rule (Order 2000) that established the Integrated Licensing Process.

⁵ Accession Number 20030724-3002.

Debbie-Anne Reese
March 11, 2024

3

In the attached Appendix A, we respond to Essex's reasons for not adopting certain study requests, but only to the extent they are based on the content required in 18 CFR 5.9(b). We also provide comments on the studies Essex does propose.

We appreciate this opportunity to comment and look forward to working with the Commission and Essex in the development of the revised study plan and subsequent license application. If you have any questions regarding this letter or our attached comments on the PSP, please contact Ken Hogan at kenneth_hogan@fws.gov or (603) 451-9266.

Sincerely yours,

Audrey Mayer
Supervisor
New England Field Office

Attachment: Appendix A – Study Requests

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Appendix A

PROPOSED STUDY PLAN SECTION 4 - REQUESTED STUDIES NOT ADOPTED

Downstream Fish Passage Assessment (Study Request 1)

Summary of Proposed Study Plan

As discussed in Section 4 of the Proposed Study Plan (PSP), Essex Company, LLC (Essex) altered its licensing proposal after review of the requested studies, with the intent of reducing the need for and/or scope of studies. Essex now proposes to replace the Lawrence Hydroelectric Project's (Project) existing trashracks with a narrow-spaced trashrack design to limit fish entrainment into Project works. Essex would develop this protection, mitigation, and enhancement measure (PM&E) in consultation with the Merrimack River Technical Committee (MRTC) for inclusion in its draft license application (DLA) for the Project.⁶ As a result, Essex is not proposing the Service's requested *Downstream Fish Passage Assessment* study (Study Request 1). In the PSP, Essex states that the existing downstream fish bypass facility should be evaluated later.

Service Response

We support Essex's approach to propose PM&E's in lieu of conducting studies to evaluate existing conditions. However, the goal of the Service's Study Request 1 is to assess behavior, passage success, immediate and latent survival, and internal and external injury of target species as they encounter the Project during downstream migrations through *all* downstream passage routes.⁷ Essex's proposed PM&E measure only addresses one viable passage route, turbine passage. Other potential downstream routes include the Project's spillway, North and South canal gatehouses and canal systems, and the Project's downstream fish bypass. While we agree that Essex's proposal to install a narrow spaced trashrack would eliminate the need to assess turbine entrainment and passage survival through the Project's intake, at this time, the proposed PM&E measure does not address all downstream passage routes. Therefore, we continue to support our Study Request 1 for the remaining passage routes at the Project. We ask that Essex include a *Downstream Fish Passage Assessment*, consistent with its licensing proposal, in the Revised Study Plan (RSP).

⁶ The Merrimack River Technical Committee (MRTC) oversees and guides the diadromous fishery restoration efforts throughout the Merrimack River watershed and consists of representatives from the Service, the National Marine Fisheries Service (NMFS), the New Hampshire Fish and Game Department (NHFGD), the Massachusetts Division of Marine Fisheries (MADMF), and the Massachusetts Division of Fisheries and Wildlife (MassWildlife).

⁷ Target species and life stages are juvenile and adult American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), and adult American eel (*Anguilla rostrata*).

Diadromous Fish Behavior, Movement, and Project Interaction Study (Study Request 5)

Summary of Proposed Study Plan

Section 4 of the PSP states that Essex is not proposing the Service's requested *Diadromous Fish Behavior, Movement, and Project Interaction Study* (Study Request 5). Essex notes that our Study Request 5 would be best developed after it can be informed by the proposed *Three-Dimensional Computational Fluid Dynamic (CFD) Modeling* (PSP Section 12; CFD Modeling Study), included in Section 12 of the PSP. However, the PSP does not articulate how the CFD Modeling Study results would inform the development of a *Diadromous Fish Behavior, Movement, and Project Interaction Study*.

Service Response

Essex's position on our Study Request 5 is unclear. While the PSP implies a study may be developed in the future, the PSP states a study is not proposed, and the PSP does not include a process for the development of that study. We note that the PSP did not evaluate our request in the context of 18 CFR 5.9(b) in its discussion of our Study Request 5 and its reasoning for not adopting the requested study. For the reasons discussed in our Study Request 5, the Service continues to seek the development and implementation of the *Diadromous Fish Behavior, Movement, and Project Interaction Study* and asks that Essex include the requested study in its RSP.

Fish Assemblage Study (Study Request 9)

Summary of Proposed Study Plan

In Section 4.1, *Fish Assemblage Study*, of the PSP, Essex rejects the Service's requested *Fish Assemblage Assessment* (Study Request 9). Essex states: "**Study request is not necessary because existing information is sufficient to answer the questions posed and the study request constitutes basic research (Study Criteria Nos. 4 and 5)...**" In defense of this position, the PSP states that "the Merrimack River..., is one of the most understood and managed rivers in the Northeast." The PSP notes that the existing fishery resources of the Merrimack River are "exhaustively summarized" in Section 5.4 of the Pre-Application Document (PAD)⁸ and that the Service did not explain how the existing information is inadequate to meet the Service's requested study's goals and objectives. The PSP finds that our study request (1) did not identify any data gaps or specify why the existing information is inadequate to characterize existing fish resources in support of the Project's licensing process, and (2) is not likely to inform the development of license requirements.

Service Response

Section 5.4.2, *Existing Fish and Aquatic Resources*, of the PAD only identifies migratory fish species found in the Project's vicinity. The PAD's Table 5.4.1 identifies a total of 49 fish species

⁸ Accession Number 20230616-5234.

found within the Merrimack River watershed from its headwaters in the White Mountains of New Hampshire to its mouth at the Atlantic Ocean. The goal of our Study Request 9 is to establish the existing baseline of the Merrimack River fishery resources in the vicinity of the Project. This information is needed to inform an analysis of Project effects on those resources.

Pursuant to 18 CFR 5.9(b)(4), our requested study noted that the Commonwealth of Massachusetts conducted a limited sampling in 2009 in the Project's vicinity. That sampling effort comprised 45 minutes of boat electrofishing upstream and downstream of the Project, for 90 minutes total, and encompassed less than 1 percent of the available habitat influenced by the Project. The Service is not aware of any other fish assemblage data specific to the Project area, and Essex has not provided other information to adequately characterize baseline fishery resources in the vicinity of the Project. As such, there continues to be a need for a fish assemblage study and report, and we ask that Essex include a *Fish Assemblage Study* in its RSP. However, we recognize that Essex believes adequate information exists to support the Project's licensing proceeding. Therefore, the Service would support a study plan that takes a two-phased approach to providing the necessary fish assemblage data. Phase 1 would consist of a detailed desktop survey and report of the existing information, which articulates the known fish assemblage specific to the Project's vicinity and identifies all remaining information gaps. The report should include information on previous survey methods, locations, and level of effort, and an appendix containing a copy of each reviewed study/survey report. Phase 2 of the study should include the development of fish assemblage field surveys as requested in our Study Request 9, as needed, and specific to fill any information gaps identified during Phase 1.

Fish Passage Improvement and Feasibility Assessment (Study Request 6)

Summary of Proposed Study Plan

In Section 4.2 of the PSP, Essex indicates it did not adopt the Service's requested *Fish Passage Improvement and Feasibility Assessment (Study Request 6)*, at this time, because the requested study would evaluate potential PM&E measures that may not be necessary. The PSP notes that the proposed fish passage studies are intended to evaluate the effectiveness of the existing fish passage facilities. If those studies indicate enhancements for fish passage are needed, the PSP acknowledges that potential next steps could be articulated in the DLA.

Service Response

In general, we accept Essex's proposed approach to our requested *Fish Passage Improvement and Feasibility Assessment (Study Request 6)*. The development and implementation of our Study Request 6 now would proactively support a review of fish passage alternatives at the Project, even though Essex is not currently proposing any modification to the existing fish passage facilities. While the Service can support a phased approach to determining fish passage effectiveness and developing alternatives, as needed, the next steps should be part of Essex's Initial Study Report (ISR), not simply identified in its DLA. Following a review of study results of Essex's proposed *Upstream Fish Passage Assessment* and *Upstream American Eel Passage Assessment*, Sections 6 and 7 of the PSP, respectively, and the Service's requested *Downstream Fish Passage Assessment* and *Diadromous Fish Behavior, Movement, and Project Interaction*

Study, Study Requests 1 and 5, respectively, we ask, pursuant to 18 CFR 5.15(c)(1), that Essex's ISR propose, if appropriate, our Study Request 6. If, at that time, the Service and Essex disagree on the need for our Study Request 6, the Service may ask that our *Fish Passage Improvement and Feasibility Assessment* be conducted, pursuant to 18 CFR 5.15(c)(4).

Sturgeon Distribution and Project Interaction Study (Study Request 7)

Summary of Proposed Study Plan

Essex did not adopt the Service's requested *Sturgeon Distribution and Project Interaction Study* (Study Request 7). In Section 4.4 of the PSP, Essex states the requested study is an attempt to search for a problem or a nexus to the Project. The PSP also implies that study would not inform potential license conditions given the proposed run-of-river operations. Further, the PSP notes that while four acoustic-tagged sturgeon have been detected at the Interstate 495 (I-495) bridge, there is no existing information to indicate that sturgeon migrate further upstream to the Project area. The PSP notes that given the low densities of sturgeon downstream of the Project, "...it is unlikely that a sub-sample of dates would yield an adequate sample size from which to inform on sturgeon population size and distribution." Essex considers the requested study inappropriate for fish species that have not been identified at the Project, or that have no fishery management agency goals for passage of the species at the Project.

Service Response

The goal of the Service's Study Request 7 is specifically to determine how Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and shortnose sturgeon (*Acipenser brevirostrum*) (collectively, sturgeon) interact with the Project to identify potential means of take resulting from the Project's operation and maintenance. While the PSP asserts that no acoustic-tagged sturgeon have been documented in the Project's vicinity upstream of the I-495 bridge, we note that the most upstream acoustic receiver was located at that bridge, and no means of detecting the sturgeon at the Project existed. Our Study Request 7 fully addressed the Commission's study request requirements demonstrating the need for information and acknowledged that the resulting information could be used to inform license conditions, including the potential need for upstream fish passage of sturgeon. Essex's concern that a sub-sample of dates would not provide sufficient information on the sturgeon population or distribution downstream of the Project should be addressed through study design and methodology. For these reasons, the Service continues to support its Study Request 7 and asks that the requested *Sturgeon Distribution and Project Interaction Study* be included in Essex's RSP.

Invasive Plant Survey (Study Request 12)

Summary of Proposed Study Plan

In Section 4.10 of the PSP, Essex does not adopt the Service's requested *Invasive Plant Survey* (Study Request 12), claiming that we did not address 18 CFR 5.9(b)(5). Specifically, the PSP states that "...the presence of invasive species is a natural occurrence and/or a likely result of

factors unrelated to the operation of the Project.” The PSP indicates that Essex will describe any proposed measures to control invasive plants within the Project’s boundary in its DLA.

Service Response

The Service’s Study Request 12 would describe the current baseline condition of invasive plant species needed to assess any continuing Project effects and potential PM&E measures to address those effects. Reservoirs and impoundments alter natural habitats and are known to provide conducive conditions for the spread and establishment of invasive aquatic plant species. The Project’s land management and maintenance activities and continued operation of the Project’s reservoir could provide suitable conditions for invasive species to establish and expand during the next license term. Studies to establish current baseline conditions at hydropower projects during relicensing are common and supported in the Commission’s guidance *A Guide to Understanding and Applying the Integrated Licensing Process Study Criteria*,⁹ and measures to address invasive species are often included as license conditions. While the PSP indicates that Essex may propose measures to control invasive plants, we are unclear how such measures would be informed if there is no information available to characterize the baseline distribution of invasive plant species. Therefore, the Service asks that Essex include our requested *Invasive Plant Survey* in its RSP.

⁹ See <https://ferc.gov/sites/default/files/2020-04/AGuidetoUnderstandingandApplyingtheIntegratedLicensingProcessStudyCriteria.pdf> (Accessed: February 28, 2024).

**COMMENTS ON PROPOSED STUDIES
PROPOSED STUDY PLAN – SECTIONS 6 – 10 AND 12**

Upstream Anadromous Fish Passage Assessment (PSP Section 6)

Section 6 of the PSP provides a proposed *Upstream Anadromous Fish Passage Assessment* study plan. The proposed study is largely consistent with the Service's Study Request 2, except that Essex does not propose to evaluate the effectiveness of upstream fish passage facilities for sea lamprey (*Petromyzon marinus*). In Section 4.14 of the PSP, Essex states that it does not propose to assess sea lamprey because (1) the 2021 *Merrimack River Watershed Comprehensive Plan for Diadromous Fishes* (Comprehensive Plan) does not provide upstream effectiveness goals for sea lamprey,¹⁰ and (2) there is lack of available existing information to evaluate and assess passage efficiencies for sea lamprey.

Comments on Essex's proposed *Upstream Anadromous Fish Passage Assessment* (PSP Section 6)

The absence of numerically specific upstream passage effectiveness goals does not negate the need to evaluate Project effects on sea lamprey or the Project's ability to provide safe, timely, and effective passage. The Service's overarching management goal for Merrimack River sea lamprey, as outlined in the Comprehensive Plan, is to restore and maintain sustainable runs for human and ecological benefits. Information from the proposed study will support an assessment of Project effects on the safe, timely, effective upstream passage of sea lamprey and inform the need for license conditions to improve passage conditions, if necessary. Therefore, the Service continues to request that Essex include sea lamprey in the proposed *Upstream Anadromous Fish Passage Assessment*.

In Section 6.6.1, *Sample Size*, Essex proposes to observe 100 radio-tagged individuals of each target fish species. Based on a presumed rate of fall-back, and an assumed rate of predation for adult American shad, adult alewife, and blueback herring (collectively, river herring), Essex proposes to tag 165 American shad and 185 river herring to have a sample size of 100 radio-tagged individuals in the study. However, Section 6.6.1 provides no supporting information to indicate that a sample size of 100 observed individuals for each target group would generate statistically significant results. In addition, as noted in our *Diadromous Fish Behavior, Movement, and Project Interaction Study* (Study Request 5), target species migrating upstream are failing to locate the fishway entrance due to what appears to be predator avoidance behavior. While the study plan considers a rate of predation that prevents consumed fish from reaching the fishway, it does not consider predator avoidance behavior when establishing the initial number of fish to tag. Please provide an explanation supporting a sample size of 100 individuals as likely to provide adequate statistical rigor.

Our Study Request 2 treated alewife and blueback herring as separate species to be assessed. The proposed study plan combines these species and addresses them as one study entity. While alewife and blueback herring are similar species, they exhibit different migratory behaviors and

¹⁰ Merrimack River Watershed Comprehensive Plan for Diadromous Fishes. Filed with the Federal Energy Regulatory Commission June 17, 2021, Accession Number 20210617-5016.

should be evaluated independently. We recognize that treating the herring species separately will increase the number of telemetry tags needed for the study and the consideration raised in Section 6.6.1 that increasing "...the number of test fish required...must be weighed against the functional limitations of effectively monitoring large numbers of fish within any one detection zone due to collisions among tag signals." Currently, the proposed study is planned for a single study season in 2025. If adopting our recommendations would result in poor data, the study may be split to evaluate different target species groups over two upstream migration seasons, 2025 and 2026, substantially reducing the potential for signal collisions.

In summary, we recommend that section 6.6.1 of the RSP (1) include an analysis and justification for the number of targeted observed radio-tagged individuals, (2) consider predation avoidance behavior when establishing the total number of tags needed to satisfy the targeted observed radio-tagged individuals, (3) treat alewife and blueback herring as separate species, and (4) consider the need for multiple study seasons to support data integrity.

In Section 6.6.3, *Radio Telemetry Monitoring Stations*, Essex proposes to operate 10 monitoring stations. However, as demonstrated in Figure 6-2 of the PSP, the proposed arrangement of the monitoring stations would not capture (1) how fish approach the Project, (2) false attraction to the Project's spillway, (3) milling or disorientation in the tailrace, or (4) fish passage success and escapement to the Project's headpond. As such, we recommend the addition of the following monitoring station(s):

- To assess how fish approach the Project, we recommend the addition of monitoring station(s) located immediately downstream of the Union Street Bridge between stations 2 and 3. The station(s) should be oriented to provide data that describe a tagged fish's position within the river reach downstream of the bridge as it approaches the Project.
- To track and monitor false attraction to the Project's spillway, we recommend the addition of monitoring station(s) located immediately downstream of the Project's spillway.¹¹
- To assess delay and far field attraction to the Project's fishway entrances, we recommend the addition of an array at the downstream end of the tailrace between stations 3 and 4.
- To document fish passage success and escapement to the Project's reservoir, we recommend the addition of a monitoring station just upstream of the Project's intake channel/power canal.

Upstream American Eel Passage Assessment (PSP Section 7)

In Section 7 of the PSP, Essex provides its proposed *Upstream American Eel Passage Assessment* study plan. The proposed study is mostly consistent with the Service's Study Request 4.

Comments on Essex's proposed *Upstream American Eel Passage Assessment (PSP Section 7)*

¹¹ With the addition of this station(s) we also recommend Sections 6.6.6.2 and 6.6.6.3 include an analysis of false attraction.

Section 7.3, *Study Area*, defines the study area as "...the section of the Merrimack River located immediately downstream of the Essex Dam and the existing upstream eel passage facilities." This geographic scope is too large and should be reduced accordingly. We recommend modifying Section 7.3 as follows:

The study area will include the section of the Merrimack River located immediately downstream of the Essex Dam, *proximal* to ~~and~~ the existing upstream eel passage facilities.

Section 7.6.2.2, *Eel Tagging and Releases*, notes that up to 500 juvenile eel will be tagged with a 12 millimeter (mm) passive integrated transponder (PIT) tag. The study proposes to tag two size classes of eels; individuals less than or equal to 150 mm, and those greater than 150 mm. Given the size of the 12 mm PIT tags, the study plan appropriately establishes an eel minimum size threshold of 113 mm.

Juvenile eel sampling conducted by the Service at the Project in 2015 indicated the majority of eel at the site were 110 mm or shorter. Of the 761 eels captured in the Project's eel ladder on July 29, 2015, 755 were less than 110 mm, none were between 110 mm and 120 mm, and 6 were over 120 mm. Given this information, the Service is concerned that the proposed study methodology will skew the tagged sample population to be unrepresentative of the eels at the Project. As a result, the Service recommends the proposed study include contingency marking/tagging and recapture methods (e.g., visual elastomer tags) in the event the size of eels captured during the study plan's implementation is similar to that observed during the Service's 2015 sampling effort.

Upstream American Eel Upstream Passage Siting Study (PSP Section 8)

In Section 8 of the PSP, Essex provides its proposed *Upstream American Eel Passage Siting Study* plan. The proposed study is generally consistent with the Service's Study Request 3.

Comments on Essex's proposed *Upstream American Eel Passage Assessment (PSP Section 8)*

In Section 8.6.1, *Nighttime Visual Surveys*, of its PSP, Essex proposes to conduct nighttime surveys to reevaluate the spatial distribution and relative abundance of juvenile eels downstream of the Essex Dam and other Project structures. Essex provides a list of "potential" survey areas noting that they "...will only be searched pending a determination that there are no significant health or safety risks associated with accessing and entering those locations." We note that the downstream face of the Project's dam and tailrace are excluded from the list of survey areas, and we recommend the RSP include them in the list of potential Project features where nighttime visual surveys occur. The Service asks that survey locations only be removed if the hazards cannot be mitigated and that Section 8.6.4, *Data Analysis and Reporting*, of the RSP include provisions for reporting why any survey areas, for any sampling method, are removed from survey, including all mitigation measures that were considered, but were deemed inadequate, to mitigate the potential hazard(s).

Section 8.6.2 *Electrofishing Surveys* of the PSP, states that backpack electrofishing surveys will be conducted downstream of Essex Dam; however, it does not specify the area(s) in which electrofishing surveys would occur. To provide a more robust estimate of the relative abundance and body size distribution of juvenile American eels found in the Project's vicinity and waters, the Service recommends the RSP include electrofishing surveys within (1) the Merrimack River from the Project's dam to the tailrace, (2) within the Spicket River from its confluence with the Merrimack River to the terminus of the North Canal, and (3) within the North and South canals in their entirety. Electrofishing survey techniques need not be limited to backpack electrofishing and should include other electrofishing methods (e.g., boat electrofishing) as environmental factors (e.g., water depth, substrate, etc.) may dictate. We also recommend section 8.6.2 of the RSP note that any eel captured during canal electrofishing surveys be released to the Project's impoundment, if agreed upon by MassWildlife.

Section 8.6.3, *Temporary Eel Traps*, of the PSP states that up to two temporary eel traps will be deployed in locations determined in consultation with the MRTC and in consideration of site access, personnel safety, and site security. The Service recommends Section 8.6.3 of the RSP be revised to provide for a minimum of three temporary eel traps to be deployed at the downstream side of the North and South canal gatehouses, and at the downstream side of the terminus of the North Canal at the Spicket River. Precise placement of the traps' ramps and the need for additional traps should be determined in consultation with the MRTC prior to the start of the ten-week survey period.

Project Operations and Fish Stranding Study (PSP Section 9)

In Section 9, *Project Operations and Fish Stranding Study*, of the PSP, Essex proposes to conduct a desktop evaluation of existing Project operational data for a five-year period of record. The analysis would include a review of detailed Project operational data, minimum flows, Merrimack River flows, impoundment elevation, and the results of its *Three-Dimensional Computational Fluid Dynamic (CFD) Modeling* study proposed in Section 12 of the PSP. Essex proposes to review Project operations from 2019-2023 and determine the conditions of the 2019 and 2023 stranding events identified in the Service's requested *Fish Stranding and Ramping Rate Study* (Study Request 10). As discussed in Section 4.12, *Fish Stranding and Ramping Rate Study*, of the PSP, Essex does not propose the Service's requested field surveys because it finds our study methodology too broad, noting that the Service did not specify the operational changes that would trigger the field surveys. In addition, Essex contends that our requested study methods assume that fish stranding events may occur under any or all operational changes even though only two stranding events were identified in our Study Request 10.

Comments on Essex's proposed *Project Operations and Fish Stranding Study*

In addition to the Essex's proposed desktop evaluation, the Service's Study Request 10 included field surveys. Specifically, Phase 1, Task 2 of our requested study included the following field components:

- Survey and map potential stranding sites and topography of the habitat beneath the Project's spillway within the zone of tailwater surface elevation fluctuation.
- Examine potential stranding sites in the study area at an appropriate time interval after an operational change.¹²
- Provide time lapse photography to monitor potential stranding sites.
- Monitor and document depth at potential stranding sites before and after an operational change, such as a reduction in spill as a crestgate is inflated, to identify areas that become rapidly isolated or dewatered in a manner that may strand fish when they are present.
- Document the number, location, and species of fish stranded, and detailed project operations that caused the stranding event. In addition, the conditions of the study/stranding area should be photo-documented.
- Document the number and species of fish stranded within the turbine bays, draft tubes, and upstream and downstream fish passage facilities during routine maintenance activities.

Essex notes that only two stranding events were identified in our Study Request 10 and finds that our requested study methods assume that fish stranding events may occur under any or all operational changes. To the contrary, Study Request 10 seeks to identify the select operational scenarios or aspects of those scenarios that do result in fish stranding events. This information could then be used to inform PM&E measures that avoid these conditions. There are two known events in recent history that, by chance, the New Hampshire Fish and Game Department (NHFGD) was present to document. This does not imply that the project operational conditions associated with these two events are the only scenarios that result in fish strandings at the Project. Without our requested field surveys and actively looking for stranded fish in conjunction with changes in project operations, the proposed study will only provide data on the two discrete events documented by NHFGD and will not inform license conditions that avoid or mitigate all stranding events that may be caused by project operations. Finally, the Service's Study Request 10 also sought information on fish strandings associated with routine project maintenance. Essex's PSP Section 9 study would not provide any information on fish strandings within the turbine bays, draft tubes, and upstream and downstream fish passage facilities, or the canal systems during routine project operation and maintenance activities. As a result, the Service recommends that Essex's RSP Section 9 include the requested field surveys outlined in our Study Request 10, Phase 1, Task 2 and the Project's associated canal system.

Essex's proposal to use its proposed CFD modeling study to further evaluate potential fish stranding in the Project's vicinity is consistent with the Service's Study Request 10. However, the proposed geographic scope for CFD modeling downstream of the Project (PSP Section 12.3, Study Area) is limited to areas downstream of fishway entrances within the tailrace, and internally within the fish lift. In contrast, Essex's PSP Section 9.3 Study Area identifies the geographic scope of the proposed *Project Operations and Fish Stranding Study* to be the tailrace, and the downstream reach below the Essex Dam. Therefore, the geographic scope of the CFD modeling study is inadequate to inform the analysis proposed by Essex in the PSP Section 9

¹²The Service's Study Request 10 specified operational conditions that may include turbine outages, rapid increases in generation, transition from 1 to 2 turbines, rate of crestgate inflation, transition of spill between crestgates, or any operational changes that may result in water surface elevation fluctuations or flow pattern changes downstream of the Project's dam and tailrace.

study. For this reason, the Service recommends that the RSP's Section 12.3 be revised to include the Merrimack River from the downstream face of the Project's dam to the downstream side of the Union Street Bridge. We provide additional comments on Essex's proposed CFD modeling study in *Three-Dimensional Computational Fluid Dynamics (CFD) Modeling* (PSP Section 12) below.

Freshwater Mussel Habitat Assessment and Survey (PSP Section 10)

In Section 10, *Freshwater Mussel Habitat Assessment and Survey*, of the PSP, Essex proposes to conduct field surveys to determine the presence, location, and species of freshwater mussels and non-native bivalves within Project-affected aquatic habitats. Proposed survey areas include the Project's impoundment, the Merrimack River immediately downstream of the Lowell Hydroelectric Project (P-2790), and the Lawrence Project's North and South canals. In addition, Essex proposes to conduct a desktop analysis of potential host-fish using currently available fishery data for the Merrimack River in the vicinity of the Project.

Comments on Essex's proposed *Freshwater Mussel Habitat Assessment and Survey*

Essex's proposed *Freshwater Mussel Habitat Assessment and Survey* study plan is generally consistent with the Service's requested Mussel Survey (Study Request 11). We note that Service's requested study would utilize fish assemblage data from our Study Request 9, which Essex is not proposing to conduct. Study Request 9 would properly inform Essex's proposed *Freshwater Mussel Habitat Assessment and Survey*, and the Service continues to support our Study Request 9 and recommend that RSP utilize the results of a fish assemblage study to inform Essex's assessment of potential host-fish in the Project's vicinity.

In Sections 10.3 and 10.6.1, *Study Area* and *Field Sampling*, respectively, Essex does not propose to sample river reaches downstream of the Project's dam and tailrace, which were included in the Service's Study Request 11. Project operations and maintenance activities (e.g., reservoir drawdowns) can influence flow and generate shear stresses that negatively affect mussel populations downstream of the Project. For this reason, the Service recommends Sections 10.3 and 10.6.1 of the RSP include surveys with the Merrimack River and downstream of the Project's spillway and downstream of the Project's tailrace.

The intent of our Study Request 11 is to provide information on mussel species presence and locations to inform an analysis of how the Project's operation and maintenance activities may affect those communities. The proposed surveys would not cover a broad enough range of water surface elevations (WSE) to accomplish this. Section 10.6.1 indicates that most surveys will occur in water depth 4 feet or less and to a maximum of 5 feet. The Project's pneumatic crest gate system increases the WSE of the impoundment by 5 feet over the dam's spillway crest. Section 10.5, *Project Nexus*, of the PSP notes the maintenance drawdowns are typically limited to 5 feet below the normal WSE. However, a recent 2022 repair of the Project's pneumatic crest gate system resulted in a reservoir drawdown of 5.5-feet below the normal WSE.¹³ As a result, we recommend Section 10.4, *Background and Existing Information*, of the RSP include

¹³ Accession Number 20220708-5159.

information on each reservoir drawdown since installation of the pneumatic crest gate system in 2008, and Section 10.5, *Project Nexus*, articulate the extent of Project effects based on that information. The Service recommends that Section 10.6.1 of the RSP be revised to specify surveys occur to a contour depth equal to the maximum-drawdown plus a 1-foot buffer zone.

In Section 10.6.1, Essex notes it would conduct surveys in the Project's North and South canals, consistent with the Service's Study Request 11, if there are no significant health or safety risks associated with accessing those areas. The Service recommends that Section 10.6.2, *Analysis and Reporting*, of the RSP include provisions that the study report document and explain any decision to remove survey locations from the study area, including a discussion of any measures considered but deemed inadequate to mitigate the potential hazard.

Three-Dimensional Computational Fluid Dynamics (CFD) Modeling (PSP Section 12)

Section 12, *Three-Dimensional Computational Fluid Dynamics (CFD) Modeling*, proposed by Essex would develop three-dimensional models of discrete areas associated with the Project's fish passage structures including the powerhouse forebay, downstream bypass, tailrace, fish lift, and fishway entrances. Essex's proposal is consistent with some aspects of the Service's requested Hydraulic Modeling Study (Study Request 8), but provides a smaller geographic scope than we requested.

Comments on Essex's proposed *Three-Dimensional Computational Fluid Dynamics (CFD) Modeling* study

The Service's Study Request 8 articulated a need to understand the complex flow fields in the Project's vicinity. This information, coupled with data from our requested *Downstream Fish Passage Assessment* (Study Request 1); *Upstream Anadromous Fish Passage Assessment* (Study Request 2); *Upstream American Eel Passage Assessment* (Study Request 4); *Diadromous Fish Behavior, Movement, and Project Interaction Study* (Study Request 5); *Sturgeon Distribution and Project Interaction Study* (Study Request 7); *Fish Stranding and Ramping Rate Study* (Study Request 10); and the *Mussel Survey* (Study Request 11), will inform an analysis of Project effects on these aquatic resources and the development of potential PM&E measures to address those effects.

Essex's PSP recognizes the benefit of the CFD modeling study in Section 4.1, where it states that the Proposed Section 12 CFD modeling study complements its proposed *Upstream Anadromous Fish Passage Assessment* (PSP Section 6), the *American Eel Upstream Passage Siting Study* (PSP Section 8), and the *Project Operations and Fish Stranding Study* (PSP Section 9). However, as proposed, Essex's CFD modeling study would constrain modeling results and only inform an assessment of upstream anadromous fish passage. As discussed above, the PSP's Section 9, *Project Operations and Fish Stranding Study*, specifies that CFD modeling results will be integrated to inform that study. Unfortunately, the proposed CFD modeling is too limited to support Essex's *Project Operations and Fish Stranding Study*.

With a proper geographic scope, CFD model results can inform an analysis of fish behavioral data collected by other proposed and requested studies. As discussed above, the Service recommends that Essex's RSP include the Service requested Studies 1, 5, and 7, and Essex's

proposed PSP Sections 6, 8, 9, and 11 with our recommended modifications. To support an analysis of the Project's effects on aquatic resources and the development of potential license conditions, the Service recommends the RSP include a Hydraulic Modeling Study with a geographic scope consistent with our Study Request 8.



Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

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Lieutenant Governor

Rebecca L. Tepper
Secretary

Bonnie Heiple
Commissioner

March 11, 2024

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

RE: Massachusetts Department of Environmental Protection's Response to Essex Company, LLC's (Essex) Proposed Study Plan (PSP): Lawrence Hydroelectric Project P-2800-054

Dear Secretary Bose:

The Watershed Planning Program (WPP) in the Massachusetts Department of Environmental Protection (MassDEP) has the following comments in response to the November 28, 2023, filing of Essex Company, LLC's (Essex) Proposed Study Plan (PSP) in support of the proposed relicensing of the Lawrence Hydroelectric Project (Project) (P-2800-054), located on the Merrimack River in the City of Lawrence, Essex County, Massachusetts. Essex proposes to continue operating under the new license in a run-of-river (ROR) mode and for its re-licensing, proposes no change to the operation of the facility.

The WPP is a statewide program with a mission to protect, enhance, and restore the quality and value of the waters of the Commonwealth. WPP engages in various activities required by the United States Environmental Protection Agency (USEPA) pursuant to the federal Clean Water Act (CWA) and associated regulations. The CWA directs states to monitor and report on the condition of their water resources, including whether they are healthy or impaired relative to their designated uses. WPP is responsible for developing surface water quality standards, monitoring and assessing water quality and creating plans to restore and protect surface waters. WPP coordinates within MassDEP on projects requesting 401 Water Quality Certifications for hydroelectric operations.

MassDEP's Water Quality study request:

On October 16, 2023, MassDEP submitted a Water Quality Study Request to Essex. The water quality study requested the following parameters be collected to identify if the operation of the facility impacts water quality in the vicinity (See Table 1).

This information is available in alternate format. Please contact Melixza Esenyie at 617-626-1282.

TTY# MassRelay Service 1-800-439-2370
MassDEP Website: www.mass.gov/dep

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Table 1: MassDEP’s Requested Water Quality Study Parameters

Aquatic Life Use	Human Health Use
Benthic macroinvertebrate sampling data	E. Coli or enterococci sampling
Water-column (phytoplankton) chlorophyll samples	Invasive plant survey
Chlorophyll a from the periphyton (attached algae) samples	Cyanotoxins
Evaluations of instream habitat	Fish tissue
Dissolved Oxygen/Temperature	
pH	
Turbidity (NTU), Total Suspended Solids (TSS), and True Color	
Nutrients (total phosphorus and total nitrogen)	
Total Dissolved Gas measurements	
Secchi disk measurements	
Sediment sampling	
Toxics in Water Column	
Fish body burden	
Chloride	

Note: Essex Company’s proposed study plan data collection parameters are highlighted in yellow; strikeouts indicate parameters MassDEP can potentially remove from the request.

In Essex’s Proposed Study Plan (PSP), they state that the study goals are to collect sufficient data to understand current water quality conditions at the Project, assess the designated uses for the two Assessment Units (AUs) (MA84A-03 and MA84A-04), and assess any effects of the Project operations on water quality in the affected AUs¹. Yet, the proposed study that includes only dissolved oxygen, temperature, and Secchi disk measurements is very limited, does not collect sufficient data to assess the facilities’ potential contribution to the relevant impairments within the AUs, would accomplish only a partial assessment of aquatic life in an outdated approach that does not include biological sampling which is a direct measurement of biological integrity, and

The goal of this study is to collect sufficient data to understand current water quality conditions at the Project, assess the designated uses for the two Assessment Units (MA84A-03 and MA84A-04) potentially affected by the Project, and assess any effects of Project operations on water quality in the affected Assessment Units. Specifically, this study seeks to:

- Measure dissolved oxygen (DO), water temperature, pH, and Secchi disk depth at the deepest known spot in the impoundment.
- Measure DO, water temperature, and pH at eleven locations under various river flow, river temperature, and project operating conditions to determine the spatial and temporal effects of project operations on water quality. Monitoring locations will include:
 - Five locations upstream of the Project dam.
 - One location in the reach immediately downstream of the dam.
 - One location in the tailrace.
 - One location downstream of the confluence of the tailrace.
 - Two locations each in both the North and South Canal.

¹ Section 11.2, p.68

does not propose any data collection to assess the impacts of facility operation to the human health use.

The presence of the dam as well as fluctuating water levels may adversely alter sediment and nutrient transfer, water temperatures, and streamflow and thereby impact aquatic resources (Kondolf 1997, Graf 2006, Schmutz and Sendzimir 2018, and Zaidel, P. A. et al. 2021) even in projects that meet the ROR criteria (Fantin-Cruz et al. 2016). Many of the requested water quality parameters (e.g., water-column (phytoplankton) chlorophyll, chlorophyll a from the periphyton (attached algae), turbidity, TSS, true color, and total phosphorus and total nitrogen) are to assess the nutrient cycling in the reaches, which is a documented impairment (“problem”) in the vicinity of the dam that can be exacerbated by impoundment conditions.

In addition, the PAD and the Essex PSP do not provide streamflow and impoundment water level data to support that the Project is operated as run-of-river; consequently, MassDEP maintains its request for instream habitat evaluation data² to evaluate potential impact on aquatic habitat of any water level or flow fluctuations caused by the facility. In sum, MassDEP continues to support collection of data for all parameters in our original request listed in Table 1, with three exceptions that are unlikely to be caused or exacerbated by operation of this facility: chloride, E. coli, and toxics in the water column.

MassDEP also requests the facility submit to MassDEP all raw data collected as a part of its water quality data collection. Also, as was stated in the original request, MassDEP supports study requests by other state and federal agencies and aims to optimize coordination in the collection of water quality parameters to minimize duplication of effort.

Sincerely,



for

Richard O. Carey, Ph.D.
Director, Watershed Planning Program
Massachusetts Department of Environmental Protection

² Habitat qualities are scored using a modification of the evaluation procedure in Plafkin et al. (1989). Most parameters evaluated are instream physical attributes often related to overall land use and are potential sources of limitation to the aquatic biota. Key physical characteristics of the waterbody and surrounding land use include the following: instream cover, epifaunal substrate, embeddedness, sediment deposition, velocity/depth combinations, channel flow status, right and left bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and compared to a regional reference station and/or a site-specific control (upstream reference) station to provide a final habitat ranking.

