

RELICENSING STUDY 3.3.16

Habitat Assessment, Surveys, and Modeling for State-Listed Mussel Species in the Connecticut River below Cabot Station

INTERIM REPORT

**Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)**

Prepared for:



Prepared by:



JANUARY 2015

TABLE OF CONTENTS

1	INTRODUCTION.....	1-1
1.1	Prior Information on Target Species.....	1-2
1.2	Study Objectives.....	1-3
2	STUDY AREA AND SURVEY SITE SELECTION.....	2-1
3	METHODS.....	3-1
4	RESULTS.....	4-1
4.1	Mussel Survey.....	4-1
4.2	Mussel Habitat.....	4-1
5	DISCUSSION.....	5-1
5.1	Summary of Mussel Community and Habitat.....	5-1
5.2	Next Steps.....	5-1
5.2.1	Develop Binary (Category 1) HSI Criteria for Target Mussel Species.....	5-1
5.2.2	Assess the Potential Effects of Project Operations on Target Mussel Species and their Habitat.....	5-2
6	LITERATURE CITED.....	6-1

LIST OF TABLES

Table 2-1: 2014 Mussel Survey Sites.....	2-2
Table 4.1-1: Mussel Species Found at Each of the 26 Survey Sites.....	4-2
Table 4.1-2: Length-Class Frequency and Mean Shell Length of Eastern Elliptio at Each Mussel Survey Site.....	4-3
Table 4.2-1: Habitat Data Collected at Each of the 2014 Mussel Survey Sites.....	4-4

LIST OF FIGURES

Figure 1.1-1: Overview of Recent Mussel Surveys on the Connecticut River.....	1-4
Figure 2-1: 2014 Mussel Survey Sites.....	2-3
Figure 3-1: 2014 Mussel Survey Locations.....	3-2

LIST OF APPENDICES

APPENDIX A – SITE PHOTOGRAPHS

LIST OF ABBREVIATIONS

cfs	cubic feet per second
CPUE	catch per unit effort
CWM	coarse woody material
FERC	Federal Energy Regulatory Commission
FirstLight	FirstLight Hydro Generating Company
HSI	Habitat Suitability Index
ILP	Integrated Licensing Process
m	meter
mm	millimeter
m/s	meters per second
MDFW	Massachusetts Division of Fisheries and Wildlife
NHESP	Natural Heritage and Endangered Species Program
PAD	Pre-Application Document
PSP	Proposed Study Plan
RSP	Revised Study Plan
SD1	Scoping Document 1
SD2	Scoping Document 2
sp.	species
SPDL	Study Plan Determination Letter
VY	Vermont Yankee Nuclear Power Plant

1 INTRODUCTION

FirstLight Hydro Generating Company (FirstLight), a subsidiary of GDF SUEZ North America, Inc., is the current licensee of the Northfield Mountain Pumped Storage Project (Northfield Mountain Project, FERC No. 2485) and the Turners Falls Hydroelectric Project (Turners Falls Project, FERC No. 1889). FirstLight has initiated with the Federal Energy Regulatory Commission (FERC, the Commission) the process of relicensing the two Projects using the FERC's Integrated Licensing Process (ILP). The current licenses for Northfield Mountain and Turners Falls Projects were issued on May 14, 1968 and May 5, 1980, respectively, with both set to expire on April 30, 2018.

As part of the ILP, FERC conducted a public scoping process during which various resource issues were identified. On October 31, 2012, FirstLight filed its Pre-Application Document (PAD) and Notice of Intent with the FERC. The PAD included FirstLight's preliminary list of proposed studies. On December 21, 2012, FERC issued Scoping Document 1 (SD1) and preliminarily identified resource issues and concerns. On January 30 and 31, 2013, FERC held scoping meetings for the two Projects. FERC issued Scoping Document 2 (SD2) on April 15, 2013.

The Natural Heritage and Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries and Wildlife (MDFW) requested a study of the potential effects of Turners Falls Project operations on state-listed freshwater mussels and their habitat downstream of the Turners Falls Dam. FirstLight filed its Proposed Study Plan (PSP) on April 15, 2013 and, per the Commission regulations, held a PSP meeting at the Northfield Visitors Center on May 14, 2013. Thereafter, FirstLight held ten resource-specific study plan meetings to allow for more detailed discussions on each PSP and on studies not being proposed. On June 28, 2013, FirstLight filed with the Commission an Updated PSP to reflect further changes to the PSP based on comments received at the meetings. On or before July 15, 2013, stakeholders filed written comments on the Updated PSP. FirstLight filed a Revised Study Plan (RSP) on August 14, 2013 with FERC addressing stakeholder comments.

On August 27, 2013 Entergy Corp. announced that the Vermont Yankee Nuclear Power Plant (VY), located on the downstream end of the Vernon Impoundment on the Connecticut River and upstream of the two Projects, will be closing no later than December 29, 2014. With the closure of VY, certain environmental baseline conditions will change during the relicensing study period. On September 13, 2013, FERC issued its first Study Plan Determination Letter (SPDL) in which many of the studies were approved or approved with FERC modification. However, due to the impending closure of VY, FERC did not act on 19 proposed or requested studies pertaining to aquatic resources. RSP Study No. 3.3.16 *Habitat Assessment, Surveys and Modeling of Suitable Habitat for State-Listed Mussel Species in the Connecticut River below Cabot*, was one of the studies that FERC did not act upon. The SPDL for these 19 studies was deferred until after FERC held a technical meeting with stakeholders on November 25, 2013 regarding any necessary adjustments to the proposed and requested study designs and/or schedules due to the impending VY closure. FERC issued its second SPDL on the remaining 19 studies on February 21, 2014, approving the RSP with certain modifications. In the February 21, 2014 SPDL, FERC approved the RSP for Study No. 3.3.16 with one modification as listed below:

- FERC recommended that FirstLight consult with the NHESP during the selection process to determine an appropriate panel of experts to develop habitat suitability index (HSI) criteria for Study No. 3.3.1 *Instream Flow Studies in Bypass Channel and below Cabot Station*.

State-listed mussel species, hereafter called "target species," include Yellow Lampmussel (*Lampsilis cariosa*; Endangered), Tidewater Mucket (*Leptodea ochracea*; Special Concern), Eastern Pondmussel (*Ligumia nasuta*; Special Concern), and Dwarf Wedgemussel (*Alasmodonta heterodon*; Endangered [federal and state]).