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The Voice of the Merrimack

Debbie-Anne Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, N.E
Washington, DC 20426

Re: Comments on the Proposed Study Plan for the Lawrence Hydroelectric project P2800-054

Dear Acting Secretary Reese,

Pursuant to the Federal Energy Regulatory Commission's (Commission or FERC) regulations 18 C.F.R. § 5.12, the Merrimack River Watershed Council (MRWC) is providing comment on Essex Company's (Essex) Proposed Study Plan (PSP) for the relicensing of the Lawrence Hydroelectric Project (FERC No. 2800), filed on November 28, 2023.

Since 1976, MRWC has worked to improve and protect the health of the Merrimack River watershed. We are engaged in water quality monitoring, ecological restoration, public recreation, education, and advocacy work on behalf of the watershed's residents and visitors. The Lawrence Hydroelectric Project, including the Great Stone Dam, its associated reservoir and canal system is a critical piece of infrastructure that impacts the entire watershed. This project impacts drinking water sources for four communities, watershed-wide efforts for anadromous fish restoration, water quality conditions for CSO receiving waters, as well as habitat and sediment regimes downstream of the project to the estuary.

MRWC filed comment and proposed a study in Accession 20231017-5012 and staff attended the January 4 & 5 PSP meetings. We appreciate this opportunity to engage with the relicensing process and work constructively with Essex and other stakeholders to arrive at outcomes that maximize benefits for the communities in the watershed and improve the health of the river.

For many of the studies not adopted in the PSP, including our proposed CSO and Drinking Water Intake Interactions within Project Area Study, Essex used an interpretation of FERC's Study Criterion No. 5:

“There is no evidence of a problem and/or the study request is an attempt to search for a problem or “nexus” (Study Criteria No. 5): Under FERC policy and regulations, a study requestor must substantiate a connection between Project operations and effects on the resource in question.”

It is our understanding that criterion 5 was addressed in the Final Rule, re Hydroelectric Licensing under the Federal Power Act under RM02-16 (Order 2002) in paragraphs 98 and 108.¹

98: "We think a common sense approach to demonstrating a nexus between project operations and resource impacts, informed by the professional judgment of qualified agency, Commission, and tribal staff, should ensure that this criterion is reasonably applied."

108: "Various industry commenters recommend that we add a criterion requiring a requester to discuss whether or not a resource problem has been identified that relates to the request.[104] This proposed criterion is too subjective. A principal feature of hydroelectric licensing in recent decades has been disagreements between license applicants and others concerning the extent to which proposed or existing projects have negative effects on natural and other resources. Whether an identified impact is or is not a problem, and the extent of the problem, are often matters of perspective. Moreover the finding of a "problem" is not a required predicate for Commission action under the comprehensive development standard of FPA Section 10(a)(1). Rather, that standard contemplates license conditions for the "protection, mitigation, and enhancement" of fish and wildlife... and for other beneficial public uses, including irrigation, flood control, water supply, and recreational and other resources."

We are concerned that Essex is misapplying Study Criterion No. 5 in its rejection of 12 of the proposed studies, including our own.

We support Essex's goal "to increase efficiencies in how data is collected and analyzed" by combining study requests into single studies. We believe that the objective of CSO interactions study can be achieved by being integrated into a general water quality study such as that proposed by MADEP that includes E.coli and/or enterococci sampling. Additional daily bacteria sampling for the three days following CSO discharges would be sufficient. MRWC would be happy to consult with Essex on different methodologies for how that data could be collected, whether manually or using remote control technology.

Essex has also rejected MADEP's proposed study, using similar justification of its interpretation of Study Criterion No. 5 that we take issue with. MADEP ultimately has 401 certification authority, and the earlier the necessary information is collected, the more efficient this process will be.

It is well established that dams create temperature and sediment sinks and alter in-stream habitats. These conditions impact a variety of different water quality variables, many of which are important to public health. The sections of the river within the Project Area are listed on MA 303 (d) for impairments requiring TMDL for E.coli and PCB in Fish Tissue. These issues are probably exacerbated by the project, via the project's ongoing impact on temperature and sediment regimes and its alteration of habitat conditions for species that provide ecosystem services that improve water quality. There are various ways that operations can be changed to reduce the public risk connected to these impacts. As the project area is both a drinking water source and a regional recreational asset that serves environmental justice communities, it is critical we have a full understanding of the project's water quality impact.

¹ FERC Accession 20030724-3002

MRWC continues to support the aims of the studies requested by FERC, MA DEP, MassWildlife, NHFG, NMFS, USFWS, Groundwork Lawrence and the Nature Conservancy and wishes to see proposals that accomplish those aims in the RSP. This project interacts with federal and state-listed endangered species, a nationally important diadromous fish run, multiple community drinking water sources and resiliency challenges in a federally recognized environmental justice community. It is critical that we have the necessary information to make informed decisions. We look forward to working with all stakeholders to arrive at the best possible outcome.

Thank you for the opportunity to provide comments on the Proposed Study Plan. Please feel free to contact me at 978-655-4742 if you have any questions.

Sincerely,
Matthew Cranney
MA Water Resources Project Manager



New Hampshire Fish and Game Department

11 Hazen Drive, Concord, NH 03301-6500
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Email: info@wildlife.nh.gov

Scott R. Mason
Executive Director

March 12, 2024

Debbie-Anne Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, N.E., Room 1A
Washington, DC 20426

RE: Comments on the Proposed Study Plan for the Lawrence Hydroelectric Project P-2800-054

Dear Secretary Reese:

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. Also, the NHFGD's 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) Has human activities and land uses that are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This letter responds to the Proposed Study Plan (PSP) submitted for the Lawrence Hydroelectric Project (Project) (P-2800-054), located on the Merrimack River in the City of Lawrence, Essex County, Massachusetts. The New Hampshire Fish and Game Department (NHFGD) provided comments on the PSP during the Initial Proposed Study Plan Meetings held on January 4 and 5, 2024.

The NHFGD is a member of the Technical Committee for Anadromous Fishery Management of the Merrimack River Basin (Technical Committee or MRTC). The Technical

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Committee, which consists of representatives from multiple resource agencies including the NHFGD, the National Marine Fisheries Service (NMFS), the Massachusetts Division of Fish and Wildlife (MDFW), the Massachusetts Division of Marine Fisheries (MDMR), and the United States Fish and Wildlife Service (USFWS), is responsible for coordinating migratory fish restoration throughout the Merrimack River watershed.

In consultation with the MRTC, the NHFGD submits the following comments on the PSP for the Lawrence Hydroelectric project.

Thank you for the opportunity to comment. If you have any questions or require additional information, please contact me at michael.a.dionne@wildlife.nh.gov.

Sincerely,



Michael Dionne
Environmental Review Coordinator

cc: Matt Carpenter (NHFGD)
Ken Hogan (USFWS)

Requested Studies Not Adopted

Page 14: Downstream Passage Assessment

Essex proposed to replace the existing trashrack with a “narrow spaced trashrack” designed in consultation of the MRTC. If designed and installed properly, a new narrow spaced trash rack could prevent entrainment and impingement of adult river herring, American Shad, and American Eels, but there are a number of other aspects to downstream passage at the project that remain poorly understood.

Juvenile alosines are able to pass through even $\frac{3}{4}$ ” spaced racks and their survival through the turbines would need to be assessed. There is no information on the proportion of fish that use the fish bypass chute vs. the spillway under different flow conditions for any species, nor has there been any comparison of mortality rates between these two potential routes of downstream passage.

There are three sections of crestgate at the spillway, each of which spills onto a combination of ledge and deeper water. Survival may vary over each crestgate and a downstream passage study is needed to determine crestgate operations protocols that would minimize mortality under a range of tailwater elevations.

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Survival through the fish bypass has also not been studied and the current configuration makes adult river herring and potentially small shad highly vulnerable to predation. There have been multiple observations of striped bass feeding on river herring where the bypass discharges into the tailrace.

Page 14 – 15: Diadromous Fish Behavior, Movement, and Project Interaction Study

Essex did not propose the Diadromous Fish Behavior, Movement, and Project Interaction Study as requested by MADMF, NHFG, NMFS, MassWildlife, and USFWS because it, “would be greatly informed by, and is also largely contingent on, the results of the Three-Dimensional Computational Fluid Dynamics (CFD) Modeling Study.” However, the CFD modelling study (Study 12) proposed in the PSP does not extend beyond the tailrace. A 2D CFD model will need to be extended to the river reach downstream to be useful in interpreting fish movement below the project (See comments under Page 34: Upstream Anadromous Fish Passage Assessment). An acoustic tagging study was done in the Lowell tailrace many years before a CFD modeling study was completed at the project (Alden 2011). The two studies complimented each other well, but the order in which they occurred was not important.

Page 16 – 17: Fish Assemblage Study

Throughout the PSP, Essex uses the proposed run-of-river (ROR) operations to narrowly define the environmental impacts of the project. The wide variety of impacts that dams have on rivers have been well documented (Baxter 1977; Zydlewski et al. 2023). While less impacting than the artificial water level fluctuations associated with hydropeaking, ROR operations do not mitigate for all project effects. Understanding the extent of project effects on sediment transport, water temperature, and species assemblages is important for making license recommendations beyond the proposed ROR operations. ROR implies that the project has no effect on river flows and yet there are many ways in which project operations influence aquatic habitat upstream and downstream of the project. The extent, timing, and rate of drawdown in the impoundment for maintenance activities can cause varying levels of impact to species upstream of the dam. Sudden changes in water level can influence habitat inundation below the project as a result of changes in generation or crestgate operations at the spillway.

Project operations that occur over a limited time frame can have long term impacts on aquatic species even at projects that are primarily operated as ROR. An example of this was recently observed at a ROR project on the Suncook River in New Hampshire, where a drawdown for dam maintenance caused a large amount of sediment to be flushed into the bypass reach downstream of the China Mill Dam. The sediment filled the interstitial spaces between rocks and boulders, which resulted in the local extirpation of Longnose Dace below the project. After the drawdown the sediment was flushed from the bypass reach, leaving no visual evidence of the project’s effect on habitat below the dam. The only evidence of an issue was in the absence of Longnose Dace from the fish assemblage in the bypass reach. The incident could have been avoided by making adjustments in the rate and extent of the drawdown which would have reduced the amount of sediment washed downstream.

Studies such as the proposed fish assemblage study are standard practice for understanding and documenting the environmental impacts of a project. They should not be dismissed as, “looking for a problem”. The fish assemblage study conducted at the Lowell Project can be used to help interpret a study at Essex, but the two projects should not be considered interchangeable. As the first upstream dam in the river, Essex is at a different point

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in the watershed where it is accessible by a number of species more tolerant of brackish water than what would be expected to occur at Lowell. Essex suggests that the presence of MRTC staff at the project implies a, “thorough understanding of the Merrimack River fishery related to the Project.” MRTC staff are typically on site to transport diadromous fish in support of restoration goals throughout the watershed. Recent observations of fish downstream of the project have only occurred in response to issues with fish passage at the site. Occasional observations of fish at the project should not be considered a suitable alternative to a proposed study.

Page 19 – 21: Sturgeon Distribution and Project Interaction Study

Essex references Stantec (2023) as the primary justification for not adopting any of the proposed sturgeon studies. On page 21 of the PSP, Essex states “Stantec (2023) performed an acoustic tagging study with a release of 50 Shortnose Sturgeon below the SR 125 Bridge in Haverhill; only one individual was detected at the I-495 bridge in Lawrence in 2020, and three individuals were detected at the I-495 bridge in Lawrence in 2021. Essex questions the request for the study given this recent multi-year study that indicates that sturgeon are not approaching the Project.” This statement does not take into context the results of the entire report. A side scan sonar survey (SSS) estimated the overwintering population of Shortnose Sturgeon in 2020/2021 at 3,786 individuals and at 3,424 individuals in 2022/2023. Using the average of the two estimates, it may be assumed that a typical overwintering population of Shortnose Sturgeon in the Merrimack River is around 3,605 individuals. The results of the tagging study should be evaluated in the context of this population estimate.

The tagging protocol was not discussed in detail in the methods of the report. All sturgeon available for detection by Stantec (2023) were tagged over a number of years by Micah Kieffer with the United States Geological Survey (USGS). The number of fish with active tags available for detection in the Merrimack River was 38 Shortnose Sturgeon / 27 Atlantic Sturgeon in 2020 and 30 Shortnose Sturgeon / 33 Atlantic Sturgeon in 2021 (personal communication, Micah Kieffer). The total number of active tags for Shortnose Sturgeon during the study period (38 in 2020 and 30 in 2021) represented about 1% of the estimated 3,605 individuals in the overwintering population of Shortnose Sturgeon in the Merrimack River. When the results of Stantec (2023) are viewed in the context of the estimated 3,605 Shortnose Sturgeon in the Merrimack River, then the 4 fish detected at the Interstate 495 Bridge in Lawrence may represent a much larger number of fish that could potentially be interacting with the Essex Project each year.

In 2020 there were a total of 23 out of a possible 38 (60.5%) tagged Shortnose Sturgeon detected at one or more acoustic receivers placed at 3 different bridges along the Merrimack River. Assuming the tagged fish are representative of movement patterns within the population, then 60.5% (2,181 individuals) of the estimated 3,605 sturgeon in the river would be expected to move some distance upstream into the project area. Of the 23 sturgeon tagged in 2020, one (4.3%) was detected at the furthest upstream receiver at river kilometer (RKM) 43.8 (Interstate 495 in Lawrence), which is 2.3 km downstream of the project. If the same percentage (4.3%) is applied to the estimated 2,181 fish out of the population as a whole, then one might assume that 94 Shortnose Sturgeon could potentially have moved upstream beyond the furthest receiver and possibly interacted with the project.

In 2021, 20 of 30 (66.6%) tagged Shortnose Sturgeon were detected in the study area. Using the same logic as above, 66.6% of 3,605 individuals would be an estimated 2,401 fish

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expected to move into the study area. Of the 20 detected sturgeon, 3 (15%) were recorded at the Interstate 495 Bridge in Lawrence. If the same percentage (15%) is applied to the estimated 2,401 fish in the river, then over 360 Shortnose Sturgeon could be assumed to have moved upstream as least as far as the Interstate 495 Bridge in Lawrence in 2021.

On Page 3, Stantec (2023) references previous tagging data collected by USGS, which recorded 12 of 52 (23%) sturgeon detected at the furthest upstream receiver at the time (RKM 38 approximately 5.8 km downstream from the Interstate 495 Bridge in Lawrence). The ratio of tagged Shortnose Sturgeon relative to Atlantic Sturgeon was not specified for the 52 fish. Assuming all 52 fish were Shortnose Sturgeon, then 37 of 52 (71%) sturgeon were detected at least as far upstream as RKM 35. Using the same assumptions as above, 71% of 3,605 fish is 2,560 fish potentially in the study area and 23% of 2,560 is 588 sturgeon that may have moved to an undetermined location upstream of RKM 38.

In reality, there are too many assumptions in the interpretation of the tagging data to rely on the acoustic telemetry component of Stantec (2023) as justification for or against further study of sturgeon downstream of the project. Stantec (2023) did an excellent job of estimating population size using SSS, but the small number of acoustic tags relative to the population estimate makes the study insufficient for drawing conclusions about the extent of upstream sturgeon movement in the river. Sturgeon are a highly mobile species. They have been documented expanding their range into habitat made accessible by dam removal (Wippelhauser et al. 2015). A percentage of the Shortnose Sturgeon detected in the Merrimack River have been detected in the Kennebec River during the spawning season (Micah Kieffer, personal communication). It is not unreasonable to assume that a certain number of sturgeon in the lower Merrimack River may make exploratory trips upstream as far as the Essex Project, especially during the spring spawning season.

Essex references the absence of sturgeon in the fish count data at the Essex fish lift as evidence that sturgeon do not interact with the project, yet the size, location, and design of the Essex fish lift make the facility highly unlikely to pass sturgeon. However, improving passage for sturgeon is not impossible. Modifications made to the Holyoke fish lift on the Connecticut River in 2015 resulted in a significant increase in annual sturgeon passage.

Prior to dam construction on the Merrimack River, the range of Atlantic and Shortnose Sturgeon extended to Amoskeag Falls in New Hampshire (Kynard and Kieffer 2009). The extent to which a highly migratory and endangered population of Shortnose Sturgeon in the lower Merrimack River interacts with the Essex Project, which is known to block access to a large portion of the species' historic range, should be among the topics worth studying before making project license recommendations. There are many logistical challenges to studying sturgeon in the Merrimack River. The question is not whether the studies should be done, but how to best complete the studies in a way that will produce viable results.

Page 30 – 31: Fish Stranding and Ramping Rate Study

Essex provides the following justification for not adopting the field component of the Fish Stranding and Ramping Rate Study: “. . . it is not clear what is considered an operational change that triggers the need for a field survey, and requestors do not identify a seasonal timeframe or geographic extent of the surveys. As requested, the study methods assume fish stranding events would occur under any or all of these conditions even though only two

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stranding events (2019 and 2023) have been identified at the Project. Essex does not believe these extensive surveys would be productive.”

The specific operational change that would trigger a field survey would be a change in crestgate operations or a change in generation that results in a sudden change in habitat inundation in the area below the spillway. The seasonal timeframe would be May and June when migratory fish are most likely to be interacting with the project.

The two stranding events referenced in the PSP appeared to be the result of crestgate operations. In 2019, Sea Lamprey were attracted to the river right corner of the dam while the southern crestgate was spilling. They became stranded when the crestgate was rapidly inflated and spill was cut off. A similar situation appeared to have occurred in 2023, where dead river herring were observed among the rocks after the northern crestgate was closed. 2023 was the first time that NHFGD staff had ever spent any time below the northern end of the spillway, so there is no way of knowing how often stranding events have occurred. The reason that there were only two documented stranding events is not because only two have occurred, but because no one has looked.

It is not clear how a review of operations data would provide any insight into stranding events without pairing the data with observations of water levels, habitat, and fish behavior below the spillway. It is also not clear how the 3D CFD model would be used to inform potential stranding events when the model does not extend beyond the tailrace into the area below the spillway, where stranding is likely to occur.

Page 31 - 32: Recreation Facilities, Use, and Aesthetics Study

The PSP references the recreation study at the Lowell Project (P-2790) as a justification for not incorporating public interviews into the Recreation Facilities, Use, and Aesthetics Study proposed by FERC. Although the Lowell Project and the Lawrence Hydroelectric Project are close in proximity, they are different in many important ways. The speculation that the, “majority of recreationists are local residents walking to work or dog-walking,” ignores the large number of seasonal anglers that fish downstream of the Essex Project from late April through June. The quality of this recreational fishery is heavily impacted by fish passage and operations at the project.

Page 32 – 33 Sea Lamprey in the Upstream Anadromous Fish Passage Assessment

The Sea Lamprey is an ecologically important diadromous fish species which has experienced declines similar to other migratory fish species native to the North Atlantic Ocean (Limburg and Waldman 2009). Despite a negative perception of Sea Lamprey based on detrimental effects of Sea Lamprey on other species where it was introduced in the Great Lakes, there are no known impacts to populations of their host species in the marine environment. Recent studies have revealed an overall positive impact of Sea Lamprey in freshwater as a source of prey, nutrient transport, and habitat modification during nest building (Arakawa and Lampman 2020; Souza et al. 2012; Weaver et al. 2015).

With the shift in emphasis toward ecological based river restoration goals including a multi-species focus, there is no clear justification for not including Sea Lamprey in upstream fish

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passage effectiveness studies at hydropower projects. Studies that have been done suggest that passage efficiency for Sea Lamprey is highly variable and site specific (Peterson et al. 2023). Essex provides no evidence to support the statement that, “Sea Lamprey tend to pass using upstream passage structures designed for alosines and Essex believes the study as proposed is sufficient to understanding sea lamprey at the Project.”

Given the challenges with obtaining fish that will be capable of navigating the upstream fish passage facilities at Essex, Sea Lamprey may present an opportunity to tag fish, in addition to American Shad, that will provide data on internal passage efficiency of the fish lift. The difference in swimming capabilities between the two species may provide valuable insight when designing improvements to upstream fish passage at the site. The potential advantages of tagging Sea Lamprey in terms of access and feasibility should be considered in the design of the upstream fish passage study for the project.

Adopted Studies

Page 34: Upstream Anadromous Fish Passage Assessment

The presence of striped bass in the tailrace, referenced on page 36 of the PSP, is the primary factor to consider for the river herring component in the study design of the proposed upstream passage evaluation. In response to striped bass predation, river herring passage at the project is typically restricted to the morning and evening hours with most successful passage occurring in the first few days of the season. This is despite large numbers of herring observed in the tailrace for 3 to 4 weeks each year starting at the beginning of May. Further upstream where there are no striped bass below the Amoskeag Fishway, the same fish that passed Essex move upstream at all hours of the day and migration takes place over a period of weeks rather than a few days. In recent years, increasing numbers of striped bass observed in the tailrace have reduced river herring passage numbers to the point that is impacting the achievement of the restoration goals outlined in the Merrimack River Comprehensive Plan (MRTC 2021).

Visual observations downstream of the project suggest that there are at least two areas of river herring congregation below the dam. One is along the river right bank, around the corner from the tailrace just below the Broadway Street Bridge (Area 1). The other is just downstream from the spillway on the river left bank (Area 2). Large schools of herring were observed at both locations in the spring of 2023 with a steady stream of herring moving upstream along both banks into these two congregation areas. River herring in Area 1 were observed entering the tailrace along the vertical ledges on river right. As they move upstream along the ledges they are attacked by striped bass, which are able to easily harass the herring from the deeper water of the tailrace. As the river herring approach the dam, they become disoriented by the upwelling flow from the turbines, which disrupts their schooling behavior and makes them more vulnerable to striped bass predation. The combination of confusing turbine outflow with the presence of large numbers of striped bass appears to make it extremely difficult for river herring to approach the entrance of the fishway, which requires navigating the deeper water of the tailrace. Signs of predation throughout the tailrace have been observed multiple times per day during the herring run for a number of years, but striped bass numbers in the tailrace appear to have increased significantly in the last 2 years. Understanding river herring movement in relation to striped bass

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movement under different flow conditions and project operations will be critical for designing an effective upstream passage solution.

Due to the complicated nature of the fish passage issues at the project, the methods proposed in the Upstream Anadromous Fish Passage Assessment will likely not achieve the goals and objectives listed in the PSP.

Goal 1: Determine approach of upstream migrants from the downstream release location towards the Project fishway under a range of operational/river conditions.

The stationary radio telemetry receiver placement detailed in Figure 6-1 and Figure 6-2 would provide a general understanding of how many tagged fish reach the area just below the project, but it will not provide information on fish movement at the scale needed to inform recommendations for improving upstream passage. The route that fish take as they approach the project could be influenced by the way spill is divided between the three crestgate sections, the amount of water flowing through the tailrace vs. the spillway, turbine operations, and/or the status of fishway attraction flows. These factors could affect fish movement at least as far downstream as the Parker Street Bridge, where there is no proposed receiver. The proposed study should be designed to try to answer the following types of questions related to how river herring approach the project:

- Do certain spill scenarios cause river herring to move up the river left bank to Area 2 below the spillway?
- Will the fish in Area 2 eventually move across the spillway and try to enter the tailrace near the old fishway or will they move back downstream and approach the tailrace from Area 1? Is their movement influenced by different spill conditions?
- What is the relative success rate of fish that approach the tailrace from different angles?
- Do all fish eventually enter the tailrace or will some fish get attracted to spillway flow and never attempt to find the fishway entrance?
- What is the relationship between river herring and striped bass movement as river herring approach the project?
- Is there a difference in flow dynamics between areas where river herring spend more or less time below the project?

As proposed the arrangement of telemetry receivers does not provide the level of detail required to interpret how fish approach the project. Much more information is needed on the movement of fish downstream of Station 4 as well as between Station 4 and Station 3. Even if more receivers were added, issues with interpreting signal strength and interference from multiple tag signals can make radio telemetry an inadequate method for answering questions about approach, especially in confined areas like the Essex Project tailrace. It will also be difficult to interpret tags from herring that have been consumed by striped bass. Presumably, these tags would not only provide false information on herring movement, but potentially accumulate in the tailrace as more herring are consumed over the course of the season.

Whether the tagged river herring are delayed by predatory behavior or consumed directly by striped bass, large accumulations of radio tags below the project could lead to issues due to collisions among tag signals, as discussed on page 36 of the PSP. The strategy of tagging fish in small groups would be effective if fish were able to move through the project at a steady rate, but the expected bottleneck below the project would likely cause a build-up of tags below the project over the course of the season. At a certain point, issues with tag collision will make it difficult to
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interpret behavioral data using the methods outlined on page 37 of the PSP: “. . . behavioral data collected in this study (i.e., duration at a specific location or passage route) will be inferred based on the signal strength and the duration and pattern of contacts documented across the detection array.”

Goal 2: Determine tailrace residence duration of upstream migrants following arrival downstream of the Project.

Large numbers of striped bass in the tailrace combined with deep water, no cover, and turbulent discharge from the turbines make the tailrace a very difficult place for river herring to spend time. It will be important to capture the residence time of river herring in Area 1 and Area 2, as well as other potential areas in the river downstream. Comparing residence time of river herring in the river downstream of the project with residence time in the tailrace is an important aspect of the study that will not be possible using the proposed methodology. The position of the receivers, as proposed, would not provide any data on the movement of fish downstream of the Broadway Bridge or at the downstream edge of the tailrace, where fish have been most frequently observed. In addition, tagged river herring consumed by striped bass will potentially confound the interpretation of river herring movement downstream of the project. Any uncertainty around whether the data represents a live river herring or the movement of a Striped Bass that consumed it will undermine confidence in the results of the study.

Goal 3: Estimate the nearfield attraction efficiency, entrance efficiency, internal efficiency, and overall efficiency of the existing upstream fish lift under a range of operational/river conditions and with both entrances in the open position.

Goal 4: Inform on fish lift entry (i.e., frequency, timing, and location of entry events).

Starting in 2012, the NHFGD and USFWS significantly increased their stocking effort in support of river herring restoration in the Merrimack River watershed. An average of 35,670 river herring were stocked annually into suitable spawning habitat upstream of the Essex Dam between 2012 and 2019. Four years after stocking numbers increased, the average number of river herring counted at the Essex fishway also increased to an average annual count of 260,452 from 2016 to 2021. In the 10 years prior to 2016, the average annual river herring count at the Essex Dam was 19,381. In 2022 and 2023, the river herring count at Essex dropped significantly compared with previous years to 50,535 and 6,129 respectively. This drop in passage numbers coincided with observations of large numbers striped bass in the tailrace where they were seen preying on very large schools of river herring as they attempted to reach the fishway entrance.

Assuming the population of river herring still measures in the hundreds of thousands, which seems likely based on the size of the river herring schools observed in the river downstream of the project, then a tagging effort of 185 river herring would be unlikely to generate enough entries into the fish lift to allow for the estimate of efficiency described in Goal 3 or the collection of fish lift entry data described in Goal 4. Assuming a population of 260,452 river herring below the project, based on the average annual count from 2016 to 2021, then the estimated percentage of fish that successfully passed upstream would have been 19% in 2022 and 2% in 2023. If these passage rates were applied to the proposed sample number of 185 tagged river herring then one would expect 35 tagged river herring to have successfully moved through the fishway in 2022 and 4 tagged river herring in 2023. These are rough estimates intended to illustrate the point that relying on tagged river herring for an estimate of fish lift passage efficiency would be unlikely to achieve the goals outlined in the PSP. The situation is

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further complicated by the typical timing of successful passage, which usually occurs over a very short period in early May. River herring tagged later in the season would be extremely unlikely to reach the fishway based on historical count data combined with on-site observations by NHFGD and USFWS staff.

The proposed Upstream Anadromous Fish Passage Assessment study will need to incorporate the following components to provide the information needed to make passage improvement recommendations for river herring:

- A tagging technology and methodology that allows for fine scale interpretation of river herring and striped bass movement in the tailrace, below the spillway, and in the river reach downstream of the Broadway Street Bridge.
- A way of accounting for tagged fish that get consumed by striped bass.
- A sample size that will be representative of the large number of river herring that have been observed below the project.

Although the Upstream Anadromous Fish Passage Assessment, as proposed, would not likely yield meaningful results for assessing river herring passage at the project, it may be an appropriate method for assessing American Shad. As discussed on page 36 of the PSP, striped bass predation appears to have less of an influence on American Shad as they approach the project and attempt to enter the fishway. The number, location, and direction of stationary receivers would need to be discussed as the proposed configuration would not provide enough information on the influence of spillway crestgate operations on shad movement as well as the residence time in the tailrace vs. the area below the spillway. The number of tags should also be discussed to ensure the statistical power of the study especially since the 185 radio tags proposed for the river herring would not likely be effective for assessing the passage efficiency of the fishway (Refer to MA Division of Marine Fisheries comments on the Lawrence PSP). Essex should also consider tagging Sea Lamprey (refer to comments under Page 32 – 33: Sea Lamprey in the Upstream Anadromous Fish Passage Assessment) in the study to provide additional information on passage efficiency at the project with another important anadromous fish species that does not appear to be influenced by Striped Bass predation. The radio telemetry study methodology would not provide shad movement at a level of detail that would be necessary to interpret shad behavior in relation to the fishway entrance, which was a useful component of the shad study conducted at Lowell (Alden 2011).

Page 50 – 51: Upstream American Eel Passage Assessment

The pit tag methodology seems promising, but there should be a back-up plan in case the eels captured at the project are too small to tag. Measurements of eels collected at the project by USFWS and NHFGD staff in the summer of 2015 found that 97% of the eels captured in the south eel ladder were less than 100mm in length. A modification of the VIE tagging method proposed for the Collection Tank Retention Evaluation could be an alternative for evaluating passage efficiency if the pit tags prove to be too large.

Page 56: American Eel Upstream Passage Siting Study

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Some justification is needed as to why the discharge of the South Canal was not proposed as a site for visual surveys. A picture of the outlet would be helpful.

In addition to CPUE, the inclusion of length/weight data, as opposed to grouping eels into size classes, would allow for comparison with over 10 years of American Eel data collected at sites throughout the Merrimack River watershed in New Hampshire. If the sample size is very large, then a representative subset should be measured and weighed. Holding captured eels in ice water is an effective means of immobilization which will facilitate the measuring process.

Page 59 – 61: Project Operations and Fish Stranding Study

Neither the Operational Data Review, as proposed, nor the 3D CFD modelling study will provide the information needed to identify potential stranding events. The proposed 3D CFD model does not cover the area below the spillway, where stranding is most likely to occur. A 2D model that extends across the spillway and into the river reach downstream may provide information on flow fields at different tailwater elevations, but field observations will likely be needed to document conditions that may cause stranding (refer to comments under Page 79 – 83: Three-Dimensional Computational Fluid Dynamics (CFD) Modeling).

The manner in which flow is divided between the three crestgate sections along with the rate of inflation/deflation of each section influences the way that fish interact with the project below the spillway. Although crestgate operations are listed among the operational data to be reviewed, it does not specify whether this data is available in a level of detail that would be useful for guiding management recommendations. The rate of crestgate inflation/deflation is a critical component of the study and it is not clear whether this type of data has been recorded. It is unlikely that reviewing operational data during two stranding events will capture all of the operational scenarios that may result in stranding.

In general, crestgate operations at the project are poorly understood as they relate to attraction flows, downstream survival, and potential fish stranding issues. Despite being one of the major aspects of the project that is within operational control, none of the proposed studies provide enough information related to crestgate operations to inform the development of license requirements. Ideally, the three crestgates should be operated in a way that 1) maximizes attraction to the fishway, 2) minimizes mortality during downstream migration, and 3) avoids stranding fish. The results of an upstream passage study, downstream passage study, and fish stranding study should be used to weigh the positives and negatives of different crestgate operational scenarios as they relate to the above three goals.

An alternative to the methodology proposed by Essex in their Project Operations and Fish Stranding Study could also incorporate a two phased approach. Phase 1 would involve deliberately manipulating the crestgates and observing the changes in habitat inundation at the south and north ends of the spillway. Different ramping rates could be applied to identify a crestgate inflation rate that may allow fish to escape the area before they become trapped. This could be done outside of the fish passage season so that rapid changes in the location of spill over the spillway does not interfere with the upstream passage season. Phase 2 could apply lessons learned from Phase 1 during the upstream fish passage season (May and June). Observations of the area below the spillway could be made before and after any operational shift that causes a change in habitat inundation below the spillway. Any stranding events could be recorded and then tied directly to a specific operational scenario.

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Page 79 – 83: Three-Dimensional Computational Fluid Dynamics (CFD) Modeling

A number of studies reference using the CFD model to aid in the interpretation of results. However, the CFD model, as proposed, does not extend downstream beyond the tailrace. To be useful in interpreting the results of multiple studies, a 2-dimensional (2D) flow model will need to be extended to an agreed upon point downstream. This is similar to what was done in the Lowell Project (P-2790) bypass reach. The results of the 2D model in the Lowell bypass was used to help inform the proposed upstream passage approach at the project.

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United States Department of the Interior



NATIONAL PARK SERVICE
NORTHEAST REGION
15 State Street
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March 11, 2024

Debbie-Anne Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

RE: Comments on Proposed Study Plan for the Lawrence Hydroelectric Project P-2800-054

Dear Acting Secretary Reese:

The National Park Service (NPS) offers the following comments on the Essex Company, LLC's (Essex) Proposed Study Plan (PSP) filed November 28, 2023 for the relicensing of the Lawrence Hydroelectric Project (Project; P-2800-054). The Project is located on the Merrimack River in in the City of Lawrence, Essex County, Massachusetts. Essex held a proposed study plan meeting on January 4 and 5, 2024.

The (NPS) filed 2 study requests consistent with the content required in the Commission's regulations at 18 CFR 5.9(b), 1) Recreation, Land Use and Aesthetic Resources Study, and 2) Water Level and Flow Effects on Historic Resources. In response, Essex proposed a combination of those studies: Recreation Facilities, Use, and Aesthetics Study; Historically Significant Waterpower Equipment Study; and Condition Assessment of Historic Properties and Associated Canal System.

NPS staff attended the PSP meetings held on January 4 and 5, 2024 to discuss studies both proposed and excluded. In response to the suggestion of a number of RAs, NGOs and representatives of the host communities, Essex agreed to hold working group meetings to discuss and further develop the PSP. However, only one meeting was held to present the recreation plan to a limited group of interested parties.

Recreation Study

NPS and other stakeholders had requested that Essex conduct visitor use surveys and filed interviews as part of any recreation study to be conducted. Although Essex has proposed to conduct a Recreation Facilities, Use, and Aesthetics Study, they have not proposed to conduct such critical on-site work. FERC's comments on the PSP dated March 8, 2024, make note of this critical omission in the PSP:

“In section 4.13, *Requested Studies Not Adopted – Recreation Facilities, Use, and Aesthetics Study*, Essex does not propose to conduct visitor use surveys or personal interviews at project and non-project sites during peak recreation season. However, without this information, we may not be able to accurately

quantify current recreational use or evaluate the adequacy of existing recreational facilities to meet current and future recreational needs in the NEPA document.

Therefore, we recommend that the RSP identify the proposed methods and procedures that would be used to quantify visitors' use, needs, and experiences at project and non-project recreational facilities. In addition, we recommend identification of public and stakeholder attitudes toward conditions and a discussion on the need for improvements of project recreational facilities and adjacent Essex-owned lands. Staff continues to recommend that Essex develop an interview/survey questionnaire to gather visitor use data that would request the following information, at a minimum: (1) age group; (2) local resident or visitor; (3) distance traveled/home zip code; (4) purpose and duration of visit; (5) day use or overnight lodging; (6) frequency or history of visiting the site or area; (7) types of recreational activities respondents participated in or plan to participate in during their visit, including primary and secondary recreation activities; (8) types of recreational equipment respondents brought or transported with them during their visit; (9) reasons for choosing the site or area; (10) other recreational sites that respondents visited or intend to visit during their trip; and (11) if there any areas of concern regarding vegetation growth on historic canal walls and trash.”

The NPS agrees with this conclusion and the recommendations listed; this degree of detailed information is needed for FERC to have adequate information upon which to base its licensing decision. Regardless of the amount of information gathered through any desktop evaluation, and publicly available studies, reports and plans, there is simply no substitute for gathering on site information from actual users. The area surrounding the project has seen considerable renewal in recent years, with literally hundreds of new residential units having been developed in existing mill and associated buildings. Along with that development, there are new restaurants and other business establishments, including new recreational amenities beyond simply areas to walk in and around the mill buildings.

As stated in our Study Request for a Recreation, Land Use, and Aesthetic Resources Study, NPS listed 8 elements that should be evaluated. We reiterate the need to include all these elements in Essex's proposed recreation-based study.

FERC also noted a deficiency in section 13.6.2, *Field Inventory*, where Essex omitted to include a comprehensive condition assessment of all recreational facilities associated with the project. NPS concurs with FERC recommendation to “describe how the current condition of each existing project and non-project recreational facility will be assessed and documented.” including georeferenced photos and written documentation.

The NPS concurs with the proposal of Groundwork Lawrence's March 11, 2024 PSP comments to evaluate recreational use and pedestrian connection opportunities above the dam and along the length of the canals, including “incorporating a public connection at the end of the north canal at the lower locks by integrating a shared use path into the project's existing infrastructure.”

Vegetation and Trash Management

NPS requested a Vegetation and Aquatic Trash Management Study. As part of their proposed recreation study Essex has proposed to look at vegetation in context of identifying where in the system there's growth on historic canal walls and concentrated trash. This work is part of their existing license requirements and therefore, needs to be evaluated in context of condition assessment and deferred maintenance; it is not really a study or part of recreation evaluation. Although Essex is currently doing vegetation clearing, there has not been any consistent plan for vegetation management.

Historically Significant Waterpower Equipment

NPS also requested a Historically Significant Waterpower Equipment Study to determine the effect of flows and water levels on historic resources. Essex proposed to photo document equipment 50 years or older and to retain an architectural historian. Their the documentation should also include an evaluation of their condition, ongoing deterioration and identifying methods to mitigate, abate and remedy those conditions. In addition to the equipment, the buildings and structures which house are multiple structures and systems that are part of the historic fabric of the whole system, which needs to be evaluated in its entirety not just as pieces related to specific hydro operations. Although only portions of the larger system are under the control of Patriot, but important to document that as well as it's part of the larger system. All historic hydro equipment should be identified.

Essex proposed to conduct a Condition Assessment of Hist Properties and Canal System; however, this is part of their responsibility under the existing license; a plan for protection and preservation going forward should be part of the application, not simply an evaluation of what there and what condition its in. Elements of Essex's proposed Condition Assessment should be combined with NPS' requested Historically Significant Waterpower Equipment Study. What's out there and its condition, and how does that impact project operations, identification of historic photos and drawings is also necessary, and a desktop study won't capture most of that important information.

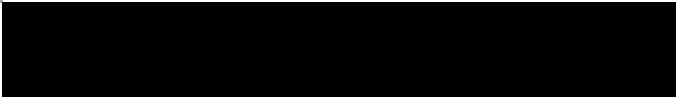



Essex is not proposing to compile a condition assessment on the actual canal walls, so it is unclear how will they determine the long-term stability and viability of the canals. Essex's maintenance program is barely a triage process. Decades of deferred maintenance must be addressed outside the context of mitigation. Any condition assessment must include a canal assessment. Project operations lower water levels which impacts the underlying condition and subsequently project operations.

The NPS looks forward to working with the applicant and other stakeholders during the relicensing process. Please contact me with any questions at kevin_mendik@nps.gov or by phone at 617-320-3496. Duncan Hay is also available to answer any technical questions related to the facilities and canal history.

Regards,



Kevin Mendik
NPS Northeast Region Hydro Program Coordinator.