1.1 Prior Information on Target Species

In 2011, a baseline freshwater mussel survey was conducted in the Turners Falls Impoundment, bypass reach, and canal in anticipation of the FERC relicensing process. Target species were not detected in any of these areas ([Biodrawverson, 2012](#)). Also in 2011, a freshwater mussel survey was conducted upstream and downstream of the Vernon Hydroelectric Project (FERC No. 1906) as part TransCanada's FERC relicensing process, and no target mussel species were found during that study ([Biodrawverson & LBG, 2012](#)). As part of the FERC license requirements for the Holyoke Hydroelectric Project, the next project below the Turners Falls Project, freshwater mussel studies were conducted in the Holyoke Dam Impoundment in 2005, 2009, and 2013, from Dry Brook (Sunderland) to the Holyoke Dam ([Tighe and Bond, 2014](#)). These studies resulted in a good understanding of the distribution and habitat of common and state-listed mussel species in the Connecticut River from the Holyoke Dam to the Vernon Dam, minus a primarily unsurveyed 13-mile reach from the Route 116 Bridge in Sunderland to Cabot Station. See [Figure 1.1-1](#) for recent mussel survey areas on the Connecticut River from the Holyoke Dam to the Vernon Dam.

Below is a summary of the available information on target species occurrences and distribution in the surveyed reaches of Connecticut River.

- **Yellow Lampmussel:** Documented in the lower impoundment of the Holyoke Dam as far upstream as the Hadley Dike, with the highest concentrations from Elwell Island (Northampton) downstream to Brunelle's Marina (South Hadley). Relict shells had been documented upstream from the Route 116 Bridge in Sunderland, mostly near Second Island (NHESP data). In addition, on March 13, 2014, NHESP filed a letter with FERC stating that on August 4, 2007 a Yellow Lampmussel shell was found near the eastern shoreline of Rawson's Island near Rock Dam, a natural falls in the Turners Falls bypass reach.

Within the limited range of the Yellow Lampmussel in the Connecticut River, it has been found in water depths from 1 to 30 feet, in slow to moderate flow conditions, and usually in sand and fine gravel substrates. Both in the Holyoke Dam Impoundment and the Connecticut River in northern Connecticut, Yellow Lampmussel were proportionately more abundant in shallow sandbars than in nearby areas with a rockier or muddier substrate. Yellow Lampmussel are found in a wider range of habitat conditions, including streams, rivers, and lakes, elsewhere in their range.

- **Eastern Pondmussel:** Documented at locations in the lower Holyoke Dam Impoundment, as far upstream as the Fort River confluence in Hadley. It also occurs in several small tributaries, such as Fort River (Amherst), Mill River (Northampton), and Mill River (Hatfield and Whately).

The Eastern Pondmussel has been found in a wide range of waterbody types in the Connecticut River watershed, including small ponds, lakes, and rivers of all sizes. It appears to be most common in ponds and relatively low-gradient streams and rivers, in slow water velocities, and in fine substrates (e.g., clay, silt/mud, sand, and fine gravel).

- **Tidewater Mucket:** This species was first documented upstream from the Holyoke Dam in 2013; a single adult mussel was found just upstream from Mitch's Marina in Hadley, in the same area where numerous Eastern Pondmussel were found.

The Tidewater Mucket inhabits coastal freshwater environments, in small to large rivers, ponds, and lakes that have or historically had direct unimpeded connections with coastal waters. In the Connecticut River watershed, it inhabits muddy, sandy, and gravelly substrates in the Connecticut River and near the mouths of major tributaries. They have been found at all available water depths, in

a variety of flow conditions, but seem to prefer depositional areas with slower currents. Although no lake or pond populations are currently known in the Connecticut River watershed, Tidewater Mucket occurs in numerous ponds in eastern Massachusetts and throughout central Maine.

- **Dwarf Wedgemussel:** There is a historic record (~1978) of this species in the Connecticut River at Sunderland. The closest known populations are in the Fort River (Amherst), Mill River (Hatfield and Whately), Ashuelot River (Swanzey, NH), and in the Connecticut River in the Bellows Falls Dam Impoundment in New Hampshire and Vermont.

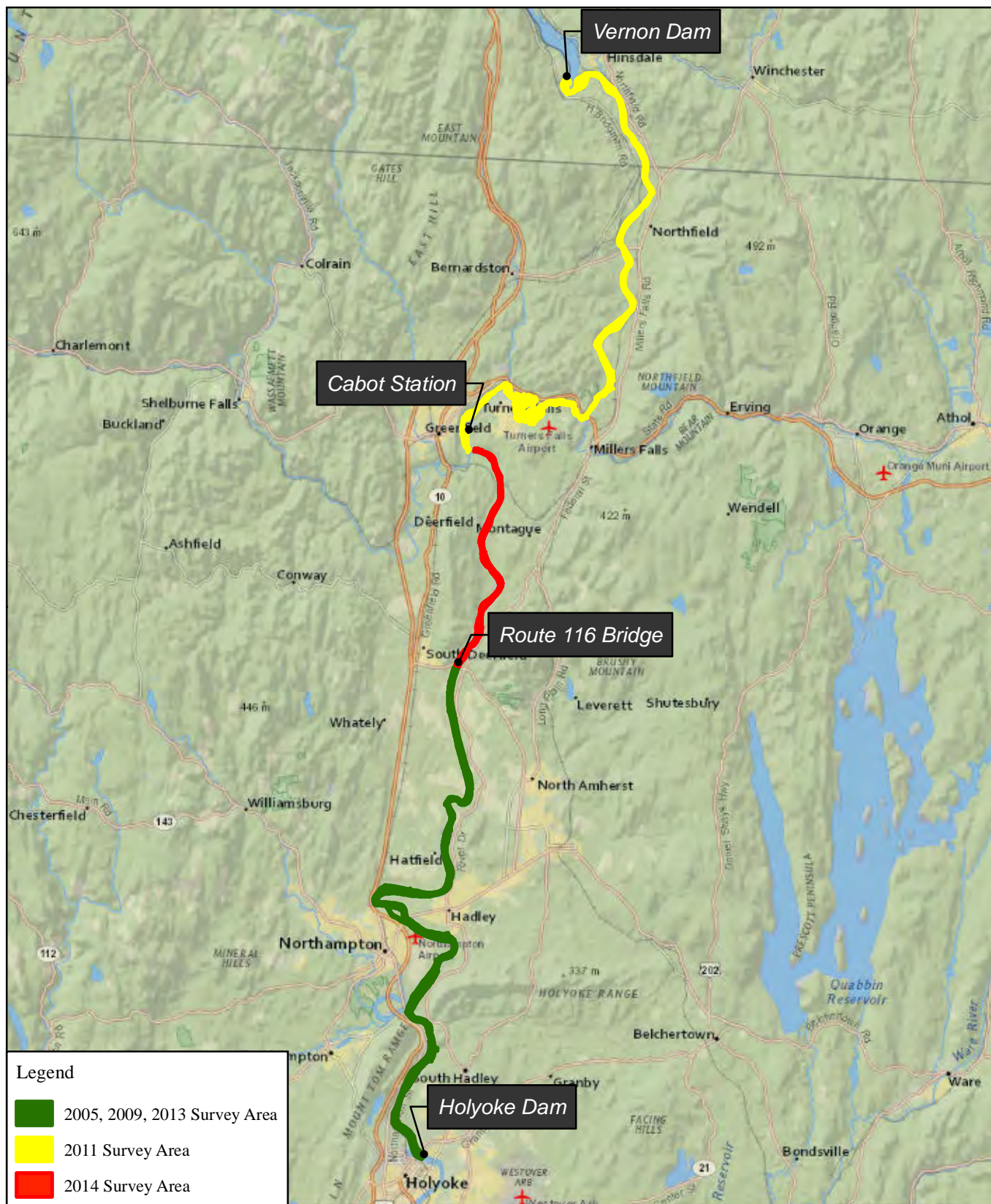
The Dwarf Wedgemussel is a generalist in terms of its preference for stream size, substrate, and flow conditions (reviewed in [Nedean 2008](#)). It inhabits small streams less than five meters wide to large rivers more than 100 meters wide. It is found in a variety of substrate types including clay, sand, gravel, and pebble, and often in areas of rivers with large amounts of silt (e.g., depositional areas and near banks). The dwarf wedgemussel inhabits very shallow water along streambanks and can move laterally or horizontally in the substrate as water levels fluctuate, but they have also been found at depths of more than 25 feet in the Connecticut River. The dwarf wedgemussel does not inhabit lakes or reservoirs but may occur in small impoundments created by run-of-river low-head dams, beaver dams, or by natural landforms that create deep and stable stream reaches. They occur in impounded portions of the upper Connecticut River.