Appendix B – Essex Response to Comments on the PSP

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
Federal Agencies			
FERC (March 8, 2024)	Upstream Anadromous Fish Passage Assessment	<p>In section 6.6.1, Sample Size, Essex states that telemetry studies must consider multiple factors, including handling and transportation effects, fish condition, and regurgitation of transmitters, as well as site-specific factors, such as fallback rates and predation, when determining sample sizes to meet study objectives. Essex proposes to tag a total of 185 adult river herring and 165 adult American shad so that at least 100 radio-tagged individuals of each species reach the near field attraction zone of the Lawrence Project's upstream fishway after accounting for losses due to fallback and predation.</p> <p>During the proposed study plan meeting, false attraction to the spillway and potential flow barriers in the tailrace were identified as additional site-specific factors that may require consideration when determining sample size to ensure that data from enough tagged fish is collected to meet study objectives. Failure to account for site-specific characteristics in the study design may result in failure to satisfy the study objectives. Therefore, please clarify in the Revised Study Plan (RSP) why these additional site-specific factors were not included in the sample size calculation.</p>	Essex conducted a minimum size sample analysis as provided for in Section 6.6.1 of this RSP. This method considers fallback rates and predation, as well as population passage rates based on the literature, margin of error, and confidence level. Using that targeted minimum and the methodology to adjust due to predation and fallback rates, HDR, on behalf of Essex, produced the initial sample size of shad to be tagged.
FERC (March 8, 2024)	Upstream Anadromous Fish Passage Assessment	<p>In section 6.6.3, Radio Telemetry Monitoring Stations, Essex proposes installing 10 monitoring stations to meet study objectives. During the proposed study plan meeting, additional monitoring stations were discussed that would improve the likelihood of meeting study objectives. Examples of these discussions included adding a monitoring station between receiver 3 and 4 to examine nearfield attraction to the upstream fishway, splitting station 3 to examine the proportions of alosines that move along each riverbank while approaching the project, and adding additional monitoring stations in the forebay to determine forebay residence time. At the meeting, Essex agreed to make modifications to the number of monitoring stations to accommodate these requests. In the RSP, please provide additional information on the locations of these newly proposed monitoring stations and how these new monitoring stations will improve the likelihood of meeting the study objectives.</p>	<p>On March 28, 2024 and April 1, 2024, Essex held calls with the MRTC to discuss the Upstream Anadromous Fish Passage Assessment. Among the items discussed was the inclusion of additional monitoring stations as part of the Upstream Anadromous Fish Passage Assessment. As added to Section 6.6.3 of this RSP, Essex added Station 4 to better detect passage at the lower portion of the downstream tailrace below the powerhouse, and Station 11 to provide detection information for radio-tagged fish having exited the upstream exit flume of the Lawrence fish lift and moved into the Project forebay. Station 12 was added to inform on radio-tagged individuals which have exited the upstream exit flume of the Lawrence fish lift and moved upstream to the point where they are exiting from the powerhouse forebay. In addition, Station 14 will be the furthest upstream location monitored for radio-tagged test fish and will be installed along the mainstem of the Merrimack River at a point between Station 13 and the Lowell Project.</p> <p>Where appropriate, Essex will capture fish behavior in the Diadromous Fish Behavior, Movement, and Project Interaction Study, which has been provided in Section 11 of this RSP.</p>
FERC (March 8, 2024)	Recreation Facilities, Use, and Aesthetics Study	<p>In section 13.6.1, Literature Review, Essex proposes to conduct a literature review to identify and describe recreational uses in the project area. Essex also proposes to issue a data request to interested stakeholders to obtain relevant documentation or applicable guidance documents for inclusion in the literature review. To ensure the literature review covers all publicly available information, we recommend that you include (list) of documents and surveys in the Literature Review.</p>	Essex has updated the Recreation Facilities, Use, and Aesthetics Study Plan in response to this comment. See Section 16.
FERC (March 8, 2024)	Recreation Facilities, Use, and Aesthetics Study	<p>Also, in the RSP, we recommend that you expand the reach of your data request to include additional stakeholders with public recreation and conservation land and recreational facilities within and adjacent to the project boundary, including the following stakeholders: the Town of Andover, Massachusetts; Andover Trails Committee, Inc.; and the Andover Village Improvement Society.</p>	Essex has updated the Recreation Facilities, Use, and Aesthetics Study Plan in response to this comment. See Section 16.
FERC (March 8, 2024)	Recreation Facilities, Use, and Aesthetics Study	<p>In section 13.6.2, Field Inventory, Essex proposes to conduct a field inventory to document existing project and non-project recreational facilities within or adjacent to the project boundary. Essex also includes a list of relevant and applicable information to be collected at each project and non-project recreation facility including a description of the recreation type and location, property ownership, recreational use and capacity, and georeferenced photographs. The proposed study, however, does not indicate whether the condition of each facility will be assessed, evaluated, and recorded.</p> <p>At the January 4, 2024, study plan meeting, Essex stated that it would assess the condition of each project and non-project recreational facility as part of the study. Therefore, we recommend that the RSP describe how the current condition of each existing project and non-project recreational facility will be assessed and documented. Staff recommends that the current condition of each site be documented with a written description and georeferenced photographs.</p>	Essex has updated the Recreation Facilities, Use, and Aesthetics Study Plan in response to this comment. See Section 16.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
FERC (March 8, 2024)	Recreation Facilities, Use, and Aesthetics Study	<p>In section 13.6.3, Visual Survey for Vegetation and Waterborne Trash, Essex proposes to conduct a single visual survey of the North Canal and South Canal to document vegetation and waterborne trash within the study area. Essex proposes to complete this single survey for vegetation and waterborne trash at the end of the growing season (e.g., August/September); however, a single survey for vegetation and waterborne trash conducted during the end of the vegetative growing season may provide only a limited understanding of the presence and effects of vegetation and waterborne trash within the North and South Canals. Adding additional survey days would improve the understanding of where and when vegetative growth and waterborne trash contribute to diminishing visual aesthetics.</p> <p>Staff recommends that the RSP add, at a minimum, two additional survey dates for vegetation surveys throughout the growing season, including one survey date during the middle of Spring (e.g., mid-May) and another survey date during the height of the growing season in early summer (e.g., late June or early July) for a total of three vegetation survey dates. Staff also recommends including one additional survey date for waterborne trash during, or a close as possible to, the height of the spring runoff, typically in April or May.</p>	Essex has updated the Recreation Facilities, Use, and Aesthetics Study Plan in response to this comment. See Section 16.
FERC (March 8, 2024)	Recreation Facilities, Use, and Aesthetics Study	<p>In section 4.13, Requested Studies Not Adopted – Recreation Facilities, Use, and Aesthetics Study, Essex does not propose to conduct visitor use surveys or personal interviews at project and non-project sites during peak recreation season. However, without this information, we may not be able to accurately quantify current recreational use or evaluate the adequacy of existing recreational facilities to meet current and future recreational needs in the NEPA document.</p> <p>Therefore, we recommend that the RSP identify the proposed methods and procedures that would be used to quantify visitors' use, needs, and experiences at project and non-project recreational facilities. In addition, we recommend identification of public and stakeholder attitudes toward conditions and a discussion on the need for improvements of project recreational facilities and adjacent Essex-owned lands. Staff continues to recommend that Essex develop an interview/survey questionnaire to gather visitor use data that would request the following information, at a minimum: (1) age group; (2) local resident or visitor; (3) distance traveled/home zip code; (4) purpose and duration of visit; (5) day use or overnight lodging; (6) frequency or history of visiting the site or area; (7) types of recreational activities respondents participated in or plan to participate in during their visit, including primary and secondary recreation activities; (8) types of recreational equipment respondents brought or transported with them during their visit; (9) reasons for choosing the site or area; (10) other recreational sites that respondents visited or intend to visit during their trip; and (11) if there any areas of concern regarding vegetation growth on historic canal walls and trash.</p>	Essex has updated the Recreation Facilities, Use, and Aesthetics Study Plan in response to this comment. See Section 16.
FERC (March 8, 2024)	Desktop Entrainment, Impingement, and Turbine Passage Survival Study	<p>Section 4.2.1 of Commission staff's November 28, 2023 Scoping Document 2 identified the effects of project operation and maintenance on fish impingement and turbine entrainment as a resource issue that would be addressed in Commission staff's National Environmental Policy Act (NEPA)3 document. In Commission staff's October 13, 2023 letter requesting additional information on the Pre-Application Document and additional study requests, staff requested that Essex complete a Desktop Entrainment, Impingement, and Survival Study to assess impingement and entrainment risk and to provide estimates of passage survival for emigrating diadromous species (i.e., adult and juvenile alosines, and adult American eel) through the project's two horizontal, Kaplan bulb turbines. In the PSP cover letter, Essex states that it does not propose to conduct the Desktop Entrainment, Impingement, and Turbine Passage Survival Study, but instead proposes to develop protection, mitigation, and enhancement (PM&E) measures to limit or prevent fish entrainment through the project turbines.</p> <p>Section 5.18(b)(5)(ii)(B) of the Commission's regulations requires Essex to provide sufficient information in any license application to analyze issues, including but not limited to, those identified during the scoping process, that will need to be addressed in the NEPA document. As stated in Commission staff's study request, there is insufficient information on entrainment or impingement potential at the project to adequately assess, pursuant to sections 4(e) and 10(a) of the Federal Power Act, potential project effects to migratory fish species and the benefits and costs of any PM&E measures Essex, or other entities, may propose. Therefore, we recommend a Desktop Entrainment, Impingement, and Turbine Passage Survival Study.</p>	As provided for in Section 9 of this RSP, Essex is proposing the Desktop Entrainment, Impingement, and Turbine Passage Survival Study.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
FERC (March 8, 2024)	Downstream American Eel Passage Assessment, Juvenile Alosine Downstream Passage Assessment, and Upstream and Downstream Adult Alosine Passage Assessment	<p>Section 4.2.1 of Scoping Document 2 identified the effects of project operation and maintenance on the passage of migratory fish species as a resource issue that would be addressed in the NEPA document. In Commission staff's October 13, 2023 letter, we requested studies to evaluate the effects of the project on migrating adult American eels (i.e., Downstream American Eel Passage Assessment), juvenile alosines (i.e., Juvenile Alosine Downstream Passage Assessment), and adult alosines (i.e., Upstream and Downstream Adult Alosine Passage Assessment). To determine if project operation negatively impacts survival and production of these species, the goals of Commission staff's requested studies are to assess: (1) passage survival through the existing downstream fish passage facility, the North and South Canals, and/or spill; (2) route selection; and (3) potential for passage delays.</p> <p>In the proposed study plan cover letter, Essex states that it does not propose to conduct any downstream fish passage studies because its proposed future PM&E measures will mitigate fish entrainment through the project turbines. Instead, Essex proposes to evaluate survival through the existing downstream fish passage facility at a later date. While Essex proposes to evaluate survival through one passage route (i.e., the existing downstream fish passage facility), Essex does not propose to evaluate survival through the other potential downstream routes available to migratory fish that were identified in Commission staff's study requests (i.e., the North and South Canals, spill over the project dam, and the project turbines). In addition, Essex does not propose to evaluate downstream passage route selection, potential for passage delay, and passage efficiency, which Commission staff need to assess potential project effects to migratory fish species and any proposed, recommended, or required fish passage enhancement measures.</p> <p>Section 5.18(b)(5)(ii)(B) of the Commission's regulations requires Essex to provide sufficient information in any license application to analyze issues, including, but not limited to, those identified during the scoping process that will need to be addressed in the NEPA document. As stated in Commission staff's study request, there is insufficient information on downstream fish passage survival, route selection, and passage delay at the project to adequately assess, pursuant to sections 4(e) and 10(a) of the Federal Power Act, potential project effects to migratory fish species or the effects of any PM&E measures Essex, or other entities, may propose. Therefore, we recommend the Downstream American Eel Passage Assessment, Juvenile Alosine Downstream Passage Assessment, and Upstream and Downstream Adult Alosine Passage Assessment studies.</p>	<p>In review of existing information and study requests, Essex anticipates providing proposed protection, mitigation, and enhancement measures (PM&Es) to limit or prevent fish entrainment through the Project's turbines. In particular, Essex is proposing to develop, in consultation with the MRTC, a narrow-spaced trashrack design to replace the existing trashrack system. Essex believes this proposal for a PM&E measure to screen the Project's intake would greatly inform the new Project proposal and would likely result in reduced study costs. Essex understands that while fish entrainment during downstream passage may be mitigated by this PM&E, the existing downstream fish bypass survival for emigrating diadromous species (i.e., adult and juvenile alosines and adult American eel) will need evaluation at a later date. As noted by the Commission in their October 13, 2023 letter, Essex will consult with the MRTC regarding this PM&E and provide details of PM&E proposals within the Draft License Application (DLA).</p> <p>Given that Essex is proposing PM&E measures related to fish entrainment and passage, Essex is not proposing to perform the Downstream Fish Passage Assessments for diadromous species. Alternatively, Essex is proposing to perform the Desktop Entrainment, Impingement, and Turbine Passage Survival Study (See Section 9). Essex also believes that existing information is sufficient for evaluation of fish survival, delay and route selection for emigrating diadromous species. Normandeau Associates, on behalf of Essex, performed a Downstream American Eel Passage Assessment at the Lawrence Hydroelectric Project in 2019, and an Evaluation of Adult Alosine Downstream Passage Effectiveness in 2020. An overview of the results of these studies is provided in Appendix C. Essex intends to file these two reports in their entirety with the Commission prior to the issuance of the SPD. These studies were performed proactively in conjunction with other studies and are "new" studies to the Commission and relicensing participants. Essex believes that existing information used along with the proposed Desktop Entrainment, Impingement, and Turbine Passage Survival Study, and the proposed PM&E measures, are sufficient for the Commission's Environmental Analysis.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NMFS (March 8, 2024)	Diadromous Fish Behavior, Movement, and Project Interaction Study	<p>Essex indicated in the introduction of Section 4 of the PSP that they were not proposing the Diadromous Fish Behavior, Movement, and Project Interaction Study “at this time”, but did state that they recognize the importance of the goals of the study to assess migratory fish behavior in and around the Lawrence tailrace. While Essex did not propose this study, they also did not include it as a sub-section with the other studies not adopted where justification was presented related to FERC’s study criteria guidelines, instead noting they “anticipate developing the details of this study in consultation with the MRTC at a [unspecified] more appropriate time.” This leaves the study in an uncertain position where it has been neither proposed nor formally not adopted with supporting justification. Essex did opine that they feel this study would be “greatly informed by, and is also largely contingent on, the results of the Three-Dimensional Computational Fluid Dynamics (CFD) Modeling Study.” We do not share this opinion and it is unclear from the information provided in the PSP why Essex feels the CFD results are needed to inform the Diadromous Fish Behavior, Movement, and Project Interaction Study, or in what way(s) the latter would be largely contingent on the former. The CFD and Diadromous Fish Behavior, Movement, and Project Interaction Study are fully-separate analyses that do not share goals or methodology.</p> <p>Nonetheless, if Essex still feels strongly that the CFD results are needed in advance of this study, there remains sufficient time to prioritize that analysis and have it completed well before the field studies which are anticipated to occur during the 2025 passage season. This leaves nearly 12 months from the study plan determination in April 2024 to complete the CFD analysis and have results in hand for the 2025 study season.</p> <p><i>Study Methodology</i></p> <p>Paragraph 4 of Section 4 (page 15) of Essex’s PSP incorrectly states that our requested Diadromous Fish Behavior, Movement, and Project Interaction Study recommends both two-dimensional and three-dimensional acoustic tracking of migratory species. In fact, our request is not prescriptive of acoustic or radio telemetry, this flexibility in methodology was intentional and was included to allow Essex some latitude with approach and to facilitate synergy with other requested studies. Notwithstanding, we agree that 3D acoustic telemetry would provide the most useful data and is our preferred approach to this study. Similar studies were conducted at the upstream Lowell Hydroelectric Project⁹ over a decade ago which provided excellent behavioral data for American shad in the tailrace (Alden 2011; Blue Leaf Environmental and Alden 2013). With advances in telemetry technology over the past decade, we see no reason why this study requested at Lawrence cannot produce comparable, if not better data than the Lowell behavioral studies.</p> <p>We provide the following recommendations that should be considered to determine the appropriate type and number of tags to deliver the data we seek. A successful study plan should incorporate:</p> <ul style="list-style-type: none"> • A telemetry technology/system that will allow for many fish to simultaneously occupy the study area, employing high frequency, high transmission rate tags. The selected tags should maximize transmission rate and detectability in high-noise environments while minimizing data loss through tag collisions. • A routine tagging program throughout the migratory season that includes tagging of both the predator and prey species to determine the behavior of both. Tag allocation should be much higher for the prey species. The Potential Applicant should minimize tag burden and handling affects to the degree possible. • Monitoring of environmental variables and Project operations throughout the length of the study. <p><i>Level of Effort and Cost</i></p> <p>Essex posited that this study will cost an estimated \$750,000–\$1,000,000, which is substantially higher than our estimate of \$500,000. Our estimate was based on the number of tags requested, and on actualized costs for similar studies conducted at other hydroelectric projects in the region. Given synergies that would be gained if this study were to be conducted concurrently with other adopted studies (e.g. the Upstream Anadromous Fish Passage Assessment) that would also require an array of receivers, it is our opinion that this study could be conducted for much less than Essex’s estimate. This potential opportunity to share resources, as appropriate, among the suite of studies to be conducted also supports the approach of completing the study now and not delaying to an unspecified later time.</p>	<p>On March 28, 2024 and April 1, 2024, Essex held a call to discuss the Diadromous Fish Behavior, Movement, and Project Interaction Study with the MRTC, as provided for in Section 11. Essex previously recognized the importance of this study plan in the PSP and has provided the study plan in the RSP for review.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
<p>NMFS (March 8, 2024)</p>	<p>Sturgeon Distribution and Project Interaction Study</p>	<p>The Merrimack River is within the range of Endangered Species Act (ESA) listed Atlantic sturgeon (threatened and endangered Distinct Populations Segments (DPSs); 77 FR 5913 and 77 FR 5880) and shortnose sturgeon (endangered; 32 FR 4001). The Merrimack River supports a spawning population of shortnose sturgeon (Kieffer and Kynard 1996). The river reach from the Essex Dam (i.e., Great Stone Dam) downstream to the ocean is designated critical habitat for the Gulf of Maine DPS of Atlantic sturgeon (82 FR 39160), and Atlantic sturgeon from multiple DPSs occur in the Merrimack River. The continued operation of the Lawrence Hydroelectric Project under a new license may affect shortnose and Atlantic sturgeon and critical habitat designated for Atlantic sturgeon. Hydroelectric project operations have the potential for take (defined in the ESA as to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct”) of these species, which is prohibited by Section 9 of the ESA. ESA Section 7 consultation is necessary if the proposed relicensing may affect listed species or critical habitat; through this consultation, an appropriate Incidental Take Statement, exempting otherwise prohibited incidental take of ESA listed sturgeon, could be issued. We have no records of any ESA consultation occurring in the past for the Project and are not aware of any studies that have taken place on potential effects of the Project on either sturgeon species or their habitat. We request a study to determine presence and movement of sturgeon downstream of and within the Lawrence Project boundary to determine if reasonable and prudent measures are necessary to minimize effects for any new license issued for the Project, and if so, to inform the development of such measures. This study will also provide information necessary for the Essex and FERC to develop a Biological Assessment to support a request for Section 7 consultation.</p> <p><i>Goals and Objectives</i></p> <p>Sturgeon currently have access to the base of the Project. If present, sturgeon may be affected by the Project, e.g., injury and stranding, and require measures to avoid and minimize effects associated with the operation and maintenance of the Project and fishway. License conditions are not limited to changes in project operations, and, if measures such as a sturgeon protection and handling plan are necessary, they would be informed by the results of this study. Actions in such a plan may include protocols for handling, reporting, and dewatering turbine units for maintenance to prevent injury or mortality to sturgeon. For example, FERC-licensed hydroelectric project that have adopted similar measures include Ellsworth (P-2727),10 Brunswick (P-2284),11 Cataract (P-2528),12 and Santee Cooper (P-199).13 This study is a baseline data collection to inform potential protection measures. Based on the results of this study and the other sturgeon studies, other license conditions may be necessary for sturgeon such as habitat protection or improvement projects and operational modifications to prevent stranding.</p> <p><i>Study Methodology</i></p> <p>Essex cites the recent Stantec report (2023) as evidence that sturgeon are not approaching the Project. However, existing information from the Stantec report demonstrates that sturgeon are reaching the I-495 bridge in Lawrence and may be moving farther upstream. Four sturgeon out of the 50 (8%) tagged sturgeon were detected at the I-495 bridge in Lawrence in 2020 and 2021. If the proportion of tagged individuals detected at the I-495 bridge in Lawrence is representative of the movements of the amphidromous population in the Merrimack, then the minimum number of individuals from the overwintering population of shortnose sturgeon to approach the Project would be 302 individuals for 2021-2022 and 273 for 2022-2023, respectively. This provides many opportunities for an ESA-listed population to interact with the Project, but without telemetry and sidescan sonar (SSS) deployed at the Project, no baseline data is available to inform license conditions. Additionally, two of the tagged sturgeon detected at the Lawrence I-495 bridge were in the area of the uppermost acoustic receiver over multiple days in late March and April. This is ample time for the sturgeon to swim upstream and interact with the Project. In 2021, all sturgeon detections occurred before or during the spawning season, suggesting a searching behavior for spawning habitat.</p> <p>Telemetry and fixed array SSS have previously been coupled and used to quantify sturgeon abundance and movement (Izzo et al. 2021). This framework provides a tested methodology that could be adapted to the Project tailrace, spillway, and downstream of the Project.</p> <p>An appropriate assessment of sturgeon presence and occupancy to determine Project interactions is not possible with the available information. For this reason, we reaffirm our request for this study and stand by the proposed methodology to use telemetry and fixed array SSS to detect sturgeon at and downstream of the Project.</p>	<p>Essex is proposing the Sturgeon Distribution and Project Interaction Study as provided for in the RSP in Section 10. Essex is not proposing to perform this study as requested because studies should be performed commensurate to the degree to which there is a known problem. As stated by the requestors, the lower Merrimack River has one of the smallest resident populations of sturgeon in the United States. As summarized in the PAD, Kieffer and Kynard (1993) found that spawning of shortnose sturgeon occurred from April to May at RM 19-22 (Haverhill area) and overwintering at RM 12-16 (the Amesbury area); Essex Dam is at RM 29. During those three years of tracking, Atlantic sturgeon also used the same general area. As acknowledged by the requestors, sturgeon movement in the lower Merrimack has been documented up to the I-495 Bridge in Lawrence. Additionally, despite the fish lift passing anadromous fish upriver of Essex Dam since 1983, no sturgeon have been reported entering the lift. The movements of sturgeon from their wintering to spawning and postspawning areas do not encompass the Merrimack River within the Project boundary. See Section 4.3 of the RSP.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NMFS (March 8, 2024)	Sturgeon Habitat Mapping and Assessment Study	<p>Essex asserts that there is no evidence of a problem/understanding of how the study would be used to inform license requirements as well as the study request is an attempt to search for a problem or “nexus.” Essex also states that the existing information is sufficient to answer the questions posed in this study request. There are five studies that NMFS has identified that focus on or encompass sturgeon habitat in the Merrimack River:</p> <ol style="list-style-type: none"> 1. Annual Movements of Shortnose and Atlantic Sturgeons in the Merrimack River, Massachusetts (Kieffer and Kynard 1993); 2. Spawning of the Shortnose Sturgeon in the Merrimack River, Massachusetts (Kieffer and Kynard 1996); 3. A Biological Assessment of shortnose sturgeon (<i>Acipenser brevirostrum</i>) (NMFS 2010); 4. Movements of Atlantic Sturgeon of the Gulf of Maine Inside and Outside of the Geographically Defined Distinct Population Segment (Wippelhauser et al. 2017); 5. Merrimack River Shortnose Sturgeon Monitoring, 2020-2022 (Stantec 2023). <p>The earlier studies (Kieffer and Kynard 1993; Kieffer and Kynard 1996) investigated sturgeon movement, habitat usage, spawning, and resident population size. During that time, peaking operations at upstream hydroelectric and storage Projects affected the hydrology of the Merrimack River that do not reflect the existing environmental conditions. The improved hydrologic regime in the Merrimack River may result in altered habitat usage and movements among other potential drivers of sturgeon behavior affected by Project operations. Several of the studies included habitat mapping for sections of the Merrimack River, however a comprehensive habitat mapping and assessment survey is necessary to fill in data gaps and investigate Project effects on sturgeon habitat within the geographic scope of the Project. For this reason, we reaffirm our request for this study and stand by the proposed methodology to survey sturgeon habitat in the impoundment and downstream of the Project. The information from this study would be used to inform the ESA Section 7 consultation and protection, mitigation, and/or enhancement measures for Atlantic or shortnose sturgeon, none of which Essex has in its current license. Measures could include aquatic habitat enhancements and fish passage.</p> <p><i>Study Methodology</i></p> <p>In a sturgeon habitat mapping study conducted by Litts and Kaeser (2016), they developed a method that could cover 25-50 km a day with the sidescan sonar. This suggests that the study requires two to three days of sidescan sonar fieldwork to collect the image data in the impoundment and downstream extent of the Merrimack River. Additional field days are necessary to validate the imagery and collect hydraulic model calibration data. Johnston et al (2019) provide modeling approaches to conduct the HSI to understand habitat suitability in the mapped areas.</p> <p>The hydraulic model can derive from the existing National Flood Insurance Program to run simulations of representative seasonal flow conditions to characterize habitat suitability. To understand the hydraulic variables that are part of HSI, the Potential Applicant could download the existing FEMA NFIP HEC-RAS model and run simulations in 1D or 2D to characterize depth-averaged velocity and depth under various flow conditions for the mapped habitat.</p>	<p>Essex is proposing the Sturgeon Distribution and Project Interaction Study in Section 10, which Essex considers an appropriate level of effort commensurate with known information and the limited scope of potential Project effects. See Section 4.4 of the RSP.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NMFS (March 8, 2024)	Climate Related Impacts on Shortnose Sturgeon Habitat	<p>The Merrimack River is within the range for ESA listed shortnose sturgeon (endangered). The Lawrence Hydroelectric Project is a barrier to the upstream migration of shortnose sturgeon, and restricts freshwater spawning, rearing, foraging, and overwintering habitat to within the 29-mile reach below the Project. Saltwater is fatal to sturgeon during early life stages (e.g., eggs and Age-0), and access to suitable freshwater habitat is essential for survival and recruitment.¹⁴ As climate-related impacts are expected to continue, including sea level rise (SLR), increased water temperatures, and variability in river flow; upstream migration of the Merrimack River salt wedge and changing hydrological conditions may reduce and degrade existing shortnose sturgeon habitat (Hare et al. 2016; Farr et al. 2021). We request a hydrodynamic water quality modeling study using established climate projections to understand the hydrological impacts of upstream salt wedge migration during the term of a new license on shortnose sturgeon habitat affected by the Lawrence Hydroelectric Project.</p> <p><i>Goals and Objectives</i></p> <p>The goal of this study is to determine the risks of increased Project effects (e.g., habitat degradation and contraction) during the term of a new license (2028-2078) on shortnose sturgeon overwintering, spawning, and rearing habitat downstream of the Project. The information collected from study request #3 — Sturgeon Habitat Mapping and Assessment Study — is essential to characterize existing and potential habitat in this study. Habitat suitability indices (HSI) are available for shortnose sturgeon and the hydrodynamic model would provide the information necessary to evaluate if environmental conditions during the license term will degrade or eliminate the existing habitat necessary for the spawning population of shortnose sturgeon in the Merrimack River. Our request is to quantify the specific conditions (i.e., salinity, temperature, and flows) that will contribute to our understanding of essential ecological processes for shortnose sturgeon within the geographic scope of the Project, and Project effects on those conditions. Essex elected to not adopt this study and claims that the request constitutes basic research/there is no evidence of a problem or how the study would be used to inform license requirements, as well as the study request is an attempt to search for a problem or “nexus,” and cites guidance from the Council on Environmental Quality (2016) that states,</p> <p><i>in accordance with NEPA’s rule of reason and standards for obtaining information regarding reasonably foreseeable effects on the human environment, agencies need not undertake new research or analysis of potential climate change impacts in the proposed action area but may instead summarize and incorporate by reference the relevant scientific literature.</i></p> <p>This guidance has since been superseded by CEQ guidance issued in 2023¹⁵ that removes the clause on not needing to undertake new research or analysis of potential climate change impacts. In addition, the revised CEQ guidance states:</p> <p><i>agencies should identify and use information on future projected GHG emissions scenarios to evaluate potential future impacts (such as flooding, high winds, extreme heat, and other climate change-related impacts) and what those impacts will mean for the physical and other relevant conditions in the affected area. Such information should help inform development of the proposed action and alternatives, including by ensuring that proposed actions and alternatives consider appropriate resilience measures, environmental justice issues, and existing State, Tribal, or local adaptation plans. When relying on a single study or projection, agencies should consider any relevant limitations and discuss them.</i></p> <p>The hydrologic changes this study will quantify are necessary information for assessing climate change-related impacts in the lower Merrimack River. The outcomes of this study will be used to inform license conditions to support the recovery and resilience of sturgeon in the Merrimack River. See our general comments for the potential actions Essex could take beyond modifications to ROR operations.</p> <p>Essex also asserts that,</p> <p><i>Effects should generally not be considered if they are remote in time (such as this request), geographically remote, or the product of a lengthy causal chain. FERC precedent uniformly maintains that climate change studies are not needed in hydropower licensing proceedings.</i></p> <p>It is FERC’s determination as to what is considered remote in time as well as what studies will yield reliable data that can be used to develop license requirements on a project by project basis. Our study request is to investigate climate effects that are likely to occur within the licensing term, therefore, within the temporal scope of a new license and not remote in time. The precedent Essex cites in relation to climate study requests is an inappropriate rationale by which to reject this study. This study is specific in the climate effects it is investigating (i.e., saltwater intrusion, temperature, and flows), which will be compared to habitat suitability indices (Crance 1986) and other relevant literature (Smith et al. 1995; Kynard et al. 2000; Farrae et al. 2014; Johnston et al. 2019; Pendleton et al. 2019; Kazyak 2020) for sturgeon to assess the potential for habitat contraction, degradation, and loss during the license term. Some of the necessary information is already available (e.g., sturgeon spawning habitat and the location of the salt wedge location) and the previous two study requests with help fill in critical data gaps. Known effects of climate change, such as sea level rise, are accelerating at a heightened rate in the northeast compared to other parts of the country (Boon 2012), which further supports the need to complete this study.</p> <p>The documented location of the salt wedge in the Merrimack River is between RM 10 and 12 (Kieffer and Kynard 1993; CDM 2003). It currently overlaps with shortnose sturgeon overwintering habitat, and with its proximity and similar streambed elevation to spawning habitat, it is essential to undertake this study to understand the impacts of saltwater intrusion and hydrodynamic changes during the term of a new license (Figure 1). Ralston et al. (2010) found that, “Unlike scaling for other tidal salt flux mechanisms that depend only on tidal amplitude, the halocline asymmetry depends on both river discharge and tidal velocity. The salinity intrusion length and stratification in the Merrimack vary more with event-to-seasonal shifts in river velocity than with spring-neap changes in tidal amplitude,” supporting the need to create a hydrodynamic model that assess flow and temperature changes in the Merrimack.</p>	<p>Essex is not proposing an evaluation of the potential impact of climate change on sturgeon at the Project. While Essex acknowledges the importance of climate change, it is unclear how such a hypothetical analysis would inform license conditions for this ROR Project. Potential climate and hydrologic changes that may occur over the course of a 30- to 50-year license are far too speculative to allow for a quantitative evaluation as requested. The state of the science is such that climate change forecasts do not exist that could reliably predict how precipitation, saltwater intrusion, snowmelt, evapotranspiration, ice out, and annual runoff patterns may change 30 to 50 years from now. As indicated by FERC in a recent (November 3, 2021) determination issued in response to a requested study, FERC determined that given the level of uncertainty that would need to be accepted with the requested study, it would not substantially contribute to an understanding of ecological processes related to anadromous fish in Project waters. See Section 4.5 of the RSP.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NMFS (March 8, 2024)	Downstream Fish Passage and Protection Assessment	<p>Essex is not proposing to conduct the requested Downstream Fish Passage Assessment citing a proposal for PM&E measures to include a narrow-spaced trashrack to exclude fish from turbine passage. We look forward to discussing the design of this proposed measure, and agree that such a measure with full exclusion for adult diadromous species would eliminate the need to conduct a downstream passage study for adult diadromous species that includes both field-testing and desktop entrainment, impingement, and turbine passage methodologies. Juvenile target species still warrant assessment, as this PM&E measure may not be protective of all life stages.</p> <p>Additionally, there are two other important passage routes that were included in our request and not addressed in the PSP and would also not be addressed with this PM&E measure. Both the existing bypass and spillway passage routes would still need to be evaluated with or without full exclusion. Essex acknowledged the former in the PSP stating the “the existing downstream fish bypass survival for emigrating diadromous species (i.e., adult and juvenile alosines and adult American eel) will need evaluation at a later date.” This study component should be accomplished concurrently with other adopted studies to inform downstream passage measures that will be prescribed. Similarly, the spillway passage route needs to be evaluated. We have a poor understanding of the risks of injury or mortality associated with spillway passage at Essex Dam, and have little information related to how commonly that route is utilized by downstream migrants. Both of these study components are critical to assess the need for improvements to downstream fish passage and protection facilities that provide safe, timely, and effective passage and survival, and should be incorporated into the Revised Study Plan (RSP).</p> <p>Under the proposed operating conditions, there are three main routes of passage at the Lawrence Project: over the spillway, through the fish bypass, and through the turbines. To evaluate Project effects on downstream passage, we need to understand the following for each target species and life stage:</p> <ul style="list-style-type: none"> • Downstream route selection probability • Downstream route survival probability • Downstream migratory delay <p>Each of these factors may change under different operating conditions (e.g., during times of more spill, more fish may use the spillway route). Eliminating one route of passage for one life stage does not provide enough information to determine Project effects on downstream passage. To determine route selection probability, we will need a telemetry study of adult and juvenile alosine (recommend using shad) with releases throughout the passage season. For route survival, we can use the detection histories with statistical models to estimate survival for routes that are commonly used. For routes that do not have a large enough sample size for a statistical analysis, we will need to augment with a route specific survival study using balloon tags or sensor fish. This can be staged with year one being a comprehensive downstream telemetry study followed by year two being route specific data acquisition where it is needed. For delay estimation, we will use time-to-event analysis (Castro-Santos and Haro 2003) with the tagging data (i.e., detection histories with covariate monitoring).</p>	<p>In review of existing information and study requests, Essex anticipates providing proposed PM&Es to limit or prevent fish entrainment through the Project’s turbines. In particular, Essex is proposing to develop, in consultation with the MRTC, a narrow-spaced trashrack design to replace the existing trashrack system. Essex believes this proposal for a PM&E measure to screen the Project’s intake would greatly inform the new Project proposal and would likely result in reduced study costs. Essex understands that while fish entrainment during downstream passage may be mitigated by this PM&E, the existing downstream fish bypass survival for emigrating diadromous species (i.e., adult and juvenile alosines and adult American eel) will need evaluation at a later date. As noted by the Commission in their October 13, 2023 letter, Essex will consult with the MRTC regarding this PM&E and provide details of PM&E proposals within the DLA.</p> <p>Given that Essex is proposing PM&E measures related to fish entrainment and passage, Essex is not proposing to perform the Downstream Fish Passage Assessments for diadromous species. Alternatively, Essex is proposing to perform the Desktop Entrainment, Impingement, and Turbine Passage Survival Study (See Section 9). Essex also believes that existing information is sufficient for evaluation of fish survival, delay and route selection for emigrating diadromous species. Normandeau Associates, on behalf of Essex, performed a Downstream American Eel Passage Assessment at the Lawrence Hydroelectric Project in 2019, and an Evaluation of Adult Alosine Downstream Passage Effectiveness in 2020. An overview of the results of these studies is provided in Appendix C. Essex intends to file these two reports in their entirety with the Commission prior to the issuance of the SPD. These studies were performed proactively in conjunction with other studies and are “new” studies to the Commission and relicensing participants. Essex believes that existing information used along with the proposed Desktop Entrainment, Impingement, and Turbine Passage Survival Study, and the proposed PM&E measures, are sufficient for the Commission’s Environmental Analysis.</p>
NMFS (March 8, 2024)	3D CFD Model Study	<p>The proposed study that Essex outlines in Section 12 of the PSP meets our expectations for understanding the near-field hydraulics of the powerhouse and fish passage facilities. We look forward to the working group meetings to maximize the benefit from the three-dimensional hydraulic model simulations.</p>	<p>Essex appreciates the support for the 3D CFD model as proposed in Section 15.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
<p>NMFS (March 8, 2024)</p>	<p>Upstream Anadromous Fish Passage Assessment</p>	<p>The proposed study that Essex describes in Section 6 of the PSP should provide valuable data to further our understanding of how fish are interacting with the Project and existing fishway components. We do have some concerns related to tag allocation. NMFS recommends sea lamprey be included in this study, as previously requested. The only information we have related to sea lamprey at the Project is count data from the fishlift, which does not characterize their movements through the Project area. Tag numbers would not need to be nearly as high as those necessary for alosines. The absence of numerically-specific upstream passage effectiveness goals does not negate the need to evaluate Project effects on sea lamprey or the Project's ability to provide safe, timely, and effective fish passage. NMFS's overarching management goal for Merrimack River sea lamprey, as outlined in the Comprehensive Plan,17 is to restore and maintain sustainable runs for human and ecological benefits. Information from the proposed study, as requested, will support an assessment of the Project's effects on the safe, timely, and effective upstream passage of sea lamprey and inform the need for potential license conditions to improve passage conditions. Therefore, we do not support Essex's proposal to omit sea lamprey from the proposed Upstream Anadromous Fish Passage Assessment, and we encourage Essex to consider including lamprey in this study in their RSP.</p> <p>For alosines, Essex is proposing to tag 165 adult American shad and 185 adult river herring for a total of 350 tags. These sample sizes proposed in the PSP for upstream passage are too low and no statistical evidence was given to support the proposed sample size. While Essex provided some justification for numbers of fish expected to fall back post-tagging given results at Lowell, they neglected to relate that these low rates still resulted in sample sizes that were unable to produce informative results even though they tagged 150 individuals with radio transmitters in that study. In the referenced Lowell relicensing study, the passage efficiency results had a greater than 10 percent uncertainty with a 75 percent confidence interval, which does not provide sufficient evidence for conditioning agencies to recommend appropriate PM&E measures. Further, while the Lowell study experienced low fall back rates, the literature on alosines suggests that post-tagging fallback can be between 24-71% (Beasley and Hightower 2000; Bailey et al. 2004; Aunins and Olney 2009; Aunins et al. 2013; Grote et al. 2014; Gahagan and Bailey 2020). The proposed fallback rates (33% for shad and 21% for alewife) are taken from the low end of ranges that may occur, especially given the collection methodology (boat electro-fishing) will impact the tagged fish at a greater level than the collection methods for the Lowell study (where fish were obtained with nets from the Lawrence fish lift).</p> <p>To properly justify a meaningful sample size, Essex should perform simulations within their chosen modeling framework (program MARK has been used in similar studies and was discussed at the PSP meeting) to identify an initial sample size that will yield less than 10% uncertainty at a 90% or greater confidence interval around a point estimate of passage at each model time or location step (i.e., antenna location) in the study. These simulations should be run for realistic values (i.e., supported by literature) that reflect high stress sampling methods and complex antenna environments, combinations of fallback, post-tag mortality, and detection efficiencies at all antenna locations.</p> <p>In terms of post-tag mortality, Essex made a good faith effort to plan for predation on tagged fish. However, predation is likely not the primary issue at hand. We hypothesize, the primary reason that river herring passage has dropped two orders of magnitude is not that the herring are being eaten; it is that they are not able to successfully pass the dense predatory conditions created by the hydraulics and confined area of the Project's tailrace. Any fish seeking to reach the lift and make passage must negotiate this dense concentration of predators. Accounting for this effect is likely to require obtaining useful data on as few as 1 in 100,000 fish. This point is not intended to influence decisions on sample size for river herring, rather it should highlight the urgent need for the Diadromous Fish Behavior, Movement, and Project Interaction Study that Essex has opted not to propose, as well as the extreme disadvantage the Project is putting on the resource in question and the active restoration efforts of the management agencies.</p> <p>Regarding antenna locations, for each decision point in the zone of passage through the Project, sufficient detections in key locations are needed to calculate a probability with confidence. Essex should use all sites proposed in the PSP and augment the array with coverage for the following areas:</p> <ul style="list-style-type: none"> • Area below the Duck Bridge as fish approach the Project flows (below proposed Station 3); • Coverage for the entire area below the spillway to identify area of false attraction under all flow conditions encountered during the study (between proposed Stations 3 and 4); • Area between the rock face on river right and the stone abutment separating the spillway and powerhouse flows to identify fish that have entered the flow field of the powerhouse and fishway (between proposed Stations 3 and 4); • Coverage of the start of the northern (river side) fishway entrance flow field (between proposed Stations 3 and 4); • Two antennas upstream of Station 9 to identify fish that drop back into the intake and bypass flows after exiting the exit flume and those that eventually depart the immediate vicinity of the powerhouse; • Two antennas at the upstream limit of the Project's impoundment to strengthen detection probability and help determine predation and delay in the impoundment. <p>Please see below the modified Figure 6-2 from the PSP to illustrate the added antennae needed surrounding the powerhouse and spillway.</p>	<p>Essex conducted a minimum size sample analysis as provided for in Section 6.6.1 of this RSP. This method considers fallback rates and predation, as well as population passage rates based on the literature, margin of error, and confidence level. Using that targeted minimum and the methodology to adjust due to predation and fallback rates, HDR, on behalf of Essex, produced the initial sample size of shad to be tagged.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NMFS (March 8, 2024)	Upstream Fish Passage Effectiveness for American Eel	NMFS supports and does not have any comments at this time on the Upstream American Eel Passage Assessment study, as proposed by Essex.	Essex appreciates the support for the study as proposed in Section 7 of this RSP.
USFWS (March 11, 2024)	Downstream Fish Passage Assessment	We support Essex's approach to propose PM&E's in lieu of conducting studies to evaluate existing conditions. However, the goal of the Service's Study Request 1 is to assess behavior, passage success, immediate and latent survival, and internal and external injury of target species as they encounter the Project during downstream migrations through all downstream passage routes. ⁷ Essex's proposed PM&E measure only addresses one viable passage route, turbine passage. Other potential downstream routes include the Project's spillway, North and South canal gatehouses and canal systems, and the Project's downstream fish bypass. While we agree that Essex's proposal to install a narrow spaced trashrack would eliminate the need to assess turbine entrainment and passage survival through the Project's intake, at this time, the proposed PM&E measure does not address all downstream passage routes. Therefore, we continue to support our Study Request 1 for the remaining passage routes at the Project. We ask that Essex include a Downstream Fish Passage Assessment, consistent with its licensing proposal, in the Revised Study Plan (RSP).	<p>In review of existing information and study requests, Essex anticipates providing proposed PM&Es to limit or prevent fish entrainment through the Project's turbines. In particular, Essex is proposing to develop, in consultation with the MRTC, a narrow-spaced trashrack design to replace the existing trashrack system. Essex believes this proposal for a PM&E measure to screen the Project's intake would greatly inform the new Project proposal and would likely result in reduced study costs. Essex understands that while fish entrainment during downstream passage may be mitigated by this PM&E, the existing downstream fish bypass survival for emigrating diadromous species (i.e., adult and juvenile alosines and adult American eel) will need evaluation at a later date. As noted by the Commission in their October 13, 2023 letter, Essex will consult with the MRTC regarding this PM&E and provide details of PM&E proposals within the DLA.</p> <p>Given that Essex is proposing PM&E measures related to fish entrainment and passage, Essex is not proposing to perform the Downstream Fish Passage Assessments for diadromous species. Alternatively, Essex is proposing to perform the Desktop Entrainment, Impingement, and Turbine Passage Survival Study (See Section 9). Essex also believes that existing information is sufficient for evaluation of fish survival, delay and route selection for emigrating diadromous species. Normandeau Associates, on behalf of Essex, performed a Downstream American Eel Passage Assessment at the Lawrence Hydroelectric Project in 2019, and an Evaluation of Adult Alosine Downstream Passage Effectiveness in 2020. An overview of the results of these studies is provided in Appendix C. Essex intends to file these two reports in their entirety with the Commission prior to the issuance of the SPD. These studies were performed proactively in conjunction with other studies and are "new" studies to the Commission and relicensing participants. Essex believes that existing information used along with the proposed Desktop Entrainment, Impingement, and Turbine Passage Survival Study, and the proposed PM&E measures, are sufficient for the Commission's Environmental Analysis.</p>
USFWS (March 11, 2024)	Diadromous Fish Behavior, Movement, and Project Interaction Study	Essex's position on our Study Request 5 is unclear. While the PSP implies a study may be developed in the future, the PSP states a study is not proposed, and the PSP does not include a process for the development of that study. We note that the PSP did not evaluate our request in the context of 18 CFR 5.9(b) in its discussion of our Study Request 5 and its reasoning for not adopting the requested study. For the reasons discussed in our Study Request 5, the Service continues to seek the development and implementation of the Diadromous Fish Behavior, Movement, and Project Interaction Study and asks that Essex include the requested study in its RSP.	Essex is proposing the Diadromous Fish Behavior, Movement, and Project Interaction Study, as provided for in Section 11 of the RSP.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
USFWS (March 11, 2024)	Fish Assemblage Study	<p>Section 5.4.2, Existing Fish and Aquatic Resources, of the PAD only identifies migratory fish species found in the Project's vicinity. The PAD's Table 5.4.1 identifies a total of 49 fish species found within the Merrimack River watershed from its headwaters in the White Mountains of New Hampshire to its mouth at the Atlantic Ocean. The goal of our Study Request 9 is to establish the existing baseline of the Merrimack River fishery resources in the vicinity of the Project. This information is needed to inform an analysis of Project effects on those resources.</p> <p>Pursuant to 18 CFR 5.9(b)(4), our requested study noted that the Commonwealth of Massachusetts conducted a limited sampling in 2009 in the Project's vicinity. That sampling effort comprised 45 minutes of boat electrofishing upstream and downstream of the Project, for 90 minutes total, and encompassed less than 1 percent of the available habitat influenced by the Project. The Service is not aware of any other fish assemblage data specific to the Project area, and Essex has not provided other information to adequately characterize baseline fishery resources in the vicinity of the Project. As such, there continues to be a need for a fish assemblage study and report, and we ask that Essex include a Fish Assemblage Study in its RSP. However, we recognize that Essex believes adequate information exists to support the Project's licensing proceeding. Therefore, the Service would support a study plan that takes a two-phased approach to providing the necessary fish assemblage data. Phase 1 would consist of a detailed desktop survey and report of the existing information, which articulates the known fish assemblage specific to the Project's vicinity and identifies all remaining information gaps. The report should include information on previous survey methods, locations, and level of effort, and an appendix containing a copy of each reviewed study/survey report. Phase 2 of the study should include the development of fish assemblage field surveys as requested in our Study Request 9, as needed, and specific to fill any information gaps identified during Phase 1.</p>	<p>Essex updated the American Eel Upstream Passage Siting Study (Section 8) to provide additional data collection on the general fish assemblage downstream of Lawrence Dam. During that study, all non-anguillid fish species will also be netted during eel electrofish events. Fish will be identified to species, counted, and total length to the nearest mm will be recorded. Essex considers this collection of fish assemblage data downstream of the Lawrence dam commensurate to which there is a known issue or problem. See Section 4.1.</p>
USFWS (March 11, 2024)	Fish Passage Improvement and Feasibility Assessment	<p>In general, we accept Essex's proposed approach to our requested Fish Passage Improvement and Feasibility Assessment (Study Request 6). The development and implementation of our Study Request 6 now would proactively support a review of fish passage alternatives at the Project, even though Essex is not currently proposing any modification to the existing fish passage facilities. While the Service can support a phased approach to determining fish passage effectiveness and developing alternatives, as needed, the next steps should be part of Essex's Initial Study Report (ISR), not simply identified in its DLA. Following a review of study results of Essex's proposed Upstream Fish Passage Assessment and Upstream American Eel Passage Assessment, Sections 6 and 7 of the PSP, respectively, and the Service's requested Downstream Fish Passage Assessment and Diadromous Fish Behavior, Movement, and Project Interaction Study, Study Requests 1 and 5, respectively, we ask, pursuant to 18 CFR 5.15(c)(1), that Essex's ISR propose, if appropriate, our Study Request 6. If, at that time, the Service and Essex disagree on the need for our Study Request 6, the Service may ask that our Fish Passage Improvement and Feasibility Assessment be conducted, pursuant to 18 CFR 5.15(c)(4).</p>	<p>Essex is not proposing the Fish Passage Improvement and Feasibility Study because the requested study necessitates data from proposed fish passage studies that have yet to be conducted, as well as the results of the CFD model, and evaluation of PM&E measures and alternatives. See Section 4.2.</p>
USFWS (March 11, 2024)	Sturgeon Distribution and Project Interaction Study	<p>The goal of the Service's Study Request 7 is specifically to determine how Atlantic sturgeon (<i>Acipenser oxyrinchus oxyrinchus</i>) and shortnose sturgeon (<i>Acipenser brevirostrum</i>) (collectively, sturgeon) interact with the Project to identify potential means of take resulting from the Project's operation and maintenance. While the PSP asserts that no acoustic-tagged sturgeon have been documented in the Project's vicinity upstream of the I-495 bridge, we note that the most upstream acoustic receiver was located at that bridge, and no means of detecting the sturgeon at the Project existed. Our Study Request 7 fully addressed the Commission's study request requirements demonstrating the need for information and acknowledged that the resulting information could be used to inform license conditions, including the potential need for upstream fish passage of sturgeon. Essex's concern that a sub-sample of dates would not provide sufficient information on the sturgeon population or distribution downstream of the Project should be addressed through study design and methodology. For these reasons, the Service continues to support its Study Request 7 and asks that the requested Sturgeon Distribution and Project Interaction Study be included in Essex's RSP.</p>	<p>Essex is proposing the Sturgeon Distribution and Project Interaction Study as provided for in the RSP in Section 10. Essex is not proposing to perform this study as requested because studies should be performed commensurate to the degree to which there is a known problem. As stated by the requestors, the lower Merrimack River has one of the smallest resident populations of sturgeon in the United States. As summarized in the PAD, Kieffer and Kynard (1993) found that spawning of shortnose sturgeon occurred from April to May at RM 19-22 (Haverhill area) and overwintering at RM 12-16 (the Amesbury area); Essex Dam is at RM 29. During those three years of tracking, Atlantic sturgeon also used the same general area. As acknowledged by the requestors, sturgeon movement in the lower Merrimack has been documented up to the I-495 Bridge in Lawrence. Additionally, despite the fish lift passing anadromous fish upriver of Essex Dam since 1983, no sturgeon have been reported entering the lift. The movements of sturgeon from their wintering to spawning and postspawning areas do not encompass the Merrimack River within the Project boundary. See Section 4.3 of the RSP.</p>
USFWS (March 11, 2024)	Invasive Plant Survey	<p>The Service's Study Request 12 would describe the current baseline condition of invasive plant species needed to assess any continuing Project effects and potential PM&E measures to address those effects. Reservoirs and impoundments alter natural habitats and are known to provide conducive conditions for the spread and establishment of invasive aquatic plant species. The Project's land management and maintenance activities and continued operation of the Project's reservoir could provide suitable conditions for invasive species to establish and expand during the next license term. Studies to establish current baseline conditions at hydropower projects during relicensing are common and supported in the Commission's guidance A Guide to Understanding and Applying the Integrated Licensing Process Study Criteria,9 and measures to address invasive species are often included as license conditions. While the PSP indicates that Essex may propose measures to control invasive plants, we are unclear how such measures would be informed if there is no information available to characterize the baseline distribution of invasive plant species. Therefore, the Service asks that Essex include our requested Invasive Plant Survey in its RSP.</p>	<p>Essex is proposing to record readily identifiable non-native species during the three vegetation surveys of the North and South Canals, to be performed as part of the Recreation Facilities, Use, and Aesthetics Study Plan See Section 16. The three surveys aim to capture vegetation through the growing season (e.g. start, peak, end).</p> <p>Essex maintains that the Invasive Plant Survey request is focused on conducting a broad investigation or general research rather than requesting a specific study intended to measure any direct project impacts on a known resource. Commonly aquatic invasive species are introduced by recreational boating and other recreation activities. It is not feasible for Essex to assess invasive species due to the dynamic nature of invasive plant populations and the continuous risk of introduction and establishment of these species by non-project related sources at any given time. See Section 4.10.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
USFWS (March 11, 2024)	Upstream Anadromous Fish Passage Assessment	<p>Section 6 of the PSP provides a proposed Upstream Anadromous Fish Passage Assessment study plan. The proposed study is largely consistent with the Service's Study Request 2, except that Essex does not propose to evaluate the effectiveness of upstream fish passage facilities for sea lamprey (<i>Petromyzon marinus</i>). In Section 4.14 of the PSP, Essex states that it does not propose to assess sea lamprey because (1) the 2021 Merrimack River Watershed Comprehensive Plan for Diadromous Fishes (Comprehensive Plan) does not provide upstream effectiveness goals for sea lamprey,10 and (2) there is lack of available existing information to evaluate and assess passage efficiencies for sea lamprey.</p> <p>The absence of numerically specific upstream passage effectiveness goals does not negate the need to evaluate Project effects on sea lamprey or the Project's ability to provide safe, timely, and effective passage. The Service's overarching management goal for Merrimack River sea lamprey, as outlined in the Comprehensive Plan, is to restore and maintain sustainable runs for human and ecological benefits. Information from the proposed study will support an assessment of Project effects on the safe, timely, effective upstream passage of sea lamprey and inform the need for license conditions to improve passage conditions, if necessary. Therefore, the Service continues to request that Essex include sea lamprey in the proposed Upstream Anadromous Fish Passage Assessment.</p>	Essex does not propose to evaluate the effectiveness of the existing upstream fish passage facilities for sea lamprey as it is not clear how this evaluation would inform license requirements. It is not clear how the Project's license would be modified based on results of an evaluation of sea lamprey. See Section 4.13.
USFWS (March 11, 2024)	Upstream Anadromous Fish Passage Assessment	<p>In Section 6.6.1, Sample Size, Essex proposes to observe 100 radio-tagged individuals of each target fish species. Based on a presumed rate of fall-back, and an assumed rate of predation for adult American shad, adult alewife, and blueback herring (collectively, river herring), Essex proposes to tag 165 American shad and 185 river herring to have a sample size of 100 radio-tagged individuals in the study. However, Section 6.6.1 provides no supporting information to indicate that a sample size of 100 observed individuals for each target group would generate statistically significant results. In addition, as noted in our Diadromous Fish Behavior, Movement, and Project Interaction Study (Study Request 5), target species migrating upstream are failing to locate the fishway entrance due to what appears to be predator avoidance behavior. While the study plan considers a rate of predation that prevents consumed fish from reaching the fishway, it does not consider predator avoidance behavior when establishing the initial number of fish to tag. Please provide an explanation supporting a sample size of 100 individuals as likely to provide adequate statistical rigor.</p>	Essex conducted a minimum size sample analysis as provided for in Section 6.6.1 of this RSP. This method considers fallback rates and predation, as well as population passage rates based on the literature, margin of error, and confidence level. Using that targeted minimum and the methodology to adjust due to predation and fallback rates, HDR, on behalf of Essex, produced the initial sample size of shad to be tagged.
USFWS (March 11, 2024)	Upstream Anadromous Fish Passage Assessment	<p>Our Study Request 2 treated alewife and blueback herring as separate species to be assessed. The proposed study plan combines these species and addresses them as one study entity. While alewife and blueback herring are similar species, they exhibit different migratory behaviors and should be evaluated independently. We recognize that treating the herring species separately will increase the number of telemetry tags needed for the study and the consideration raised in Section 6.6.1 that increasing "...the number of test fish required... must be weighed against the functional limitations of effectively monitoring large numbers of fish within any one detection zone due to collisions among tag signals." Currently, the proposed study is planned for a single study season in 2025. If adopting our recommendations would result in poor data, the study may be split to evaluate different target species groups over two upstream migration seasons, 2025 and 2026, substantially reducing the potential for signal collisions.</p>	On March 28, 2024 and April 1, 2024, Essex held a call to discuss the Upstream Anadromous Fish Passage Assessment with the MRTC. Among the items discussed was the acknowledgement that this study could be limited to tagging of Adult American shad, and river herring (i.e. alewife and blueback herring) could be removed from the study plan.
USFWS (March 11, 2024)	Upstream Anadromous Fish Passage Assessment (PSP Section 6)	<p>In Section 6.6.3, Radio Telemetry Monitoring Stations, Essex proposes to operate 10 monitoring stations. However, as demonstrated in Figure 6-2 of the PSP, the proposed arrangement of the monitoring stations would not capture (1) how fish approach the Project, (2) false attraction to the Project's spillway, (3) milling or disorientation in the tailrace, or (4) fish passage success and escapement to the Project's headpond. As such, we recommend the addition of the following monitoring station(s):</p> <ul style="list-style-type: none"> • To assess how fish approach the Project, we recommend the addition of monitoring station(s) located immediately downstream of the Union Street Bridge between stations 2 and 3. The station(s) should be oriented to provide data that describe a tagged fish's position within the river reach downstream of the bridge as it approaches the Project. • To track and monitor false attraction to the Project's spillway, we recommend the addition of monitoring station(s) located immediately downstream of the Project's spillway.11 • To assess delay and far field attraction to the Project's fishway entrances, we recommend the addition of an array at the downstream end of the tailrace between stations 3 and 4. • To document fish passage success and escapement to the Project's reservoir, we recommend the addition of a monitoring station just upstream of the Project's intake channel/power canal. 	On March 28, 2024 and April 1, 2024, Essex held a call to discuss the Upstream Anadromous Fish Passage Assessment with the MRTC. Among items discussed was the addition of monitoring stations. Essex updated the study plan in Section 6 of the RSP accordingly. Essex also intends to perform the Diadromous Fish Behavior, Movement, and Project Interaction Study as proposed in Section 11.
USFWS (March 11, 2024)	Upstream American Eel Passage Assessment (PSP Section 7)	<p>Section 7.3, Study Area, defines the study area as "...the section of the Merrimack River located immediately downstream of the Essex Dam and the existing upstream eel passage facilities." This geographic scope is too large and should be reduced accordingly. We recommend modifying Section 7.3 as follows:</p> <p style="padding-left: 40px;">The study area will include the section of the Merrimack River located immediately downstream of the Essex Dam, proximal to and the existing upstream eel passage facilities.</p>	Essex updated the Upstream American Eel Passage Assessment in Section 7 of the RSP to address this comment.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
USFWS (March 11, 2024)	Upstream American Eel Passage Assessment (PSP Section 7)	<p>Section 7.6.2.2, Eel Tagging and Releases, notes that up to 500 juvenile eel will be tagged with a 12 millimeter (mm) passive integrated transponder (PIT) tag. The study proposes to tag two size classes of eels; individuals less than or equal to 150 mm, and those greater than 150 mm. Given the size of the 12 mm PIT tags, the study plan appropriately establishes an eel minimum size threshold of 113 mm.</p> <p>Juvenile eel sampling conducted by the Service at the Project in 2015 indicated the majority of eel at the site were 110 mm or shorter. Of the 761 eels captured in the Project's eel ladder on July 29, 2015, 755 were less than 110 mm, none were between 110 mm and 120 mm, and 6 were over 120 mm. Given this information, the Service is concerned that the proposed study methodology will skew the tagged sample population to be unrepresentative of the eels at the Project. As a result, the Service recommends the proposed study include contingency marking/tagging and recapture methods (e.g., visual elastomer tags) in the event the size of eels captured during the study plan's implementation is similar to that observed during the Service's 2015 sampling effort.</p>	Essex updated the Upstream American Eel Passage Assessment in Section 7 of the RSP to address this comment.
USFWS (March 11, 2024)	Upstream American Eel Upstream Passage Siting Study (PSP Section 8)	<p>In Section 8.6.1, Nighttime Visual Surveys, of its PSP, Essex proposes to conduct nighttime surveys to reevaluate the spatial distribution and relative abundance of juvenile eels downstream of the Essex Dam and other Project structures. Essex provides a list of "potential" survey areas noting that they "...will only be searched pending a determination that there are no significant health or safety risks associated with accessing and entering those locations." We note that the downstream face of the Project's dam and tailrace are excluded from the list of survey areas, and we recommend the RSP include them in the list of potential Project features where nighttime visual surveys occur. The Service asks that survey locations only be removed if the hazards cannot be mitigated and that Section 8.6.4, Data Analysis and Reporting, of the RSP include provisions for reporting why any survey areas, for any sampling method, are removed from survey, including all mitigation measures that were considered, but were deemed inadequate, to mitigate the potential hazard(s).</p>	Essex updated the American Eel Upstream Passage Siting Study in Section 8 of the RSP to address this comment.
USFWS (March 11, 2024)	Upstream American Eel Upstream Passage Siting Study (PSP Section 8)	<p>Section 8.6.2 Electrofish Surveys of the PSP, states that backpack electrofishing surveys will be conducted downstream of Essex Dam; however, it does not specify the area(s) in which electrofishing surveys would occur. To provide a more robust estimate of the relative abundance and body size distribution of juvenile American eels found in the Project's vicinity and waters, the Service recommends the RSP include electrofishing surveys within (1) the Merrimack River from the Project's dam to the tailrace, (2) within the Spicket River from its confluence with the Merrimack River to the terminus of the North Canal, and (3) within the North and South canals in their entirety. Electrofishing survey techniques need not be limited to backpack electrofishing and should include other electrofishing methods (e.g., boat electrofishing) as environmental factors (e.g., water depth, substrate, etc.) may dictate. We also recommend section 8.6.2 of the RSP note that any eel captured during canal electrofishing surveys be released to the Project's impoundment, if agreed upon by MassWildlife.</p>	Essex updated the American Eel Upstream Passage Siting Study in Section 8 of the RSP to address this comment, with the exception of electrofishing in the North and South Canals.
USFWS (March 11, 2024)	Upstream American Eel Upstream Passage Siting Study (PSP Section 8)	<p>Section 8.6.3, Temporary Eel Traps, of the PSP states that up to two temporary eel traps will be deployed in locations determined in consultation with the MRTC and in consideration of site access, personnel safety, and site security. The Service recommends Section 8.6.3 of the RSP be revised to provide for a minimum of three temporary eel traps to be deployed at the downstream side of the North and South canal gatehouses, and at the downstream side of the terminus of the North Canal at the Spicket River. Precise placement of the traps' ramps and the need for additional traps should be determined in consultation with the MRTC prior to the start of the ten-week survey period.</p>	Essex updated the American Eel Upstream Passage Siting Study in Section 8 of the RSP to address this comment.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
USFWS (March 11, 2024)	Project Operations and Fish Stranding Study	<p>In addition to the Essex's proposed desktop evaluation, the Service's Study Request 10 included field surveys. Specifically, Phase 1, Task 2 of our requested study included the following field components:</p> <ul style="list-style-type: none"> • Survey and map potential stranding sites and topography of the habitat beneath the Project's spillway within the zone of tailwater surface elevation fluctuation. • Examine potential stranding sites in the study area at an appropriate time interval after an operational change.¹² • Provide time lapse photography to monitor potential stranding sites. • Monitor and document depth at potential stranding sites before and after an operational change, such as a reduction in spill as a crestgate is inflated, to identify areas that become rapidly isolated or dewatered in a manner that may strand fish when they are present. • Document the number, location, and species of fish stranded, and detailed project operations that caused the stranding event. In addition, the conditions of the study/stranding area should be photo-documented. • Document the number and species of fish stranded within the turbine bays, draft tubes, and upstream and downstream fish passage facilities during routine maintenance activities. <p>Essex notes that only two stranding events were identified in our Study Request 10 and finds that our requested study methods assume that fish stranding events may occur under any or all operational changes. To the contrary, Study Request 10 seeks to identify the select operational scenarios or aspects of those scenarios that do result in fish stranding events. This information could then be used to inform PM&E measures that avoid these conditions. There are two known events in recent history that, by chance, the New Hampshire Fish and Game Department (NHFGD) was present to document. This does not imply that the project operational conditions associated with these two events are the only scenarios that result in fish strandings at the Project. Without our requested field surveys and actively looking for stranded fish in conjunction with changes in project operations, the proposed study will only provide data on the two discrete events documented by NHFGD and will not inform license conditions that avoid or mitigate all stranding events that may be caused by project operations. Finally, the Service's Study Request 10 also sought information on fish strandings associated with routine project maintenance. Essex's PSP Section 9 study would not provide any information on fish strandings within the turbine bays, draft tubes, and upstream and downstream fish passage facilities, or the canal systems during routine project operation and maintenance activities. As a result, the Service recommends that Essex's RSP Section 9 include the requested field surveys outlined in our Study Request 10, Phase 1, Task 2 and the Project's associated canal system.</p>	<p>Essex is not proposing to perform field surveys. These surveys pose an unacceptable level of risk as it would entail personnel going below the dam during adverse conditions (e.g. increased spill, night) for likely limited to no information.</p> <p>Based on conversations with the MRTC, Essex understands that the primary areas of concern for potential stranding sites are located below the dam at rock outcrops on either side of the dam (left and right abutments). Essex is proposing to use existing aerial imagery, in combination with collected imagery, to identify potential fish stranding sites further downstream below the Essex dam. Essex anticipates installing trail cameras at a location on either side of the dam to capture hourly photographs of the areas over an extended period of time. Essex anticipates consulting with the MRTC following issuance of the SPD on the location of the trail cameras as well as the period of record for installation. See Section 12.</p>
USFWS (March 11, 2024)	Project Operations and Fish Stranding Study (PSP Section 9)	<p>Essex's proposal to use its proposed CFD modeling study to further evaluate potential fish stranding in the Project's vicinity is consistent with the Service's Study Request 10. However, the proposed geographic scope for CFD modeling downstream of the Project (PSP Section 12.3, Study Area) is limited to areas downstream of fishway entrances within the tailrace, and internally within the fish lift. In contrast, Essex's PSP Section 9.3 Study Area identifies the geographic scope of the proposed Project Operations and Fish Stranding Study to be the tailrace, and the downstream reach below the Essex Dam. Therefore, the geographic scope of the CFD modeling study is inadequate to inform the analysis proposed by Essex in the PSP Section 9 study. For this reason, the Service recommends that the RSP's Section 12.3 be revised to include the Merrimack River from the downstream face of the Project's dam to the downstream side of the Union Street Bridge. We provide additional comments on Essex's proposed CFD modeling study in Three-Dimensional Computational Fluid Dynamics (CFD) Modeling (PSP Section 12) below.</p>	<p>Based on conversations with the MRTC, Essex understands that the primary areas of concern for potential stranding sites are located below the dam at rock outcrops on either side of the dam (left and right abutments). Essex is proposing to use existing aerial imagery, in combination with collected imagery, to identify potential fish stranding sites further downstream below the Essex dam. Essex anticipates installing trail cameras at a location on either side of the dam to capture hourly photographs of the areas over an extended period of time. Essex anticipates consulting with the MRTC following issuance of the SPD on the location of the trail cameras as well as the period of record for installation. See Section 12.</p>
USFWS (March 11, 2024)	Freshwater Mussel Habitat Assessment and Survey (PSP Section 10)	<p>Essex's proposed Freshwater Mussel Habitat Assessment and Survey study plan is generally consistent with the Service's requested Mussel Survey (Study Request 11). We note that Service's requested study would utilize fish assemblage data from our Study Request 9, which Essex is not proposing to conduct. Study Request 9 would properly inform Essex's proposed Freshwater Mussel Habitat Assessment and Survey, and the Service continues to support our Study Request 9 and recommend that RSP utilize the results of a fish assemblage study to inform Essex's assessment of potential host-fish in the Project's vicinity.</p>	<p>Essex appreciates the general support for the proposed Freshwater Mussel Habitat Assessment and Survey as provided for in Section 13.</p>
USFWS (March 11, 2024)	Freshwater Mussel Habitat Assessment and Survey (PSP Section 10)	<p>In Sections 10.3 and 10.6.1, Study Area and Field Sampling, respectively, Essex does not propose to sample river reaches downstream of the Project's dam and tailrace, which were included in the Service's Study Request 11. Project operations and maintenance activities (e.g., reservoir drawdowns) can influence flow and generate shear stresses that negatively affect mussel populations downstream of the Project. For this reason, the Service recommends Sections 10.3 and 10.6.1 of the RSP include surveys with the Merrimack River and downstream of the Project's spillway and downstream of the Project's tailrace.</p>	<p>Essex updated the Freshwater Mussel Habitat Assessment and Survey as provided for in Section 13 to add additional mussel survey locations downstream from the Project's dam.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
USFWS (March 11, 2024)	Freshwater Mussel Habitat Assessment and Survey (PSP Section 10)	The intent of our Study Request 11 is to provide information on mussel species presence and locations to inform an analysis of how the Project's operation and maintenance activities may affect those communities. The proposed surveys would not cover a broad enough range of water surface elevations (WSE) to accomplish this. Section 10.6.1 indicates that most surveys will occur in water depth 4 feet or less and to a maximum of 5 feet. The Project's pneumatic crest gate system increases the WSE of the impoundment by 5 feet over the dam's spillway crest. Section 10.5, Project Nexus, of the PSP notes the maintenance drawdowns are typically limited to 5 feet below the normal WSE. However, a recent 2022 repair of the Project's pneumatic crest gate system resulted in a reservoir drawdown of 5.5-feet below the normal WSE.13 As a result, we recommend Section 10.4, Background and Existing Information, of the RSP include information on each reservoir drawdown since installation of the pneumatic crest gate system in 2008, and Section 10.5, Project Nexus, articulate the extent of Project effects based on that information. The Service recommends that Section 10.6.1 of the RSP be revised to specify surveys occur to a contour depth equal to the maximum-drawdown plus a 1-foot buffer zone.	Essex updated the Freshwater Mussel Habitat Assessment and Survey as provided for in Section 13 to add additional information on contour depth.
USFWS (March 11, 2024)	Freshwater Mussel Habitat Assessment and Survey (PSP Section 10)	In Section 10.6.1, Essex notes it would conduct surveys in the Project's North and South canals, consistent with the Service's Study Request 11, if there are no significant health or safety risks associated with accessing those areas. The Service recommends that Section 10.6.2, Analysis and Reporting, of the RSP include provisions that the study report document and explain any decision to remove survey locations from the study area, including a discussion of any measures considered but deemed inadequate to mitigate the potential hazard.	Essex is not proposing to perform mussel surveys in South Canal given the significant health and safety concerns.
USFWS (March 11, 2024)	Three-Dimensional Computational Fluid Dynamics (CFD) Modeling (PSP Section 12)	The Service's Study Request 8 articulated a need to understand the complex flow fields in the Project's vicinity. This information, coupled with data from our requested Downstream Fish Passage Assessment (Study Request 1); Upstream Anadromous Fish Passage Assessment (Study Request 2); Upstream American Eel Passage Assessment (Study Request 4); Diadromous Fish Behavior, Movement, and Project Interaction Study (Study Request 5); Sturgeon Distribution and Project Interaction Study (Study Request 7); Fish Stranding and Ramping Rate Study (Study Request 10); and the Mussel Survey (Study Request 11), will inform an analysis of Project effects on these aquatic resources and the development of potential PM&E measures to address those effects.	Essex considers the 3D CFD model as proposed sufficient for the Commission to perform their Environmental Analysis.
USFWS (March 11, 2024)	Three-Dimensional Computational Fluid Dynamics (CFD) Modeling (PSP Section 12)	<p>Essex's PSP recognizes the benefit of the CFD modeling study in Section 4.1, where it states that the Proposed Section 12 CFD modeling study complements its proposed Upstream Anadromous Fish Passage Assessment (PSP Section 6), the American Eel Upstream Passage Siting Study (PSP Section 8), and the Project Operations and Fish Stranding Study (PSP Section 9). However, as proposed, Essex's CFD modeling study would constrain modeling results and only inform an assessment of upstream anadromous fish passage. As discussed above, the PSP's Section 9, Project Operations and Fish Stranding Study, specifies that CFD modeling results will be integrated to inform that study. Unfortunately, the proposed CFD modeling is too limited to support Essex's Project Operations and Fish Stranding Study.</p> <p>With a proper geographic scope, CFD model results can inform an analysis of fish behavioral data collected by other proposed and requested studies. As discussed above, the Service recommends that Essex's RSP include the Service requested Studies 1, 5, and 7, and Essex's proposed PSP Sections 6, 8, 9, and 11 with our recommended modifications. To support an analysis of the Project's effects on aquatic resources and the development of potential license conditions, the Service recommends the RSP include a Hydraulic Modeling Study with a geographic scope consistent with our Study Request 8.</p>	Essex considers the 3D CFD model as proposed sufficient for the Commission to perform their Environmental Analysis.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NPS (March 20, 2024)	Recreation Study	<p>NPS and other stakeholders had requested that Essex conduct visitor use surveys and filed interviews as part of any recreation study to be conducted. Although Essex has proposed to conduct a Recreation Facilities, Use, and Aesthetics Study, they have not proposed to conduct such critical on-site work. FERC's comments on the PSP dated March 8, 2024, make note of this critical omission in the PSP:</p> <p>"In section 4.13, Requested Studies Not Adopted – Recreation Facilities, Use, and Aesthetics Study, Essex does not propose to conduct visitor use surveys or personal interviews at project and non-project sites during peak recreation season. However, without this information, we may not be able to accurately quantify current recreational use or evaluate the adequacy of existing recreational facilities to meet current and future recreational needs in the NEPA document.</p> <p>Therefore, we recommend that the RSP identify the proposed methods and procedures that would be used to quantify visitors' use, needs, and experiences at project and non-project recreational facilities. In addition, we recommend identification of public and stakeholder attitudes toward conditions and a discussion on the need for improvements of project recreational facilities and adjacent Essex-owned lands. Staff continues to recommend that Essex develop an interview/survey questionnaire to gather visitor use data that would request the following information, at a minimum: (1) age group; (2) local resident or visitor; (3) distance traveled/home zip code; (4) purpose and duration of visit; (5) day use or overnight lodging; (6) frequency or history of visiting the site or area; (7) types of recreational activities respondents participated in or plan to participate in during their visit, including primary and secondary recreation activities; (8) types of recreational equipment respondents brought or transported with them during their visit; (9) reasons for choosing the site or area; (10) other recreational sites that respondents visited or intend to visit during their trip; and (11) if there are any areas of concern regarding vegetation growth on historic canal walls and trash."</p> <p>The NPS agrees with this conclusion and the recommendations listed; this degree of detailed information is needed for FERC to have adequate information upon which to base its licensing decision. Regardless of the amount of information gathered through any desktop evaluation, and publicly available studies, reports and plans, there is simply no substitute for gathering on site information from actual users. The area surrounding the project has seen considerable renewal in recent years, with literally hundreds of new residential units having been developed in existing mill and associated buildings. Along with that development, there are new restaurants and other business establishments, including new recreational amenities beyond simply areas to walk in and around the mill buildings.</p>	Essex updated the Recreation Facilities, Use, and Aesthetics Study in Section 16 of the RSP to address this comment.
NPS (March 20, 2024)	Recreation Study	As stated in our Study Request for a Recreation, Land Use, and Aesthetic Resources Study, NPS listed 8 elements that should be evaluated. We reiterate the need to include all these elements in Essex's proposed recreation-based study.	Essex is proposing the Recreation Facilities, Use, and Aesthetics Study as provided for in Section 16. The study focuses on identifying and evaluating factors within Essex's control. Essex believes the study as proposed, with focus groups, user-surveys, and data requests, are sufficient to address the Commission's Environmental Analysis, and generally does encompass the elements (e.g. reviewing trail options, land uses, and portage options).
NPS (March 20, 2024)	Recreation Study	FERC also noted a deficiency in section 13.6.2, Field Inventory, where Essex omitted to include a comprehensive condition assessment of all recreational facilities associated with the project. NPS concurs with FERC recommendation to "describe how the current condition of each existing project and non-project recreational facility will be assessed and documented." including georeferenced photos and written documentation.	Essex updated the Recreation Study in Section 16 of the RSP to address this comment.
NPS (March 20, 2024)	Recreation Study	The NPS concurs with the proposal of Groundwork Lawrence's March 11, 2024 PSP comments to evaluate recreational use and pedestrian connection opportunities above the dam and along the length of the canals, including "incorporating a public connection at the end of the north canal at the lower locks by integrating a shared use path into the project's existing infrastructure."	The Recreation Facilities, Use, and Aesthetics Study as proposed in this RSP includes a literature review, and focus group discussions as well as user surveys. Essex believes this approach will be sufficient to inform the Commission's Environmental Analysis. Stakeholders will have the opportunity to provide information regarding trails and a shared-use path along the North Canal as part of this study.
NPS (March 20, 2024)	Vegetation and Trash Management	NPS requested a Vegetation and Aquatic Trash Management Study. As part of their proposed recreation study Essex has proposed to look at vegetation in context of identifying where in the system there's growth on historic canal walls and concentrated trash. This work is part of their existing license requirements and therefore, needs to be evaluated in context of condition assessment and deferred maintenance; it is not really a study or part of recreation evaluation. Although Essex is currently doing vegetation clearing, there has not been any consistent plan for vegetation management.	Essex updated the Recreation Facilities, Use, and Aesthetics Study in Section 16 of the RSP to include additional vegetation and waterborne trash surveys. Any evaluations of PM&Es related to vegetation and waterborne trash can be evaluated in the DLA.
NPS (March 20, 2024)	Historically Significant Waterpower Equipment	NPS also requested a Historically Significant Waterpower Equipment Study to determine the effect of flows and water levels on historic resources. Essex proposed to photo document equipment 50 years or older and to retain an architectural historian. Their the documentation should also include an evaluation of their condition, ongoing deterioration and identifying methods to mitigate, abate and remedy those conditions. In addition to the equipment, the buildings and structures which house are multiple structures and systems that are part of the historic fabric of the whole system, which needs to be evaluated in its entirety not just as pieces related to specific hydro operations. Although only portions of the larger system are under the control of Patriot, but important to document that as well as it's part of the larger system. All historic hydro equipment should be identified.	Essex anticipates developing a Historic Properties Management Plan (HPMP) to describe how the licensee will consider and manage historic properties within the Project's area of potential effects during the term of the new license. Information presented in the Report on Historically Significant Waterpower Equipment will inform the development of the HPMP.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NPS (March 20, 2024)	Historically Significant Waterpower Equipment	Essex proposed to conduct a Condition Assessment of Hist Properties and Canal System; however, this is part of their responsibility under the existing license; a plan for protection and preservation going forward should be part of the application, not simply an evaluation of what there and what condition its in. Elements of Essex's proposed Condition Assessment should be combined with NPS' requested Historically Significant Waterpower Equipment Study. What's out there and its condition, and how does that impact project operations, identification of historic photos and drawings is also necessary, and a desktop study won't capture most of that important information.	Essex anticipates developing an HPMP to describe how the licensee will consider and manage historic properties within the Project's area of potential effects during the term of the new license. Information presented in the Report on Historically Significant Waterpower Equipment will inform the development of the HPMP.
NPS (March 20, 2024)	Historically Significant Waterpower Equipment	Essex is not proposing to compile a condition assessment on the actual canal walls, so it is unclear how will they determine the long-term stability and viability of the canals. Essex's maintenance program is barely a triage process. Decades of deferred maintenance must be addressed outside the context of mitigation. Any condition assessment must include a canal assessment. Project operations lower water levels which impacts the underlying condition and subsequently project operations.	Essex is proposing the Condition Assessment of Historic Properties and Associated Canal System as provided for in Section 18, which includes a desktop evaluation of the North and South Canals.
State Agencies			
MADMF (March 11, 2024)	Downstream Migratory Species Passage Assessment	Essex's approach to propose PM&E's in lieu of conducting studies to evaluate existing conditions, has merit and is supported by the MA DMF. However, the goal of the MA DMF's Study Request 1 is to assess behavior, passage success, immediate and latent survival, and internal and external injury of target species as they encounter the Project during downstream migrations through all downstream passage routes.6 Essex's proposed PM&E measure only addresses one viable passage route, turbine passage. Other potential downstream routes include the Project's spillway, North and South canal gatehouses and canal systems, and the Project's downstream fish bypass. While we agree that Essex's proposal to install a narrow spaced trashrack would eliminate the need to assess turbine entrainment and passage survival through the Project's intake, at this time, the proposed PM&E measure does not address all downstream passage routes; and therefore, we continue to support our Study Request 1 for the remaining passage routes at the Project and ask that Essex include a Downstream Fish Passage Assessment, commensurate of its licensing proposal, in the Revised Study Plan (RSP).	<p>In review of existing information and study requests, Essex anticipates providing proposed PM&Es to limit or prevent fish entrainment through the Project's turbines. In particular, Essex is proposing to develop, in consultation with the MRTC, a narrow-spaced trashrack design to replace the existing trashrack system. Essex believes this proposal for a PM&E measure to screen the Project's intake would greatly inform the new Project proposal and would likely result in reduced study costs. Essex understands that while fish entrainment during downstream passage may be mitigated by this PM&E, the existing downstream fish bypass survival for emigrating diadromous species (i.e., adult and juvenile alosines and adult American eel) will need evaluation at a later date. As noted by the Commission in their October 13, 2023 letter, Essex will consult with the MRTC regarding this PM&E and provide details of PM&E proposals within the DLA.</p> <p>Given that Essex is proposing PM&E measures related to fish entrainment and passage, Essex is not proposing to perform the Downstream Fish Passage Assessments for diadromous species. Alternatively, Essex is proposing to perform the Desktop Entrainment, Impingement, and Turbine Passage Survival Study (See Section 9). Essex also believes that existing information is sufficient for evaluation of fish survival, delay and route selection for emigrating diadromous species. Normandeau Associates, on behalf of Essex, performed a Downstream American Eel Passage Assessment at the Lawrence Hydroelectric Project in 2019, and an Evaluation of Adult Alosine Downstream Passage Effectiveness in 2020. An overview of the results of these studies is provided in Appendix C. Essex intends to file these two reports in their entirety with the Commission prior to the issuance of the SPD. These studies were performed proactively in conjunction with other studies and are "new" studies to the Commission and relicensing participants. Essex believes that existing information used along with the proposed Desktop Entrainment, Impingement, and Turbine Passage Survival Study, and the proposed PM&E measures, are sufficient for the Commission's Environmental Analysis.</p>
MADMF (March 11, 2024)	Diadromous Fish Behavior, Movement, and Project Interaction Study	<p>Essex's position on our Study Request 5 is unclear. While the PSP implies a study may be developed in the future, Essex did not commit to doing so, the PSP clearly states it is not proposed, and the PSP does not include a process for the development of that study. We note that the PSP did not address the study criteria outlined in 18 CFR 5.9 in its discussion of our Study Request 5 and its reasoning for not adopting the requested study. For the reasons discussed in our Study Request 5, the MA DMF continues to seek the development and implementation of the Diadromous Fish Behavior, Movement, and Project Interaction Study and asks that Essex include the requested study in its RSP.</p> <p>Additionally, MA DMF provides the following recommendations that should be considered to determine the appropriate type and number of tags to deliver the needed data. A successful study plan should incorporate:</p> <ul style="list-style-type: none"> • A telemetry technology/system that will allow for many fish to simultaneously occupy the study area, employing high frequency, high transmission rate tags. The selected tags should maximize transmission rate and detectability in high-noise environments while minimizing data loss through tag collisions. • A routine tagging program throughout the migratory season that includes tagging of both the predator and prey species to determine the behavior of both. Tag allocation should be much higher for the prey species. Essex should minimize tag burden and handling affects to the greatest degree possible. • Monitoring of environmental variables and Project operations throughout the length of the study. 	Essex is proposing the Diadromous Fish Behavior, Movement, and Project Interaction Study as provided for in Section 11 of this RSP.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MADMF (March 11, 2024)	Fish Passage Improvement and Feasibility Assessment	<p>In general, we accept Essex's proposed approach to our requested Fish Passage Improvement and Feasibility Assessment (Study Request 7). The development and implementation of our Study Request 7 now, would proactively support a review of fish passage alternatives at the Project, even though Essex is not currently proposing any modification to the existing fish passage facilities. While MA DMF suspects the existing fish passage facilities are woefully inadequate, little data exists to confirm a need for improvements to the Project's fish passage facilities, at this time. As such, MA DMF understands why Essex may find implementation of our Study Request 7 to be premature. We do not agree, however, that next steps should simply be identified in its DLA. Instead, following a review of study results of Essex's proposed Upstream Fish Passage Assessment, Upstream American Eel Passage Assessment, Sections 6 and 7 of the PSP, respectively, and MA DMF's requested Downstream Fish Passage Assessment and MA DMF's requested Diadromous Fish Behavior, Movement, and Project Interaction Study, we ask, pursuant to 18 CFR 5.15(c)(1), that Essex's Initial Study Report (ISR) propose, if appropriate, our Study Request 7. If, at that time, the MA DMF and Essex disagree on the need for our Study Request 7, the MA DMF will ask that our Fish Passage Improvement and Feasibility Assessment be conducted, pursuant to 18 CFR 5.15(c)(4).</p>	<p>Essex is not proposing the Fish Passage Improvement and Feasibility Study because the requested study necessitates data from proposed fish passage studies that have yet to be conducted, as well as the results of the CFD model, and evaluation of PM&E measures and alternatives. See Section 4.2.</p>
MADMF (March 11, 2024)	Upstream Anadromous Fish Passage Assessment	<p>In Section 6 of the PSP, Essex provides its proposed Upstream Anadromous Fish Passage Assessment study plan. The proposed study is largely consistent with MA DMF's Study Request 2, except Essex does not propose to evaluate the effectiveness of upstream fish passage facilities for sea lamprey (<i>Petromyzon marinus</i>). In Section 4.14 of the PSP, Essex states that it does not propose to assess sea lamprey because (1) the 2021 Merrimack River Watershed Comprehensive Plan for Diadromous Fishes (MRTC 2021) does not provide upstream effectiveness goals for sea lamprey, and (2) there is lack of available existing information to evaluate and assess passage efficiencies for sea lamprey. MA DMF recommends sea lamprey be included in this study, as previously requested. The only information we have related to sea lamprey at the Project is count data from the fish lift, which does not characterize their movements through the Project area or the passage effectiveness of the Project. The absence of numerically-specific upstream passage effectiveness goals does not negate the need to evaluate Project effects on sea lamprey or the Project's ability to provide safe, timely, and effective fish passage. MA DMF's overarching management goal for sea lamprey in the Merrimack River, as outlined in the Comprehensive Plan, is to restore and maintain sustainable runs for human and ecological benefits. Information from the proposed study, as requested, will support an assessment of the Project's effects on the safe, timely, and effective upstream passage of sea lamprey and inform the need for potential license conditions to improve passage conditions. Therefore, we do not support Essex's proposal to omit sea lamprey from the proposed Upstream Anadromous Fish Passage Assessment, and we encourage Essex to consider including lamprey in this study in their RSP.</p>	<p>Essex does not propose to evaluate the effectiveness of the existing upstream fish passage facilities for sea lamprey as it is not clear how this evaluation would inform license requirements. It is not clear how the Project's license would be modified based on results of an evaluation of sea lamprey. See Section 4.13.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MADMF (March 11, 2024)	Upstream Anadromous Fish Passage Assessment	<p>In Section 6.6.1, Sample Size, Essex proposes to observe 100 radio tagged individuals of each target fish species. To accomplish this and based on a presumed rate of fallback, and an assumed rate of mortality and predation for adult American shad, adult alewife and blueback herring (collectively, river herring), Essex proposes to tag 165 American shad and 185 river herring. This approach is flawed for several reasons, including:</p> <ul style="list-style-type: none"> • Section 6.6.1 provides no supporting information to indicate that a sample size of 100 individuals observed below the project for each group targeted would generate statistically significant results. To properly justify a meaningful sample size, Essex should perform simulations with program MARK (as specified in Section 6.6.6.3 Data Analysis – Parameter estimates for Evaluating Passage Success) to identify a sample size where the point estimate and corresponding 95% or 75% confidence interval overlapped the true survival or passage value (see Molina-Moctezuma and Zydlewski 2020). These simulations should be run for realistic (meaning values from the literature that reflect high stress sampling methods and complex antenna environments) combinations of fallback, post-tag mortality, and detection efficiencies. The minimum number of samples needed to yield reliable results should then be applied to what might be expected at the most upstream passage station to produce viable results for total Project passage, meaning attrition through all components of passage should be accounted for in the number arriving at the most downstream point of the study. • Essex's method of arriving at a necessary samples size is incorrect and produces tagging numbers that would not be expected to yield 100 fish at the Project. Essex calculated sample size by starting at 100 and asked what was 50% of that number, meaning with alewife and a mortality rate of 50% they added 50 tags. However, to get the correct number of tags the question is not what is 50% of 100, it is what number would yield 100 after a loss of 50%? As an equation, it would be presented as $100 = x * (1 - 0.5)$ where solving for x would resolve to $x = 100 / 0.5 = 200$. If you treated mortality and fallback sequentially, you would then calculate the 21% fallback $x = 200 / (1 - 0.21) = 253$. This will still be an underestimate as fallback and tagging mortality are not sequential, they are simultaneous. In the case of alewife, Essex has not decomposed mortality from their expected predation and tagging mortality, but if we considered all tagging effects (i.e., mortality and fallback) additive the needed amount of tags to get 100 tagged river herring to the project would be 345. So, the actual number needed based on their expected mortality and fallback rates would be between 253 and 345. For shad, the tags needed based on the rates in the PSP can be calculated additively, meaning $x = 100 / (0.25 + 0.33) = 238$. While the number of total tags required to complete this study would lead to tag interference if all fish survived and approached the Project, it is important to remember that at no point would all these tags be expected to be in the region of interest (above Station 3) as tag releases would be staged over the season and the actual required sample sizes would still be expected to yield Essex's proposed 100 tags in that area. If this is still an overwhelming concern, we recommend the study be split to evaluate different target species groups over two upstream migration seasons. • The fallback and mortality rates used in the PSP were justified as being similar to what was experienced by tagged fish in the recent studies at the Lowell Project. However, those fish were collected by dip net from the exit channel of the Lawrence fishway while the fish for the current study will be electro-fished. These methods differ greatly in that fish that had already ascended the Lawrence Project selected for individuals that were highly motivated and in adequate condition to aggressively migrate upstream. The condition of fish tagged below Lawrence would be unknown but unlikely to select for 100% of fish that would be passing Lawrence. Secondly, electrofishing is more stressful to fish than dip-netting, meaning there will likely be greater post-tagging effects on fish in this study. The alosine tagging literature has mortality rates between 17-75% and fallback between 24-71% (Beasley and Hightower 2000, Bailey et al. 2004, Aunins and Olney 2009, Aunins et al. 2013, Grote et al. 2014, Gahagan and Bailey 2020). • Our Study Request 5 treated alewife and blueback herring as separate species to be assessed. The proposed study plan combines these species and addresses them as one. While alewife and blueback herring are similar species, they do exhibit different migratory behaviors and should be evaluated independently. We recognize the consideration raised in Section 6.6.1 that increasing "...the number of test fish required... must be weighed against the functional limitations of effectively monitoring large numbers of fish within any one detection zone due to collisions among tag signals." If upon adopting our recommendations, it is determined that poor data will be the result, instead of conducting the study in one migratory season, we recommend the study be split to evaluate different target species groups over two upstream migration seasons. <p>In summary, we recommend that section 6.6.1 of the RSP (1) include a simulation or power analysis and justification for the number of targeted observed radio tagged individuals, (2) apply the correct equations to calculate sample sizes that would be expected to yield the target number of fish, (3) re-consider expected mortality and fallback rates where appropriate, (4) treat alewife and blueback herring as separate species, and (5) consider the need for multiple study seasons to support data integrity.</p>	Essex conducted a minimum size sample analysis as provided for in Section 6.6.1 of this RSP. This method considers fallback rates and predation, as well as population passage rates based on the literature, margin of error, and confidence level. Using that targeted minimum and the methodology to adjust due to predation and fallback rates, HDR, on behalf of Essex, produced the initial sample size of shad to be tagged.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MADMF (March 11, 2024)	Upstream Anadromous Fish Passage Assessment	<p>In Section 6.6.3, Radio Telemetry Monitoring Stations, Essex proposes to establish and monitor 10 monitoring stations. However, as demonstrated in Figure 6-2 of the PSP, none of the proposed monitoring stations would be situated to monitor (1) how fish approach the Project, (2) false attraction to the Project's spillway, (3) milling or disorientation in the tailrace, or (4) fish passage success and escapement through the Project's headpond. As such, MA DMF recommends the addition of the following monitoring station(s):</p> <ul style="list-style-type: none"> • Area below the Duck Bridge as fish approach the Project flows (below proposed Station 3, covering the approach to the immediate project flows); • Coverage for the entire area below the spillway to identify area of false attraction under all flow conditions encountered during the study (between proposed Stations 3 and 4); • Area between the rock face on river right and the stone abutment separating the spillway and powerhouse flows to identify fish that have entered the flow field of the powerhouse and fishway (between proposed Stations 3 and 4, identifying fish that have entered the tailrace and are available for passage); • Coverage of the start of the northern (river side) fishway entrance flow field (between proposed Stations 3 and 4); • Two antennas upstream of Station 9 to identify fish that drop back into the intake and bypass flows after exiting the exit flume and those that eventually depart the immediate vicinity of the powerhouse; • An antenna at the upstream limit of the Project's impoundment help determine predation and delay in the impoundment and a second antenna upstream of that to provide a viable detection probability for the antenna at the limit of the impoundment. It is possible that the proposed Station 10 could function as one of these antennas or be moved to do so. <p>Please see below the modified Figure 6-2 from the PSP to illustrate the added antennae needed (red ellipses) surrounding the powerhouse and spillway:</p>	<p>On March 28, 2024 and April 1, 2024, Essex held a call to discuss the Upstream Anadromous Fish Passage Assessment with the MRTC. Among the items discussed was the inclusion of additional monitoring stations as part of the Upstream Anadromous Fish Passage Assessment. As added to Section 6.6.3 of this RSP, Essex added Station 4 to better detect passage at the lower portion of the downstream tailrace below the powerhouse, and Station 11 to provide detection information for radio-tagged fish having exited the upstream exit flume of the Lawrence fish lift and moved into the Project forebay. Station 12 was added to inform on radio-tagged individuals which have exited the upstream exit flume of the Lawrence fish lift and moved upstream to the point where they are exiting from the powerhouse forebay. In addition, Station 14 will be the furthest upstream location monitored for radio-tagged test fish and will be installed along the mainstem of the Merrimack River at a point between Station 13 and the Lowell Project.</p> <p>Where appropriate, Essex will capture fish behavior in the Diadromous Fish Behavior, Movement, and Project Interaction Study, which has been provided in Section 11 of this RSP.</p>
MADMF (March 11, 2024)	Study of Upstream Fish Passage Effectiveness for American Eel	<p>Section 7.3 Study Area defines the study area as "...the section of the Merrimack River located immediately downstream of the Essex Dam and the existing upstream eel passage facilities." This geographic scope is too large and should be reduced accordingly. We recommend modifying Section 7.3 as follows: The study area will include the section of the Merrimack River located immediately downstream of the Essex Dam, proximal to and the existing upstream eel passage facilities.</p>	Essex revised the proposed Upstream American Eel Passage Assessment in Section 7 of the RSP to address this comment.
MADMF (March 11, 2024)	Study of Upstream Fish Passage Effectiveness for American Eel	<p>In Section 7.6.2.2 Eel Tagging and Releases, notes that up to 500 juvenile eel will be tagged with a 12 millimeter (mm) passive integrated transponder (PIT) tags. The study proposes to tag two size classes of eels, individuals less than or equal to 150 mm and those greater than 150 mm. Given the size of the 12 mm PIT tags, the study plan appropriately establishes an eel minimum size threshold of 113 mm.</p> <p>Juvenile eel sampling conducted by United States Fish and Wildlife Service (USFWS) at the Project in 2015, indicates the majority of eel at the site are 110mm or shorter. Of the 761 eels captured in the Project's eel ladder on July 29, 2015, 755 were less than 110 mm, none were between 110 mm and 120 mm, and 6 were over 120 mm. Given this information, MA DMF is concerned that the proposed study methodology will skew the tagged sample population such that it is not representative of the eels utilizing the upstream passage facilities at the Project. As a result, MA DMF recommends the proposed study include a contingency marking/tagging and recapture methods (e.g., visual elastomer tags) in the event the size of eels captured during the study plans' implementation is like that experienced during USFWS' 2015 sampling effort.</p>	Essex revised the proposed Upstream American Eel Passage Assessment in Section 7 of the RSP to address this comment.
MADMF (March 11, 2024)	American Eel Upstream Passage Siting Study	<p>In Section 8.6.1 Nighttime Visual Surveys, of its PSP, Essex proposes to conduct nighttime surveys to reevaluate the spatial distribution and relative abundance of juvenile eels downstream of the Essex Dam and other Project structures. Essex provides a list of "potential" survey areas noting that they "...will only be searched pending a determination that there are no significant health or safety risks associated with accessing and entering those locations." We note that the downstream face of the Project's dam and tailrace are excluded from the list of survey areas and recommend the RSP include them in the list of Project features where nighttime visual surveys occur. Conducting environmental surveys in and around hydroelectric projects is inherently dangerous, and MA DMF appreciates Essex's commitment to the protection and safety of personnel. MA DMF expect Essex to take every precaution necessary to keep personnel safe through the development of proper safety protocols, provision of any necessary personal protective equipment (PPE), and training. MA DMF asks that survey locations only be removed if the hazards cannot be mitigated and that Section 8.6.4 Data Analysis and Reporting of the RSP include provisions for reporting why any survey areas, for any sampling method, are removed from survey and all measures considered to mitigate the potential hazard(s) but determined to be inadequate.</p>	Essex updated the American Eel Upstream Passage Siting Study in Section 8 of the RSP to address this comment.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MADMF (March 11, 2024)	American Eel Upstream Passage Siting Study	Section 8.6.2 Electrofish Surveys of the PSP, states that backpack electrofishing surveys will be conducted downstream of Essex Dam. Section 8.6.2, however, does not specify the area(s) for electrofishing surveys to occur. To provide a more robust estimate of the relative abundance and body size distribution of juvenile American eels found in the Project's vicinity and waters, MA DMF recommends the RSP include electrofishing surveys within (1) the Merrimack River from the Project's dam to the tailrace, (2) within the Spicket River from its confluence with the Merrimack River to the terminus of the North Canal, and (3) within the North and South canals in their entirety. Electrofishing survey techniques should not be limited to backpack electrofishing and may include other electrofishing methods (e.g., boat electrofishing) as environmental factors (e.g., water depth, substrate, etc.) may dictate. We also recommend section 8.6.2 of the RSP note that any eel captured during canal electrofishing surveys be released to the Project's impoundment if agreed upon by the Massachusetts Division of Fisheries and Wildlife.	Essex updated the American Eel Upstream Passage Siting Study in Section 8 of the RSP to address this comment, with the exception of electrofishing in the North and South Canals.
MADMF (March 11, 2024)	American Eel Upstream Passage Siting Study	The PSP, in Section 8.6.3 Temporary Eel Traps, states that up to two temporary eel traps will be deployed in locations determined in consultation with the MRTC and in consideration of site access, personnel safety, and site security. MA DMF recommends Section 8.6.3 of the RSP be revised to provide for a minimum of three temporary eel traps to be deployed as follows: at the downstream side of the North and South canal gatehouses, and at the downstream side of the terminus of the North Canal at the Spicket River. Precise placement of the trap ramps and the need for additional traps should be determined in consultation with the MRTC prior to the start of the ten-week survey period.	Essex updated the American Eel Upstream Passage Siting Study in Section 8 of the RSP to address this comment.