1.2 Study Objectives

This study had two objectives:

1. Delineate, through field surveys, populations of state-listed mussels and suitable habitat from Cabot Station downstream to the Route 116 Bridge in Sunderland. Characterize the distribution, abundance, demographics, and habitat use of these populations. Identify potential habitat for state-listed species based on habitat preference of each species.
2. Develop binary HSI curves for all state-listed mussel species found to occur in the 35-mile reach downstream from Cabot Station, using species-specific data from the Connecticut River and other rivers in the Northeast, along with relevant publications and expert review. These HSI curves will be used in Study No. 3.3.1 *Instream Flow Studies in Bypass Channel and below Cabot Station* to evaluate the potential effects of Turners Falls Project operations on state-listed mussel species.

Due to ongoing consultation with FERC and stakeholders on HSI criteria development for mussels, and integration with Study No. 3.3.1, this report summarizes information collected in 2014 for the first objective. HSI development and an assessment of the potential effects of Turners Falls Project operations on state-listed mussels will occur in 2015.



RELICENSING STUDY 3.3.16
 NORTHERN MOUNTAIN/TURNERS FALLS
 HABITAT ASSESSMENT, SURVEYS, AND MODELING OF
 SUITABLE HABITAT FOR STATE-LISTED MUSSEL SPECIES
 IN THE CT RIVER BELOW CABOT STATION



Figure 1.1-1:
 Overview of Recent Mussel
 Surveys on the
 Connecticut River

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2 STUDY AREA AND SURVEY SITE SELECTION

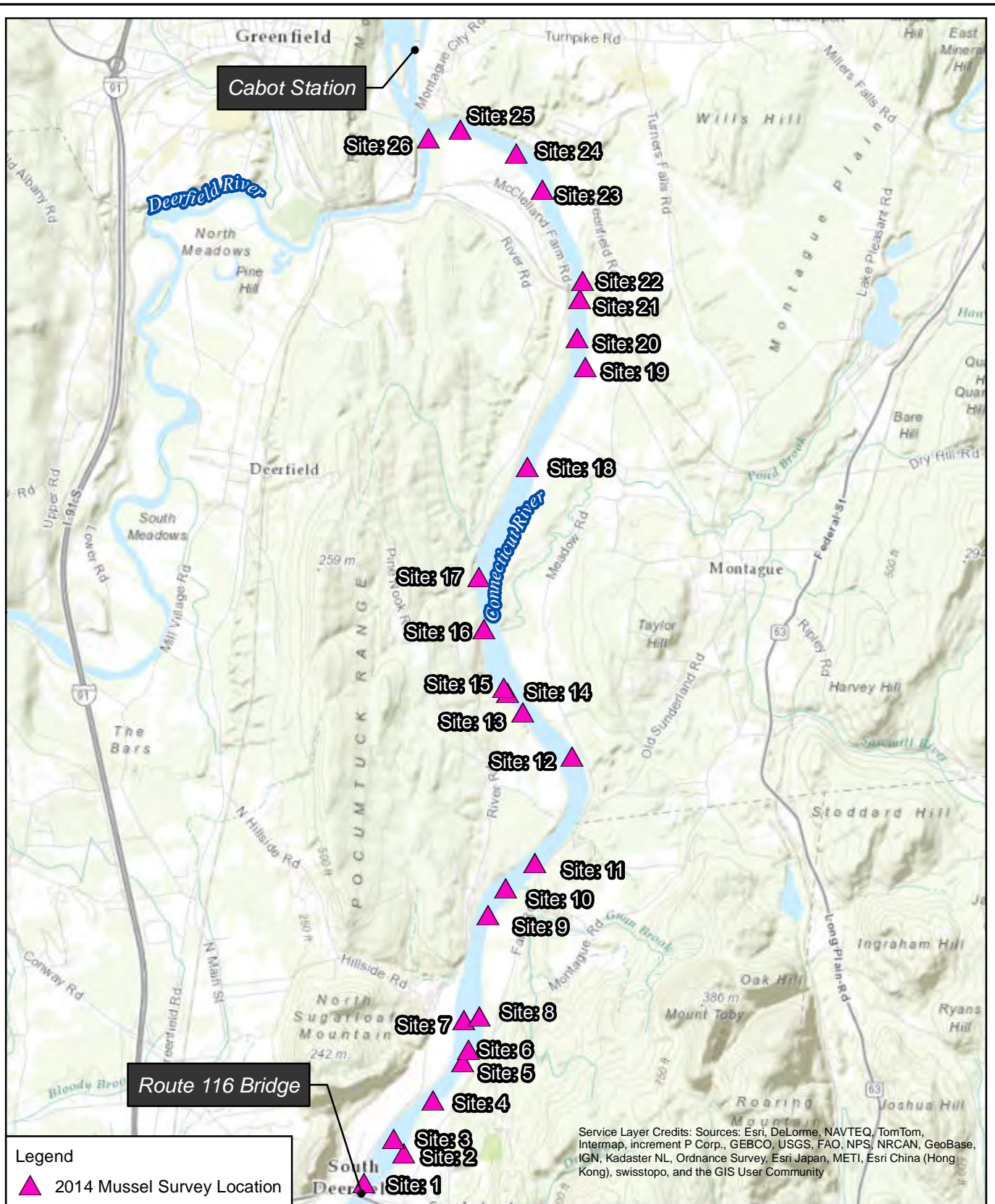
The field component of this study focused on the 13-mile reach of the Connecticut River between Cabot Station and the Route 116 Bridge in Sunderland ([Figure 2-1](#)). In June 2014, a habitat assessment was completed throughout this reach using NHESP's Endangered Species Habitat Assessment Guidelines: Freshwater Mussels ([MDFW, 2013](#)). This was completed on multiple trips, including an excursion specifically for this purpose, and three excursions to complete odonate fieldwork (Study No. 3.3.10 *Assess Operation Impact on Emergency of State-Listed Odonates*) during which additional habitat information was collected for the mussel study. Results of this assessment, and a map of mussel survey sites, were discussed with NHESP (conference call with Ethan Nedeau (Biodrawiversity) and Peter Hazelton and Jesse Leddick (NHESP) on July 16, 2014) to reach concurrence on where suitable habitat likely existed and the most effective survey technique(s). This discussion resulted in concurrence on 26 mussel survey locations ([Figure 2-1](#), [Table 2-1](#)).