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MADMF (March 11, 2024)	Stranding Evaluation Study	<p>In addition to the Essex's proposed desktop evaluation, MA DMF's Study Request 8 included field surveys. Specifically, Phase 1, Task 2 of our requested study included the following field components:</p> <ul style="list-style-type: none"> • Survey and map potential stranding sites and topography of the habitat beneath the Project's spillway within the zone of tailwater surface elevation fluctuation. • Examine potential stranding sites in the study area at an appropriate time interval after an operational change. • Provide time lapse photography to monitor potential stranding sites. • Monitor and document depth at potential stranding sites before and after an operational change, such as a reduction in spill as a crestgate is inflated, to identify areas that become rapidly isolated or dewatered in a manner that may strand fish when they are present. • Document the number, location, and species of fish stranded, and detailed project operations that caused the stranding event. In addition, the conditions of the study/stranding area should be photo-documented. • Document the number and species of fish stranded within the turbine bays, draft tubes, and upstream and downstream fish passage facilities during routine maintenance activities. <p>Essex notes that only two stranding events were identified in our Study Request 8 and finds that our requested study methods assumes that fish stranding events may occur under any or all operational changes. We respectfully disagree. Our requested study does not presume that fish stranding occurs under all Project operational changes. To the contrary, our study request seeks to identify which operational scenarios or aspects of those scenarios that do result in fish stranding events. This information could then be used to inform PM&E measures that avoid these conditions. There are two known events in recent history that by chance the New Hampshire Fish and Game Department (NHFGD) was present to document. This does not imply that the project operational conditions associated with these two events are the only scenarios that result in fish strandings at the Project. Without our requested field surveys and actively looking for stranded fish in conjunction with changes in project operations, the proposed study will only provide data on the two discrete events documented by NHFGD and will not inform license conditions that avoid or mitigate all stranding events that may be caused by project operations. Finally, MA DMF's Study Request 8 also sought information on fish strandings associated with routine project maintenance. Essex's PSP Section 9 study would not provide any information on fish strandings within the turbine bays, draft tubes, and upstream and downstream fish passage facilities, or the canal systems during routine project operation and maintenance activities. As a result, MA DMF recommends that Essex's RSP Section 9 include the requested field surveys outlined in our Study Request 8, Phase 1, Task 2 and the Project's associated canal system.</p> <p>Essex's proposal to use its proposed CFD modeling study to further evaluate potential fish stranding in the Project's vicinity is consistent with MA DMF's Study Request 8. However, the geographic scope for CFD modeling downstream of the Project, as proposed in the PSP Section 12.3 Study Area, is limited to areas downstream of fishway entrances within the tailrace, and internally within the fish lift. In contrast, Essex's PSP Section 9.3 Study Area identifies the geographic scope of the proposed Project Operations and Fish Stranding Study to be the tailrace, and the downstream reach below the Essex Dam. Therefore, the geographic scope of the CFD modeling study is inadequate to inform the analysis proposed by Essex in the PSP Section 9 study. For this reason, MA DMF recommends that the RSP's Section 12.3 be revised to include the Merrimack River from the downstream face of the Project's dam to the downstream side of the Union Street Bridge. We provide additional comments on Essex's proposed CFD modeling study in Three-Dimensional Computational Fluid Dynamics (CFD) Modeling (PSP Section 12) below.</p>	<p>Essex is not proposing to perform field surveys. These surveys pose an unacceptable level of risk as it would entail persons going below the dam during adverse conditions (e.g. increased spill, night) for likely limited to no information.</p> <p>Based on conversations with the MRTC, Essex understands that the primary areas of concern for potential stranding sites are located below the dam at rock outcrops on either side of the dam (left and right abutments). Essex is proposing to use existing aerial imagery, in combination with collected imagery, to identify potential fish stranding sites further downstream below the Essex dam. Essex anticipates installing trail cameras at a location on either side of the dam to capture hourly photographs of the areas over an extended period of time. Essex anticipates consulting with the MRTC following issuance of the SPD on the location of the trail cameras as well as the period of record for installation. See Section 12.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MADMF (March 11, 2024)	Three-Dimensional Computational Fluid Dynamics (CFD) Modeling	<p>MA DMF's Study Request 1 articulated a need to understand the complex flow fields in the Project's vicinity. This information coupled with data from our requested Downstream Fish Passage Assessment (Study Request 5), Upstream Anadromous Fish Passage Assessment (Study Request 4), Upstream American Eel Passage Assessment (Study Request 3), Diadromous Fish Behavior, Movement, and Project Interaction Study (Study Request 6), and the Fish Stranding and Ramping Rate Study (Study Request 8) will inform an analysis of Project effects on these aquatic resources and the development of potential PM&E measures to address those effects.</p> <p>Essex's PSP recognizes the benefit of the CFD modeling study in Section 4.1, where it states that the Proposed Section 12 CFD modeling study complements its proposed Upstream Anadromous Fish Passage Assessment (PSP Section 6), the American Eel Upstream Passage Siting Study (PSP Section 8), and the Project Operations and Fish Stranding Study (PSP Section 9). While this statement could be true, Essex's proposed CFD modeling study and its associated geographic scope constrains modeling results such that, as proposed it will only inform an assessment of upstream anadromous fish passage. As discussed above, the PSP's Section 9 Project Operations and Fish Stranding Study specifies that CFD modeling results will be integrated to inform that study. Unfortunately, for reasons discussed therein, the proposed CFD modeling will not support Essex's Project Operations and Fish Stranding Study either.</p> <p>With a proper geographic scope CFD model results can inform an analysis of fish behavioral data collected by other proposed and requested studies. As discussed above, MA DMF recommends that Essex's RSP include MA DMF requested Studies 5 and 6, and Essex's proposed PSP Sections 6, 8, 9, and 11 with our recommended modifications. As a result, and to support an analysis of the Project's effects on aquatic resource and the development of potential license conditions, MA DMF recommends the RSP include a Hydraulic Modeling Study with a geographic scope consistent with our Study Request 1.</p>	Essex considers the 3D CFD model as proposed sufficient for the Commission to perform their Environmental Analysis.
MassWildlife (March 11, 2024)	Invasive Plant Baseline Study: Survey, Mapping and Assessment	<p>MassWildlife's Study Request would characterize current baseline conditions of invasive species needed to assess the continuing Project effects and potential PM&E measures to address such effects. Artificial impoundments, reservoirs, and canals, as areas of altered natural flows, are more vulnerable to invasion and establishment of invasive species than natural systems. For example, artificial impoundments tend to have less abundant and less diverse plant communities and more disturbed habitats, priming them for invasion by invasive species. Land disturbances from past and ongoing Project maintenance, as well as that for future maintenance, favor establishment of invasive plants over native plants. Using citizen reported data from INaturalist⁹, there are nineteen (19) invasive species reported within 200 feet of the Merrimack River between the upstream Essex Dam and downstream to the first major grade break. Of these, 17 of 19 are species found within habitats found around the Project and area of influence. Continued Project operations during the next license term will continue these ongoing Project effects. Studies to establish baseline conditions during relicensing are common and supported by the Commission's Guidance Document¹⁰. Measures to address invasive species are often included in license conditions. While the PSP suggests that Essex may propose measures to control invasive plants, without baseline information about invasive species, it is unclear how such measures will be informed. Therefore, MassWildlife asks that Essex include our INVASIVE PLANT BASELINE STUDY: SURVEY, MAPPING AND ASSESSMENT (STUDY REQUEST 1) in the Revised Study Plan (RSP).</p>	<p>Essex is proposing to record readily identifiable non-native species during the three vegetation surveys of the North and South Canals, to be performed as part of the Recreation Facilities, Use, and Aesthetics Study Plan See Section 16. The three surveys aim to capture vegetation through the growing season (e.g. start, peak, end).</p> <p>Essex maintains that the Invasive Plant Survey request is focused on conducting a broad investigation or general research rather than requesting a specific study intended to measure any direct project impacts on a known resource. Commonly aquatic invasive species are introduced by recreational boating and other recreation activities. It is not feasible for Essex to assess invasive species due to the dynamic nature of invasive plant populations and the continuous risk of introduction and establishment of these species by non-project related sources at any given time. See Section 4.10.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MassWildlife (March 11, 2024)	State-listed Odonates and Assemblage, Baseline Data Collection and Assessment of Operational Impacts	<p>MassWildlife's study would characterize the emerging rare 11 riverine odonate (dragonflies and damselflies) assemblage and habitats. The study requested water flow and elevation data sufficient to understand the relationship between odonate emergence/eclosure and project operations. This study is a necessary component of assessing the potential effects of Project operations on State-listed and special conservation status odonate populations and habitat use. Odonates are a critical element of aquatic ecosystems both for their role as aquatic prey and predator, but also for their role as aerial prey and predator during the adult flight period. We strongly disagree with Essex's application of their own criterion 5 (see cover letter). We will address other elements of their response below.</p> <p>Essex continues to state that the project is operated as run-of-river, where inflows equal outflows, but data to support that statement has not been submitted on the record (see cover letter). As just one example deviation from run-of-river, and information submitted on the record, is that Essex performs maintenance drawdowns in the impoundment and plans to include routine maintenance drawdown in the next license. The timing, rate of change, and magnitude of these drawdowns and other potential flow alterations are critical for impact assessment to rare odonate populations within the impoundment and downstream of the dam. Previous FERC studies at Turner's Fall Dam on the Connecticut River (P-1889, Relicensing Study 3.3.10) demonstrate how altered flows risk inundation and hence mortality of several rare odonate species during their brief and highly vulnerable eclosion periods. This includes a similar species assemblage found in the Merrimack River including the State Endangered Riverine Clubtail, which is likely most impacted from operations because of its short eclosion distance from the waterline.</p> <p>Furthermore, it's unknown how the odonate composition and relative abundance are distributed by available river habitat driven directly and indirectly by Project operations including lentic conditions in the impoundment (e.g., slower water velocity, fine sediment accumulation, increased water temperatures, see MassWildlife Run-Of-River comment above). The requested study provides the necessary baseline data to establish protection, mitigation, and enhancement measures for future Project operations. The Commission required the completion of odonate studies for other re-licensing of, most recently for the Turner's Falls Dam (FERC No. P-1889, Biodiversity 2015), and the Wilder Hydroelectric Dam (P-1892), Bellows Falls Hydroelectric Project (P-1855), Vernon Hydroelectric Project (P-1904) (Study 25 Dragonfly and Damselfly Inventory and Assessment for the latter three). MassWildlife's study request is consistent with these studies and the Commission's study request criterion. Therefore, MassWildlife asks that Essex include our State-listed Odonates and Assemblage, Baseline Data Collection and Assessment of Operational Impacts (Study Request 8) in the RSP.</p>	<p>Essex is not aware of an identified, site-specific problem with odonates (dragonflies and damselflies) populations and Project effects. The Project currently and as proposed operates as ROR with no bypassed reach, meaning inflows to the Lawrence Project match outflows below the Project. The Project is limited to operating in a ROR mode by reacting to and passing inflows, therefore the Project is not fluctuating its upstream impoundment (e.g., store and release or peaking operations) resulting in water elevation changes that may affect potential odonates.</p> <p>However, as discussed during the PSP meetings, Essex is proposing to provide PM&E measures to mitigate any potential Project impacts to odonates during occasional unit trips and Project maintenance activities. See Section 4.9 of the RSP.</p>
MassWildlife (March 11, 2024)	Fish Assemblage Assessment	<p>MassWildlife addressed Essex's approach to Criterion 5 (see cover letter) and will address other elements herein. While the PSP indicates the existing fishery resources are "exhaustively summarized" in the PAD, Section 5.4.2 Existing Fish and Aquatic Resources only identifies migratory fish species found in the Project's vicinity. The PAD's Table 5.4.1 identifies a total of 49 fish species found within the Merrimack River watershed from its headwaters in the White Mountains of New Hampshire to its mouth at the Atlantic Ocean, approximately 117 miles of river that traverses from high mountain grades through multiple hydroelectric dams with their own operational parameters and out to and including tidally influenced and tidal sections of the river. Within this length will be a mixture of migratory and resident fishes with variable habitat needs. The goal of MassWildlife's Study Request 4 is to establish the existing and baseline of fish species within the vicinity of the Project.</p> <p>Determining species occurrence, distribution, and abundance of fish species will clarify what species occur in the project influenced area, both spatially and temporally relative to habitats which may be affected by Project operations. This information will also 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.</p>	<p>Essex updated the American Eel Upstream Passage Siting Study (Section 8) to provide additional data collection on the general fish assemblage downstream of Lawrence Dam. During that study, all non-anguillid fish species will also be netted during eel electrofishing events. Fish will be identified to species, counted, and total length to the nearest mm will be recorded. Essex considers this collection of fish assemblage data downstream of the Lawrence dam commensurate to which there is a known issue or problem. See Section 4.1.</p>
MassWildlife (March 11, 2024)	Fish Assemblage Assessment	<p>Essex further states that "requestors should also describe why existing information is insufficient to inform the development of license requirements and/or contribute to the development of PM&E measures."</p> <p>The only relevant data to the Project was collected by MassWildlife in 2009 through boat electrofishing. This sampling effort encompassed less than 1 percent of the available habitat and focused on only one of the habitats present in the river, mid-depth pools. Consequently, the data produced by the 2009 surveys are not considered representative of a complete species assemblage of habitats potentially impacted by Project operations. A study that yields robust representation of the fishes in the project area requires sampling of all habitat types, using a variety of sampling techniques, as outlined in the MassWildlife study request.</p>	<p>Essex updated the American Eel Upstream Passage Siting Study (Section 8) to provide additional data collection on the general fish assemblage downstream of Lawrence Dam. During that study, all non-anguillid fish species will also be netted during eel electrofishing events. Fish will be identified to species, counted, and total length to the nearest mm will be recorded. Essex considers this collection of fish assemblage data downstream of the Lawrence dam commensurate to which there is a known issue or problem. See Section 4.1.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MassWildlife (March 11, 2024)	Fish Assemblage Assessment	<p>In the PSP, Patriot states that “MassWildlife do not mention the recent and robust Fish Assemblage Study that was performed upstream at the Lowell Project in 2020 (Normandeau 2021). USFWS and MassWildlife do mention 2009 surveys at the Lawrence Project, the results of which are consistent with the Lowell Fish Assemblage Study and the information provided in the Project PAD.”</p> <p>Essex argues that the Fish Assemblage Study performed upstream at the Lowell Project in 2020 (Normandeau 2021) are consistent with the PAD and offers additional, adequate information. MassWildlife reviewed the Normandeau (2021) Fish Assemblage Study for the Lowell Project. The study was conducted upstream of the Lowell project. This study offers some good, general fish information relative to the lower Merrimack River, but it is an inappropriate analog for the Lawrence Project. The Lawrence Project is located 11 miles downstream of the Lowell Project and is characterized by a different suite of habitat types (e.g., larger drainage area, tidally influenced freshwater habitats). Fishes in the Lawrence Project vicinity are cumulatively impacted the upriver dams and the Lawrence Project, both through physical habitat effects and passage challenges. Fish assemblages reflect differing river habitats as well as in response to the cumulative effects of anthropogenic impacts on those habitats, including from the presence of dams and their impoundments. It is well-established that fish assemblages change according to their longitudinal location within river systems (Vannote et al. 1980, Sedell et al. 1989, Doretto et al. 2020). Also, dams and their impoundments can increasingly alter fish assemblages from historical configurations in ways that can diminish biodiversity and reduce species persistence (Poff et al. 2007, Liemann et al. 2012, Cooper et al. 2017). The Essex PSP did not provide appropriate information to describe fish assemblages, nor provide adequate alternatives to providing this information through the adopted studies.</p>	<p>Essex updated the American Eel Upstream Passage Siting Study (Section 8) to provide additional data collection on the general fish assemblage downstream of Lawrence Dam. During that study, all non-anguillid fish species will also be netted during eel electrofishing events. Fish will be identified to species, counted, and total length to the nearest mm will be recorded. Essex considers this collection of fish assemblage data downstream of the Lawrence dam commensurate to which there is a known issue or problem. See Section 4.1.</p>
MassWildlife (March 11, 2024)	Fish Assemblage Assessment	<p>Essex states that “agency representatives with jurisdiction over the Merrimack River fisheries [including MassWildlife] and the Lawrence upstream and downstream fish passage structures have a comprehensive understanding of the fish communities associated with the Project.” They state that “representatives of the MRTC regularly visit the Project’s upstream fish lift and have firsthand knowledge of the fish species that enter the lift...Essex believes that available information is adequate to characterize existing fish resources.”</p> <p>MassWildlife is a member of the MRTC and disagrees that there is comprehensive understanding of the fish communities associated with the Project. The PSP inaccurately represented existing knowledge of fish communities associated with the Project. While fish counts at the passage structures can provide insight on fish species that pass through the Project and are counted, fish counts do not offer any information about fishes that may approach the passage structures and not enter them, nor do they consider fishes and their habitats impacted by Project operations due to factors beyond by passage. Fish passage data cannot provide an accurate description of fish communities experiencing ongoing Project effects, rather, it provides information about fish that are passing through the passage structures. In order to develop relevant license conditions, fish assemblage information needs to include all fishes associated with the Project area and effects. Therefore, Project-specific fish assemblage information continues to be necessary.</p>	<p>Essex updated the American Eel Upstream Passage Siting Study (Section 8) to provide additional data collection on the general fish assemblage downstream of Lawrence Dam. During that study, all non-anguillid fish species will also be netted during eel electrofishing events. Fish will be identified to species, counted, and total length to the nearest mm will be recorded. Essex considers this collection of fish assemblage data downstream of the Lawrence dam commensurate to which there is a known issue or problem. See Section 4.1.</p>
MassWildlife (March 11, 2024)	Fish Assemblage Assessment	<p>The PSP states, “MassWildlife do not provide any data gaps or sufficiently pose a problem with the existing information provided, and it is unlikely that there have been any significant changes to this reach that would make previous evaluations no longer accurate...As such, potential Project effects are unlikely to have any measurable, causal relationship with general fish species composition.”</p> <p>MassWildlife identified both data gaps and problems with the existing information in the submitted Fish Assemblage Study Request. The Essex PSP did not provide evidence that “potential Project effects are unlikely to have any measurable, causal relationship with general fish species composition.” Supporting data was not provided by the Essex PSP nor is known to exist by MassWildlife subject matter experts (R. Quiñones, pers. comm. 2024, C. Slater, pers. comm. 2024).</p> <p>Further, the existence of the dam and impoundment result in ongoing effects to the fisheries and downstream habitats. For instance, retention of sediments behind dams starves downstream habitats from the full spectrum of sediments found naturally, while also cementing existing sediments (Kondolf 1997, Graf 2006, Schmutz and Sendzimir 2018 and references therein). These impacts to sediment distribution have been documented even when dams are ROR (Fantin-Cruz et al. 2016). Furthermore, changes to sediment transfer due to dams and their operations are known to result in decreased fish diversity as well as decreased spawning success of a variety of lithophilic species (aka gravel-loving species), including sturgeon and lamprey. Species of both sturgeon and lamprey are known to occur in the Project area but their distribution, abundance and potential interactions with the Project are unknown. MassWildlife’s Fish Assemblage Study, as well as our requested sturgeon studies¹², would provide the information necessary to address these data gaps.</p>	<p>Essex updated the American Eel Upstream Passage Siting Study (Section 8) to provide additional data collection on the general fish assemblage downstream of Lawrence Dam. During that study, all non-anguillid fish species will also be netted during eel electrofishing events. Fish will be identified to species, counted, and total length to the nearest mm will be recorded. Essex considers this collection of fish assemblage data downstream of the Lawrence dam commensurate to which there is a known issue or problem. See Section 4.1.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MassWildlife (March 11, 2024)	Fish Assemblage Assessment	<p>MassWildlife delineated habitats between the Lowell dam and the Highway 95 bridge at Salisbury Point (Essex PSP) as the area for the fish assemblage study. Essex argued that this “nearly 41-mile stretch of river, most of which is outside the Project boundary, has little or no nexus to the Project operations.”</p> <p>Dams and impoundments alter water quality and downstream habitats (as in Poff et al. 2007, Fantin-Cruz et al. 2016, Abbott 2023). Dams have been documented to increase water temperatures, decrease oxygen concentration, alter nutrient transfer, and result in more abundant invasive species within impoundments and downstream habitats. Studies by the Massachusetts Division of Ecological Restoration (e.g., Abbott 2023) found that some dams in Massachusetts can significantly increase water temperatures and decrease dissolved oxygen concentrations for several miles downstream. The PAD and PSP offer no information about thermal habitats or species assemblages associated with the project and its effects, nor the extent of those effects. MassWildlife identified Salisbury Point as the shift from freshwater to saltwater influenced habitats.</p> <p>Here and in our study request, we provide a clear nexus between Project operations and fish assemblages within and downstream of the Project. MassWildlife’s Fish Assemblage Study is necessary to determine if “potential Project effects are unlikely to have any measurable, causal relationship with general fish species composition (Essex PSP).” No evidence was provided in the Essex PAD or PSP to support their assertion that Project operations are unlikely to affect fish species. Furthermore, the Essex PSP did not propose any alternative studies to provide the necessary information to support or refute this claim.</p>	<p>Essex updated the American Eel Upstream Passage Siting Study (Section 8) to provide additional data collection on the general fish assemblage downstream of Lawrence Dam. During that study, all non-anguillid fish species will also be netted during eel electrofishing events. Fish will be identified to species, counted, and total length to the nearest mm will be recorded. Essex considers this collection of fish assemblage data downstream of the Lawrence dam commensurate to which there is a known issue or problem. See Section 4.1.</p>
MassWildlife (March 11, 2024)	Fish Assemblage Assessment	<p>The PSP states, “In lieu of a generic fish assemblage study that is better suited for a river that is less understood or managed, Essex is proposing downstream passage measures and a suite of targeted studies related to upstream diadromous fish passage including an upstream anadromous fish passage assessment, an upstream American eel study, and a Project Operations and Fish Stranding Study.”</p> <p>Reliance of studies focused only on diadromous species will not fully describe the fish assemblage potentially impacted by the project as diadromous species only represent a small fraction (<30%; Hartel et al. 2002) of the fish species historically found in the lower Merrimack River. Focusing efforts from the start on a limited subset of the fishery and then only addressing their passage and habitat needs fails to provide information and analysis for the remaining ~70% of fish species.</p> <p>The baseline information requested through this study will help assess ongoing Project effects on the structure, distribution, and abundance of fish species. The information will help MassWildlife and other agencies 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.), the Clean Water Act (33 U.S.C. §1251 et seq.), and the Massachusetts Endangered Species Act. Therefore, we ask that Essex include MassWildlife’s Fish Assemblage Study in its RSP.</p>	<p>Essex updated the American Eel Upstream Passage Siting Study (Section 8) to provide additional data collection on the general fish assemblage downstream of Lawrence Dam. During that study, all non-anguillid fish species will also be netted during eel electrofishing events. Fish will be identified to species, counted, and total length to the nearest mm will be recorded. Essex considers this collection of fish assemblage data downstream of the Lawrence dam commensurate to which there is a known issue or problem. See Section 4.1.</p>