HABITAT ASSESSMENT, SURVEYS, AND MODELING FOR STATE-LISTED MUSSEL SPECIES IN THE CONNECTICUT RIVER BELOW CABOT STATION

Table 2-1: 2014 Mussel Survey Sites.

Site	Date	Starting Point		Ending Point*		Distance (m)	Duration	Survey Type	Site Description
		Latitude	Longitude	Latitude	Longitude				
1	7/23/2014	42.46903	-72.58466	42.46996	-72.58438	100	1.00	SCUBA	Deeper channel on west side of the river.
2	7/2/2014	42.47220	-72.57912	42.47328	-72.57885	150	2.00	Snorkel	Side-channel of 1st Island.
3	7/23/2014	42.47366	-72.58057	42.47416	-72.57994	100	1.50	SCUBA	Sand & gravel bar on the west of 1st Island.
4	7/23/2014	42.47777	-72.57508	42.47832	-72.57368	150	1.00	SCUBA	Ledge outcrop.
5	8/19/2014	42.48180	-72.57101	42.48641	-72.57098	500	6.00	SCUBA	Downstream and along the west side of 2nd Island.
6	7/2/2014	42.48306	-72.57013	42.48353	-72.56990	75	2.00	SCUBA	Downstream tail of 2nd Island.
7	7/23/2014	42.48618	-72.57087	42.48705	-72.57048	125	1.50	SCUBA	West side of 2nd Island, 3/5 across channel.
8	7/23/2014	42.48658	-72.56869	42.48733	-72.56864	100	1.50	SCUBA	East side channel of 2nd Island.
9	7/23/2014	42.49712	-72.56767	42.49778	-72.56692	100	1.50	SCUBA	Near gravel bar.
10	7/23/2014	42.49992	-72.56522	42.50062	-72.56420	100	1.50	SCUBA	Near gravel bar.
11	7/23/2014	42.50265	-72.56113	42.50362	-72.55986	150	1.50	SCUBA	Deep water upstream from sandbar.
12	7/24/2014	42.51375	-72.55609	42.51463	-72.55686	125	1.50	SCUBA	Sandbar.
13	7/24/2014	42.51830	-72.56309	42.51880	-72.56398	100	1.50	SCUBA	Near prominent ledges.
14	7/1/2014	42.52031	-72.56530	42.52083	-72.56579	75	2.00	SCUBA	Just downstream of 3rd Island
15	7/1/2014	42.52082	-72.56585	42.52399	-72.56794	400	3.00	SCUBA	West side-channel of 3rd Island.
16	7/1/2014	42.52692	-72.56875	42.52846	-72.56904	175	2.00	SCUBA	Just upstream of 3 Island, western shoreline.
17	8/4/2014	42.53231	-72.56953	42.53348	-72.56925	125	1.25	SCUBA	Deeper water upstream of constriction.
18	7/24/2014	42.54387	-72.56289	42.54491	-72.56233	125	1.25	SCUBA	Center of straight stretch.
19	7/24/2014	42.55432	-72.55489	42.55479	-72.55489	75	1.25	SCUBA	Outside of bend.
20	7/24/2014	42.55736	-72.55611	42.55788	-72.55618	75	1.25	SCUBA	Alongside sandbar.
21	8/4/2014	42.56145	-72.55580	-	-	50	1.25	SCUBA	Railroad bridge.
22	7/24/2014	42.56334	-72.55547	42.56468	-72.55569	150	1.25	SCUBA	Deeper channel on east side, upstream of RR bridge.
23	8/4/2014	42.57280	-72.56128	42.57328	-72.56139	75	1.25	Snorkel	Downstream of 4th Island.
24	8/4/2014	42.57649	-72.56500	42.57673	-72.56547	75	1.25	SCUBA	Upstream of 4th Island.
25	8/4/2014	42.57893	-72.57297	-	-	50	1.25	SCUBA	Downstream of ledges.
26	8/4/2014	42.57799	-72.57742	-	-	100	1.25	SCUBA	Deerfield confluence.

* For the survey sites without end point coordinates, these sites were surveyed in a non-linear fashion. See [Figure 3-1](#) for areal survey areas.