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MassWildlife (March 11, 2024)	Evaluation of Potential Project Impacts on the Merrimack River and Floodplain Habitats throughout the Term of a New License	<p>No information exists on the effects of project operations on key components of Merrimack River ecology, including floodplains. The PAD mentions associated aquatic resources (e.g., list of fish species) but does not state or evaluate how the Project may impact habitats under current and future conditions. Furthermore, the PAD does not consider how climate change may exacerbate project impacts nor how it may alter future project operations and capacity. MassWildlife addressed Essex’s approach to Criterion 5 (see cover letter) and will address other elements below.</p> <p>1. The study request does not provide a methodology. The Commission cannot require a study that lacks definition and methodology to perform the study...”</p> <p>MassWildlife disagrees with Essex’s statement that MassWildlife’s study failed to propose specific methodology for evaluating current and future impacts to sediment transport, water temperature, nutrient cycling, streamflow, and inland flooding. Methodologies with citations and links to manuals for each requested Task are detailed in the study request. However, we welcome discussion of how methods and collections may be aligned to simultaneously meet different agencies’ PSP goals. For instance, the measures of water quality parameters, such as temperature and sediment composition, could be collected using methods outlined in the Massachusetts Department of Environmental Protection’s PSP and still meet the goals of this study.</p> <p>2. The PSP states, “[w]hile Essex acknowledges the importance of climate change, it is unclear how such a hypothetical analysis would inform license conditions for this ROR Project. Potential climate and hydrologic changes that may occur over the course of a 30- to 50-year license are far too speculative to allow for a quantitative evaluation as requested. The state of the science is such that climate change forecasts do not exist that could reliably predict how precipitation, snowmelt, evapotranspiration, ice out, and annual runoff patterns may change 30 to 50 years from now.”</p> <p>The state of climate science has dramatically grown in the recent years and is such that we can predict climate change impacts with “high confidence” (IPCC 2023, NCA 2023). Climate change forecasts currently exist that predict climate change impacts on Massachusetts temperature, precipitation, and hydrology throughout the life of a new license. For instance, mean summer water temperatures in the lower Merrimack River are expected to increase by about 6°F by 2070 (https://www.usgs.gov/apps/ecosheds/ice-northeast/). Extreme low flows at the Project are expected to decrease by 21% in the same timeframe (A. Delsantos and R. Palmer, pers. comm. 2024)13. As stated above responding to SD2, MassWildlife will provide projections of air and water temperatures, precipitation, streamflow, and sea level rise specific to the Project to the Commission. Projections use reliable predictions of precipitation, snowmelt, evapotranspiration, and annual runoff patterns for 2030, 2050, 2070.</p> <p>3. From Essex PSP: “As already noted, the National Environmental Policy Act defines “effects” as changes to the human environment from the proposed action that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action. Effects should generally not be considered if they are remote in time (such as this request), geographically remote, or the product of a lengthy causal chain.” Essex further states that “FERC has determined that climate change studies are not likely to yield reliable data that can be used to develop license requirements.”</p> <p>FERC has included analysis of climate change effects in evaluations of hydropower projects. For example, FERC analyzed climate projections 30-50 years into the future in their Environmental Assessment for the Rollinsford Hydroelectric Project (FERC Project No. P-3777-011). They state “that Hare et al. (2016) identified American shad and river herring as highly vulnerable to the anticipated effects of climate change due to their habitat specialization, dependence on both freshwater and marine resources, sensitivity to water temperatures, and complex spawning cycle. Commerce also states that the effects of climate change in New England may be compounded since the areas surrounding many river basins where shad and river herring are found are heavily populated and have been affected by the effects of agriculture, industrialization, and urbanization, including dams and hydropower development. Commerce states that, for the reasons listed above, the compounding effects of climate change should be evaluated as part of the environmental analysis of the Rollinsford Project.” American shad and river herring in the Lawrence Project area belong to the same management units (or stocks) as those associated with the Rollinsford Project; they are also similarly affected by compounding stressors from climate change, urbanization, industrialization, dams and hydropower development. It would be illogical to require analysis of climate effects on the northerly portion of the management unit, as was required for Rollinsford Project, but not for the southerly portion. Consequently, MassWildlife contends that evaluation of the interaction of climate change and the Lawrence Project is needed as part of FERC’s environmental analysis to understand the effects and ongoing effects of this Project.</p> <p>The PSP also states that the effects of climate change are “remote” in time. First, the duration of FERC licenses are 30-50 years, so the timescale for analysis is appropriate. Further, they are not geographically remote as the study request and specific tasks therein have been scaled to the Project’s area of effect, which is sub-set of the watershed. Further, the effects are not the product of a lengthy causal chain as they can directly impact ongoing and reasonably foreseeable future Project operations and effects. Therefore, MassWildlife requests that Essex include our requested study, Evaluation of Potential Project Impacts on the Merrimack River and Floodplain Habitats throughout the Term of a New License (MassWildlife Study Request 5), in the RSP.</p>	<p>Essex is not proposing to perform this study. See Section 4.7. While Essex acknowledges the importance of climate change, it is unclear how such a hypothetical analysis would inform license conditions for this ROR Project. Potential climate and hydrologic changes that may occur over the course of a 30- to 50-year license are far too speculative to allow for a quantitative evaluation as requested. The state of the science is such that climate change forecasts do not exist that could reliably predict how precipitation, snowmelt, evapotranspiration, ice out, and annual runoff patterns may change 30 to 50 years from now. As already noted, the NEPA defines “effects” as changes to the human environment from the proposed action that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action. Effects should generally not be considered if they are remote in time (such as this request), geographically remote, or the product of a lengthy causal chain. FERC precedent uniformly maintains that climate change studies are not needed in hydropower licensing proceedings. FERC has acknowledged that climate change is a complex issue, but under NEPA and Council on Environmental Quality regulations, it is afforded discretion based on its expertise and experience to determine the scope of an environmental analysis based on available information. FERC has determined that climate change studies are not likely to yield reliable data that can be used to develop license requirements.</p> <p>Regarding requestors attempt to link this study to the structural integrity of Project infrastructure, as noted in the Commission’s SD2, the Project is subject to Part 12 of the Commission’s regulations (Safety of Water Power Projects and Project Works) under the current license. Part 12 requires, among other things, periodic operational inspections by Commission staff focusing on the continued safety of the structures. Projects that are subject to Part 12 must also be inspected and evaluated every 5 years by an independent consultant and a consultant’s safety report must be submitted for Commission review.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MassWildlife (March 11, 2024)	Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem	<p>MassWildlife and The Nature Conservancy (TNC) identified potential Project-related impacts to the City of Lawrence and the Merrimack River ecosystem in their study requests. Of primary concern is inland flooding likely exacerbated by the Project on the upstream and north side of the dam during high flow events and electrical brown-outs resulting from aging infrastructure (MVPC 2018). The proposed study would analyze alternatives to status quo project operations that could alleviate such impacts via license requirements and mitigation measures. Given that high flow events are expected to increase in frequency, duration and magnitude throughout the life of a new license (A. Delsantos and R. Palmer, U.S. Geological Service, pers. comm. 2024), the study is necessary to fully evaluate reasonably foreseeable climate change effects.</p> <p>This study would also inform FERC’s environmental analysis. The study aligns with CEQ’s guidelines for consideration of climate change in NEPA reviews. The guidelines state that the review must consider alternatives to the proposed action that eliminate or mitigate direct, indirect and cumulative climate change impacts to the human environment, “including environmental justice impacts.” Furthermore, the evaluation “can inform possible adaptation measures to address the effects of climate change, ultimately enabling the selection of smarter, more resilient action.” MassWildlife’s study request outlined one method, a desktop analysis, that could be used to complete the study.</p>	<p>Essex is not proposing to perform this study. See Section 4.8. While Essex acknowledges the importance of climate change, it is unclear how such a hypothetical analysis would inform license conditions for this ROR Project. Potential climate and hydrologic changes that may occur over the course of a 30- to 50-year license are far too speculative to allow for a quantitative evaluation as requested. The state of the science is such that climate change forecasts do not exist that could reliably predict how precipitation, snowmelt, evapotranspiration, ice out, and annual runoff patterns may change 30 to 50 years from now. As already noted, the NEPA defines “effects” as changes to the human environment from the proposed action that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action. Effects should generally not be considered if they are remote in time (such as this request), geographically remote, or the product of a lengthy causal chain. FERC precedent uniformly maintains that climate change studies are not needed in hydropower licensing proceedings. FERC has acknowledged that climate change is a complex issue, but under NEPA and Council on Environmental Quality regulations, it is afforded discretion based on its expertise and experience to determine the scope of an environmental analysis based on available information. FERC has determined that climate change studies are not likely to yield reliable data that can be used to develop license requirements.</p>
MassWildlife (March 11, 2024)	Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem	<p>MassWildlife and The Nature Conservancy (TNC) identified potential Project-related impacts to the City of Lawrence and the Merrimack River ecosystem in their study requests. Of primary concern is inland flooding likely exacerbated by the Project on the upstream and north side of the dam during high flow events and electrical brown-outs resulting from aging infrastructure (MVPC 2018). The proposed study would analyze alternatives to status quo project operations that could alleviate such impacts via license requirements and mitigation measures. Given that high flow events are expected to increase in frequency, duration and magnitude throughout the life of a new license (A. Delsantos and R. Palmer, U.S. Geological Service, pers. comm. 2024), the study is necessary to fully evaluate reasonably foreseeable climate change effects.</p> <p>This study would also inform FERC’s environmental analysis. The study aligns with CEQ’s guidelines for consideration of climate change in NEPA reviews. The guidelines state that the review must consider alternatives to the proposed action that eliminate or mitigate direct, indirect and cumulative climate change impacts to the human environment, “including environmental justice impacts.” Furthermore, the evaluation “can inform possible adaptation measures to address the effects of climate change, ultimately enabling the selection of smarter, more resilient action.” MassWildlife’s study request outlined one method, a desktop analysis, that could be used to complete the study.</p> <p>Essex’s assertion that “potential climate effects described in the study request are too speculative to allow for the evaluation requested” is addressed in our response to Essex’s rejection of MassWildlife’s Study Request 5, the section immediately above.</p>	<p>Essex is not proposing to perform this study. See Section 4.8. While Essex acknowledges the importance of climate change, it is unclear how such a hypothetical analysis would inform license conditions for this ROR Project. Potential climate and hydrologic changes that may occur over the course of a 30- to 50-year license are far too speculative to allow for a quantitative evaluation as requested. The state of the science is such that climate change forecasts do not exist that could reliably predict how precipitation, snowmelt, evapotranspiration, ice out, and annual runoff patterns may change 30 to 50 years from now. As already noted, the NEPA defines “effects” as changes to the human environment from the proposed action that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action. Effects should generally not be considered if they are remote in time (such as this request), geographically remote, or the product of a lengthy causal chain. FERC precedent uniformly maintains that climate change studies are not needed in hydropower licensing proceedings. FERC has acknowledged that climate change is a complex issue, but under NEPA and Council on Environmental Quality regulations, it is afforded discretion based on its expertise and experience to determine the scope of an environmental analysis based on available information. FERC has determined that climate change studies are not likely to yield reliable data that can be used to develop license requirements.</p>
MassWildlife (March 11, 2024)	Fish Passage Improvement and Feasibility Assessment	<p>MassWildlife generally accepts Essex’s proposed approach to our requested Fish Passage Improvement and Feasibility Assessment (Study Request 6). The development and implementation of our Study Request 11 now, would proactively support a review of fish passage alternatives at the Project, even though Essex is not currently proposing any modification to the existing fish passage facilities. While MassWildlife suspects the existing fish passage facilities are woefully inadequate, little data exists to confirm a need for improvements to the Project’s fish passage facilities, currently. As such, MassWildlife understands why Essex may find implementation of our Study Request 11 to be premature. We do not agree, however, that next steps should simply be identified in its DLA. Instead, Essex’s Initial Study Report (ISR) should propose our study request, if appropriate, following a review of study results of Essex’s proposed Upstream Fish Passage Assessment, Upstream American Eel Passage Assessment, Sections 6 and 7 of the PSP, respectively, and the requested Downstream Fish Passage Assessment and requested Diadromous Fish Behavior, Movement, and Project Interaction Study, Study Requests 1 and 5, respectively.</p>	<p>Essex is not proposing the Fish Passage Improvement and Feasibility Study because the requested study necessitates data from proposed fish passage studies that have yet to be conducted, as well as the results of the CFD model, and evaluation of PM&E measures and alternatives. See Section 4.2.</p>