RELICENSING STUDY 3.3.16
NORTHFIELD MOUNTAIN/TURNERS FALLS
HABITAT ASSESSMENT, SURVEYS, AND MODELING OF
SUITABLE HABITAT FOR STATE-LISTED MUSSEL SPECIES
IN THE CT RIVER BELOW CABOT STATION

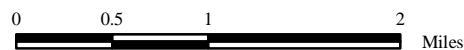


Figure 2-1:
2014 Mussel
Survey Locations

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3 METHODS

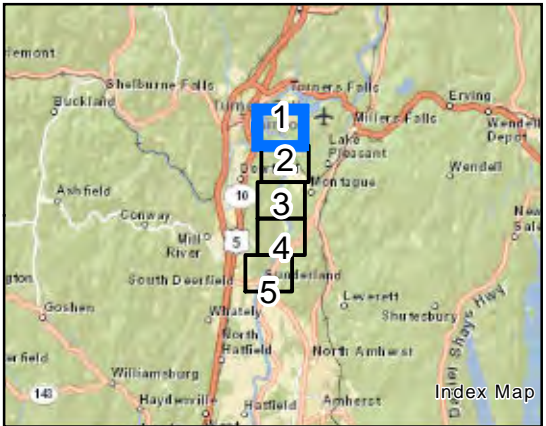
Preceding the 2014 fieldwork, a study plan and scientific collection permit application was submitted to NHESP, and a permit was issued in mid-May 2014.

Biologists conducted semi-quantitative (i.e., timed qualitative) surveys at 26 sites ([Figures 3-1 through 3-5](#), photographs contained in [Appendix A](#)). Survey duration depended on the spatial extent and quality of the habitat at each location, and ranged from 1.5 to 6.0 person-hours per site. Sites were reached by motorboat or kayak.

Surveys were conducted at times of high water clarity and low to normal flows, during the months of July and August 2014. Surveys were conducted using SCUBA in depths over four feet, and by snorkeling in shallower waters.

The Catch per Unit Effort (CPUE) method was used to qualitatively assess mussel species abundance. Specifically, the number of individuals of each species encountered within a defined amount of time was tallied, and the CPUE values (mussels/hour) were calculated.

Shell length data were collected for 1,250 Eastern Elliptio; these data were not collected for other species because no live mussels of other species were found during the surveys. Similarly, biologists planned to record several microhabitat parameters for individuals of each target species, but these data were not recorded because no live target species were found. Spent shells and location were collected for target species and will be submitted to NHESP in January 2015.



RELICENSING STUDY 3.3.16

NORTHFIELD MOUNTAIN/TURNERS FALLS
HABITAT ASSESSMENT, SURVEYS, AND
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SUITABLE HABITAT FOR STATE-LISTED MUSSEL
SPECIES
IN THE CT RIVER BELOW CABOT STATION

Figure 3-1
2014 Mussel Survey Locations
Map 1 of 5

Legend

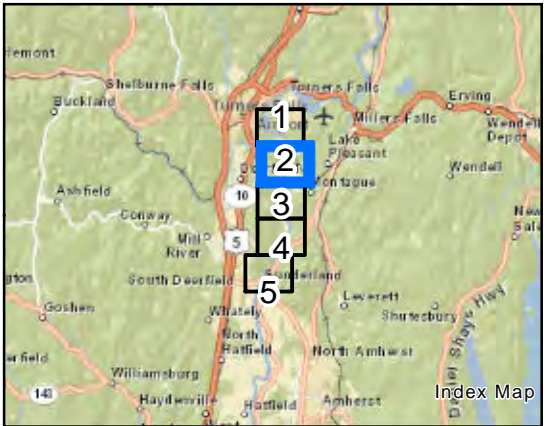
- Cumulative Mile Marker
- 2014 FirstLight Mussel Survey Area

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0 500 1,000 2,000 Feet
1 inch = 1,000 feet







RELICENSING STUDY 3.3.16


NORTHFIELD MOUNTAIN/TURNERS FALLS
HABITAT ASSESSMENT, SURVEYS, AND
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SUITABLE HABITAT FOR STATE-LISTED MUSSEL
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Figure 3-2
2014 Mussel Survey Locations
Map 2 of 5

Legend

 Cumulative Mile Marker

 2014 FirstLight Mussel Survey Area



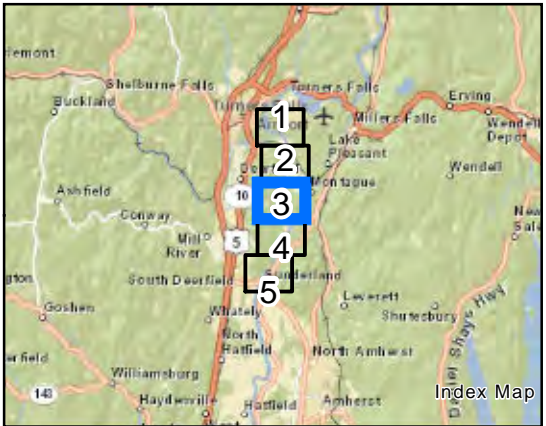
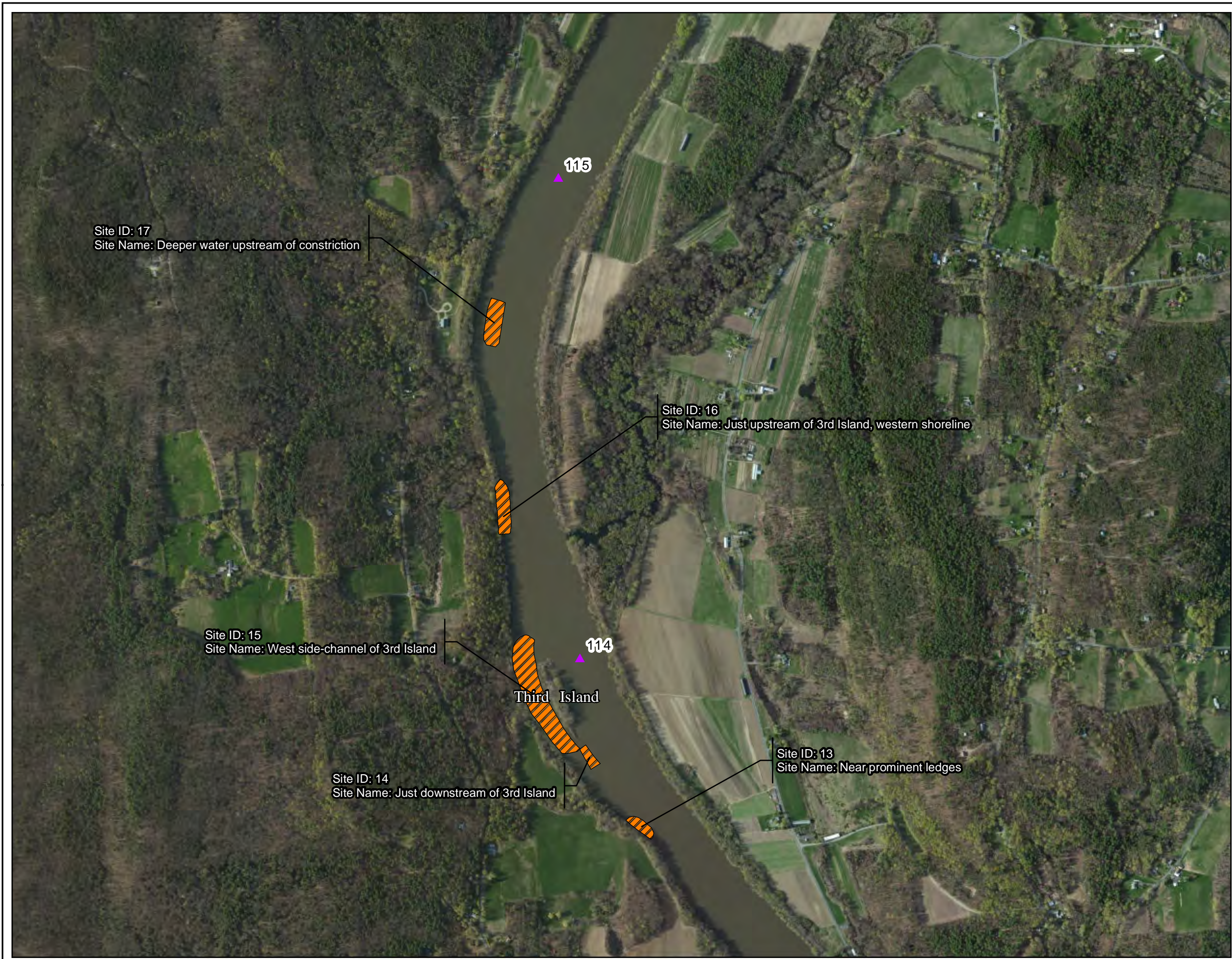
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0 500 1,000 2,000 Feet

1 inch = 1,000 feet







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NORTHFIELD MOUNTAIN/TURNERS FALLS
HABITAT ASSESSMENT, SURVEYS, AND
MODELING OF
SUITABLE HABITAT FOR STATE-LISTED MUSSEL
SPECIES
IN THE CT RIVER BELOW CABOT STATION

Figure 3-3
2014 Mussel Survey Locations
Map 3 of 5

Legend

 Cumulative Mile Marker

 2014 FirstLight Mussel Survey Area



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0

500

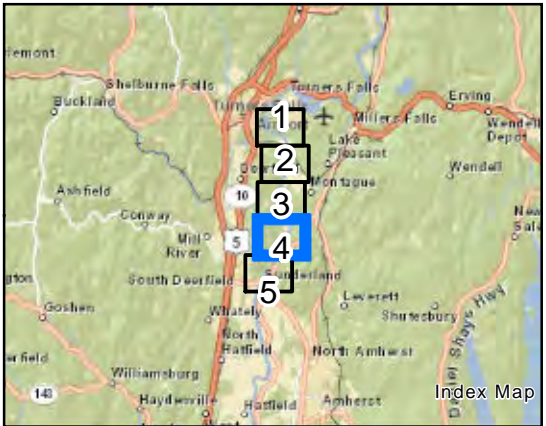
1,000

2,000

Feet

1 inch = 1,000 feet







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NORTHFIELD MOUNTAIN/TURNERS FALLS
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Figure 3-4
2014 Mussel Survey Locations
Map 4 of 5

Legend

 Cumulative Mile Marker

 2014 FirstLight Mussel Survey Area



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0

500

1,000

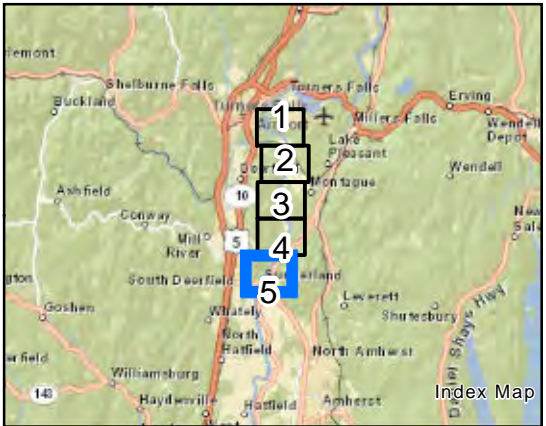
2,000

Feet

1 inch = 1,000 feet



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HABITAT ASSESSMENT, SURVEYS, AND
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Figure 3-5
2014 Mussel Survey Locations
Map 5 of 5

Legend

- Cumulative Mile Marker
- 2014 FirstLight Mussel Survey Area

1 inch = 1,000 feet

0 500 1,000 2,000 Feet

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4 RESULTS

4.1 Mussel Survey

No live target mussel species were found. One old relic Yellow Lampmussel shell was found at Site 5, near Second Island ([Table 4.1-1](#)). Eastern Elliptio was the only live mussel species found during the survey. This species was usually too numerous to count; precise counts were only recorded at three sites where density was low; the lowest CPUE for Eastern Elliptio was 53 mussels/hour at Site 26, at the mouth of the Deerfield River. At most sites, thousands or even tens of thousands of Eastern Elliptio were observed, and they occupied a wide range of depth, flow, and substrate conditions. A total of 1,250 Eastern Elliptio were measured (50 randomly selected individuals at each of 25 survey sites). Shell length data are summarized in [Table 4.1-2](#). Two Eastern Lampmussel shells were found (Sites 2 and 17). Approximately 30 Alewife Floater shells were found at Site 15, and three other Alewife Floater shells were also found at Sites 2 and 5.

4.2 Mussel Habitat

Although habitat suitability criteria for target species has not yet been developed (see [Section 5.1.1](#)), the pre-survey habitat assessment, site selection process, and the data collected at each mussel survey site considered and documented a broad range of habitat conditions ([Table 4.2-1](#)). In terms of mesohabitat coverage, runs comprised approximately 83 percent of habitat, followed by pools (14 percent), and riffles (3 percent). Surveyed water depths ranged from shallow shorelines and exposed gravel bars to 7.6 meters (~25 feet). Substrate was primarily a mix of sand, gravel, and cobble, with some silt and clay at a few sites, and lesser amounts of boulder and bedrock. Sandbars, which have been identified as critical habitat types for Yellow Lampmussels in the Holyoke Dam Impoundment, were present in several areas, notably downstream of Second Island. Flow velocity was variable, usually moderate to strong in the thalweg and diminishing toward shorelines and in flow refugia created by islands, ledges, and point bars. Aquatic vegetation was typically sparse, often confined to intermediate depths (1-2 meters) near shorelines, although it was more abundant near Third Island (Site 14 and 15). Large woody material was mostly restricted to shorelines and pools.