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MassWildlife (March 11, 2024)	Diadromous Fish Behavior, Movement, and Project Interaction Study	Essex's position on our Study Request 12 is unclear. While the PSP implies a study may be developed in the future, Essex did not commit to doing so, the PSP clearly states it is not proposed, and the PSP does not include a process for the development of that study. This leaves the study in an uncertain position where it has been neither proposed nor formally not adopted with supporting justification. Essex did state that they feel this study would be "greatly informed by, and is also largely contingent on, the results of the Three-Dimensional Computational Fluid Dynamics (CFD) Modeling Study." We do not share this opinion and it is unclear from the information provided in the PSP why Essex feels the CFD results are needed to inform the Diadromous Fish Behavior, Movement, and Project Interaction Study, or in what way(s) the latter would be largely contingent on the former. The CFD Study and Diadromous Fish Behavior, Movement, and Project Interaction Study are fully-separate analyses that do not share goals or methodology. Nonetheless, if Essex still feels strongly that the CFD results are needed in advance of this study, there remains plenty of time to prioritize that analysis and have it completed well before the field studies which are anticipated to occur during the 2025 passage season. For the reasons discussed in our Study Request 12, MassWildlife continues to seek the development and implementation of the Diadromous Fish Behavior, Movement, and Project Interaction Study and asks that Essex include the requested study in its RSP.	Essex is proposing the Diadromous Fish Behavior, Movement, and Project Interaction Study as provided for in Section 11 of this RSP.
MassWildlife (March 11, 2024)	Downstream Migrating Species Passage Assessment	Essex's approach of proposing PM&E's in lieu of conducting studies to evaluate existing conditions, has merit and is supported by MassWildlife in concept. However, the goal of the MassWildlife's Study Request 13 is to assess behavior, passage success, immediate and latent survival, and internal and external injury of target species (i.e., juvenile alosines and adult American Eel) as they encounter the Project during downstream migrations through all downstream passage routes. Essex's proposed PM&E measure only addresses one viable passage route, turbine passage. Other potential downstream routes include the Project's spillway, North and South canal gatehouses and canal systems, and the Project's downstream fish bypass. While we agree that Essex's proposal to install a narrow spaced trashrack would eliminate the need to assess turbine entrainment and passage survival through the Project's intake, at this time, the proposed PM&E measure does not address all downstream passage routes; and therefore, we continue to support our Study Request 13 for the remaining passage routes at the Project and ask that Essex include a Downstream Fish Passage Assessment, commensurate of its licensing proposal, in the RSP.	<p>In review of existing information and study requests, Essex anticipates providing proposed PM&Es to limit or prevent fish entrainment through the Project's turbines. In particular, Essex is proposing to develop, in consultation with the MRTC, a narrow-spaced trashrack design to replace the existing trashrack system. Essex believes this proposal for a PM&E measure to screen the Project's intake would greatly inform the new Project proposal and would likely result in reduced study costs. Essex understands that while fish entrainment during downstream passage may be mitigated by this PM&E, the existing downstream fish bypass survival for emigrating diadromous species (i.e., adult and juvenile alosines and adult American eel) will need evaluation at a later date. As noted by the Commission in their October 13, 2023 letter, Essex will consult with the MRTC regarding this PM&E and provide details of PM&E proposals within the DLA.</p> <p>Given that Essex is proposing PM&E measures related to fish entrainment and passage, Essex is not proposing to perform the Downstream Fish Passage Assessments for diadromous species. Alternatively, Essex is proposing to perform the Desktop Entrainment, Impingement, and Turbine Passage Survival Study (See Section 9). Essex also believes that existing information is sufficient for evaluation of fish survival, delay and route selection for emigrating diadromous species. Normandeau Associates, on behalf of Essex, performed a Downstream American Eel Passage Assessment at the Lawrence Hydroelectric Project in 2019, and an Evaluation of Adult Alosine Downstream Passage Effectiveness in 2020. An overview of the results of these studies is provided in Appendix C. Essex intends to make these two reports available in their entirety with the Commission prior to the issuance of the SPD. These studies were performed proactively in conjunction with other studies and are "new" studies to the Commission and relicensing participants. Essex believes that existing information used along with the proposed Desktop Entrainment, Impingement, and Turbine Passage Survival Study, and the proposed PM&E measures, are sufficient for the Commission's Environmental Analysis.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MassWildlife (March 11, 2024)	Sturgeon Distribution and Project Interaction Study	<p>The goal of MassWildlife's Study is specifically to determine how Atlantic and shortnose sturgeon (<i>Acipenser oxyrinchus oxyrinchus</i> and <i>Acipenser brevirostrum</i>, respectively; collectively, sturgeon) interact with the Project to identify potential means of take resulting from the Project's operation and maintenance. The PSP clearly demonstrates a lack of information on this subject. While the PSP asserts that no acoustic tagged sturgeon have been documented in the Project's vicinity upstream of the I-495 bridge, the PSP neglects to mention that the most upstream acoustic receiver was located at that bridge and no means of detecting the sturgeon at the Project existed. Effects on sturgeon that currently have access to the base of the dam may be injured or stranded, for example, during operation of the Project and fishway. License conditions are not limited to changes in project operations, and, if measures such as a sturgeon protection and handling plan are necessary, they would be informed by the results of this study. Actions in a plan may include protocols for handling, reporting, and dewatering turbine units for maintenance to prevent injury or mortality to sturgeon. For example, FERC-licensed hydroelectric project that have adopted similar measures include Ellsworth (P-2727), 14 Brunswick (P-2284), 15 Cataract (P-2528), 16 and Santee Cooper (P-199).¹⁷ This study is a baseline data collection to inform potential protection measures.</p> <p>Essex cites the Stantec (2023) report as evidence that sturgeon do not approach the project. However, if the proportion of tagged individuals represents a sample of the amphidromous population in the Merrimack, then the individuals from the overwintering population of shortnose sturgeon to approach the Project would be 302 individuals for 2021-2022 and 273 for 2022-2023, respectively. This provides many opportunities for sturgeon to interact with the Project, but without telemetry or side-scan sonar deployed at the Project, no baseline data is available to inform license conditions. Additionally, two of the tagged sturgeon detected at the Lawrence I-495 bridge, which was the most upstream receiver in the study, were in the area over multiple days in late March and April. This is ample time for the sturgeon to swim upstream and interact with the Project. In 2021, all sturgeon detections occurred before or during the spawning season, suggesting searching behavior for spawning habitat.</p> <p>Our Study Request 7 fully addressed the Commission's study Criterion demonstrating the need for information and acknowledged that the resulting information could be used to inform license conditions, including the potential need for upstream fish passage of sturgeon. Essex's concern that a sub-sample of dates would not provide sufficient information on the sturgeon population or distribution downstream of the Project should be addressed through study design and methodology. Telemetry and fixed array SSS have previously been coupled and used to quantify sturgeon abundance and movement (Izzo et al. 2021). This framework provides a tested methodology that could be adapted to the Project tailrace, spillway, and downstream of the Project.</p> <p>An appropriate assessment of sturgeon presence and occupancy to determine Project interactions is not possible with the available information. MassWildlife continues to support our study request and asks that Essex include the requested Sturgeon Distribution and Project Interaction Study in the PSP.</p>	<p>Essex is proposing the Sturgeon Distribution and Project Interaction Study as provided for in the RSP in Section 10. Essex is not proposing to perform this study as requested because studies should be performed commensurate to the degree to which there is a known problem. As stated by the requestors, the lower Merrimack River has one of the smallest resident populations of sturgeon in the United States. As summarized in the PAD, Kieffer and Kynard (1993) found that spawning of shortnose sturgeon occurred from April to May at RM 19-22 (Haverhill area) and overwintering at RM 12-16 (the Amesbury area); Essex Dam is at RM 29. During those three years of tracking, Atlantic sturgeon also used the same general area. As acknowledged by the requestors, sturgeon movement in the lower Merrimack has been documented up to the I-495 Bridge in Lawrence. Additionally, despite the fish lift passing anadromous fish upriver of Essex Dam since 1983, no sturgeon have been reported entering the lift. The movements of sturgeon from their wintering to spawning and postspawning areas do not encompass the Merrimack River within the Project boundary. See Section 4.3 of the RSP.</p>
MassWildlife (March 11, 2024)	Sturgeon Habitat Assessment and Mapping Study	<p>The Project is a barrier to the upstream migration of sturgeon, and restricts freshwater spawning, rearing, foraging, and overwintering habitat within the 29-mile reach below the Project. The Project also traps sediment in the impoundment and alters natural downstream sediment transport. Sediment trapped in the impoundment by the Project may be inundating historical sturgeon habitat. Conversely, dams may prevent downstream transport, leading to depauperate habitat lacking the necessary spawning and rearing substrate such as cobble, rock, and gravel, or degraded by embedded sand and finer sediments (i.e., habitat lacking well-oxygenated, interstitial spaces suitable for egg incubation and hatching). MassWildlife requests a bathymetric habitat assessment and mapping study to quantify the Project effects on sturgeon habitat in the Project boundary and downstream of the dam.</p> <p>Under the current hydraulic regime of the Project, which is proposed for the next license, only two existing studies exist that focus on or encompass sturgeon habitat in the Merrimack River.</p> <ol style="list-style-type: none"> 1. Movements of Atlantic Sturgeon of the Gulf of Maine Inside and Outside of the Geographically Defined Distinct Population Segment (Wippelhauser et al. 2017) 2. Merrimack River Shortnose Sturgeon Monitoring, 2020-2022 (Stantec 2023). <p>The improved hydrologic regime in the Merrimack River may result in altered habitat usage and movements among other potential drivers of sturgeon behavior affected by Project operations. Several of the studies included habitat mapping for sections of the Merrimack River, however a comprehensive habitat mapping and assessment survey is necessary to fill in data gaps and investigate Project effects on sturgeon habitat within the geographic scope of the Project.</p> <p>Therefore, MassWildlife requests that Essex includes our study request entitled, Sturgeon Habitat Assessment and Mapping Study (MassWildlife Study Request 16), in the RSP. The information from this study would be used to inform protection, mitigation, and/or enhancement measures for sturgeon, none of which Essex has with its current license. Measures could include aquatic habitat enhancements, protective measures during maintenance and operations, and fish passage.</p>	<p>Essex is proposing the Sturgeon Distribution and Project Interaction Study in Section 10, which Essex considers an appropriate level of effort commensurate with known information and the limited scope of potential Project effects. See Section 4.4 of the RSP.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
<p>MassWildlife (March 11, 2024)</p>	<p>Project Impacts on Sturgeon Spawning and Rearing Habitat from Future Conditions</p>	<p>The Lawrence Hydroelectric Project is a barrier to the upstream migration of shortnose sturgeon, and restricts freshwater spawning, rearing, foraging, and overwintering habitat to within the 29-mile reach below the Project. Saltwater is fatal to shortnose sturgeon during early life stages (e.g., eggs and Age-0), and access to suitable freshwater habitat is essential for survival and recruitment.19 As climate-related impacts are expected to continue, including sea level rise (SLR), increased water temperatures, and variability in river flow; upstream migration of the Merrimack River salt wedge and changing hydrological conditions may reduce and degrade existing shortnose sturgeon habitat (Hare et al. 2016). MassWildlife requests a hydrodynamic water quality modeling study using established climate projections to understand the hydrological impacts of upstream salt wedge migration during the term of a new license on shortnose sturgeon habitat affected by the Project.</p> <p>Essex’s use of the CEQ (2016) guidance has been superseded by CEQ guidance in 2023 that removes the clause on not needing to undertake new research or analysis of potential climate change impacts. The hydrologic changes this study will quantify are necessary information for assessing climate change-related impacts in the lower Merrimack River. The information collected from study request #16 — Sturgeon Habitat Assessment and Mapping Study — is essential to characterize existing and potential habitat in this study. Habitat suitability indices (HSI) are available for shortnose sturgeon and the hydrodynamic model would provide the information necessary to evaluate if environmental conditions during the license term will degrade or eliminate the existing habitat necessary for the spawning population of shortnose sturgeon in the Merrimack River.</p> <p>MassWildlife’s study request is to investigate climate effects that are likely to occur within the licensing term, therefore, within the temporal scope of a new license and not remote in time as Essex claims. This study is specific in the climate effects it is investigating (i.e., saltwater intrusion, temperature, and flows), which will be compared to habitat suitability indices (Crance 1986) and other relevant literature (e.g., Kynard et al. 2000; Farrae et al. 2014; Johnston et al. 2019) for sturgeon to assess the potential for habitat contraction, degradation, and loss during the license term. Some of the necessary information is already available (e.g., sturgeon spawning habitat and the location of the salt wedge location) and the previous two study requests with help fill in critical data gaps. Known effects of climate change, such as sea level rise, are accelerating at a heightened rate in the northeast compared to other parts of the country (Boon 2012), which further supports the need to complete this study.</p> <p>Therefore, MassWildlife requests that Essex includes our study request entitled, Project Impacts on Sturgeon Spawning and Rearing Habitat from Future Conditions (MassWildlife Study Request 17), in the RSP. The information from this study would be used to inform protection, mitigation, and/or enhancement measures for sturgeon, none of which Essex has with its current license. Measures could include aquatic habitat enhancements, protective measures during maintenance and operations, and fish passage.</p>	<p>Essex is not proposing an evaluation of the potential impact of climate change on sturgeon at the Project. While Essex acknowledges the importance of climate change, it is unclear how such a hypothetical analysis would inform license conditions for this ROR Project. Potential climate and hydrologic changes that may occur over the course of a 30- to 50-year license are far too speculative to allow for a quantitative evaluation as requested. The state of the science is such that climate change forecasts do not exist that could reliably predict how precipitation, saltwater intrusion, snowmelt, evapotranspiration, ice out, and annual runoff patterns may change 30 to 50 years from now. As indicated by FERC in a recent (November 3, 2021) determination issued in response to a requested study, FERC determined that given the level of uncertainty that would need to be accepted with the requested study, it would not substantially contribute to an understanding of ecological processes related to anadromous fish in Project waters. See Section 4.5 of the RSP.</p>
<p>MassWildlife (March 11, 2024)</p>	<p>Freshwater Mussel and Non-native Corbicula Baseline Data Collection and Operational Impacts</p>	<p>Scope and Intent</p> <p>The first main objective of MassWildlife’s requested study is to “conduct field surveys to characterize the distribution, composition, and relative abundance of freshwater mussels and non-native bivalves in the impoundment, canals, and reaches downstream of the Essex Dam influenced by Project operations.” Essex proposes mussel surveys focused in the “project impoundment to inform the potential effect of occasional impoundment drawdowns...” that are typically 5 feet below normal pool levels (PSP 10.5 Project Nexus). MassWildlife supports studying impoundment drawdown impacts to freshwater mussels; however, Essex has shifted and narrowed the scope of MassWildlife’s requested study to focus only on the impoundment mussel assemblage and only the portion of habitat within the drawdown exposure zone. This approach is not only inadequate to estimate potential impacts of impoundment drawdowns but omits needed survey effort to collect baseline data throughout all Project-affected areas including depths throughout the impoundment, reaches downstream of the dam, and the North and South canals. MassWildlife does not agree that surveys as described by Essex are sufficient to meet our Study Objectives or to characterize mussels within the project’s area of effect and thus to understand ongoing impacts of the project. Surveys must be done in all areas of the Project effect: impoundment, downstream and canals.</p> <p>This reflects Essex’s interpretation of Criterion 5 and significant understatement of ongoing Run-of-River impacts to habitat conditions and hence mussel assemblages upstream and downstream of the dam. (see general Criterion 5 and Run-of-River comments above). For example, fine sediment accumulation in the impoundment and sediment coarsening downstream of the dam are known drivers of mussel species composition, distribution, and abundance (Haag et al. 2012). Project-affected areas have not been sampled for mussels in the past and require surveys to provide baseline data to inform potential protection, mitigation, and enhancement measures. Further, Essex’s sole focus on impoundment drawdown impacts informs their proposed survey design that fails to obtain baseline freshwater mussel assemblage and habitat conditions in all areas affected by the Project. Therefore, as originally requested, MassWildlife recommends performing field habitat assessments and mussel surveys within suitable and representative mussel sites identified in preliminary field habitat assessment in the impoundment, canal, and downstream Project-affected reaches to meet baseline data needs. MassWildlife also recommends additional surveys and/or sites to sufficiently estimate the impact of impoundment drawdowns (see comments below).</p>	<p>On March 28, 2024 and April 1, 2024, Essex held calls with the MRTC to discuss the Freshwater Mussel Habitat Assessment and Survey. Essex updated the study plan as provided for in Section 13 to add additional mussel survey locations within the Merrimack River downstream from the Project’s dam and within the North Canal. Essex is not proposing to perform mussel surveys in South Canal given the significant health and safety concerns.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MassWildlife (March 11, 2024)	Freshwater Mussel and Non-native Corbicula Baseline Data Collection and Operational Impacts	<p>Host Fishes</p> <p>The second main objective from MassWildlife's requested study plan is to: <i>assess potential host-fish for documented freshwater mussel species through review of relevant publications and concurrent fish data collected upstream, downstream, and passing through the Essex Dam.</i></p> <p>Essex altered this objective in the proposed plan to: <i>assess potential host-fish for documented freshwater mussel species through review of currently available fish data collected for the Merrimack River upstream, downstream, and passing through the Essex Dam.</i></p> <p>As proposed, Essex's PSP study cannot determine if fish passage at the dam, historically designed and focus on very specific diadromous species, may be driving mussel distributions upstream and downstream of the dam. First, the Essex fails to identify the source of fish data for mussel host-fish assessment and therefore, MassWildlife cannot determine if the fish data is sufficient to achieve this objective. Essex's "review of currently available data" suggests the use of existing fish data that likely underrepresents the extant fish assemblage. We address this in more detail in our response herein to Essex not adopting MassWildlife Fish Assemblage Assessment. Second, the PSP study does not include field mussel surveys downstream of the dam. Without both upstream and downstream fish and mussel assemblage baseline data, Essex cannot sufficiently assess the impact of the dam as a barrier to fish and consequently mussel species distributions (i.e., dispersal) (Watters 1996) or ongoing effects from Project operations.</p>	Essex is proposing a suite of targeted fish and aquatic studies (see Sections 6-15 of the RSP), which includes collecting general fish assemblage data during electroshocking events as part of the American Eel Upstream Passage Siting Study (Section 8).
MassWildlife (March 11, 2024)	Freshwater Mussel and Non-native Corbicula Baseline Data Collection and Operational Impacts	<p>Drawdown Area of Exposure vs. Baseline Elevations off Crest</p> <p>One of the objectives of the MassWildlife study was to understand the impact from drawdowns, which is discussed in the PSP. However, the pool elevation varies based on flows (PAD, Section 4.4).</p> <p>We were unable to find information in the PAD or PSP that describes the water surface elevation during past drawdowns or associated with proposed maintenance drawdown. The PSP uses the crest elevation of 44.2 feet as a reference point for the up to 4 feet areas of exposure. However, if a drawdown is initiated when the pool elevation is lower (e.g., 41.2 feet) then the area of exposure also shifts down in elevation for the additional foot of surface elevation change. Thus, it is unclear if surveys measured 0-4 feet off the crest elevation represent the actual areas of exposure from drawdowns, which is critical to collecting accurate data. MassWildlife does not object to using the crest or normal pool as a reference point, but needs clarity of the proposed area to represent the area of exposure captured in the proposed 0-4 ft survey elevations.</p>	On March 28, 2024 and April 1, 2024, Essex held calls with the MRTC to discuss the Freshwater Mussel Habitat Assessment and Survey. Essex updated the study plan as provided for in Section 13 to add clarification on depth of surveys.
MassWildlife (March 11, 2024)	Freshwater Mussel and Non-native Corbicula Baseline Data Collection and Operational Impacts	<p>Number and Distribution of Transects/Sites (PSP 10.61)</p> <p>The PSP is focused on impoundment drawdown impacts, such that sites are confined to depths ≤ 4ft (note our comments above about the reference point). This design significantly underrepresents potential viable mussel habitat in big river systems (e.g., Biodiversity 2015, Kaeser et al 2019) and does not meet the need of collecting baseline mussel data throughout all Project-affected areas (i.e., MassWildlife's first main objective in requested study). Preliminary surveys are first needed in the impoundment, canals, and downstream to assess habitat and relative mussel abundance for site establishment and subsequent mussel and habitat data collection. Depth should not be a limitation for preliminary surveys to establish sites for further mussel investigation. Preliminary surveys can be conducted by visual assessment via snorkel and SCUBA, and/or via habitat mapping using side scan sonar (e.g., Kaeser et al. 2019).</p> <p>Essex proposes 21 sites in the impoundment equating to approximately 2 sites/mile. However, no information is provided in the PSP about the locations or distribution of potential habitat, which may be patchy, to support their proposal. Determining the number of sites first requires information about the amount and distribution of available habitat, determined by preliminary habitat assessment surveys. The purpose of the surveys is to search all available habitat (or a reasonable sub-set of the habitats). Placing a priori limitation on the survey effort before knowledge of the habitat is gained could result in dramatically underrepresenting the mussel assemblage, or expending effort in areas where no mussels are expected. Further, in the canals, more sites are likely necessary to adequately represent mussel populations (e.g. in the North Canal, ~ 2 sites/mi might yield only one or two sites within the canals).</p> <p>Essex provided insufficient information to determine their use of fixed distances between sites and fixed survey transects. As above, field survey effort should follow preliminary habitat assessment surveys. The habitat assessments are then used to inform the number, distribution and spacing of site selection. Using arbitrary fixed plots could result in under-representing the mussel assemblage or expending effort in areas where no mussels are expected.</p> <p>The PSP study plan would only collect impoundment data in areas of less than 4 feet in depth to represent the drawdown zone. However, the PSP proposes no method to contextualize that data by comparing to areas of suitable habitat not subject to the drawdowns. Therefore, MassWildlife recommends adding sites at depths unimpacted by the drawdowns in addition to sites within the drawdown exposure zone. Exposed and unexposed surveys should be paired within a site and can fit the site dimensions proposed by Essex (e.g., 50-m long and 5-m wide).</p>	On March 28, 2024 and April 1, 2024, Essex held calls with the MRTC to discuss the Freshwater Mussel Habitat Assessment and Survey. Essex updated the study plan as provided for in Section 13 to add clarification on their use of fixed distances between sites and fixed survey transects.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MassWildlife (March 11, 2024)	Freshwater Mussel and Non-native Corbicula Baseline Data Collection and Operational Impacts	<p>Survey Details</p> <ul style="list-style-type: none"> • PSP 10.6.1, Figure 10-1 - Special consideration for site selection should be given to areas downstream of islands, tributary confluences, coves, and mesohabitats of stable and suitable substrate composition of mussel habitat. Areas to consider but are not limited to Pine Island, Fish Brook confluence, Richardson Brook confluence, Trull Brook confluence, and Bartlett Brook confluence. • PSP 10.6.1 – Essex proposes survey site dimension of 50-m long with a maximum width of 5m. Survey's should aim for at least 3 person hours per site with a minimum of 50-m long sites. However, sites should not have pre-defined area dimensions and should rather be determined by the extent of suitable habitat, mussel bed distribution, and density. MassWildlife supports surveys parallel to the bank moving upstream but would consider alternative survey designs (e.g., transects/plots perpendicular to flow). Based on work conducted in other rivers, mussel habitat occurs in patches of variable size and shape, thus linear transects can miss important habitat and cause biologists to spend time in areas of unsuitable habitat. • PSP 10.6.1 – Essex proposes mussel measurements that are insufficient to assess basic evaluation of species population condition. MassWildlife recommends accurate counts of all mussel species identified as Species of Greatest Conservation Need (SGCN) in the 2015 Massachusetts State Wildlife Action Plan (Table 1). Counts for non-SGCN species (i.e., Eastern Elliptio, Eastern Floater) can be estimated especially if abundances are high (e.g., >1,000 individuals). For mussel SGCN that are not state-listed (e.g., Alewife Floater, Eastern Lampmussel), the first 50 individuals per site should be measured for shell length and assessed for shell condition. All state-listed species should be counted, measured, and assessed for shell-condition. If not directly measured, surveyors should note the presence of juvenile mussels (e.g., <30-40mm) for all species to provide evidence of recent reproduction. The presence and relative abundance (i.e., range estimates) of non-native mollusks, notably Asian Clam (Corbicula), Zebra and Quagga mussels (Dreissena), should also be recorded. • PSP 10.6.1 – Essex proposes habitat parameters to estimate, however more clarity is needed. Previous mussel work in large rivers estimated percentages of submerged and emergent aquatic vegetation, benthic algae, count of large woody debris, and classification of water velocity. In addition to collecting minimum and maximum water depth, surveyors should also collect 5 representative water depths per surveyor. The same approach can be applied to substrate composition by recording the dominant substrate at 5 representative points per surveyor to calculate site percentages. Surveyors should also report estimated canopy cover using a spherical densiometer, water temperature, and mesohabitat percentages (e.g., riffle, run, pool). <p>These environmental parameters are typically collected in standard mussel surveys in Massachusetts and provide baseline environmental site characterization.</p>	On March 28, 2024 and April 1, 2024, Essex held calls with the MRTC to discuss the Freshwater Mussel Habitat Assessment and Survey. Essex updated the study plan as provided for in Section 13.
MassWildlife (March 11, 2024)	Freshwater Mussel and Non-native Corbicula Baseline Data Collection and Operational Impacts	<p>Survey Details</p> <p>PSP 10.6.2 – All raw data shall be made available to MassWildlife.</p>	Essex can provide the raw field data associated with the mussels survey, such as the field notes and water quality measurements.
MassWildlife (March 11, 2024)	Freshwater Mussel and Non-native Corbicula Baseline Data Collection and Operational Impacts	<p>Survey Details</p> <p>PSP 10.6.1 & 10.7 – Essex should meet with MassWildlife prior to discuss proposed mussel sampling sites and survey protocols before the study begins. Field identification of many state-listed species requires considerable expertise and field experience. Therefore, all study plans that involve field surveys and identification of state-listed species in Massachusetts must comply with the following:</p> <ol style="list-style-type: none"> MassWildlife requires pre-approval of the candidate biologist prior to conducting surveys. The selected biologists shall submit written survey protocols for MassWildlife approval prior to initiation of field work. Survey protocols shall list the specific taxonomic characteristics for definitive identification as well as the characteristics of similar or easily confused species. Photo-documentation is required. Interaction with, handling, collection or of state-listed species requires the selected biologist submit a request for a state-issued Scientific Collection Permit. Failure to be in possession of a valid state-issued Collection Permit is a violation of the Massachusetts Endangered Species Act. Collection Permits are issued for each project and location, so permits issued to parties for other sites or purposes (e.g. academic use) are not valid for this purpose. <p>Therefore, MassWildlife requests that Essex includes our study request, as written in the RSP.</p>	On March 28, 2024 and April 1, 2024, Essex held a call to discuss the Freshwater Mussel Habitat Assessment and Survey with the MRTC. Essex is aware of these requirements and updated the study plan as provided for in Section 13.