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)
HABITAT ASSESSMENT, SURVEYS, AND MODELING FOR STATE-LISTED MUSSEL SPECIES IN THE
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Table 4.1-1: Mussel Species Found at Each of the 26 Survey Sites.

Site	Mussel Species			
	Eastern Elliptio	Eastern Lampmussel	Alewife Floater	Yellow Lampmussel
1	100s			
2	1,000s	1(S)	1(S)	
3	150			
4	64			
5	1,000s		2(S)	1(S)
6	100			
7	1,000s			
8	100s			
9	1,000s			
10	100s			
11	1,000s			
12	150			
13	100s			
14	1,000s			
15	1,000s		30(S)	
16	1,000s			
17	1,000s	1(S)		
18	1,000s			
19	1,000s			
20	1,000s			
21	1,000s			
22	1,000s			
23	1,000s			
24	100s			
25	100s			
26	53			

S=shell only

HABITAT ASSESSMENT, SURVEYS, AND MODELING FOR STATE-LISTED MUSSEL SPECIES IN THE CONNECTICUT RIVER BELOW CABOT STATION

Table 4.1-2: Length-Class Frequency and Mean Shell Length of Eastern Elliptio at Each Mussel Survey Site.

Site	N	Frequency per each Length Class (mm)										Average Length (mm)	Length Range (mm)
		<10	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.6	70-79.9	80-89.9	90-99.9		
1	50	0	0	0	7	8	21	9	5	0	0	54.8	31.5 - 74.0
2	50	1	4	3	12	14	6	9	1	0	0	43.7	31.0 - 79.0
3	50	0	0	0	5	4	17	20	4	0	0	57.6	30.0 - 77.0
4*	50	0	3	0	1	4	6	29	7	0	0	59.5	12.5 - 75.0
6*	50	0	0	2	13	10	13	10	2	0	0	49.6	29.0 - 76.0
7	50	0	2	0	0	2	26	17	3	0	0	57.5	12.5 - 79.0
8	50	0	1	2	12	19	9	6	1	0	0	45.6	19.0 - 76.0
9	50	0	8	0	0	0	8	21	13	0	0	57.2	10.0 - 76.0
10	50	0	0	0	2	4	20	17	7	0	0	59.6	32.0 - 79.0
11	50	0	0	0	0	1	13	26	10	0	0	63.7	49.5 - 78.0
12	50	0	0	0	1	13	14	19	3	0	0	56.3	39.0 - 74.0
13	50	0	5	0	1	2	8	19	15	0	0	59.9	12.0 - 79.0
14	50	0	12	0	1	3	6	4	18	6	0	55.0	10.0 - 88.0
15	50	0	2	1	1	3	6	18	16	3	0	63.9	13.0 - 88.0
16	50	0	1	0	7	5	8	10	10	9	0	61.6	11.5 - 89.0
17	50	0	3	2	0	1	14	9	18	1	2	61.4	10.5 - 93.5
18	50	0	0	0	0	1	20	19	8	2	0	63.1	49.0 - 83.0
19	50	0	4	2	0	5	14	10	9	4	2	59.1	17.0 - 92.0
20	50	0	0	1	1	2	28	14	4	0	0	57.3	24.0 - 78.0
21	50	0	0	1	2	5	0	17	19	5	1	66.7	24.0 - 93.0
22	50	0	0	0	2	5	7	19	8	4	5	66.0	39.5 - 95.0
23	50	0	1	10	0	6	13	8	8	4	0	54.1	19.0 - 88.0
24	50	0	0	8	1	2	8	9	16	5	1	61.2	21.0 - 96.0
25	50	0	0	1	5	3	3	12	15	11	0	66.1	22.0 - 86.0
26	50	1	2	14	8	2	8	13	2	0	0	44.1	5.0 - 79.0
Total	1250	2	48	47	82	124	296	364	222	54	11	57.8	5.0 - 96.0

*No data were collected at Site 5 because it overlapped with Sites 6 and 7.

Table 4.2-1: Habitat Data Collected at Each of the 2014 Mussel Survey Sites.

Site	Water Depth (m)		Flow Velocity*	Mesohabitat Coverage (%)			Substrate**						CWM***	Veg****	Vegetation Type
	Mean	Max		Run	Pool	Riffle	Silt/Clay	Sand	Gravel	Cobble	Boulder	Bedrock			
1	2.4	2.7	F	100	0	0		X	X	X			1	1	<i>Vallisneria sp.</i>
2	0.6	2.6	L	95	5	0	X	X	X	X			2	1	<i>Vallisneria sp.</i> and algae
3	0.9	1.9	L-M	60	0	40		X	X	X			1	1	<i>Vallisneria sp.</i>
4	3.0	7.6	L-M-F	20	70	10	X	X	X			XX	1	2	Algae, emergent vegetation in shallow pool
5	2.1	5.5	L	80	20	0	X	XX	X	X			1	1	<i>Vallisneria sp.</i>
6	1.8	3.0	L	70	30	0	X	XX	X	X			1	1	<i>Vallisneria sp.</i>
7	2.0	3.0	L-M-F	80	20	0	X	X	X	X			1	1	<i>Vallisneria sp.</i>
8	0.8	2.4	M-F	80	20	0	X	X	X	X			1	2	<i>Vallisneria sp.</i>
9	1.8	2.7	L	100	0	0	X	X	X	X			2	2	<i>Vallisneria sp.</i> , with some algae
10	0.6	1.0	M	90	0	10		X	X	X			1	2	<i>Vallisneria sp.</i>
11	3.8	3.9	M	100	0	0		X	X	X	X		1	1	-
12	2.1	2.4	F	100	0	0		XX	X	X			2	1	-
13	2.7	4.0	L-M	45	50	5		X	X	X	X	XX	1	1	-
14	1.4	1.8	M	100	0	0		XX		X			2	5	<i>Vallisneria sp.</i> , <i>Potamogeton sp.</i>
15	0.3	2.4	M-F	95	5	0	X	X	X	X			2	7	<i>Vallisneria sp.</i> , <i>Potamogeton sp.</i>
16	1.2	2.7	M	80	20	0	X	X	X	X			2	3	<i>Vallisneria sp.</i>
17	2.8	3.1	M	100	0	0		X	X	X			1	2	<i>Vallisneria sp.</i>
18	2.1	2.1	F	100	0	0		X	X	X			1	1	-
19	2.1	3.0	L-M	50	50	0	X	X	X	X			3	2	<i>Vallisneria sp.</i>
20	1.0	1.5	L-M	100	0	0		X	X	X			1	1	<i>Vallisneria sp.</i>
21	3.6	4.2	F	100	0	0		X	X	X		X	1	1	-
22	3.4	4.0	M	100	0	0		X	X	X	X		1	1	<i>Vallisneria sp.</i>
23	0.9	2.0	L-F	40	60	0	X	X	X	X	X		2	2	<i>Vallisneria sp.</i>
24	1.5	2.5	F	100	0	0		X	X	XX			1	1	<i>Vallisneria sp.</i>
25	1.8	2.5	L-M	50	40	10		X	X	XX			1	3	Algae
26	1.8	8.0	M-F	70	25	5		XX	X	X			1	1	-