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
MassDEP (March 11, 2024)	Water Quality Study	<p>On October 16, 2023, MassDEP submitted a Water Quality Study Request to Essex. The water quality study requested the following parameters be collected to identify if the operation of the facility impacts water quality in the vicinity (See Table 1).</p> <p>In Essex's Proposed Study Plan (PSP), they state that the study goals are to collect sufficient data to understand current water quality conditions at the Project, assess the designated uses for the two Assessment Units (AUs) (MA84A-03 and MA84A-04), and assess any effects of the Project operations on water quality in the affected AUs1. Yet, the proposed study that includes only dissolved oxygen, temperature, and Secchi disk measurements is very limited, does not collect sufficient data to assess the facilities' potential contribution to the relevant impairments within the AUs, would accomplish only a partial assessment of aquatic life in an outdated approach that does not include biological sampling which is a direct measurement of biological integrity, and does not propose any data collection to assess the impacts of facility operation to the human health use.</p> <p>The presence of the dam as well as fluctuating water levels may adversely alter sediment and nutrient transfer, water temperatures, and streamflow and thereby impact aquatic resources (Kondolf 1997, Graf 2006, Schmutz and Sendzimir 2018, and Zaidel, P. A. et al. 2021) even in projects that meet the ROR criteria (Fantin-Cruz et al. 2016). Many of the requested water quality parameters (e.g., water-column (phytoplankton) chlorophyll, chlorophyll a from the periphyton (attached algae), turbidity, TSS, true color, and total phosphorus and total nitrogen) are to assess the nutrient cycling in the reaches, which is a documented impairment ("problem") in the vicinity of the dam that can be exacerbated by impoundment conditions.</p> <p>In addition, the PAD and the Essex PSP do not provide streamflow and impoundment water level data to support that the Project is operated as run-of-river; consequently, MassDEP maintains its request for instream habitat evaluation data2 to evaluate potential impact on aquatic habitat of any water level or flow fluctuations caused by the facility. In sum, MassDEP continues to support collection of data for all parameters in our original request listed in Table 1, with three exceptions that are unlikely to be caused or exacerbated by operation of this facility: chloride, E. coli, and toxics in the water column.</p>	<p>Essex held meetings with the MADEP and MassWildlife on April 3 and 5, 2024. Essex has revised the study plan accordance with those conversations to include additional locations, nutrient testing, macroinvertebrate data, and turbidity, TSS, and color sampling.</p> <p>Essex maintains that the Water Quality study as proposed in Section 14 of the RSP is sufficient to inform on the water quality directly applicable to the Project's operations and will provide the necessary information to inform the issuance of the Project's new license and associated 401 Water Quality Certificate.</p>
MassDEP (March 11, 2024)	Water Quality Study	<p>MassDEP also requests the facility submit to MassDEP all raw data collected as a part of its water quality data collection. Also, as was stated in the original request, MassDEP supports study requests by other state and federal agencies and aims to optimize coordination in the collection of water quality parameters to minimize duplication of effort.</p>	<p>Essex can provide the raw water quality collection as per the Water Quality Study.</p>
NHFGD (March 12, 2024)	Downstream Passage Assessment	<p>Essex proposed to replace the existing trashrack with a "narrow spaced trashrack" designed in consultation of the MRTC. If designed and installed properly, a new narrow spaced trash rack could prevent entrainment and impingement of adult river herring, American Shad, and American Eels, but there are a number of other aspects to downstream passage at the project that remain poorly understood.</p> <p>Juvenile alosines are able to pass through even ¾" spaced racks and their survival through the turbines would need to be assessed. There is no information on the proportion of fish that use the fish bypass chute vs. the spillway under different flow conditions for any species, nor has there been any comparison of mortality rates between these two potential routes of downstream passage.</p> <p>There are three sections of crestgate at the spillway, each of which spills onto a combination of ledge and deeper water. Survival may vary over each crestgate and a downstream passage study is needed to determine crestgate operations protocols that would minimize mortality under a range of tailwater elevations.</p> <p>Survival through the fish bypass has also not been studied and the current configuration makes adult river herring and potentially small shad highly vulnerable to predation. There have been multiple observations of striped bass feeding on river herring where the bypass discharges into the tailrace.</p>	<p>In review of existing information and study requests, Essex anticipates providing proposed PM&Es to limit or prevent fish entrainment through the Project's turbines. In particular, Essex is proposing to develop, in consultation with the MRTC, a narrow-spaced trashrack design to replace the existing trashrack system. Essex believes this proposal for a PM&E measure to screen the Project's intake would greatly inform the new Project proposal and would likely result in reduced study costs. Essex understands that while fish entrainment during downstream passage may be mitigated by this PM&E, the existing downstream fish bypass survival for emigrating diadromous species (i.e., adult and juvenile alosines and adult American eel) will need evaluation at a later date. As noted by the Commission in their October 13, 2023 letter, Essex will consult with the MRTC regarding this PM&E and provide details of PM&E proposals within the DLA.</p> <p>Given that Essex is proposing PM&E measures related to fish entrainment and passage, Essex is not proposing to perform the Downstream Fish Passage Assessments for diadromous species. Alternatively, Essex is proposing to perform the Desktop Entrainment, Impingement, and Turbine Passage Survival Study (See Section 9). Essex also believes that existing information is sufficient for evaluation of fish survival, delay and route selection for emigrating diadromous species. Normandeau Associates, on behalf of Essex, performed a Downstream American Eel Passage Assessment at the Lawrence Hydroelectric Project in 2019, and an Evaluation of Adult Alosine Downstream Passage Effectiveness in 2020. An overview of the results of these studies is provided in Appendix C. Essex intends to make these two reports available in their entirety with the Commission prior to the issuance of the SPD. These studies were performed proactively in conjunction with other studies and are "new" studies to the Commission and relicensing participants. Essex believes that existing information used along with the proposed Desktop Entrainment, Impingement, and Turbine Passage Survival Study, and the proposed PM&E measures, are sufficient for the Commission's Environmental Analysis.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NHFGD (March 12, 2024)	Diadromous Fish Behavior, Movement, and Project Interaction Study	<p>Essex did not propose the Diadromous Fish Behavior, Movement, and Project Interaction Study as requested by MADMF, NHFG, NMFS, MassWildlife, and USFWS because it, “would be greatly informed by, and is also largely contingent on, the results of the Three-Dimensional Computational Fluid Dynamics (CFD) Modeling Study.” However, the CFD modelling study (Study 12) proposed in the PSP does not extend beyond the tailrace. A 2D CFD model will need to be extended to the river reach downstream to be useful in interpreting fish movement below the project (See comments under Page 34: Upstream Anadromous Fish Passage Assessment). An acoustic tagging study was done in the Lowell tailrace many years before a CFD modeling study was completed at the project (Alden 2011). The two studies complimented each other well, but the order in which they occurred was not important.</p>	<p>On March 28, 2024 and April 1, 2024, Essex held calls with the MRTC to discuss the Diadromous Fish Behavior, Movement, and Project Interaction Study, as provided for in Section 11. Essex previously recognized the importance of this study plan in the PSP and has provided the study plan in the RSP for review.</p>
NHFGD (March 12, 2024)	Fish Assemblage Study	<p>Throughout the PSP, Essex uses the proposed run-of-river (ROR) operations to narrowly define the environmental impacts of the project. The wide variety of impacts that dams have on rivers have been well documented (Baxter 1977; Zydlewski et al. 2023). While less impacting than the artificial water level fluctuations associated with hydropeaking, ROR operations do not mitigate for all project effects. Understanding the extent of project effects on sediment transport, water temperature, and species assemblages is important for making license recommendations beyond the proposed ROR operations. ROR implies that the project has no effect on river flows and yet there are many ways in which project operations influence aquatic habitat upstream and downstream of the project. The extent, timing, and rate of drawdown in the impoundment for maintenance activities can cause varying levels of impact to species upstream of the dam. Sudden changes in water level can influence habitat inundation below the project as a result of changes in generation or crestgate operations at the spillway.</p> <p>Project operations that occur over a limited time frame can have long term impacts on aquatic species even at projects that are primarily operated as ROR. An example of this was recently observed at a ROR project on the Suncook River in New Hampshire, where a drawdown for dam maintenance caused a large amount of sediment to be flushed into the bypass reach downstream of the China Mill Dam. The sediment filled the interstitial spaces between rocks and boulders, which resulted in the local extirpation of Longnose Dace below the project. After the drawdown the sediment was flushed from the bypass reach, leaving no visual evidence of the project’s effect on habitat below the dam. The only evidence of an issue was in the absence of Longnose Dace from the fish assemblage in the bypass reach. The incident could have been avoided by making adjustments in the rate and extent of the drawdown which would have reduced the amount of sediment washed downstream.</p> <p>Studies such as the proposed fish assemblage study are standard practice for understanding and documenting the environmental impacts of a project. They should not be dismissed as, “looking for a problem”. The fish assemblage study conducted at the Lowell Project can be used to help interpret a study at Essex, but the two projects should not be considered interchangeable. As the first upstream dam in the river, Essex is at a different point in the watershed where it is accessible by a number of species more tolerant of brackish water than what would be expected to occur at Lowell. Essex suggests that the presence of MRTC staff at the project implies a, “thorough understanding of the Merrimack River fishery related to the Project.” MRTC staff are typically on site to transport diadromous fish in support of restoration goals throughout the watershed. Recent observations of fish downstream of the project have only occurred in response to issues with fish passage at the site. Occasional observations of fish at the project should not be considered a suitable alternative to a proposed study.</p>	<p>Essex updated the American Eel Upstream Passage Siting Study (Section 8) to provide additional data collection on the general fish assemblage downstream of Lawrence Dam. During that study, all non-anguillid fish species will also be netted during eel electrofishing events. Fish will be identified to species, counted, and total length to the nearest mm will be recorded. Essex considers this collection of fish assemblage data downstream of the Lawrence dam commensurate to which there is a known issue or problem. See Section 4.1.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NHFGD (March 12, 2024)	Sturgeon Distribution and Project Interaction Study	<p>Essex references Stantec (2023) as the primary justification for not adopting any of the proposed sturgeon studies. On page 21 of the PSP, Essex states “Stantec (2023) performed an acoustic tagging study with a release of 50 Shortnose Sturgeon below the SR 125 Bridge in Haverhill; only one individual was detected at the I-495 bridge in Lawrence in 2020, and three individuals were detected at the I-495 bridge in Lawrence in 2021. Essex questions the request for the study given this recent multi-year study that indicates that sturgeon are not approaching the Project.” This statement does not take into context the results of the entire report. A side scan sonar survey (SSS) estimated the overwintering population of Shortnose Sturgeon in 2020/2021 at 3,786 individuals and at 3,424 individuals in 2022/2023. Using the average of the two estimates, it may be assumed that a typical overwintering population of Shortnose Sturgeon in the Merrimack River is around 3,605 individuals. The results of the tagging study should be evaluated in the context of this population estimate.</p> <p>The tagging protocol was not discussed in detail in the methods of the report. All sturgeon available for detection by Stantec (2023) were tagged over a number of years by Micah Kieffer with the United States Geological Survey (USGS). The number of fish with active tags available for detection in the Merrimack River was 38 Shortnose Sturgeon / 27 Atlantic Sturgeon in 2020 and 30 Shortnose Sturgeon / 33 Atlantic Sturgeon in 2021 (personal communication, Micah Kieffer). The total number of active tags for Shortnose Sturgeon during the study period (38 in 2020 and 30 in 2021) represented about 1% of the estimated 3,605 individuals in the overwintering population of Shortnose Sturgeon in the Merrimack River. When the results of Stantec (2023) are viewed in the context of the estimated 3,605 Shortnose Sturgeon in the Merrimack River, then the 4 fish detected at the Interstate 495 Bridge in Lawrence may represent a much larger number of fish that could potentially be interacting with the Essex Project each year.</p> <p>In 2020 there were a total of 23 out of a possible 38 (60.5%) tagged Shortnose Sturgeon detected at one or more acoustic receivers placed at 3 different bridges along the Merrimack River. Assuming the tagged fish are representative of movement patterns within the population, then 60.5% (2,181 individuals) of the estimated 3,605 sturgeon in the river would be expected to move some distance upstream into the project area. Of the 23 sturgeon tagged in 2020, one (4.3%) was detected at the furthest upstream receiver at river kilometer (RKM) 43.8 (Interstate 495 in Lawrence), which is 2.3 km downstream of the project. If the same percentage (4.3%) is applied to the estimated 2,181 fish out of the population as a whole, then one might assume that 94 Shortnose Sturgeon could potentially have moved upstream beyond the furthest receiver and possibly interacted with the project.</p> <p>In 2021, 20 of 30 (66.6%) tagged Shortnose Sturgeon were detected in the study area. Using the same logic as above, 66.6% of 3,605 individuals would be an estimated 2,401 fish expected to move into the study area. Of the 20 detected sturgeon, 3 (15%) were recorded at the Interstate 495 Bridge in Lawrence. If the same percentage (15%) is applied to the estimated 2,401 fish in the river, then over 360 Shortnose Sturgeon could be assumed to have moved upstream as least as far as the Interstate 495 Bridge in Lawrence in 2021.</p> <p>On Page 3, Stantec (2023) references previous tagging data collected by USGS, which recorded 12 of 52 (23%) sturgeon detected at the furthest upstream receiver at the time (RKM 38 approximately 5.8 km downstream from the Interstate 495 Bridge in Lawrence). The ratio of tagged Shortnose Sturgeon relative to Atlantic Sturgeon was not specified for the 52 fish. Assuming all 52 fish were Shortnose Sturgeon, then 37 of 52 (71%) sturgeon were detected at least as far upstream as RKM 35. Using the same assumptions as above, 71% of 3,605 fish is 2,560 fish potentially in the study area and 23% of 2,560 is 588 sturgeon that may have moved to an undetermined location upstream of RKM 38.</p> <p>In reality, there are too many assumptions in the interpretation of the tagging data to rely on the acoustic telemetry component of Stantec (2023) as justification for or against further study of sturgeon downstream of the project. Stantec (2023) did an excellent job of estimating population size using SSS, but the small number of acoustic tags relative to the population estimate makes the study insufficient for drawing conclusions about the extent of upstream sturgeon movement in the river. Sturgeon are a highly mobile species. They have been documented expanding their range into habitat made accessible by dam removal (Wippelhauser et al. 2015). A percentage of the Shortnose Sturgeon detected in the Merrimack River have been detected in the Kennebec River during the spawning season (Micah Kieffer, personal communication). It is not unreasonable to assume that a certain number of sturgeon in the lower Merrimack River may make exploratory trips upstream as far as the Essex Project, especially during the spring spawning season.</p> <p>Essex references the absence of sturgeon in the fish count data at the Essex fish lift as evidence that sturgeon do not interact with the project, yet the size, location, and design of the Essex fish lift make the facility highly unlikely to pass sturgeon. However, improving passage for sturgeon is not impossible. Modifications made to the Holyoke fish lift on the Connecticut River in 2015 resulted in a significant increase in annual sturgeon passage.</p> <p>Prior to dam construction on the Merrimack River, the range of Atlantic and Shortnose Sturgeon extended to Amoskeag Falls in New Hampshire (Kynard and Kieffer 2009). The extent to which a highly migratory and endangered population of Shortnose Sturgeon in the lower Merrimack River interacts with the Essex Project, which is known to block access to a large portion of the species' historic range, should be among the topics worth studying before making project license recommendations. There are many logistical challenges to studying sturgeon in the Merrimack River. The question is not whether the studies should be done, but how to best complete the studies in a way that will produce viable results</p>	<p>Essex is proposing the Sturgeon Distribution and Project Interaction Study as provided for in the RSP in Section 10. Essex is not proposing to perform this study as requested because studies should be performed commensurate to the degree to which there is a known problem. As stated by the requestors, the lower Merrimack River has one of the smallest resident populations of sturgeon in the United States. As summarized in the PAD, Kieffer and Kynard (1993) found that spawning of shortnose sturgeon occurred from April to May at RM 19-22 (Haverhill area) and overwintering at RM 12-16 (the Amesbury area); Essex Dam is at RM 29. During those three years of tracking, Atlantic sturgeon also used the same general area. As acknowledged by the requestors, sturgeon movement in the lower Merrimack has been documented up to the I-495 Bridge in Lawrence. Additionally, despite the fish lift passing anadromous fish upriver of Essex Dam since 1983, no sturgeon have been reported entering the lift. The movements of sturgeon from their wintering to spawning and postspawning areas do not encompass the Merrimack River within the Project boundary. See Section 4.3 of the RSP.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NHFGD (March 12, 2024)	Fish Stranding and Ramping Rate Study	<p>Essex provides the following justification for not adopting the field component of the Fish Stranding and Ramping Rate Study: “. . . it is not clear what is considered an operational change that triggers the need for a field survey, and requestors do not identify a seasonal timeframe or geographic extent of the surveys. As requested, the study methods assume fish stranding events would occur under any or all of these conditions even though only two stranding events (2019 and 2023) have been identified at the Project. Essex does not believe these extensive surveys would be productive.”</p> <p>The specific operational change that would trigger a field survey would be a change in crestgate operations or a change in generation that results in a sudden change in habitat inundation in the area below the spillway. The seasonal timeframe would be May and June when migratory fish are most likely to be interacting with the project.</p> <p>The two stranding events referenced in the PSP appeared to be the result of crestgate operations. In 2019, Sea Lamprey were attracted to the river right corner of the dam while the southern crestgate was spilling. They became stranded when the crestgate was rapidly inflated and spill was cut off. A similar situation appeared to have occurred in 2023, where dead river herring were observed among the rocks after the northern crestgate was closed. 2023 was the first time that NHFGD staff had ever spent any time below the northern end of the spillway, so there is no way of knowing how often stranding events have occurred. The reason that there were only two documented stranding events is not because only two have occurred, but because no one has looked.</p> <p>It is not clear how a review of operations data would provide any insight into stranding events without pairing the data with observations of water levels, habitat, and fish behavior below the spillway. It is also not clear how the 3D CFD model would be used to inform potential stranding events when the model does not extend beyond the tailrace into the area below the spillway, where stranding is likely to occur.</p>	<p>Essex is not proposing to perform field surveys. These surveys pose an unacceptable level of risk as it would entail persons going below the dam during adverse conditions (e.g. increased spill, night) for likely limited to no information.</p> <p>Based on conversations with the MRTC, Essex understands that the primary areas of concern for potential stranding sites are located below the dam at rock outcrops on either side of the dam (left and right abutments). Essex is proposing to use existing aerial imagery, in combination with collected imagery, to identify potential fish stranding sites further downstream below the Essex dam. Essex anticipates installing trail cameras at a location on either side of the dam to capture hourly photographs of the areas over an extended period of time. Essex anticipates consulting with the MRTC following issuance of the SPD on the location of the trail cameras as well as the period of record for installation. See Section 12.</p>
NHFGD (March 12, 2024)	Recreation Facilities, Use, and Aesthetics Study	<p>The PSP references the recreation study at the Lowell Project (P-2790) as a justification for not incorporating public interviews into the Recreation Facilities, Use, and Aesthetics Study proposed by FERC. Although the Lowell Project and the Lawrence Hydroelectric Project are close in proximity, they are different in many important ways. The speculation that the, “majority of recreationists are local residents walking to work or dog-walking,” ignores the large number of seasonal anglers that fish downstream of the Essex Project from late April through June. The quality of this recreational fishery is heavily impacted by fish passage and operations at the project.</p>	<p>Essex revised the Recreation Facilities, Use, and Aesthetics Study in Section 16 of the RSP to incorporate Visitor-Intercept Surveys.</p>
NHFGD (March 12, 2024)	Sea Lamprey in the Upstream Anadromous Fish Passage Assessment	<p>The Sea Lamprey is an ecologically important diadromous fish species which has experienced declines similar to other migratory fish species native to the North Atlantic Ocean (Limburg and Waldman 2009). Despite a negative perception of Sea Lamprey based on detrimental effects of Sea Lamprey on other species where it was introduced in the Great Lakes, there are no known impacts to populations of their host species in the marine environment. Recent studies have revealed an overall positive impact of Sea Lamprey in freshwater as a source of prey, nutrient transport, and habitat modification during nest building (Arakawa and Lampman 2020; Souza et al. 2012; Weaver et al. 2015).</p> <p>With the shift in emphasis toward ecological based river restoration goals including a multi-species focus, there is no clear justification for not including Sea Lamprey in upstream fish passage effectiveness studies at hydropower projects. Studies that have been done suggest that passage efficiency for Sea Lamprey is highly variable and site specific (Peterson et al. 2023). Essex provides no evidence to support the statement that, “Sea Lamprey tend to pass using upstream passage structures designed for alosines and Essex believes the study as proposed is sufficient to understanding sea lamprey at the Project.”</p> <p>Given the challenges with obtaining fish that will be capable of navigating the upstream fish passage facilities at Essex, Sea Lamprey may present an opportunity to tag fish, in addition to American Shad, that will provide data on internal passage efficiency of the fish lift. The difference in swimming capabilities between the two species may provide valuable insight when designing improvements to upstream fish passage at the site. The potential advantages of tagging Sea Lamprey in terms of access and feasibility should be considered in the design of the upstream fish passage study for the project.</p>	<p>Essex does not propose to evaluate the effectiveness of the existing upstream fish passage facilities for sea lamprey as it is not clear how this evaluation would inform license requirements. It is not clear how the Project’s license would be modified based on results of an evaluation of sea lamprey. See Section 4.13.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NHFGD (March 12, 2024)	Upstream Anadromous Fish Passage Assessment	<p>The presence of striped bass in the tailrace, referenced on page 36 of the PSP, is the primary factor to consider for the river herring component in the study design of the proposed upstream passage evaluation. In response to striped bass predation, river herring passage at the project is typically restricted to the morning and evening hours with most successful passage occurring in the first few days of the season. This is despite large numbers of herring observed in the tailrace for 3 to 4 weeks each year starting at the beginning of May. Further upstream where there are no striped bass below the Amoskeag Fishway, the same fish that passed Essex move upstream at all hours of the day and migration takes place over a period of weeks rather than a few days. In recent years, increasing numbers of striped bass observed in the tailrace have reduced river herring passage numbers to the point that is impacting the achievement of the restoration goals outlined in the Merrimack River Comprehensive Plan (MRTC 2021).</p> <p>Visual observations downstream of the project suggest that there are at least two areas of river herring congregation below the dam. One is along the river right bank, around the corner from the tailrace just below the Broadway Street Bridge (Area 1). The other is just downstream from the spillway on the river left bank (Area 2). Large schools of herring were observed at both locations in the spring of 2023 with a steady stream of herring moving upstream along both banks into these two congregation areas. River herring in Area 1 were observed entering the tailrace along the vertical ledges on river right. As they move upstream along the ledges they are attacked by striped bass, which are able to easily harass the herring from the deeper water of the tailrace. As the river herring approach the dam, they become disoriented by the upwelling flow from the turbines, which disrupts their schooling behavior and makes them more vulnerable to striped bass predation. The combination of confusing turbine outflow with the presence of large numbers of striped bass appears to make it extremely difficult for river herring to approach the entrance of the fishway, which requires navigating the deeper water of the tailrace. Signs of predation throughout the tailrace have been observed multiple times per day during the herring run for a number of years, but striped bass numbers in the tailrace appear to have increased significantly in the last 2 years. Understanding river herring movement in relation to striped bass movement under different flow conditions and project operations will be critical for designing an effective upstream passage solution.</p> <p>Due to the complicated nature of the fish passage issues at the project, the methods proposed in the Upstream Anadromous Fish Passage Assessment will likely not achieve the goals and objectives listed in the PSP.</p>	<p>On March 28, 2024 and April 1, 2024, Essex held calls with the MRTC to discuss the Upstream Anadromous Fish Passage Assessment. Among the items discussed was the inclusion of additional monitoring stations as part of the Upstream Anadromous Fish Passage Assessment. As added to Section 6.6.3 of this RSP, Essex added Station 4 to better detect passage at the lower portion of the downstream tailrace below the powerhouse, and Station 11 to provide detection information for radio-tagged fish having exited the upstream exit flume of the Lawrence fish lift and moved into the Project forebay. Station 12 was added to inform on radio-tagged individuals which have exited the upstream exit flume of the Lawrence fish lift and moved upstream to the point where they are exiting from the powerhouse forebay. In addition, Station 14 will be the furthest upstream location monitored for radio-tagged test fish and will be installed along the mainstem of the Merrimack River at a point between Station 13 and the Lowell Project.</p> <p>Where appropriate, Essex will capture fish behavior in the Diadromous Fish Behavior, Movement, and Project Interaction Study, which has been provided in Section 11 of this RSP.</p>
NHFGD (March 12, 2024)	Upstream Anadromous Fish Passage Assessment	<p>Goal 1: Determine approach of upstream migrants from the downstream release location towards the Project fishway under a range of operational/river conditions.</p> <p>The stationary radio telemetry receiver placement detailed in Figure 6-1 and Figure 6-2 would provide a general understanding of how many tagged fish reach the area just below the project, but it will not provide information on fish movement at the scale needed to inform recommendations for improving upstream passage. The route that fish take as they approach the project could be influenced by the way spill is divided between the three crestgate sections, the amount of water flowing through the tailrace vs. the spillway, turbine operations, and/or the status of fishway attraction flows. These factors could affect fish movement at least as far downstream as the Parker Street Bridge, where there is no proposed receiver. The proposed study should be designed to try to answer the following types of questions related to how river herring approach the project:</p> <ul style="list-style-type: none"> • Do certain spill scenarios cause river herring to move up the river left bank to Area 2 below the spillway? • Will the fish in Area 2 eventually move across the spillway and try to enter the tailrace near the old fishway or will they move back downstream and approach the tailrace from Area 1? Is their movement influenced by different spill conditions? • What is the relative success rate of fish that approach the tailrace from different angles? • Do all fish eventually enter the tailrace or will some fish get attracted to spillway flow and never attempt to find the fishway entrance? • What is the relationship between river herring and striped bass movement as river herring approach the project? • Is there a difference in flow dynamics between areas where river herring spend more or less time below the project? <p>As proposed the arrangement of telemetry receivers does not provide the level of detail required to interpret how fish approach the project. Much more information is needed on the movement of fish downstream of Station 4 as well as between Station 4 and Station 3. Even if more receivers were added, issues with interpreting signal strength and interference from multiple tag signals can make radio telemetry an inadequate method for answering questions about approach, especially in confined areas like the Essex Project tailrace. It will also be difficult to interpret tags from herring that have been consumed by striped bass. Presumably, these tags would not only provide false information on herring movement, but potentially accumulate in the tailrace as more herring are consumed over the course of the season.</p> <p>Whether the tagged river herring are delayed by predatory behavior or consumed directly by striped bass, large accumulations of radio tags below the project could lead to issues due to collisions among tag signals, as discussed on page 36 of the PSP. The strategy of tagging fish in small groups would be effective if fish were able to move through the project at a steady rate, but the expected bottleneck below the project would likely cause a build-up of tags below the project over the course of the season. At a certain point, issues with tag collision will make it difficult to interpret behavioral data using the methods outlined on page 37 of the PSP: "... behavioral data collected in this study (i.e., duration at a specific location or passage route) will be inferred based on the signal strength and the duration and pattern of contacts documented across the detection array."</p>	<p>On March 28, 2024 and April 1, 2024, Essex held calls with the MRTC to discuss the Upstream Anadromous Fish Passage Assessment. Among the items discussed was the inclusion of additional monitoring stations as part of the Upstream Anadromous Fish Passage Assessment. As added to Section 6.6.3 of this RSP, Essex added Station 4 to better detect passage at the lower portion of the downstream tailrace below the powerhouse, and Station 11 to provide detection information for radio-tagged fish having exited the upstream exit flume of the Lawrence fish lift and moved into the Project forebay. Station 12 was added to inform on radio-tagged individuals which have exited the upstream exit flume of the Lawrence fish lift and moved upstream to the point where they are exiting from the powerhouse forebay. In addition, Station 14 will be the furthest upstream location monitored for radio-tagged test fish and will be installed along the mainstem of the Merrimack River at a point between Station 13 and the Lowell Project.</p> <p>Where appropriate, Essex will capture fish behavior in the Diadromous Fish Behavior, Movement, and Project Interaction Study, which has been provided in Section 11 of this RSP.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NHFGD (March 12, 2024)	Upstream Anadromous Fish Passage Assessment	<p>Goal 2: Determine tailrace residence duration of upstream migrants following arrival downstream of the Project.</p> <p>Large numbers of striped bass in the tailrace combined with deep water, no cover, and turbulent discharge from the turbines make the tailrace a very difficult place for river herring to spend time. It will be important to capture the residence time of river herring in Area 1 and Area 2, as well as other potential areas in the river downstream. Comparing residence time of river herring in the river downstream of the project with residence time in the tailrace is an important aspect of the study that will not be possible using the proposed methodology. The position of the receivers, as proposed, would not provide any data on the movement of fish downstream of the Broadway Bridge or at the downstream edge of the tailrace, where fish have been most frequently observed. In addition, tagged river herring consumed by striped bass will potentially confound the interpretation of river herring movement downstream of the project. Any uncertainty around whether the data represents a live river herring or the movement of a Striped Bass that consumed it will undermine confidence in the results of the study.</p> <p>Goal 3: Estimate the nearfield attraction efficiency, entrance efficiency, internal efficiency, and overall efficiency of the existing upstream fish lift under a range of operational/river conditions and with both entrances in the open position.</p>	<p>On March 28, 2024 and April 1, 2024, Essex held calls with the MRTC to discuss the Upstream Anadromous Fish Passage Assessment. Among the items discussed was the inclusion of additional monitoring stations as part of the Upstream Anadromous Fish Passage Assessment. As added to Section 6.6.3 of this RSP, Essex added Station 4 to better detect passage at the lower portion of the downstream tailrace below the powerhouse, and Station 11 to provide detection information for radio-tagged fish having exited the upstream exit flume of the Lawrence fish lift and moved into the Project forebay. Station 12 was added to inform on radio-tagged individuals which have exited the upstream exit flume of the Lawrence fish lift and moved upstream to the point where they are exiting from the powerhouse forebay. In addition, Station 14 will be the furthest upstream location monitored for radio-tagged test fish and will be installed along the mainstem of the Merrimack River at a point between Station 13 and the Lowell Project.</p> <p>Where appropriate, Essex will capture fish behavior in the Diadromous Fish Behavior, Movement, and Project Interaction Study, which has been provided in Section 11 of this RSP.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NHFGD (March 12, 2024)	Upstream Anadromous Fish Passage Assessment	<p>Goal 4: Inform on fish lift entry (i.e., frequency, timing, and location of entry events).</p> <p>Starting in 2012, the NHFGD and USFWS significantly increased their stocking effort in support of river herring restoration in the Merrimack River watershed. An average of 35,670 river herring were stocked annually into suitable spawning habitat upstream of the Essex Dam between 2012 and 2019. Four years after stocking numbers increased, the average number of river herring counted at the Essex fishway also increased to an average annual count of 260,452 from 2016 to 2021. In the 10 years prior to 2016, the average annual river herring count at the Essex Dam was 19,381. In 2022 and 2023, the river herring count at Essex dropped significantly compared with previous years to 50,535 and 6,129 respectively. This drop in passage numbers coincided with observations of large numbers striped bass in the tailrace where they were seen preying on very large schools of river herring as they attempted to reach the fishway entrance.</p> <p>Assuming the population of river herring still measures in the hundreds of thousands, which seems likely based on the size of the river herring schools observed in the river downstream of the project, then a tagging effort of 185 river herring would be unlikely to generate enough entries into the fish lift to allow for the estimate of efficiency described in Goal 3 or the collection of fish lift entry data described in Goal 4. Assuming a population of 260,452 river herring below the project, based on the average annual count from 2016 to 2021, then the estimated percentage of fish that successfully passed upstream would have been 19% in 2022 and 2% in 2023. If these passage rates were applied to the proposed sample number of 185 tagged river herring then one would expect 35 tagged river herring to have successfully moved through the fishway in 2022 and 4 tagged river herring in 2023. These are rough estimates intended to illustrate the point that relying on tagged river herring for an estimate of fish lift passage efficiency would be unlikely to achieve the goals outlined in the PSP. The situation is further complicated by the typical timing of successful passage, which usually occurs over a very short period in early May. River herring tagged later in the season would be extremely unlikely to reach the fishway based on historical count data combined with on-site observations by NHFGD and USFWS staff.</p> <p>The proposed Upstream Anadromous Fish Passage Assessment study will need to incorporate the following components to provide the information needed to make passage improvement recommendations for river herring:</p> <ul style="list-style-type: none"> • A tagging technology and methodology that allows for fine scale interpretation of river herring and striped bass movement in the tailrace, below the spillway, and in the river reach downstream of the Broadway Street Bridge. • A way of accounting for tagged fish that get consumed by striped bass. • A sample size that will be representative of the large number of river herring that have been observed below the project. <p>Although the Upstream Anadromous Fish Passage Assessment, as proposed, would not likely yield meaningful results for assessing river herring passage at the project, it may be an appropriate method for assessing American Shad. As discussed on page 36 of the PSP, striped bass predation appears to have less of an influence on American Shad as they approach the project and attempt to enter the fishway. The number, location, and direction of stationary receivers would need to be discussed as the proposed configuration would not provide enough information on the influence of spillway crestgate operations on shad movement as well as the residence time in the tailrace vs. the area below the spillway. The number of tags should also be discussed to ensure the statistical power of the study especially since the 185 radio tags proposed for the river herring would not likely be effective for assessing the passage efficiency of the fishway (Refer to MA Division of Marine Fisheries comments on the Lawrence PSP). Essex should also consider tagging Sea Lamprey (refer to comments under Page 32 – 33: Sea Lamprey in the Upstream Anadromous Fish Passage Assessment) in the study to provide additional information on passage efficiency at the project with another important anadromous fish species that does not appear to be influenced by Striped Bass predation. The radio telemetry study methodology would not provide shad movement at a level of detail that would be necessary to interpret shad behavior in relation to the fishway entrance, which was a useful component of the shad study conducted at Lowell (Alden 2011).</p>	<p>On March 28, 2024 and April 1, 2024, Essex held calls with the MRTC to discuss the Upstream Anadromous Fish Passage Assessment. Among the items discussed was the inclusion of additional monitoring stations as part of the Upstream Anadromous Fish Passage Assessment. As added to Section 6.6.3 of this RSP, Essex added Station 4 to better detect passage at the lower portion of the downstream tailrace below the powerhouse, and Station 11 to provide detection information for radio-tagged fish having exited the upstream exit flume of the Lawrence fish lift and moved into the Project forebay. Station 12 was added to inform on radio-tagged individuals which have exited the upstream exit flume of the Lawrence fish lift and moved upstream to the point where they are exiting from the powerhouse forebay. In addition, Station 14 will be the furthest upstream location monitored for radio-tagged test fish and will be installed along the mainstem of the Merrimack River at a point between Station 13 and the Lowell Project.</p> <p>Where appropriate, Essex will capture fish behavior in the Diadromous Fish Behavior, Movement, and Project Interaction Study, which has been provided in Section 11 of this RSP.</p>
NHFGD (March 12, 2024)	Upstream American Eel Passage Assessment	<p>The pit tag methodology seems promising, but there should be a back-up plan in case the eels captured at the project are too small to tag. Measurements of eels collected at the project by USFWS and NHFGD staff in the summer of 2015 found that 97% of the eels captured in the south eel ladder were less than 100mm in length. A modification of the VIE tagging method proposed for the Collection Tank Retention Evaluation could be an alternative for evaluating passage efficiency if the pit tags prove to be too large.</p>	<p>Essex revised the proposed Upstream American Eel Passage Assessment in Section 7 of the RSP to address this comment.</p>
NHFGD (March 12, 2024)	American Eel Upstream Passage Siting Study	<p>Some justification is needed as to why the discharge of the South Canal was not proposed as a site for visual surveys. A picture of the outlet would be helpful.</p> <p>In addition to CPUE, the inclusion of length/weight data, as opposed to grouping eels into size classes, would allow for comparison with over 10 years of American Eel data collected at sites throughout the Merrimack River watershed in New Hampshire. If the sample size is very large, then a representative subset should be measured and weighed. Holding captured eels in ice water is an effective means of immobilization which will facilitate the measuring process.</p>	<p>Essex updated the American Eel Upstream Passage Siting Study in Section 8 of the RSP to address this comment. The South Canal outlet passes flow through an underground penstock until it rejoins the Merrimack River beneath the waters surface at a point approximately 3,000 feet downstream of Essex Dam. Since there is no physical structure here which will serve to congregate eels for upstream passage it has not been included on the list of potential survey areas.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
NHFGD (March 12, 2024)	Project Operations and Fish Stranding Study	<p>Neither the Operational Data Review, as proposed, nor the 3D CFD modelling study will provide the information needed to identify potential stranding events. The proposed 3D CFD model does not cover the area below the spillway, where stranding is most likely to occur. A 2D model that extends across the spillway and into the river reach downstream may provide information on flow fields at different tailwater elevations, but field observations will likely be needed to document conditions that may cause stranding (refer to comments under Page 79 – 83: Three-Dimensional Computational Fluid Dynamics (CFD) Modeling).</p> <p>The manner in which flow is divided between the three crestgate sections along with the rate of inflation/deflation of each section influences the way that fish interact with the project below the spillway. Although crestgate operations are listed among the operational data to be reviewed, it does not specify whether this data is available in a level of detail that would be useful for guiding management recommendations. The rate of crestgate inflation/deflation is a critical component of the study and it is not clear whether this type of data has been recorded. It is unlikely that reviewing operational data during two stranding events will capture all of the operational scenarios that may result in stranding.</p> <p>In general, crestgate operations at the project are poorly understood as they relate to attraction flows, downstream survival, and potential fish stranding issues. Despite being one of the major aspects of the project that is within operational control, none of the proposed studies provide enough information related to crestgate operations to inform the development of license requirements. Ideally, the three crestgates should be operated in a way that 1) maximizes attraction to the fishway, 2) minimizes mortality during downstream migration, and 3) avoids stranding fish. The results of an upstream passage study, downstream passage study, and fish stranding study should be used to weigh the positives and negatives of different crestgate operational scenarios as they relate to the above three goals.</p> <p>An alternative to the methodology proposed by Essex in their Project Operations and Fish Stranding Study could also incorporate a two phased approach. Phase 1 would involve deliberately manipulating the crestgates and observing the changes in habitat inundation at the south and north ends of the spillway. Different ramping rates could be applied to identify a crestgate inflation rate that may allow fish to escape the area before they become trapped. This could be done outside of the fish passage season so that rapid changes in the location of spill over the spillway does not interfere with the upstream passage season. Phase 2 could apply lessons learned from Phase 1 during the upstream fish passage season (May and June). Observations of the area below the spillway could be made before and after any operational shift that causes a change in habitat inundation below the spillway. Any stranding events could be recorded and then tied directly to a specific operational scenario.</p>	<p>Essex is not proposing to perform field surveys. These surveys pose an unacceptable level of risk as it would entail personnel going below the dam during adverse conditions (e.g. increased spill, night) for likely limited to no information.</p> <p>Based on conversations with the MRTC, Essex understands that the primary areas of concern for potential stranding sites are located below the dam at rock outcrops on either side of the dam (left and right abutments). Essex is proposing to use existing aerial imagery, in combination with collected imagery, to identify potential fish stranding sites further downstream below the Essex dam. Essex anticipates installing trail cameras at a location on either side of the dam to capture hourly photographs of the areas over an extended period of time. Essex anticipates consulting with the MRTC following issuance of the SPD on the location of the trail cameras as well as the period of record for installation. See Section 12.</p>
NHFGD (March 12, 2024)	Three-Dimensional Computational Fluid Dynamics (CFD) Modeling	<p>A number of studies reference using the CFD model to aid in the interpretation of results. However, the CFD model, as proposed, does not extend downstream beyond the tailrace. To be useful in interpreting the results of multiple studies, a 2-dimensional (2D) flow model will need to be extended to an agreed upon point downstream. This is similar to what was done in the Lowell Project (P-2790) bypass reach. The results of the 2D model in the Lowell bypass was used to help inform the proposed upstream passage approach at the project.</p>	<p>Essex considers the 3D CFD model as proposed sufficient for the Commission to perform their Environmental Analysis.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
Non-Governmental Organizations (NGOs)			
<p>Nashua River Watershed Association</p> <p>(March 7, 2024)</p>	<p>General</p>	<p>The Nashua River Watershed is the third largest tributary to the Merrimack River. The Nashua River watershed at-large is a key component of migratory fish restoration in the Merrimack River watershed, due in part to the extensive lentic and lotic fish nursery habitat found throughout the watershed. Reiterating our comments on the Scoping Document, we strongly request that relicensing of the Project be contingent upon improved fish passage at the Project, as the current fish passage counts at the Project are dismal and the need for improved passage is urgent.</p> <p>NRWA supports all requests for studies by the relevant agencies: USFWS, NMFS, NOAA, MADMF, MADEP, MassWildlife, and NHFG.</p> <p>The impacts of the project on the EJ Community of City of Lawrence should be taken into account; therefore, the Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience should be studied.</p> <p>Management of the impoundment has had clear impacts to the boathouse at Riverfront State Park, the home for the Greater Lawrence Boating Program. Riverbank erosion has been severe, and needs to be studied, and remedial solutions identified.</p> <p>Studies to evaluate the project impacts on historical structures, and to identify steps to enhance such should be conducted. All options to enhance recreational opportunities in the project area should be evaluated and advanced.</p> <p>NRWA shares the Merrimack River Watershed Council’s concern about the three CSO discharges and the Lowell WWTP discharge to the reservoir for the dam, and the need for a study to evaluate the CSO and Drinking Water Intake interactions within the Project Area.</p> <p>NRWA agrees with the need for an Invasive Plant Baseline Survey. Invasive plants in the Nashua River Watershed exclusively occur in the impoundments above the dams. The slowing of the river and increased boat traffic make the introduction of invasive species most likely to occur in these reaches. The project proponent states that “Performing an invasive plant species survey at the Project is not justified, as it would only represent a snapshot in time.” We argue that this survey would be helpful in documenting when and where the invasive plants show up. The surveys should be conducted every 5 years.</p> <p>Water Quality Study – NRWA strongly agrees with MADEP that the water quality study include phytoplankton samples, algae, nutrients, sediment sampling, and toxicants. Not including these parameters ignores the fact that dam impoundments, even run-of-river dams, act as “sinks” for all of these parameters.</p>	<p>The fish passage studies Essex is proposing will evaluate the effectiveness of the existing Project passage facilities and operations. If facility enhancements for passage are needed at the Project, a review of passage alternatives may be prudent at that point. At the conclusion of the fish passage studies, Essex will summarize recommended next steps in its study report or in the DLA. Such an approach is prudent, consistent with FERC precedent at other Projects, will result in targeted useful information, and will not result in delay in the overall licensing process.</p> <p>Essex will perform an assessment of impacts to Environmental Justice (EJ) communities in the Draft License Application (DLA). However, for the reasons stated in RSP Section 4.6, Essex is not proposing to perform the Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem Study.</p> <p>Essex is proposing to conduct field reconnaissance and visitor-intercept surveys at the Lawrence Riverfront State Park in the Recreation Facilities, Use, and Aesthetics Study, which will provide insight on the condition, use, and potential improvements of the facility. Additionally, opportunities to enhance other recreational facilities in the project area will be assessed in this study. Essex is also proposing to perform a Condition Assessment of Historic Properties and Associated Canal System, in which potential impacts of current and proposed project operations on historic resources will be identified.</p> <p>Essex is not proposing to perform the CSO and Drinking Water Intake Interactions within Project Area Study for the reasons described in RSP Section 4.11. Essex is proposing a Water Quality Study with a focus on dissolved oxygen, water temperature, and pH under various river flows, river temperatures, and Project operating conditions to determine the spatial and temporal effects of project operations on water quality. Essex’s proposed study is consistent with the study recommended by FERC.</p> <p>While Essex is proposing a Water Quality Study, potential Project effects are unlikely to have any measurable, causal relationship with parameters such as phytoplankton, attached algae (periphyton), nutrients (total phosphorus and total nitrogen), chloride, and Escherichia coli (E. coli). The Project is not responsible for the presence of any polychlorinated biphenyls (PCBs), heavy metals, polycyclic aromatic hydrocarbons (PAHs), cyanotoxins, or pesticides in the impounded area or in fish tissue.</p>
<p>Great Lawrence Sanitation District (GLSD)</p> <p>(March 11, 2024)</p>	<p>Study Request on operations Minimum Flow Requirements and requests two changes to operational conditions.</p>	<p>GLSD supports the Project Operations study and requests two changes. First, the proposed review of the operational conditions should be January 1, 1989 – December 31, 2023 (35 years). 1989 is the beginning date EPA used when determining the 7Q10 rate in GLSD’s current NPDES permit. Further, 1989-2004 is the approximate period when the dam flows had the most significant occurrences of not meeting the 951 cfs minimum flow limit. In particular, the years 1991, 1993, 1995, 1999, and 2001 had consecutive low flow values below the permit’s minimum flow limit. It is important to understand the causes of these low flow periods and whether dam operations contributed to the below minimum flows.</p> <p>Second, and relatedly, GLSD requests that the study expressly (1) analyzes whether Essex’s proposed reduction of the impoundment/reservoir behind the dam will affect the dam’s ability to meet the minimum flow requirements, and (2) evaluate operational or other changes that would improve the dam’s ability to meet the 951 cfs minimum limit. It is not clear from the proposed study whether these issues will be analyzed.</p>	<p>Essex maintains that the duration of time proposed in the Project Operations and Fish Stranding Study in section 12 of the RSP is sufficient to inform on minimum flows relevant to current ROR operations at the Lawrence Project. Essex has operated the Project in accordance with the FERC license with no violations. In accordance with the license, under Article 32, the Project operates in a ROR mode and fulfills the minimum flow requirement.</p> <p>Additionally, compliance history including information pertaining to inspections of the facilities can be found in Section 4.8.2 of the PAD.</p>

Commentor (Filing Date)	Study Name	Comment	Essex Response to Comment
Groundwork Lawrence (GWL) (March 11, 2024)	Study Plan requested changes	<p>Over the past two decades GWL has made repeated requests to the project owner for access to project lands to develop recreational amenities. To enable the development of recreational amenities on project lands above and below the dam as well as along the canals, GWL requests the study plan identify / complete any FERC required investigations, provide design guidelines or precedents to support design development, and establish a road map for right of way acquisition and park implementation.</p> <p>The Massachusetts Department of Conservation and Recreation along with the City of Lawrence have played important roles developing and stewarding of recreational amenities within the project area. GWL is proud to have played an important role in these efforts as well. We request the proposed study plan identify locations where the project owner should be responsible for owning and maintaining new recreational amenities. Specifically, GWL requests the study plan investigate ways to incorporate a pedestrian connection at the end of the north canal at the lower locks by integrating a shared use path into the project's existing infrastructure.</p> <p>GWL supports efforts by other stakeholders to for the study plan to advance an "Evaluation of Alternatives to Minimize Project Impacts and Support Climate Resilience of the City of Lawrence and the Merrimack River Ecosystem." This alternative analysis should evaluate statutory historic preservation opportunities, innovative management options such as the Augusta Canal Authority, and ways to increase the utility of the project's canals. The alternatives analysis should protect the role the head pond plays as source of drinking water.</p>	<p>Essex has revised the proposed Recreation Facilities, Use, and Aesthetics Study in Section 16 of the RSP to address include focus group discussions, visitor-use surveys, and an expanded consultation and literature review list. GWL will have additional opportunities to participate in this study.</p>
Merrimack River Watershed Council (MRWC) (March 12, 2024)	Proposes that early water quality studies be conducted.	<p>We are concerned that Essex is misapplying Study Criterion No. 5 in its rejection of 12 of the proposed studies, including our own.</p> <p>We support Essex's goal "to increase efficiencies in how data is collected and analyzed" by combining study requests into single studies. We believe that the objective of CSO interactions study can be achieved by being integrated into a general water quality study such as that proposed by MADEP that includes E.coli and/or enterococci sampling. Additional daily bacteria sampling for the three days following CSO discharges would be sufficient. MRWC would be happy to consult with Essex on different methodologies for how that data could be collected, whether manually or using remote control technology.</p> <p>Essex has also rejected MADEP's proposed study, using similar justification of its interpretation of Study Criterion No. 5 that we take issue with. MADEP ultimately has 401 certification authority, and the earlier the necessary information is collected, the more efficient this process will be.</p>	<p>Essex maintains that the proposed Water Quality Study as proposed in Section 14 is sufficient to inform on spatial and temporal effects of Project operations on water quality.</p> <p>An analysis of potential pathogens introduced to the watershed from CSO or other means is the responsibility of sanitation system operators. Project operations do not directly introduce pollutants or contaminants to the Merrimack River or subsequent drinking water supply. The Water Quality Study as proposed is intended to examine water quality in relation to project related flows, achieved by measuring dissolved oxygen, water temperature, and pH under various flow scenarios to inform on the Project related impacts on water quality.</p>

Appendix C – Summary of
Results from Downstream
American Eel Passage
Assessment at the Lawrence
Hydroelectric Project in 2019,
and an Evaluation of Adult
Alosine Downstream
Passage Effectiveness in
2020

Essex installed a series of stationary radio-telemetry receivers at the Lawrence Project to assess the arrival and downstream passage of:

- Radio-tagged adult silver-phase American eels originally released in support of ongoing passage studies at the upstream Lowell Hydroelectric Project (FERC No. 2790) and Garvins Falls Development of the Merrimack River Hydroelectric Project (FERC No. 1893) during fall 2019, and
- Radio-tagged adult alewife and American shad originally released in support of ongoing passage studies at the upstream Lowell and Mine Falls Hydroelectric Project (FERC No. 3442) during spring 2020.

The locations of radio-telemetry monitoring stations were consistent during both study periods and provided coverage as follows:

Monitoring Station 40: This station consisted of a single Lotek SRX radio-receiver and an aerial antenna and was installed and calibrated in a manner to provide detection information for radio-tagged fish as they approached the upstream face of Essex Dam (approximately 10.75 miles downstream of the Lowell tailrace).

Monitoring Station 41: Station 41 consisted of a single Lotek SRX receiver and aerial antenna and was installed and calibrated to detect radio-tagged fish as they entered the Lawrence forebay and approached the intake area.

Monitoring Station 42: This station consisted of a single Orion radio-receiver and aerial antenna installed within the downstream bypass chute and calibrated to provide detection information for radio-tagged fish exiting the forebay via that route.

Monitoring Station 43: Station 41 consisted of a single Lotek SRX radio-receiver and aerial antenna installed at a location overlooking the Lawrence powerhouse tailrace. Detections at this location were used to confirm downstream passage of individuals via the Project turbine units.

Monitoring Station 44: This station consisted of a single Lotek SRX radio-receiver and aerial antenna oriented to provide detection information for radio-tagged fish having moved downstream of the Essex Dam spillway. Detections at this location were used to help confirm downstream passage of individuals via the Project spillway.

Monitoring Station 45: This station was installed at the Essex County Correctional Facility and consisted of a single Lotek SRX receiver with an aerial antenna oriented perpendicular to the river. Detections at this station were intended to confirm passage at the Lawrence Dam. This location was located approximately 2.1 miles downstream of Lawrence Dam.

Monitoring Station 46: Station 46 was installed at the Merrimack River Park in Haverhill, Massachusetts. Detections at this station were intended to provide additional confirmation of passage at the Lawrence Dam. This location was located approximately 6.5 miles downstream of Lawrence Dam and 4.1 miles downstream of Station 45.

Data analysis included the evaluation of upstream residence duration (i.e., time from arrival at dam [Station 40] until downstream passage, downstream passage route utilization, and downstream passage survival. Note that no adjustment to the estimates of downstream eel passage survival

was made to correct for the potential influences of “drift” and results should be interpreted with that in mind.

Lawrence Downstream Adult Eel Passage:

- Period of arrival at the Project – October 18-November 26, 2019
- Project operations (Figure 1):
 - Single turbine in operation through October 17 then two turbines in operation
 - Spill conditions present after October 17
 - Downstream bypass in operation for duration of the study (160 cfs)
- Number of radio-tagged individuals which approached Project – 111
- Median upstream residence duration – 0.1 hours
- Percentage of individuals passing within 24 hours of arrival – 94%
- Downstream passage route utilization rates (excluding unknown or no pass)
 - Turbine: 51.4%
 - Spill: 38.7%
 - Downstream bypass: 0.9%
- Downstream passage survival
 - Whole station - 90.3% (75% CI = 84.8%-93.9%)
 - Turbine – 82.9% (75% CI = 76.0%-89.9%)
 - Spill - 98.2% (75% CI = 92.3%-99.9%)

Lawrence Downstream Adult River Herring Passage:

- Period of arrival at the Project – May 17-June 20, 2020
- Project operations (Figure 2):
 - At least one turbine in operation for duration of the study
 - Spill present to some extent for duration of the study
 - Downstream bypass in operation for the duration of the study (160 cfs)
- Number of radio-tagged individuals which approached Project – 233
- Median upstream residence duration – 24.4 hours
- Percentage of individuals passing within 24 hours of arrival – 45%
- Downstream passage route utilization rates (excluding unknown or no pass)
 - Turbine: 16%
 - Spill: 6%
 - Downstream bypass: 67%
- Downstream passage survival
 - Whole station - 38.7% (75% CI = 34.9%-42.6%)
 - Turbine – 28.9% (75% CI = 21.3%-38.1%)
 - Downstream bypass - 41.3% (75% CI = 36.8%-46.0%)

Lawrence Downstream Adult American Shad Passage:

- Period of arrival at the Project – May 22-June 30, 2020
- Project operations (Figure 2):
 - At least one turbine in operation for duration of the study

- Spill present to some extent for duration of the study
- Downstream bypass in operation for the duration of the study (160 cfs)
-
- Number of radio-tagged individuals which approached Project – 158
- Median upstream residence duration – 11.6 hours
- Downstream passage route utilization rates (excluding unknown or no pass)
 - Turbine: 4%
 - Spill: 0%
 - Downstream bypass: 92%
- Downstream passage survival
 - Whole station - 94.8% (75% CI = 92.3%-96.5%)
 - Downstream bypass – 95.9% (75% CI = 93.5%-97.4%)

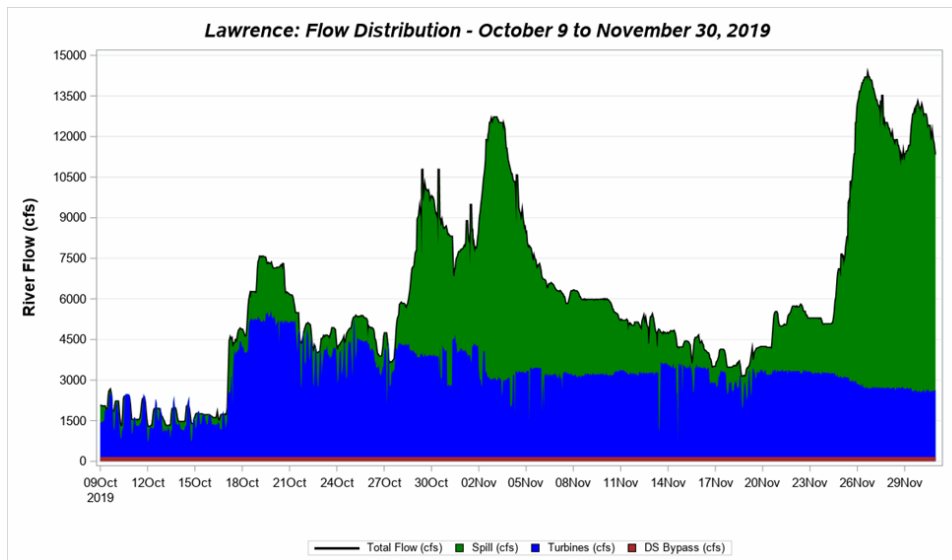


Figure 1. Total, spill, turbine and downstream bypass flow (cfs) as reported at Lawrence for the period October 9 to November 30, 2019.

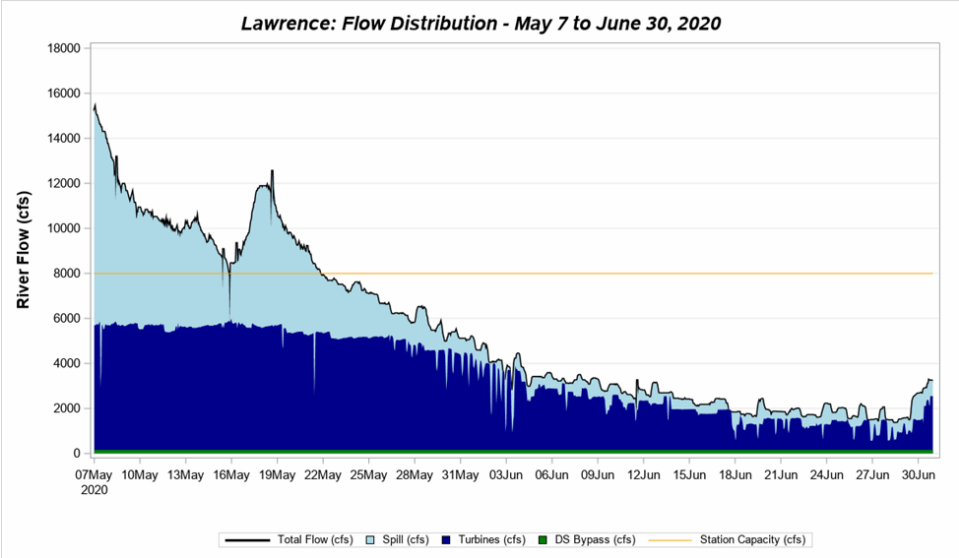


Figure 2. Total, spill, turbine and downstream bypass flow (cfs) as reported at Lawrence for the period May 7 to June 30, 2020.