Notes:

*Qualitative descriptors of flow velocity: *L* = Light (<0.1 m/s), *M* = Moderate (0.1 to 0.3 m/s), *F* = Fast (>0.3 m/s). Multiple conditions possible at each site.

**X = present, XX = present and the dominant type.

***CWM = Coarse Woody Material. 3 Abundance Classes: 1 = <1%, 2 = 1-10%, 3 = 10-25%

****Veg = Vegetation. 7 Abundance Classes: 1 (<1%), 2 (1-5%), 3 (5-10%), 4 (10-20%), 5 (20-40%), 6 (40-70%), 7 (>70%)

See [Appendix A](#) for photographs of these sites.

5 DISCUSSION

5.1 Summary of Mussel Community and Habitat

The mussel community in the reach from Cabot Station to the Route 116 Bridge appears to be strongly dominated by Eastern Elliptio, as no live mussels of other species were found. Eastern Elliptio are common to abundant in a wide range of habitat types, and the presence of a relatively high proportion of juveniles (which are usually underrepresented in qualitative surveys) suggests recruitment success is high.

The presence of more than 30 Alewife Floater shells suggest that live Alewife Floater may also exist within this reach, but at very low population densities and possibly confined to small patches that were undetected in the 2014 survey. Only old relict shells of Yellow Lampmussel (1) and Eastern Lampmussel (2) were found, which is consistent with results of the few reports (NHESP data) in this reach in recent years. To our knowledge, live Eastern Lampmussel and Yellow Lampmussel have never been documented in this reach, nor have Tidewater Mucket or Eastern Pondmussel. Dwarf Wedgemussel were not found in 2014, and the most recent report of Dwarf Wedgemussel in this reach was from ~1978 (shell only).

Water depths were variable; some areas (near islands and point bars) were very shallow or dewatered during low flow conditions, but maximum depths at survey sites ranged from 6-25 feet. Water velocity was usually light to moderate (typically in the range of 0.1 to 0.3 m/s), and flow refugia were present at nearly all sites, even where moderate to strong velocities were prevalent. Substrate was characterized by co-dominance of sand, gravel, and cobble, and extensive sandbars were present. Silt, sand, aquatic vegetation, and organic material (detritus and coarse wood) were common closer to shorelines and in flow refugia. Based on the habitat parameters described in [Table 4.2-1](#), and considering the general habitat preferences of the four target species ([Section 1.1](#)), the study reach contains some areas of suitable habitat for each of the four target species. Further analyses of habitat suitability will be completed as described in [Section 5.2](#).

5.2 Next Steps

5.2.1 Develop Binary (Category 1) HSI Criteria for Target Mussel Species

FirstLight will develop binary HSI criteria for all state-listed mussel species documented in the 35-mile reach between Cabot Station and Dinosaur Footprints Reservation. Based on 2014 survey results and prior data, these species include Yellow Lampmussel, Tidewater Mucket, and Eastern Pondmussel. Binary HSIs have not yet been developed or vetted for any of the state-listed mussel species in Massachusetts. FirstLight will facilitate the development of binary HSIs using the following approach:

- Gather, review, and synthesize all available information on the distribution and habitat preference of all state-listed or federally listed mussel species documented to occur in the 35-mile project area. Information will come primarily from journal articles, government and consultant reports (“gray literature”), case studies contributed from the region’s most experienced malacologists, and any field data collected specifically to develop the HSI criteria for state-listed mussel species documented in the Project area.
- Based on available information, develop binary HSI criteria for key parameters (e.g., water depth, flow velocity, substrate, shear stress, relative shear stress, Froude number) for each species, along with a written rationale for the criteria.
- A Delphi panel of experts, which will include a mussel specialist with NHESP, will review and fine-tune the binary HSI criteria based on expert opinion.

- Finalize binary HSI criteria for each species and present to stakeholders for final review.

5.2.2 Assess the Potential Effects of Project Operations on Target Mussel Species and their Habitat

Study No. 3.3.1 and Study No. 3.2.2 *Hydraulic Study of Turners Falls Impoundment, Bypass Reach below Cabot Station*, combined with the mussel surveys and habitat assessments that were completed during the mussel study, will help to identify both the species and locations where flow regime effects are more likely to occur, and will help provide an overall assessment of these effects. The specific methods for evaluating the effects of the flow regime on state listed mussels, using the HSI criteria developed using the process described above, are contained in Study No. 3.3.1.

6 LITERATURE CITED

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APPENDIX A – SITE PHOTOGRAPHS



Mussel survey site #1.



Mussel survey site #2.



Mussel survey site #3.



Mussel survey site #4.



Mussel survey site #5.



Mussel survey site #6.



Mussel survey site #7.



Mussel survey site #8.



Mussel survey site #9.



Mussel survey site #10.



Mussel survey site #11.



Mussel survey site #12.



Mussel survey site #13.



Mussel survey site #14.



Mussel survey site #15.



Mussel survey site #16.



Mussel survey site #17.



Mussel survey site #18.



Mussel survey site #19.



Mussel survey site #21.



Mussel survey site #22.



Mussel survey site #23.



Mussel survey site #24.



Mussel survey site #25.



Mussel survey site #26.



Relict Yellow Lampmussel shell from Site 5.